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**APPENDIX D – TECHNICAL SPECIFICATIONS**

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# PART E – TECHNICAL SPECIFICATION

**TfNSW**  
Specification for  
Cardiff Railway Station  
Easy Access Upgrade  
March 2012

**Revision C**  
**Tender Issue**

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**Other Documents comprised in Part E**

- Door Hardware Schedule
- Mechanical Services Specification
- Electrical Services Specification
- Hydraulic Services Specification

**E1 PREAMBLE****E1.1 GENERAL****E1.1.1 GENERAL**

TfNSW proposes to construct Easy Access facilities and other upgrading works at Cardiff Railway Station to meet the expectation from the community for better access and improved facilities at the station.

It is planned to provide access for mobility impaired persons from the existing station entry points to train boarding points. The work includes provision of new easy access lifts, new stairs at the western side, new ticket office with a family accessible toilet, extension of existing footbridge, new balustrade and anti-throw screens, new concrete footpath, and regrading of existing paths, provision of disabled persons' car spaces, and other miscellaneous improvements.

These upgrading works shall be required to impact minimally on the existing station and train operations. New and current technologies for construction that will achieve minimal impact are preferred to traditional methods. Throughout the course of the works, the Station is to remain fully operational and contractor shall provide any required temporary facilities (e.g. temporary footpath, lighting, power, alteration to existing ramp etc.) and maintain continuous and safe access for passengers and staff.

TfNSW proposes to appoint a company to undertake the construction work up to and including the commissioning of the upgraded facilities.

**E1.1.2 COMPLIANCE**

This RFT shall be read as a complete document (Parts A to E inclusive with all attached appendices). The Contractor is required to successfully deliver the project in accordance with these Technical Requirements and achieve the following outcomes:

- Maintain safety for workers, station staff and public during construction.
- Comply with all aspects of these Technical Requirements and accompanying drawings;
- Comply with all relevant RTA and TfNSW standards;
- Minimise the impact and inconvenience to the local community during construction;
- Maximise the quality of the completed project and hence benefit to the local community;
- Minimise the time for completion;
- Maximise value for money for TfNSW;
- Minimise the risks and costs to TfNSW.

**E1.1.3 COMPLIANCE WITH REVIEW OF ENVIRONMENTAL FACTORS**

An REF Application has yet to be assessed. Conditions contained within the pending approval documents are to be complied with by the Contractor.

**E1.1.4 ADDITIONAL INFORMATION**

The Appendices to this RFT provide additional information on the Work and a number of TfNSW's requirements and installations. Unless otherwise specified elsewhere in the RFT, the Work of the RFT must comply with the standards, materials and methods defined in these Appendices.

**E1.1.5 INFORMATION NOT PROVIDED IN THE RFT**

If the Contractor discovers that the documents provided by the Principal are not correct or are incomplete, the contractor must submit a Request for Information (RFI) to the Principal's Representative, that:

- Gives full details of the error or omission; and
- Lists the date for Practical Completion is not to be delayed, and
- For items that are within the expertise of the Contractor, suggests a resolution.

The Principal's Representative will either:

- Provide the information requested; or
- Accept the resolution suggested by the Contractor; or
- Instruct the Contractor to carry out further investigation and report on options for resolution.

**E2 SCOPE OF WORKS****E2.1 GENERAL****E2.1.1 SURVEY & SETOUT**

Requirement: At the commencement of the contract the Contractor shall set out the works.

Confirm levels of all lift entrances at all levels.

Confirm the distances between external sides of lift shafts and the corners of the platform building with the platform edge.

Refer to TfNSW document TSR Q1 Quality Management Clause 7.4 for details of set-out and survey requirements.

**E2.1.2 EXISTING SERVICES**

Requirement: Before excavation, the Contractor shall locate all underground railway services in the line of proposed excavations.

The Contractor shall locate the existing services by services search require, sonar or electronic means, and any other method necessary to locate the position of these existing services, and report their findings to the Principal's Representative before commencing excavation. The Contractor shall allow for the expenses and up to six weeks for the issue of railway services search and marking on site.

Existing public utility services outside the station site and in the path of proposed excavation shall also be located and the Contractor shall arrange with the authorities responsible for these services to determine the exact location of these services prior to commencing excavation. No mechanical excavation will be allowed within one (1) metre of the centre of existing services. Obtain approval by relevant service providers for any excavation nearby public utility services.

The Contractor must rectify, at his own cost, all damage to any services that has occurred during the course of the works.

The Contractor shall be responsible for the relocation or protection, or any other works required to treat utility services impacted by the works to comply with all legislative requirements and those requirements of the relevant service authority and/or owner.

The Contractor shall make provision for the liaison, design, approvals, construction and commissioning of relocated utility services, and any other utility services works required to complete the works in accordance with the Drawings.

**E2.1.3 ENQUIRIES**

The Contractor and their sub-consultants shall not discuss the works, progress, etc. with the public local businesses or any media representations, but will direct all enquiries to the Principal's Representative.

**E2.1.4 QUALITY ASSURANCE**

Requirement: Where there is a recognised quality assurance program applicable to a specified product, provide assurance of product quality under the authority of that program. The program shall be one in which the manufacturer has in place a quality control management system that is subject to continual monitoring through quality audits by a recognised independent organisation.

**E2.1.5 QUALITY MANAGEMENT**

Provide quality management in accordance with the following TfNSW documents:

- TCA Standard Requirements
- TSR Q1 – Quality Management
- CM-ST-177/1.0

### E2.1.6 DILAPIDATION SURVEY

The Contractor must provide to the Principal's Representative a complete dilapidation survey of all existing buildings, structures, and services before commencing work on site, including the immediate adjoining buildings that share a common boundary with the site.

The survey must clearly identify and record in writing and photographs the state of buildings, structures and services. Any existing damage must be recorded.

The dilapidation survey will form the basis of assessment of damages to existing buildings, structures or services during and at the completion of the works.

The Contractor must rectify, at their own cost, all damage that has occurred during the course of the works.

### E2.1.7 ON-SITE COMMUNICATION

The Contractor shall be responsible for managing all communication on site.

Prior to commencement on site, prepare a 'Communication and Customer Relation Plan' and deliver it to the Principal's Representative. The plan must be approved by the Principal's Representative prior to work commencing on site. This will include communication with the following:

600) Station Manager:

Use of existing station compound for site and construction access and storage.

Arranging a suitable time for work with a minimum of four weeks' notice of the commencement date of these works.

Relocation of existing platform furniture affected by the new work and its reinstatement at existing or new locations.

Supply and erect a total of two (2) billboards of a size not less than 1200 mm high and 2400 mm wide, to a specification supplied by TfNSW through the Principal's Representative. The name of the Principal Contractor and its 24 hour emergency contact number shall be prominently displayed on site. They shall be erected two weeks prior to commencing on site.

Supply and erect Information Update Board of A1 size, advising the public of progress of the construction work. This is to be updated monthly throughout the currency of work on site. Each board and each update thereafter shall show:

- Altered access arrangements.
- Uneven floor surfaces.
- Warning signs for items such as cranes and material handling.
- Unsafe or non-accessible areas.

When the work on site is likely to cause disruption by altered traffic, noise, dust, night work, work outside permitted hours etc., to the surrounding community, a letter box drop must be undertaken to nearby residents and businesses to advise the:

- Nature of the disruption.
- Length of the disruption.
- Action being undertaken to minimise disruption.
- Contact telephone numbers for enquiries.
- An apology on behalf of TfNSW.

Design of all signs and written communication shall be approved by the Principal's Representative before commissioning of signwriting or printing.

### E2.1.8 NOTICE

Advise the Principal's Representative a minimum of four (4) weeks prior to any commissioning of new facilities for public use, to enable TfNSW Management to adequately advise community and stakeholders.

The Contractor must give the Principal's Representative written notice of intended work to TfNSW's equipment in order to facilitate coordination of the services and relevant personnel as per the following time schedule.

Telephone, alarms, P.A. systems, CCTV, CountryLink or CityRail equipment: 28 days.

Temporary relocation of railway services: 16 weeks (proposal to relocate railway services must be agreed to by the Principal's Representative).

Request for midnight to dawn possessions: 16 weeks (no guarantee that such request will be granted).

<b>Certifier</b>	<b>Hold/Witness Point</b>	<b>Description</b>
Geotechnical Engineer	Witness	Inspect bearing capacity of foundation.
Structural Engineer	Hold	Inspection of lift shaft pit reinforcement.
Structural Engineer	Hold	Inspection of steel reinforcement to concrete columns, beams and slabs.
Structural Engineer	Hold	Submit work shop drawings for steelwork.
Structural Engineer	Hold	Inspection of fabricated steelwork prior to hot dipped galvanising.
Structural Engineer	Witness	Erected Steelwork.
Architect	Witness	Items to be built in: located in their correct positions, including damp-proof course, flashings, bolts and structural steelwork.
Architect	Witness	Structural steel 50% Completion.
Architect	Witness	Structural steel 100% Completion.
Architect	Witness	Internal Finishes 100% Completion.
Architect	Witness	Cladding Painting 100% Completion.
Electrical Engineer	Witness	25% Completion – Inspection of wiring prior to covering up.
Electrical Engineer	Witness	50% Completion – Testing Electrical Switchboard.
Electrical Engineer	Hold	100% Completion – Final Testing including TfNSW testing.
Hydraulics Engineer	Witness	25% Completion checking invert levels.
Hydraulics Engineer	Hold	50% Testing Drainage.
Hydraulics Engineer	Hold	100% Completion and testing system.
Mechanical Engineer	Hold	100% Completion and testing system.
Architect	Hold	Submit shop drawings as detailed in the Trade Specifications
Architect	Hold	Submit or prepare samples as detailed in the Trade Specifications

### **E2.1.9 SCHEDULE OF HOLD AND WITNESS POINTS**

Notify Principal's Representative giving a minimum of four working days notice for hold and witness points nominated at each trade Section.

### **E2.1.10 STANDARDS AND APPROVALS/CONDITIONS**

The Contractor shall comply with the requirements of the Building Code of Australia, Australian Standards, TfNSW Standards, CityRail Station Design Guide CSR006 Vol 1 & 2, March 1996 and the conditions of the REF Assessment.

## **E2.2 SCOPE OF WORK**

### **E2.2.1 GENERAL**

The scope of work to be carried out at Cardiff Railway Station broadly includes, but is not limited to, the provision of two new lifts, the extension of the existing footbridge and the provision of a new balustrade and anti throw screens, new stairs at the western side, new ticket office with a family accessible toilet, raising of the level of the existing platforms, new concrete footpath, and regrading of existing paths, provision of disabled persons' car spaces, and other miscellaneous improvements.

The construction works under this Contract shall comprise the provision of all labour, materials, plant and equipment for completing the upgrading works and handing over of the total Contract Works to a standard that is acceptable by TfNSW.

### **E2.2.2 SITE ESTABLISHMENT AND PRELIMINARIES**

Relocation of all existing services where affected by the works including water, electrical, telephone, PA, sewer and stormwater drainage, as necessary to carry out the works.

Provision of all site establishment, including hoardings, sheds/buildings, amenities, temporary services, temporary lighting, etc. as necessary to carry out the works.

Provision of, including maintenance thereof, of all temporary works including hoardings, barricading, signage, lighting as necessary to maintain station operations and safe and convenient access to the public. The hoarding shall be constructed to TfNSW standard and in such a way to maintain minimum platform width of 2000 mm. Hoarding shall be checked regularly for structural integrity and maintained free of graffiti.

Provision of all mandatory safety signage, station identification signage, and communication signage as required and specified.

Allowance for all necessary after-hours access and safeworking requirements. Any construction work, in particular electrical work, which may affect normal station operation shall be undertaken after hours or on weekends.

Support and maintain the operation of lights and other railway services in the vicinity of where demolition and construction works will be undertaken. Temporary lighting shall be provided to maintain satisfactory illumination level acceptable to the Principal's Representative and Station Manager.

Assess all existing services with respect to their current capacity. The Contractor will be responsible to upgrade existing services, such as existing stormwater services and electrical services, to accommodate the proposed works.

Prior to work commencing, shop drawings for electrical work, structural steel and lift works shall be submitted to TfNSW for review and acceptance.

Determine the location of existing services and drains in the vicinity of new works and demolition area; disconnect, cap and seal and remove redundant services.

Disconnect, make safe and remove redundant electrical apparatus.

Provide for the complete management and coordination with the TfNSW's personnel regarding disconnection and relocation/reconnections/expansion of any services (e.g. Telephones, P.A. systems, CountryLink, CityRail equipment and CCTV).

Obtaining of permission from Council and payment of fees and bond for tree removals, road/drainage work, parking for construction purpose and any associated inspection of Council officer.

Preparation and submission of traffic management plans to relevant authorities if public road access and position of bus stops/taxi stands are to be altered due to construction work.

The Contractor must install all mandatory, safety, and communications signage as specified, including road signage.

The Contractor must allow for the management and coordination of the installation of new station signage by others.

### **E2.2.3 SUMMARY SCOPE OF NEW WORKS**

#### **General**

The scope of the new works is as defined in this RFT, the drawings and specification and all relevant TfNSW regulations. It includes, but is not limited to the items listed below. Refer to Clause 2.10 for demolition works.

#### **Lift shafts**

Construct two new lift shafts of concrete and steel framed construction, steel framed roof and Colorbond clad roofing panels, and fibre cement cladding panels with fixed glazing to the walls.

Construct new canopies at Footbridge Level.

Provide all services required in connection with the new work including guttering and downpipes, connection to stormwater drainage, electrical services etc.

#### **Platform**

Raise level of existing platform as indicated.

Extend platform as shown on drawings.

Re-install furniture and signage, and provide new furniture and signage as detailed.

Provide new edge coping, and tactile and yellow pavers to edge of platforms as detailed and to the requirements of TfNSW.

**Platform building**

Construct new building comprising Ticket Office, Staff Amenities, Family Accessible Toilet and awnings on two sides.

Provide all services to new building as required.

**Footbridge**

Extend existing footbridge to new lifts.

Provide balustrading to footbridge extensions.

Remove existing balustrades and provide new balustrading and anti throw screens to both sides of existing footbridge.

**Existing stairs**

Remove and replace existing balustrades. Provide new tactile tiles and stair nosings.

**New Stairs**

Provide new concrete stairs from Footbridge Level to Car Park Level, complete with balustrades, handrails and tactile tiles.

**Site work generally**

Provide new paths and re-grade existing paths where shown.

New paving at Upper Accessway Level,

Re-construct existing crib block wall on the west side as required by new ground profile and levels.

Construct new retaining walls.

Convert 5 existing parking spaces to 3 spaces for disabled surfaces, including linemarking and signage.

New concrete paving at Lift entries at Upper Access Level and Lower Parking level, including balustrades and other ancillary works.

Provide new fencing where indicated.

Provide new bicycle racks.

**Temporary works**

Provide temporary stair from Footbridge Level to Car Park level, including balustrades,

**Making good**

The contractor shall make good any damage to existing structures, surfaces and other building elements resulting from demolition or new work.

The Contractor shall make good any damaged surfaces resulting from demolition of the redundant drainage pits and existing concrete path in the Upper Accessway as shown on the Drawings

**General**

Provide metalwork installations as required to complete the project, including grated drainage, steel mesh and pipe-rail balustrades, grated aluminium lift shaft ceilings, fixtures and fittings, ventilation louvres, stainless steel handrails, fencing, platform seats and bins and signage.

Provide all required guttering and support systems, downpipes and connection to stormwater drainage.

Paint line-marking to door thresholds of platform building and platform copings for the full length of the platforms, including night-safe zone as directed by the Principal's Representative. Allow for linemarking of the carpark.

**E2.2.4 ELECTRICAL SCOPE OF WORK**

Refer to the electrical specification for the electrical scope of work for the project.

**E2.2.5 HYDRAULIC SCOPE OF WORK**

Supply and install sanitary drainage and plumbing and sanitary fixtures.

Install gutters to the new roofs, downpipes and drainage to service these gutters as shown on the Contract Drawings

Allow to restore all disturbed concrete and make good.

Supply and install rainwater reuse tank to the platform with connection to ticket office services.

Allow for preparation of Workshop and As Built drawings.

Work shall be carried out to cause minimal disruption.

### **E2.2.6 MECHANICAL SCOPE OF WORK**

Refer to the mechanical services specification for the mechanical scope of work for the project.

### **E2.2.7 LIFT SCOPE OF WORK**

Provide two (2) Liftronic lifts, 17-person capacity and hoisting speed with air-conditioned car and internal car fitout complying with disabled access requirements, including installation of handrails.

Supply and install a Services Termination Box on top of each lift control box for the termination of lift phone and CCTV camera. The style and finishes of the termination box shall match the lift control box to be supplied by the lift contractor.

### **E2.2.8 CIVIL ENGINEERING SCOPE OF WORK**

Works required for the regrading of the Upper Accessway and provision of disabled parking in the Lower Car Park, including but not limited to, the provision of all necessary materials, equipment and labour associated with the removal and disposal of existing pavement, construction of new pavement, footpath, kerb and channel, guardrail, linemarking of car spaces, provision of signage, utility service relocation, signage, demolition and removal of redundant pits.

The Contract requires completion of all activities including provision of all necessary materials, equipment and labour associated with and relevant to the construction of civil works to the car park. Activities may include but are not limited to clearing and grubbing, erosion and sedimentation control, demolition, earthworks, retaining walls, road works, stormwater drainage, fencing, and any other ancillary works that may be required. Refer to Contract Documents for particular requirements.

### **E2.2.9 TRAFFIC MANAGEMENT**

The safe and effective management of traffic is a key requirement of the Contract, and the Contractor shall:

- minimise impacts on traffic and cater for the needs of all traffic, where ever possible;
- provide a safe environment for the travelling public and construction personnel;
- provide advance notification of traffic events to the public; and
- communicate the arrangements for and impacts of any item of works affecting traffic.

The Contractor shall comply with performance requirements for Traffic Management including as a minimum AS 1742 and all standards, guidelines or other requirements of the RTA and Lake Macquarie Council.

#### **Performance Requirements**

The Contractor shall conduct all operations so as to minimise obstruction and inconvenience to the public, and shall be responsible for all works associated with traffic management including but not limited to any drainage, pavement, line marking, signing, traffic barriers, communication, and any temporary works.

Unless agreed otherwise by the Principal, the Contractor shall maintain all existing pedestrian movements within the Limit of Works at all times. Temporary pathways, as required, shall be provided and maintained by the Contractor to provide smooth, free-draining, clean and unimpeded access.

The Contractor shall also plan and implement its works so as not to affect traffic on public holidays or on days of any planned major public events that may generate significant traffic movements in the vicinity of the Site. This also includes major public events remote from the Site that may generate significant traffic movements through or in the vicinity of the Site.

The Contractor shall also maintain access to commercial properties during trading hours, and consider the access requirements of individual owners/occupiers in the programming and execution of the Works.

#### **Traffic Management Plans**

The Contractor shall prepare Traffic Management Plans for the management of any impacts the works have on traffic in accordance with the performance requirements included in this specification and relevant legislation.

The Contractor shall be responsible for obtaining all necessary approvals, and the co-ordination, implementation and other arrangements associated with Traffic Management Plans. Each Traffic Management Plan shall be a complete document incorporating the following:

- a statement of purpose including an overview of the Plan, its purpose and justification for the proposed work method including details of any alternative work methods considered;
- computer generated scaled drawings that clearly show the proposed traffic staging together with the measures to adequately control traffic;
- the location, timing and extent of any proposed road or lane closures or other impacts on traffic;
- the timing of any proposed road or lane closures or other event that impacts on traffic;
- any proposed signing and pavement markings, including any changes to the existing signing, pavement markings or existing traffic control devices;
- measures proposed to mitigate the disruption to traffic, including traffic that is disrupted outside of the limits of work;
- the agreement of Lake Macquarie Council;
- a complete list of relevant contacts including Contractor's and Principal's representatives, emergency services, statutory authorities and service providers;
- the findings and actions from a road safety audit of the Traffic Management Plan; and
- a Communication Plan, which, as a minimum includes provision of formal advice of the proposed traffic impacts to all relevant stakeholders, including but not limited to residents, businesses, Lake Macquarie Council, public transport operators, emergency services and responsible authorities not less than seven days prior to the proposed works. It may also incorporate the following as appropriate:
  - provision of variable message signs in advance of and during the works;
  - preparation and submission of newspaper advertisements in relevant local newspapers, following the Principal's agreement to do so;
  - the nomination of a person who is responsible as the community contact for the traffic event; and
- Process and Responsibilities

The Contractor shall prepare and submit each Traffic Management Plan at not less than the following timeframes:

- a preliminary Traffic Management Plan for the Principal's review at least 4 weeks prior to the commencement of the proposed works impacting traffic; and
- a final Traffic Management Plan, incorporating any comments arising from the review of the preliminary Traffic Management Plan, for the Principal's review at least two weeks prior to the commencement of the proposed works impacting traffic.

The Contractor shall in the preparation of the Traffic Management Plan allow the following times for the Principal's review of each stage of the Traffic Management Plan:

- one week for the preliminary Traffic Management Plan; and
- one week for the final Traffic Management Plan.

#### **E2.2.10 LANDSCAPING SCOPE OF WORK**

Provide landscaping services as detailed on the landscaping drawings.

#### **E2.2.11 COORDINATION WITH OTHER SUPPORT WORKS**

Coordinate with TfNSW's preferred contractors the relocation, removal, reinstatement, and installation of CCTV cameras and other railway services in order to facilitate the demolition and construction works. The Contractor shall provide the Principal's Representative at least one month's notice of any required CCTV/PA/Ticketing/railway service relocation. There is no guarantee that any existing railway services can be relocated to make way for the new works. Where it is not feasible to relocate existing services, other alternative methodology shall be developed and proposed by the Contractor to the Principal's Representative for acceptance.

Coordinate and implement the duties of the Principal Contractor for the following works, which shall be undertaken on site by others:

CCTV relocation, removal, reinstatement and installation works (to be undertaken by TfNSW or contractor nominated by TfNSW). Note: Containment is to be provided by the Contractor under this Contract.

The supply and installation of station and lift phones and public address system (to be undertaken by TfNSW Communications & Control System Group). Note: Containment is to be provided by the Contractor under this Contract.

The supply and installation of station signage (to be undertaken by contractor nominated and engaged directly by TfNSW).

Power upgrade between Integral Energy's network and the installation side of the Consumer Mains will be undertaken by TfNSW's Renewals Division.

#### **E2.2.12 RELOCATIONS OF PLATFORM FURNITURE**

Removal and reinstatement later of all existing items of station furniture affected by the works. This will include access ramps, platform seats, light posts and lights, sign posts, signs, station bins, and station Help Points. Provide new footings and fastenings as required for all relocated furniture.

The Contractor shall install/modify/relocate the following items and fixtures:

- All existing station seats, rubbish bins and light poles. They are to be repainted to match TfNSW's Corporate Identity Colour Scheme Manual.

#### **E2.2.13 DEMOLITION & HAZARDOUS MATERIALS**

##### **General**

The Contractor shall undertake all demolition and waste disposal works required to achieve the Scope of Work.

The Contractor must perform demolition work including but not limited to the following:

Partially deconstruct existing ramps to facilitate temporary connection during construction.

Excavate as required for new lift pits and new stairs and the platform building.

Decommission, cap-off, seal and remove all redundant external pipework, ducts, cabling, vents stacks and downpipes, and make good.

Arrange for safe removal of asbestos as identified in the Hazardous Materials Survey (survey attached in Appendix).

Remove and arrange for relocation/reinstatement of platform furniture and other items, including items which are to remain the property and TfNSW, including light poles and light fittings.

Removal of existing concrete footpath, kerb and channel and redundant drainage pits, as shown on the Drawings. The Contractor shall make good any damaged surfaces resulting from demolition, clearing and grubbing. The Contractor shall also reinstate such surfaces, where applicable, with native vegetation sufficient to ensure a stable ground surface and prevent any sedimentation or erosion.

All demolition is to be conducted in strict accordance with AS2601, The Code of Practice for the Safe Removal of Asbestos [NOHSC:2002(1988)], Hazardous Materials Survey for Asbestos 29.03.06, Hazardous Materials Identification and Evaluation Report, the Code of Practice for the Management and Control of Asbestos in Workplaces [NOHSC:2018(2005)].

The Contractor must make good ground affected by demolition including filling and compacting substrate materials and finishing with asphalt, concrete paving slabs and/or other finishing materials to match existing surrounding finishes.

Inspection of existing areas that will undergo alteration/demolition for the presence of asbestos sheets. Perform tests to confirm and arrange for all necessary actions to ensure sheets are removed and disposed in accordance with relevant regulations.

Inspection of existing surfaces that are required to be painted and/or altered/demolished for the presence of "red lead" paint. Perform tests to confirm and arrange for the appropriate protective measure to be undertaken by Contractor. Remove lead paint with an acceptable 'stick and peel-away' system.

Excavated spoil is to be tested for presence of hazardous materials before disposal. Contractor shall dispose hazardous materials at designated tip sites and disposal docket shall be submitted to the Principal's Representative.

**Platform**

Demolish Ticket Office building including awning and external columns.

Demolish awning at south end of platform, complete with glazed screens.

Remove seats, rubbish bins and other platform furniture and fittings as required to facilitate raising of the platform level.

**Existing stairs**

Remove existing balustrades.

**Footbridge Level**

Demolish paving at street entry for construction of new ramps

Remove existing balustrade

**Site generally**

Demolish existing stairs from Upper Accessway Level to Footbridge

Remove existing stair from Upper Accessway Level to Car Park

Remove paving in various areas as shown on drawings

Remove perimeter fencing as shown on drawings

Remove fencing enclosure to garbage storage area

Remove sections of crib wall near lower car park

Remove existing trees where indicated on drawings

Excavate as required for new works

**Services**

Remove all redundant services, including main switchboard and transformers.

**Miscellaneous demolition**

Carry out miscellaneous demolition work as required to enable the contract works to be carried out, even if this is not specifically indicated on the drawings or specification.

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**E2.3 COORDINATION WITH STATION OPERATION**

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**E2.3.1 EXISTING STATION ACCESS & STATION OPERATION**

Works that affect normal station operations (i.e. passenger and staff access to platforms, entrance ways, ticket office, subway and stairs) must be programmed outside station peak hours or during track possession. Proposal that involves alteration to normal station operation shall be accepted by the Principal's Representative and the Station Manager.

The Contractor must maintain safe access for the public via the existing entrances for the entire contract.

The Contractor must provide large and appropriate signs (typically 1000 x 700 mm custom made signs) advising temporary closure or relocation of station entry and exit. They shall be displayed at various strategic locations around the station.

The Contractor must provide a safety hoarding around work areas within the station. Signs advising the passengers of 'Way Out', 'Station Exit' and 'No Standing at this part of Platform' are to be displayed where appropriate.

Where existing lights, lamps or lamp poles are altered due to the works, similar level of illumination must be maintained by provision of temporary lighting.

The booking office and TVMs shall remain open during normal rail opening hours for passengers to purchase tickets.

The contractor must relocate and make good the platform public address speakers that will be affected by the Contractor's activities. The Contractor must install all necessary cabling/conduits to maintain the operation of the public address system.

The Contractor must make good and safe, all affected paving.

**E2.3.2 LIMITATIONS FOR CONSTRUCTION WORKS ON THE STATION**

The works must be planned in stages to ensure that all station services can be adequately provided to the public.

During morning period (between the hours of 05.30 to 09.30), this includes:

- Ticket sales from the ticket window and all TVMs.

During the evening peak period (between the hours of 16.00 to 19.00), this includes:

- Ticket sales from the ticket window and all TVMs.

Outside of peak periods, this includes:

Ticket sales from the ticket window and one TVM.

At all times the following station elements must be maintained fully operational:

- Public toilets.
- CCTV surveillance of all areas currently covered by cameras.
- Passenger Information Displays Screens (PIDS), either in the current location or in an alternate location on the concourse. If relocation is required, disconnection and reconnection will be carried out by TfNSW staff. All other costs are deemed to be included in the contract price.

Unless otherwise directed by the Principal's Representative, the distance between the platform edge and any hoarding must be a minimum of 2.6 metres.

The following is strictly prohibited:

- Work methods with a high risk of causing interruptions to train services.
- Except between the hours of 21.00 and 05.30 daily, the use in the station concourse of jack hammers or other equipment likely to generate excessive noise.
- Concrete cutting saws must not be used on the concourse between the hours of 05.30 and 21.00 daily.
- In the morning and evening peak periods, transport of materials through the concourse.
- Restrictions to pedestrian access on the footpaths along streets adjoining the station.

### **E2.3.3 EXISTING SERVICES**

The Contractor must protect and/or divert existing services to be retained before demolition commences. Reinstate all existing services following completion of works.

### **E2.3.4 WORK TO BE UNDERTAKEN DURING TRACK POSSESSION**

Where construction work cannot be undertaken safely or where safeworking and electrical clearance cannot be achieved e.g. lifting of any prefabricated members/units into position, they are to be completed during a track possession period. The available track possessions are nominated in this RFT.

### **E2.3.5 STAGING AND SITE CONSTRAINTS**

With the exception of working during scheduled track possessions, working hours are limited by the Environmental Protection Authority to 0700 to 1800 Monday to Friday and 0800 to 1300 on Saturdays. No works are permitted on site on Sundays and Public Holidays.

Generally the works shall be staged in such a way as to allow the Station to remain open at all times and to ensure the safety of the public. The contractor shall prepare a Construction Staging Plan and submit details for approval by the principal.

### **E2.3.6 SAFETY AND CLEANLINESS OF STATION**

Maintain the site in a safe condition at all times, protecting the public and TfNSW's employees who may require access through the area of the works.

Sweep down public space, which includes platform surfaces, stairs and access/egress areas, which are affected by the works on a daily basis. Do not sweep onto track.

Clean up the site on a daily basis and at the completion of the Work.

Remove all debris and rubbish to leave the area in a clean tidy and safe condition.

### **E2.3.7 TRAFFIC AND PEDESTRIAN MANAGEMENT**

Prior to the works commencing on site the Contractor must prepare and submit to Council and other relevant authorities for approval a detailed traffic and pedestrian management plan. A copy of the original submission and the final approved submission must be provided to the Principal's Representative.

The plan must ensure:

- Continued operation of existing shops and commercial premises operating in close proximity to the station.
- Continued operation of any bus or taxi zones, and bicycle facilities.
- Provision of suitable traffic marshalling devices and directional signage detailing revised pedestrian access and traffic routes.
- Safe pedestrian and vehicular movement around construction zones.
- Adequate commuter access into the station.
- Provision of all labour and resources necessary for effective pedestrian and traffic management.
- Safe movement and operation of construction plant, materials deliveries, parking etc.
- Comprehensive planning for the special needs during weekend track possessions.

The Contractor must pay all costs, fees and charges for the provision of traffic and pedestrian management.

### **E2.3.8 SERVICES EXCAVATION**

Excavate for services in platform and public areas. Provide all necessary shoring and cover sheets to open excavations.

## **E2.4 OTHER REQUIREMENTS**

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### **E2.4.1 WORKS BY OTHERS**

TfNSW's staff or direct contractors shall be responsible for the following items, which shall not form part of the contract. Contractor is, however, required to manage and coordinate with TfNSW's staff or direct contractors with the installation of these services. This would include acting as Principal Contractor and be held responsible for the safety of these workers.

The provision of the following shall be undertaken directly by TfNSW:

- Provision of temporary Booking Office
- Station Passenger Information with plasma screens.
- Supply and installation of Ticket Vending Machines.

During track possession, other contractors or work groups may be undertaking work at or close to the station. Contractor must allow for coordinating their activities with these work groups.

### **E2.4.2 HOARDINGS**

The provision of temporary hoarding to the relevant TfNSW's standards and balustrades to allow safe public access during the works and to ensure that the public is excluded and protected from the works areas.

Ensure hoarding are free of sharp corners and projections. Maintain hoarding in good condition and remove graffiti immediately. Where hoarding is located less than 2600 mm away from platform edge, diagonal yellow lines are to be painted on the platform surface and signposted to warn passengers of narrowness of platform.

Signs advising passengers of 'Way Out', 'Station Exit' and 'No Standing at this part of Platform' are to be supplied by the Contractor and displayed on the platform and station hoarding.

Note: Open wire and post temporary fencing with mesh and concrete feet, e.g. ATF, are **not** to be used on this site.

### **E2.4.3 SCAFFOLDING, TEMPORARY WORKS AND SUPPORT**

Proposal to install metal scaffolding around the proposed lift shafts must be submitted to the Principal's Representative for acceptance before installation. The scaffolding structure shall be assessed and, where necessary, electrically bonded to TfNSW requirements. A continuous rigid barrier shall be installed to the exterior perimeter of the scaffolding tower where the safe working clearance to the 1500v overhead wiring is infringed. In all cases, shade cloth shall be installed around the perimeter of the scaffolding tower.

Any applications for temporary road closure must be submitted well in advance to the local council. A traffic management plan with qualified traffic controllers must be put into place if local traffic conditions are to be altered due to the works. A letter drop to the immediate neighbourhood advising of such traffic alteration is mandatory.

On request by the Principal's Representative, the Contractor shall obtain professional structural assessment if the integrity of any existing structures is likely to be adversely affected because of the work. Any temporary support work is to be designed and certified by a qualified structural engineer at the Contractor's expense.

#### **E2.4.4 INFRASTRUCTURE CERTIFICATION**

The Contractor shall arrange, at his own cost, a qualified PW52 track inspector to inspect and certify the track infrastructure is suitable for train running after each track possession if the existing tracks have been disturbed in any way e.g. track may have been used as an access for cherry picker and other machinery for construction purposes during a possession.

All remedial works required by the PW52 shall be undertaken and completed before the end of the track possession.

Any excess ballast used for construction of temporary access crossing must be removed at the end of each track possession.

Any electrical or signal infrastructure disturbed or damaged must be reported immediately to the Principal's Representative. The Contractor shall be liable for the cost of rectification. It is therefore advisable for Contractor to take extreme precaution and protect existing signal/electrical infrastructure when work is undertaken in the vicinity of such equipment.

#### **E2.4.5 SITE COMPOUND AND TEMPORARY SERVICES**

The contractor shall submit his proposal to the Principal's Representative for acceptance before setting up his site compound at the station. A chain wire fencing must be provided to separate the railway corridor from the site compound if the contractor elects to set up his compound adjacent to running lines. Double gates must be installed at appropriate locations to permit continuous after hour access for railway maintenance vehicles.

It is Contractor's responsibility to apply for and obtain his own water, telephone, sewer and electrical services. Where power is to be obtained from external electricity suppliers such as Integral Energy, the supply must be provided via an isolation transformer with specific railway earthing arrangement.

#### **E2.4.6 UPGRADED POWER SUPPLY**

The upgraded power supply is expected to be made available by TfNSW for the commissioning of the lifts (Note: Contractor shall provide temporary power supply for the installation of the lifts). In the event that delay necessitates suspension of any activity, the Contractor shall progress all other parts of the works in accordance with the contract scope and the approved construction program. If they delay becomes extended such that the Contractor has completed all possible work, the Principal's Representative may direct the Contractor to close the site and return when the updated power supply is available. Where the Principal's Representative issues such direction, the Contractor shall be entitled to claim reasonable re-establishment costs for shall not be entitled to claim delay costs.

#### **E2.4.7 WORKSITE PROTECTION**

Any construction related work within the railway corridor must be protected in accordance with a Worksite Protection Plan issued by a qualified P04 officer (from penal approved by TfNSW) to be engaged by the Contractor.

The Worksite Protection Plan shall describe the level of protection required for the workers and the Contractor is obliged to provide the protection as necessary.

## E3 GENERAL REQUIREMENTS

### E3.1 GENERAL

#### E3.1.1 RESPONSIBILITIES

##### Performance

Structural: If required, provide structures, installations and components as follows:

- Fixed accessways: To AS 1657.
- Structural design actions: To AS/NZS 1170.0 and the **Structural design actions schedule**.

##### Design

Design by contractor: If the contractor provides design, use only appropriately qualified persons and conform to all statutory requirements.

Conflict with the documents: If it is believed that a conflict exists between statutory requirements and the documents, notify the Principal's Representative immediately and provide a recommendation to resolve the conflict.

#### E3.1.2 PRECEDENCE

##### General

Worksections and referenced documents:

- The requirements of other worksections of the specification override conflicting requirements of this worksection.
- The requirements of the worksections override conflicting requirements of their referenced documents.
- The requirements of the referenced documents are minimum requirements.

#### E3.1.3 CROSS REFERENCES

##### General

Requirement: Conform to the following:

- *Demolition*.
- *Service trenching*.

##### Common requirements

Requirement: Conform to the following:

- *Adhesives, sealants and fasteners*.
- *Fire-stopping*.
- *Metals and prefinishes*.

##### Cross referencing styles

Within the text:

- Worksection titles are indicated by *Italicised* text.
- Subsection titles are indicated by **BOLD** text.
- Clause titles are indicated by **Bold** text.

#### E3.1.4 REFERENCED DOCUMENTS

##### Contractual relationships

General: Responsibilities and duties of the principal, contractor and Principal's Representative are not altered by requirements in the documents referenced in this specification.

##### Current editions

General: Use referenced documents which are the editions, with amendments, current 3 months before the closing date for tenders, except where other editions or amendments are required by statutory authorities.

### E3.1.5 INTERPRETATION

#### Abbreviations

General: For the purposes of this specification the following abbreviations apply:

- AS: Australian Standard.
- BCA: Building Code of Australia.
- EMC: Electromagnetic compatibility.
- MSDS: Material safety data sheets.
- NATA: National Association of Testing Authorities.
- NZS: New Zealand Standard.
- VOC: Volatile organic compound.

#### Definitions

General: For the purposes of this specification, the definitions given below apply.

- Approved: 'Approved', 'reviewed', 'directed', 'rejected', 'endorsed' and similar expressions mean 'approved (reviewed, directed, rejected, endorsed) in writing by the Principal's Representative'.
- Attendance: 'Attendance', 'provide attendance' and similar expressions mean 'give assistance for examination and testing'.
- Principal's Representative: 'Principal's Representative' has the same meaning as 'architect' or 'superintendent' and is the person appointed by the 'owner' or 'principal' under the contract.
- Default: Specified value, product or installation method which is to be provided unless otherwise documented.
- Design life: The period of time for which it is assumed, in the design, that an asset will be able to perform its intended purpose with only anticipated maintenance but no major repair or replacement being necessary.
- Documented: 'Documented', 'as documented' and similar terms mean contained in the contract documents.
- Economic life: The period of time from the acquisition of an asset to when the asset, while still physically capable of fulfilling its function and with only anticipated maintenance, ceases to be the lowest cost alternative for satisfying that function.
- Geotechnical site investigation: The process of evaluating the geotechnical characteristics of the site in the context of existing or proposed construction.
- Give notice: 'Give notice', 'submit', 'advise', 'inform' and similar expressions mean 'give notice (submit, advise, inform) in writing to the Principal's Representative'.
- High level interface: Systems transfer information in a digital format using an open system interface.
- Hold point: The activity cannot proceed without the approval of the Principal's Representative.
- Hot-dip galvanized: Zinc coated to AS/NZS 4680 after fabrication with coating thickness and mass to AS/NZS 4680 Table 1.
- IP: 'IP', 'IP code', 'IP rating' and similar expression have the same meaning as 'IP Code' in AS 60529.
- Joints:
  - . Construction joint: A joint with continuous reinforcement provided to suit construction sequence.
  - . Control joint: An unreinforced joint between or within discrete elements of construction which allows for relative movement of the elements.
    - \* Contraction joint: An opening control joint with a bond breaking coating separating the joint surfaces to allow independent and controlled contraction of different parts or components, induced by shrinkage, temperature changes or other causes. It may include unbound dowels to assist vertical deflection control.
    - \* Expansion joint: A closing control joint with the joint surfaces separated by a compressible filler to allow axial movement due to thermal expansion or contraction with changes in temperature or creep. It may include unbound dowels to assist vertical deflection control.
    - \* Isolation joint: A joint between elements of a structure designed to isolate structural movement while permitting horizontal and/or vertical movement between abutting elements.

- . Weakened plane joint: A contraction joint created by forming a groove, extending at least one quarter the depth of the section, either by using a grooving tool, by sawing, or by inserting a premoulded strip.
- . Structural control joint: A control joint (contraction, expansion and isolation) in structural elements when used with applied material and finishes.
- . Substrate joint: A joint in the substrate which includes construction joints and joints between different materials.
- . Sealant joint: A joint filled with a flexible synthetic compound which adheres to surfaces within the joint to prevent the passage of dust, moisture and gases.
- Local government authority: A body established for the purposes of local government by or under a law applying in a state or territory.
- Low level interface: Systems transfer information via terminals and voltage free contacts.
- Metallic-coated: Steel coated with zinc or aluminium-zinc alloy as follows:
  - . Metallic-coated steel sheet: To AS 1397. Metal thicknesses specified are base metal thicknesses.
  - . Ferrous open sections zinc coated by an in-line process: To AS/NZS 4791.
  - . Ferrous hollow sections zinc coated by a continuous or specialised process: To AS/NZS 4792.
- Network Utility Operator: A person who undertakes the piped distribution of drinking water or natural gas for supply or is the operator of a sewerage system or a stormwater system.
- Network Distributor: Body responsible for the distribution and control of electricity.
- Obtain: 'Obtain', 'seek' and similar expressions mean 'obtain (seek) in writing from the Principal's Representative'.
- Practical completion or Defects free completion: The requirements for these stages of completion are defined in the relevant building contract for the project.
- Pipe: Includes pipe and tube.
- Principal: 'Principal' has the same meaning as 'owner', 'client' and 'proprietor' and is the party to whom the contractor is legally bound to construct the works.
- Professional engineer: A person who is listed on the National Professional Engineers Register (NPER) in the relevant discipline at the relevant time.
- Proprietary: 'Proprietary' means identifiable by naming manufacturer, supplier, installer, trade name, brand name, catalogue or reference number.
- Provide: 'Provide' and similar expressions mean 'supply and install' and include development of the design beyond that documented.
- Readily accessible: To AS/NZS 3000.
- Registered testing authority:
  - . An organisation registered by the National Association of Testing Authorities (NATA) to test in the relevant field; or
  - . An organisation outside Australia registered by an authority recognised by NATA through a mutual recognition agreement; or
  - . An organisation recognised as being a Registered Testing Authority under legislation at the time the test was undertaken.
- Required: Means required by the documents, the local council or statutory authorities.
- If required: A conditional specification term for work which may be shown in the documents or is a legislative requirement.
- Samples: Includes samples, prototypes and sample panels.
- Statutory authority: A public sector entity created by legislation, that is, a specific law of the Commonwealth.
- Supply: 'Supply', 'furnish' and similar expressions mean 'supply only'.
- Tests:
  - . Pre-completion tests: Tests carried out before completion tests.
    - \* Type tests: Tests carried out on an item identical with a production item, before delivery to the site.
    - \* Production tests: Tests carried out on a purchased item, before delivery to the site.

- \* Progressive tests: Tests carried out during installation to demonstrate performance in according with this specification.
- \* Site tests: Tests carried out on site.
- . Completion tests: Tests carried out on completed installations or systems and fully resolved before the date for, to demonstrate that the installation or system, including components, controls and equipment, operates correctly, safely and efficiently, and meets performance and other requirements. The Principal's Representative may direct that completion tests be carried out after the date for practical completion.
- Tolerance: The permitted difference between the upper limit and the lower limit of dimension, value or quantity.
- Verification: Provision of evidence or proof that a performance requirement has been met or a default exists.
- Witness points: Provides an opportunity to attend an activity but does not involve an obligation. The activity can proceed without approval from the Principal's Representative.

### **E3.1.6 CONTRACT DOCUMENTS**

#### **Services diagrammatic layouts**

General: Layouts of service lines, plant and equipment shown on the drawings are diagrammatic only, except where figured dimensions are provided or calculable.

Before commencing work:

- Obtain measurements and other necessary information.
- Coordinate the design and installation in conjunction with all trades.

#### **Levels**

General: Spot levels take precedence over contour lines and ground profile lines.

#### **Drawings and manuals for existing services**

Warranty: No warranty is given as to the completeness or accuracy of drawings and/or manuals of existing services.

### **E3.1.7 INSPECTION**

#### **Notice**

Concealment: If notice of inspection is required in respect of parts of the works that are to be concealed, advise when the inspection can be made before concealment.

Tests: Give notice of the time and place of documented tests.

Minimum notice for inspections to be made and for witnessing of tests: 4working days.

Light level requirements: to AS/NZS 1680.2.4.

#### **Attendance**

General: Provide attendance for documented inspections and tests.

### **E3.1.8 SUBMISSIONS**

#### **General**

Submit to: The Principal's Representative

Default timing: Make submissions at least 5 working days before ordering products for, or starting installation of, the respective portion of the works.

Program: Allow in the construction program for at least the following times for response to submissions:

- Shop drawings: 10 working days.
- Samples and prototypes: 5 working days.
- Manufacturers' or suppliers' recommendations: 5 working days.
- Product data: 5working days.
- Product/design substitution or modification: 5 working days.

Proposed products schedules: If major products are not specified as proprietary items, submit a schedule of those proposed for use within 3 weeks of site possession.

**Proprietor's requirements**

The Contractor must submit all certificates, inspection records, test results/records and verification records to the Principal's Representative for review under clause 9.14 of the General Conditions, no later than ten (10) Business Days following the certification, inspection or test date.

**Identification**

General: Identify the project, contractor, subcontractor or supplier, manufacturer, applicable product, model number and options, as appropriate and include pertinent contract document references. Include service connection requirements and product certification.

Non-compliance: Identify proposals for non-compliance with project requirements, and characteristics which may be detrimental to successful performance of the completed work.

**Errors**

General: If a submission contains errors, make a new or amended submission as appropriate, indicating changes made since the previous submission.

**Submissions – electronic copies**

File format: dwg and pdf.

Transmission medium: email.

**Submissions – hard copy**

Quantity: 3 sets.

- Loose documents larger than A3: One transparency on heavyweight plastic film the same size as the standard contract drawings.
- Loose documents up to and including A3: One copy.

Standard contract drawing size: A1

**Authorities**

Authorities' approvals: Submit documents showing approval by the authorities whose requirements apply to the work.

Correspondence: Submit copies of correspondence and notes of meetings with authorities whose requirements apply to the work.

**Building penetrations**

General: If it is proposed to penetrate or fix to the following, submit details of the methods proposed to maintain the required structural, fire and other properties:

- Structural building elements including external walls, fire walls, fire doors and access panels, other tested and rated assemblies or elements, floor slabs and beams.
- Membrane elements including damp-proof courses, waterproofing membranes and roof coverings. If penetrating membranes, provide a waterproof seal between the membrane and the penetrating component.

**Certification**

General: Submit certification that the plant and equipment submitted meets all requirements of the contract documents.

**Execution details**

General: Before starting the installation of building services, submit the following:

- Embedded services: Proposed method for embedding services in concrete walls or floors or chasing into concrete or masonry walls.
- Fixing of services: Typical details of locations, types and methods of fixing services to the building structure.
- Inaccessible services: If services will be enclosed and not accessible after completion, submit proposals for location of service runs and fittings.

**Inspection and testing**

General: Submit an inspection and testing plan which is consistent with Clause 8.2 of TfNSW's TSR Q1 Quality Management. Include particulars of test stages and procedures.

Test reports: Submit written reports on nominated tests.

**Marking and labelling**

General: Before marking and labelling submit:

- Samples of the proposed labels.

- A schedule showing, for each item or type of item:
  - . A description of the item or type of item sufficient to identify it.
  - . The proposed text of the marking or label
  - . The proposed location of the marking or label.

**Materials and components**

Product certification: If products must conform to product certification schemes, submit evidence of conformance.

Product data: For proprietary equipment, submit the manufacturer's product data as follows:

- Technical specifications and drawings.
- Type-test reports.
- Performance and rating tables.
- Recommendations for installation and maintenance.

**Substitutions**

Identified proprietary items: Identification of a proprietary item does not necessarily imply exclusive preference for the item so identified, but indicates the necessary properties of the item.

Alternatives: If alternatives to the documented products, methods or systems are proposed, submit sufficient information to permit evaluation of the proposed alternatives, including the following:

- Evidence that the performance is equal to or greater than that specified.
- Evidence of conformity to a cited standard.
- Samples.
- Essential technical information, in English.
- Reasons for the proposed substitutions.
- Statement of the extent of revisions to the contract documents.
- Statement of the extent of revisions to the construction program.
- Statement of cost implications including costs outside the contract.
- Statement of consequent alterations to other parts of the works.

Availability: If the documented products or systems are unavailable within the time constraints of the construction program, submit evidence.

Criteria: If the substitution is for any reason other than unavailability, submit evidence that the substitution:

- Is of net enhanced value to the principal.
- Is consistent with the contract documents and is as effective as the identified item, detail or method.

**Samples**

Submission: Submit nominated samples.

Incorporation of samples: If it is intended to incorporate samples into the works, submit proposals. Incorporate samples in the works which have been endorsed for inclusion. Do not incorporate other samples.

Retention of samples: Keep endorsed samples in good condition on site, until the date of practical completion.

**Shop drawings**

General: Include dimensioned drawings showing details of the fabrication and installation of structural elements, building components, services and equipment, including relationship to building structure and other services, cable type and size, and marking details.

Diagrammatic layouts: Coordinate work shown diagrammatically in the contract documents, and submit dimensioned set-out drawings.

Services coordination: Coordinate with other building and service elements. Show adjusted positions on the shop and record drawings.

Space requirements: Check space requirements of equipment and services indicated diagrammatically in the contract documents.

Submission medium: Electronic and hard copy

Drawing size: A1

Checking: Ensure that the drawings have been checked before submission.

Building work drawings for building services: Submit detailed dimensioned drawings showing all:

- Access doors and panels.
- Conduits to be cast in slabs.
- Holding down bolts and other anchorage and/or fixings required complete with loads to be imposed on the structure during installation and operation.
- Openings, penetrations and block-outs.
- Sleeves.
- Plinths, kerbs and bases.
- Required external openings.

## **E3.2 PRODUCTS**

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### **E3.2.1 GENERAL**

#### **Manufacturers' or suppliers' recommendations**

General: Provide and select, if no selection is given, transport, deliver, store, handle, protect, finish, adjust and prepare for use the manufactured items in accordance with the current written recommendations and instructions of the manufacturer or supplier.

Proprietary items/systems/assemblies: Assemble, install or fix to substrate in accordance with the current written recommendations and instructions of the manufacturer or supplier.

Project modifications: Advise of activities that supplement, or are contrary to, manufacturers' or suppliers' written recommendations and instructions.

#### **Sealed containers**

General: If materials or products are supplied by the manufacturer in closed or sealed containers or packages, bring the materials or products to point of use in the original containers or packages.

#### **Prohibited materials**

Do not provide the following:

- Materials listed in the Safe Work Australia Hazardous Substances Information System (HSIS).
- Materials that use chlorofluorocarbon (CFC) or hydro chlorofluorocarbon (HCFC) in the manufacturing process.

### **E3.2.2 TESTS**

#### **Attendance**

General: Provide attendance on tests.

#### **Testing authorities**

General: Except for site tests, have tests carried out by a Registered testing authority and submit test reports.

- Reports: Submit copies of test reports, including certificates for type tests, showing the observations and results of tests and conformance or non-conformance with requirements.
- Site tests: Use instruments calibrated by authorities accredited by a Registered testing authority.

#### **Notice to proprietor**

For all tests to be witnessed by the Principal or its representative(s), the Contractor must provide the Principal's Representative with at least five (5) Business Days written notice for any tests to be performed in Australia external to the Asset Lands, and at least 45 days written notice for tests to be performed overseas, or such other time as determined from time-to-time by the Principal's Representative, to enable the Principal to make arrangements for attendance.

### **E3.2.3 MATERIALS AND COMPONENTS**

#### **Consistency**

General: For each material or product use the same manufacturer or source and provide consistent type, size, quality and appearance.

#### **Corrosion resistance**

General: Conform to the following atmospheric corrosivity category as defined in AS/NZS 2312.

Atmospheric corrosivity category: Low

#### **Situation**

The following classification of situation applies to the **Corrosion resistance and durability tables**.

- Internal: Building fabric protected from salt and moisture by vapour barriers, sarking, sheathing and building wraps.
- External: Includes external leaf and air spaces behind external leaf brickwork or blockwork walls.

#### **Galvanizing**

Severe conditions: Galvanize mild steel components (including fasteners) to AS 1214 or AS/NZS 4680 as appropriate, if:

- Exposed to weather.
- Embedded in masonry.
- Exposed to or in air spaces behind the external leaf of masonry walls.
- In contact with chemically treated timber, other than copper chrome arsenate (CCA).

#### **PVC products**

Verification: Provide third party verification to demonstrate that PVC products proposed for the project satisfy the criteria required by the GBCA for their Credit in the Materials category of Green star assessment.

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### **E3.3 EXECUTION**

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#### **E3.3.1 OFF SITE DISPOSAL**

##### **Removal of material**

General: Dispose of building waste material off site to the requirements of the relevant authorities.

#### **E3.3.2 WALL CHASING**

##### **Holes and chases**

General: If holes and chases are required in masonry walls, provide proposals to demonstrate that the structural integrity of the wall is maintained. Do not chase walls nominated as fire or acoustic rated. Parallel chases or recesses on opposite faces of a wall: Not closer than 600 mm to each other.

#### **E3.3.3 FIXING**

##### **General**

Suitability: If equipment is not suitable for fixing to non-structural building elements, fix directly to structure and trim around penetrations in non-structural elements.

##### **Fasteners**

General: Use proprietary fasteners capable of transmitting the loads imposed, and sufficient to ensure the rigidity of the assembly.

#### **E3.3.4 SERVICES CONNECTIONS**

##### **Connections**

General: Connect to network distributor services or service points. Excavate to locate and expose connection points. Reinstatement of the surfaces and facilities that have been disturbed.

##### **Network distributors' requirements**

General: If the network distributor elects to perform or supply part of the works, make the necessary arrangements. Install equipment supplied, but not installed, by the authorities.

#### **E3.3.5 SERVICES INSTALLATION**

##### **General**

Fixing: If non-structural building elements are not suitable for fixing services to, fix directly to structure and trim around holes or penetrations in non-structural elements.

Installation: Install equipment and services plumb, fix securely and organise reticulated services neatly. Allow for movement in both structure and services.

Concealment: Unless otherwise documented, conceal all cables, ducts, trays and pipes except where installed in plant spaces, ceiling spaces and riser cupboards. If possible, do not locate on external walls.

**Lifting:** Provide heavy items of equipment with permanent fixtures for lifting as recommended by the manufacturer.

**Suspended ground floors:** Keep all parts of services under suspended ground floors at least 150 mm clear of the ground surface. Make sure services do not impede access.

**Arrangement:** Arrange services so that services running together are parallel with each other and with adjacent building elements.

**Dissimilar metals:** Join dissimilar metals with fittings of electrolytically compatible material.

**Temporary capping:** During construction protect open ends of pipe with metal or plastic covers or caps.

### **Piping**

**General:** Install piping in straight lines at uniform grades without sags. Arrange to prevent air locks. Provide sufficient unions, flanges and isolating valves to allow removal of piping and fittings for maintenance or replacement of plant.

**Spacing:** Provide at least 25 mm clear between pipes and between pipes and building elements, additional to insulation.

**Changes of direction:** Provide long radius elbows or bends and sets where practicable, and swept branch connections. Provide elbows or short radius bends where pipes are led up or along walls and then through to fixtures. Do not provide mitred fittings.

**Vibration:** Arrange and support piping so that it remains free from vibration whilst permitting necessary movements. Minimise the number of joints.

**Embedded pipes:** Do not embed pipes that operate under pressure in concrete or surfacing material.

**Valve groupings:** If possible, locate valves in groups.

**Pressure testing precautions:** Isolate items not rated for the test pressure. Restrain pipes and equipment to prevent movement during pressure testing.

### **Differential movement**

**General:** If the geotechnical site investigation report predicts differential movements between buildings and the ground in which pipes or conduits are buried, provide control joints in the pipes or conduits, as follows:

- Location: Adjacent to the pipe or conduit supports which are closest to the perimeter of the building.
- Arrangement: Arrange pipes and conduits to minimise the number of control joints.
- Magnitude: Accommodate the predicted movements.

## **E3.3.6 BUILDING PENETRATIONS**

### **Penetrations**

**Fire rated building elements:** Seal penetrations with a system conforming to AS 4072.1.

**Non-fire rated building elements:** Seal penetrations around conduits and sleeves. Seal around cables within sleeves. If the building element is acoustically rated, maintain the rating.

### **Sleeves**

**General:** If piping or conduit penetrates building elements, provide metal or PVC sleeves formed from pipe sections as follows:

- Movement: Arrange to permit normal pipe or conduit movement.
- Diameter (for non fire-rated building elements): Sufficient to provide an annular space around the pipe or pipe insulation of at least 12 mm.
- Prime paint ferrous surfaces.
- Terminations:
  - . If cover plates are fitted: Flush with the finished building surface.
  - . In fire-rated and acoustic-rated building elements: 50 mm beyond finished building surface.
  - . In floors draining to floor wastes: 50 mm above finished floor.
  - . Elsewhere: 5 mm beyond finished building surface.
- Termite management: To AS 3660.1.
- Thickness:
  - . Metal:  $\geq 1$  mm.

. PVC:  $\geq 3$  mm.

Sleeves for cables: For penetrations of cables not enclosed in conduit through ground floor slabs, beams and external walls provide sleeves formed from PVC pipe sections.

### E3.3.7 SUPPORT AND STRUCTURES

#### General

Requirement: Provide incidental supports and structures to suit the services.

### E3.3.8 PIPE SUPPORTS

#### Support systems

General: Provide proprietary support systems of metallic-coated steel construction.

Vertical pipes: Provide anchors and guides to maintain long pipes in position, and supports to balance the mass of the pipe and its contents.

Saddles: Do not provide saddle type supports for pipes  $> DN 25$ .

Dissimilar metals: If pipe and support materials are dissimilar, provide industrial grade electrically non-conductive material securely bonded to the pipe to separate them. Provide fixings of electrolytically compatible material.

Uninsulated pipes: Clamp piping supports directly to pipes.

Insulated pipes:

- Spacers: Provide spacers at least as thick as the insulation between piping supports and pipes. Extend either side of the support by at least 20 mm.
- Spacer material: Rigid insulation material of sufficient strength to support the piping and suitable for the temperature application.

#### Support spacing

Cold and heated water pipes: To AS/NZS 3500.1 Table 5.2. Provide additional brackets, clips or hangers to prevent pipe movement caused by water pressure effects.

Sanitary plumbing: To AS/NZS 3500.2 Table 9.1.

Fuel gas: To AS 5601 Table 5.5.

Other pipes: To AS/NZS 3500.1 Table 5.2.

#### Hangers

Conform to the **Hanger size table**.

#### Hanger size table

Nominal pipe size (DN)	Minimum hanger diameter (mm) for single hangers
$\leq 50$	9.5
65 to 90	12.7
100 to 125	15.8
150 to 200	19.0

### E3.3.9 FINISHES TO BUILDING SERVICES

#### General

General: If exposed to view (including in plant rooms), paint new building services and equipment. Surfaces painted or finished off-site: Conform to the *Metals and prefinishes* worksection.

Exceptions: Do not paint chromium or nickel plating, anodised aluminium, GRP, stainless steel, non-metallic flexible materials and normally lubricated machined surfaces. Surfaces with finishes applied off-site need not be re-painted on-site provided the corrosion resistance of the finish is not less than that of the respective finish documented.

#### Standard

General: Conform to the recommendations of AS/NZS 2311 Sections 3, 6 and 7 or AS/NZS 2312 Sections 5, 8 and 10, as applicable.

#### Powder coating

Standard:

- Aluminium for architectural applications: To AS 3715.
- Other metals: To AS 4506.

#### **Painting systems**

New unpainted interior surfaces: To AS/NZS 2311 Table 5.1.

New unpainted exterior surfaces: To AAS/NZS 2311 Table 5.2.

#### **Paint application**

Coats: Apply the first coat immediately after substrate preparation and before contamination of the substrate can occur. Ensure each coat of paint or clear finish is uniform in colour, gloss, thickness and texture and free of runs, sags, blisters or other discontinuities.

Combinations: Do not combine paints from different manufacturers in a paint system.

Protection: Remove fixtures before starting to paint and refix in position undamaged when painting is complete.

#### **Underground metal piping**

Corrosion protection: Provide corrosion protection for the following:

- Underground ferrous piping.
- Underground non-ferrous metal piping in corrosive environments.

Protection methods: Select from the following:

- Cathodic protection: Sacrificial anodes or impressed current. Incorporate a facility for periodic testing. Conform to the recommendations of AS 2832.1.
- Continuous wrapping using proprietary petroleum taping material.
- Impermeable flexible plastic coating.
- Sealed polyethylene sleeve.

#### **Low VOC emitting paints**

Provide the following low odour/low environmental impact paint types with the following VOC limits:

- Primers and undercoats: < 65 g/litre.
- Low gloss white or light coloured latex paints for broadwall areas: < 16 g/litre.
- Coloured low gloss latex paints: < 16 g/litre.
- Gloss latex paints: < 75 g/litre.

### **E3.3.10 WARRANTIES**

#### **General**

General: If a warranty is documented or if a manufacturer's standard warranty extends beyond the end of the defects liability period, name the principal as warrantee. Register with manufacturers as necessary. Retain copies delivered with components and equipment.

Commencement: Commence warranty periods at practical completion or at acceptance of installation, if acceptance is not concurrent with practical completion.

Approval of installer: If installation is not by manufacturer, and product warranty is conditional on the manufacturer's approval of the installer, submit the manufacturer's written approval of the installing firm.

### **E3.3.11 RECORD DRAWINGS**

#### **General**

General: Submit record drawings. Show the 'as installed' locations of building elements, plant and equipment. Show off-the-grid dimensions where applicable.

Shop drawings: Submit all documented shop drawings, including 'as installed' amendments.

Services: Show dimensions, types and location of the services in relation to permanent site features and other underground services. Show the spatial relationship to building structure and other services. Include all changes made during commissioning and the maintenance period.

Services below ground or concealed: If services and fittings are below ground or concealed, show the depth and dimensioned references that will allow the future location of the service for maintenance or expansion.

Extensions and/or changes to existing: If a drawing shows extensions and/or alterations to existing installations, include sufficient of the existing installation to make the drawing comprehensible without reference to drawings of the original installation.

**Accuracy**

Progress recording: Keep one set of shop drawings on site at all times expressly for the purpose of marking changes made during the progress of the works.

Documents: Incorporate all modifications made during the progress of the work and testing period. Show any provisions for the future.

Endorsement: Sign and date all record drawings.

**Drawing layout**

General: Use the same borders and title block as the contract drawings.

**Quantity and format**

General: Conform to **SUBMISSIONS**.

**Date for submission**

General: Not later than 2 weeks after the date of practical completion.

**E3.3.12 OPERATION AND MAINTENANCE MANUALS**

**General**

General: Submit operation and maintenance manuals for the whole of the work.

Authors and compilers: Personnel experienced in the maintenance and operation of equipment and systems installed, and with editorial ability.

Referenced documents: If referenced documents or technical worksections require that manuals be submitted, include corresponding material in the operation and maintenance manuals.

Subdivision: By installation or system, depending on project size.

**Contents**

General: Include the following:

- Table of contents: For each volume. Title to match cover.
- Directory: Names, addresses, and telephone and facsimile numbers of principal consultant, subconsultants, contractor, subcontractors and names of responsible parties.
- Record drawings: Complete set of record drawings, full size.
- Drawings and technical data: As necessary for the efficient operation and maintenance of the installation.
- Installation description: General description of the installation.
- Systems descriptions and performance: Technical description of the systems installed and mode of operation, presented in a clear and concise format readily understandable by the principal's staff. Identify function, normal operating characteristics, and limiting conditions.
- Equipment descriptions:
  - . Name, address, email address and telephone and facsimile numbers of the manufacturer and supplier of items of equipment installed, together with catalogue list numbers.
  - . Schedules (system by system) of equipment, stating locations, duties, performance figures and dates of manufacture. Provide a unique code number cross-referenced to the record and diagrammatic drawings and schedules, including spare parts schedule, for each item of equipment installed.
  - . Manufacturers' technical literature for equipment installed, assembled specifically for the project, excluding irrelevant matter. Mark each product data sheet to clearly identify specific products and component parts used in the installation, and data applicable to the installation.
  - . Supplements to product data to illustrate relations of component parts. Include typed text as necessary.
- Certificates:
  - . Certificates from authorities.
  - . Copies of manufacturers' warranties.
  - . Product certification.
  - . Test certificates for each service installation and all equipment.

- . Test reports
- . Balancing reports for mechanical installations.
- . Control system testing and commissioning results.
- . 7 day record of all trends at commissioning.
- Operation procedures:
  - . Manufacturers' technical literature as appropriate.
  - . Safe starting up, running-in, operating and shutting down procedures for systems installed. Include logical step-by-step sequence of instructions for each procedure.
  - . Control sequences and flow diagrams for systems installed.
  - . Legend for colour-codes services.
  - . Schedules of fixed and variable equipment settings established during commissioning and maintenance.
  - . Procedures for seasonal changeovers.
  - . If the installation includes cooling towers, a water efficiency management plan.
- Maintenance procedures:
  - . Detailed recommendations for preventative maintenance and procedures, including schedule of maintenance work including frequency and manufacturers' recommended tests.
  - . Manufacturer's technical literature as appropriate. Register with manufacturer as necessary. Retain copies delivered with equipment.
  - . Safe trouble-shooting, disassembly, repair and reassembly, cleaning, alignment and adjustment, balancing and checking procedures. Provide logical step-by-step sequence of instructions for each procedure.
  - . Schedule of spares recommended to be held on site, being those items subject to wear or deterioration and which may involve the principal in extended deliveries when replacements are required. Include complete nomenclature and model numbers, and local sources of supply.
  - . Schedule of normal consumable items, local sources of supply, and expected replacement intervals up to a running time of 40 000 hours. Include lubrication schedules for equipment.
  - . Schedules for recording recommissioning data to enable changes in the system over time can be identified.
  - . Instructions for use of tools and testing equipment.
  - . Emergency procedures, including telephone numbers for emergency services, and procedures for fault finding.
  - . Material safety data sheets (MSDS).
- Maintenance records:
  - . Prototype periodic maintenance and performance report to AS 1851, AS/NZS 3666.2 and AS/NZS 3666.3 as appropriate, prepared to include project specific details.
  - . Submit, in binders which match the manuals, loose leaf log book pages designed for recording completion activities including operational and maintenance procedures, materials used, test results, comments for future maintenance actions and notes covering the condition of the installation. Include completed log book pages recording the operational and maintenance activities performed up to the time of practical completion.
  - . Number of pages: The greater of 100 pages or enough pages for the maintenance period and a further 12 months.

**Format – electronic copies**

Printing: Except for drawings required in the **RECORD DRAWINGS** clause provide material that can be legibly printed on A4 size paper.

Scope: Provide the same material as documented for hardcopy in electronic format.

Quantity and format: Conform to **Submissions – electronic copies**.

**Format – hard copy**

General: A4 size loose leaf, in commercial quality, 4 ring binders with hard covers, each indexed, divided and titled. Include the following features:

- Cover: Identify each binder with typed or printed title 'OPERATION AND MAINTENANCE MANUAL', to spine. Identify title of project, volume number, volume subject matter, and date of issue.
- Dividers: Durable divider for each separate element, with typed description of system and major equipment components. Clearly print short titles under laminated plastic tabs.
- Drawings: Fold drawings to A4 size with title visible, insert in plastic sleeves (one per drawing) and accommodate them in the binders.
- Pagination: Number pages.
- Ring size: 50 mm maximum, with compressor bars.
- Text: Manufacturers' printed data, including associated diagrams, or typewritten, single-sided on bond paper, in clear concise English.

Number of copies: 3.

**Date for submission**

Date for draft submission: The earlier of the following:

- 2 weeks before the date for practical completion.
- Commencement of training on services equipment.

Date for final submission: Within 2 weeks after practical completion.

**E3.3.13 TOOLS AND SPARE PARTS**

**Spare parts**

General: Provide spare parts listed in the appropriate worksections.

**Tools and spare parts schedule**

General: At least 8 weeks before the date for practical completion, submit a schedule of tools, portable instruments and spare parts necessary for maintenance of the installation. For each item state the recommended quantity and the manufacturer's current price. Include the following in the prices:

- Checking receipt, marking and numbering in accordance with the spare parts schedule.
- Packaging and delivery to site.
- Painting, greasing and packing to prevent deterioration during storage.
- Referencing equipment schedules in the operation and maintenance manuals.
- Suitable means of identifying, storing and securing the tools and instruments. Include instructions for use.

Replacement: Replace spare parts used during the maintenance period.

**E3.3.14 COMMISSIONING AND COMPLETION TESTS**

**Reports**

General: Submit reports indicating observations and results of tests and compliance or non-compliance with requirements.

**Notice**

Inspection: Give sufficient notice for inspection to be made of the commissioning and completion testing of the installation.

**Controls**

General: Calibrate, set and adjust control instruments, control systems and safety controls.

**Samples**

General: Remove unincorporated samples on completion.

**Circuit protection**

General: Confirm that circuit protective devices are sized and adjusted to protect installed circuits.

**Completion tests**

General: Test the works under the contract to demonstrate compliance with the documented performance requirements of the installation.

Functional checks: Carry out functional and operational checks on energised equipment and circuits and make final adjustments for the correct operation of safety devices and control functions.

Proprietary equipment: Submit type test reports confirming compliance of proprietary equipment.

Sound pressure level measurements: Conform to the following:

- Correction for background noise: To AS/NZS 2107 Table B1.
- External: To AS 1055.1.
- Internal: To AS/NZS 2107.
- Measurement positions: If a test position is designated only by reference to a room or space, do not take measurements less than 1 m from the floor, ground or walls.
- Sound pressure level analysis: Measure the sound pressure level and the background sound pressure level over the full range of octave band centre frequencies from 31.5 Hz to 8 kHz at the designated positions.
- Sound pressure levels: Measure the A-weighted sound pressure levels and the A-weighted background sound pressure levels at the designated positions.

Test instruments: Use instruments calibrated by a registered testing authority.

**Certification**

General: On satisfactory completion of the installation and before the date of practical completion, submit certificates stating that each installation is operating correctly.

**E3.3.15 CLEANING**

**Final cleaning**

General: Before practical completion, clean throughout, including all exterior and interior surfaces except those totally and permanently concealed from view.

Labels: Remove all labels not required for maintenance.

**E3.3.16 PERIODIC MAINTENANCE OF SERVICES**

**General**

General: During the maintenance period, carry out periodic inspections and maintenance work as recommended by manufacturers of supplied equipment, and promptly rectify faults.

Emergencies: Attend emergency calls promptly.

Annual maintenance: Carry out recommended annual maintenance procedures before the end of the maintenance period.

Maintenance period: The greater of the defects liability period and the period nominated in the **Maintenance requirements schedule**.

**Maintenance program**

General: Submit details of maintenance procedures and program, relating to installed plant and equipment, 6 weeks before the date for practical completion. Indicate dates of service visits. State contact telephone numbers of service operators and describe arrangements for emergency calls.

**Maintenance records**

General: Record in binders provided with operation and maintenance manuals.

Referenced documents: If referenced documents or technical worksections require that log books or records be submitted, include this material in the maintenance records.

Service visits: Record comments on the functioning of the systems, work carried out, items requiring corrective action, adjustments made and name of service operator. Obtain the signature of the principal's designated representative.

**Site control**

General: Report to the principal's designated representative on arriving at and before leaving the site.

**E3.3.17 POST-CONSTRUCTION MANDATORY INSPECTIONS AND MAINTENANCE**

**General**

General: For the duration of the defects liability period, provide inspections and maintenance of safety measures required by the following:

- The Building Code of Australia.
- AS 1851.
- Other statutory requirements applicable to the work.

Records: Provide mandatory records.

Certification: Certify that mandatory inspections and maintenance have been carried out and that the respective items conform to statutory requirements. Submit certification.

Annual inspection: Provide an annual inspection and maintenance immediately prior to the end of the defects liability period.

**E3.4 SELECTIONS**

**E3.4.1 SCHEDULES**

**General**

Provide all warranties required by the various Trade Section of this specification.

Provide all standard warranties provided by manufacturers for products used throughout the Works.

**Warranty schedule**

Warranties shall include, but not be limited to, those listed in the Warranty Schedule.

<b>Warranty schedule</b>	<b>Form</b>	<b>Period</b>
Roofing and roofing installation	Written	25 years
Waterproofing	Written	25 years
Lift Manufacturers	Written	As noted in Liftronic specifications
Lift Installation	Written	As noted in Liftronic specifications
Air conditioning plant and equipment	Written	As noted in the Mechanical Services specification
Mechanical Ventilation	Written	As noted in the Mechanical Services specification
Electrical services and equipment	Written	As noted in the Electrical Services specification
Hydraulic services and equipment	Written	As noted in the Hydraulic Services specification

## E4 ADHESIVES, SEALANTS AND FASTENERS

### E4.1 GENERAL

#### E4.1.1 RESPONSIBILITIES

##### General

Fitness for purpose: Provide adhesives, sealants and fasteners capable of transmitting imposed loads, sufficient to ensure the rigidity of the assembly, or integrity of the joint.

Finished surface: Provide adhesives and sealants that will not cause discolouration.

Compatibility: Do not use sealants or adhesives that are incompatible with the products to which they are applied.

Sealant replacement: Use sealants that can be safely removed without compromising the application of the replacement sealant for future refurbishment.

Selections: Conform to the **Selections**.

#### E4.1.2 PRECEDENCE

##### General

Worksections and referenced documents:

- The requirements of other worksections of the specification override conflicting requirements of this worksection.
- The requirements of this worksection overrides conflicting requirements of its referenced documents.
- The requirements of the referenced documents are minimum requirements.

#### E4.1.3 CROSS REFERENCES

##### General

Requirement: Conform to the following:

- *General requirements*.

#### E4.1.4 SUBMISSIONS

##### Sealants

Samples: Submit colour samples of visible joint sealants.

Documents: Submit technical data sheets.

#### E4.1.5 INSPECTION

##### Notice

Inspection: Give notice so that inspection may be made of joints and penetrations prepared for the application of sealants to the **Installed sealant tests schedule**.

#### E4.1.6 PERFORMANCE

##### Adhesives and sealants

General: Provide adhesives and sealants capable of transmitting imposed loads, sufficient to ensure the rigidity of the assembly, or integrity of the joint and which will not cause discolouration of finished surfaces.

Compatibility: Do not use sealants or adhesives that are incompatible with the products to which they are applied.

Movement: Where an adhered or sealed joint may be subject to movement, select a system accredited to accommodate the projected movement under the conditions of service.

Refurbishment: Use sealants that can be safely removed and prepared for refurbishment.

##### Fasteners

Provide fasteners accredited for the particular use, capable of transmitting imposed loads and maintaining the rigidity of the assembly.

## E4.2 PRODUCTS

### E4.2.1 ADHESIVES

#### Standards

Mastic adhesive: To AS 2329.

Polymer emulsion adhesive for timber: To AS 2754.2, not inferior to Type 3.

#### High strength adhesive tape

General description: A foam of cross linked polyethylene or closed cell acrylic coated both sides with a high performance acrylic adhesive system, encased in release liners of paper or polyester.

Product classification: Ensure product suitability for the following substrates:

- Firm high strength foam tapes for high energy surfaces including most bare metals such as stainless steel and aluminium.
- Conformable high strength foam for medium energy surfaces including many plastics and paints, and bare metals.
- Conformable high strength foam for lower energy surfaces including many plastics, most paints and powder coatings, and bare metals.

Thickness: Select the tape to ensure a mismatch between surfaces does not exceed half the tape thickness under the applied lamination pressure.

### E4.2.2 SEALANTS

#### Standards

General: To ISO 11600.

#### External masonry joints

General: Provide sealant and bond breaking backing materials compatible with each other and the substrate and which are non-staining to masonry. Do not use bituminous materials with absorbent masonry units.

Bond breaking backing:

- Bond breaking materials: Non-adhesive to sealant, or faced with a non-adhering material.
- Foamed materials: Closed-cell or impregnated, not water-absorbing.

#### Fire rated control joints

General: Provide sealant materials that maintain the nominated fire-resisting rating.

- Fire stopping: To AS 4072.1.

#### Pointing and bedding

General: Provide sealants for fast moving joints in light weight building elements that are compatible with the contact materials.

#### Fire rated pointing, bedding and stopping

General: Provide sealant materials that maintain the nominated fire-resisting rating.

- Fire stopping: To AS 4072.1.

#### Floor control joints

General: Provide trafficable sealants for that are compatible with the contact materials.

Bond breaking backing:

- Bond breaking materials: Non-adhesive to sealant, or faced with a non-adhering material.
- Foamed materials: Closed-cell or impregnated, not water-absorbing.

### E4.2.3 FASTENERS

#### General

Masonry anchors: Proprietary expansion or chemical type.

Plain washers: To AS 1237.1.

- Provide washers to the heads and nuts of bolts, and the nuts of coach bolts.

Plugs: Proprietary purpose-made plastic.

Powder-actuated fasteners: To AS/NZS 1873.4.

Stainless steel fasteners: To ASTM A240/A240M.

Steel nails: To AS 2334.

- Length: At least 2.5 x the thickness of the member being secured, and at least 4 x the thickness if the member is plywood or building board < 10 mm thick.

Unified hexagon bolts, screws and nuts: To AS/NZS 2465.

Fasteners in CCA treated timber: Epoxy coated or stainless steel.

**Bolts**

Coach bolts: To AS/NZS 1390.

Hexagon bolts Grades A and B: To AS 1110.1.

Hexagon bolts Grade C: To AS 1111.1.

**Corrosion resistance**

Atmospheric corrosivity category: To the *General requirements* worksection.

Steel products: Conform to the **Corrosion resistance table** or provide proprietary products with metallic and/or organic coatings of equivalent corrosion resistance.

**Corrosion resistance table – Atmospheric corrosivity categories A and B to AS/NZS 2312**

Situation	Self drilling screws to AS 3566.2 Class	Threaded fasteners and anchors		Powder actuated fasteners	
		Material	Minimum local metallic coating thickness (µm)	Material grade	Minimum local metallic coating thickness (µm)
Internal	1	Electroplated zinc	4	Electroplated zinc	4
External	3	Electroplated zinc or Hot-dip galvanized	30	Stainless steel 316	

**Corrosion resistance table – Atmospheric corrosivity category C to AS/NZS 2312**

Situation	Self drilling screws to AS 3566.2 Class	Threaded fasteners and anchors		Powder actuated fasteners	
		Material	Minimum local metallic coating thickness (µm)	Material grade	Minimum local metallic coating thickness (µm)
Internal	2	Electroplated zinc	12	Electroplated zinc	12
External	4	Hot-dip galvanized	50	Stainless steel 316	

**Corrosion resistance table – Atmospheric corrosivity categories D and F to AS/NZS 2312**

Situation	Self drilling screws to AS 3566.2 Class	Threaded fasteners and anchors		Powder actuated fasteners	
		Material	Minimum local metallic coating thickness (µm)	Material grade	Minimum local metallic coating thickness (µm)
Internal	3	Electroplated zinc or Hot-dip	30	Stainless steel 316	

Situation	Self drilling screws to AS 3566.2 Class	Threaded fasteners and anchors		Powder actuated fasteners	
		Material	Minimum local metallic coating thickness (µm)	Material grade	Minimum local metallic coating thickness (µm)
		galvanized			
External	Stainless steel 316 <sup>1</sup>	Stainless steel 316		Stainless steel 316	

<sup>1</sup> Avoid organic coating in Category F zones.

**Finishes**

Electroplating:

- Metric thread: To AS 1897.
- Imperial thread: To AS 4397.

Galvanizing:

- Threaded fasteners: To AS 1214.
- Other fasteners: To AS/NZS 4680.

Mild steel fasteners: Galvanize if:

- Embedded in masonry.
- In external timbers.
- In contact with chemically treated timber, other than CCA treated timber.

Epoxy coated:

- CCA Treated timber.

**Nuts**

Hexagon chamfered thin nuts Grades A and B: To AS 1112.4.

Hexagon nuts Grade C: To AS 1112.3.

Hexagon nuts Style 1 Grades A and B: To AS 1112.1.

Hexagon nuts Style 2 Grades A and B: To AS 1112.2.

**Screws**

Coach screws: To AS/NZS 1393.

Hexagon screws Grades A and B: To AS 1110.2.

Hexagon screws Grade C: To AS 1111.2.

Hexagon socket screws: To AS 1420 and AS/NZS 1421.

Machine screws: To AS/NZS 1427.

Self-drilling screws: To AS 3566.1 and AS 3566.2.

Self-tapping screws:

- Crossed recessed countersunk (flat – common head style): To AS/NZS 4407.
- Crossed recessed pan: To AS/NZS 4406.
- Crossed recessed raised countersunk (oval): To AS/NZS 4408.
- Hexagon: To AS/NZS 4402.
- Hexagon flange: To AS/NZS 4410.
- Hexagon washer: To AS/NZS 4409.
- Slotted countersunk (flat – common head style): To AS/NZS 4404.
- Slotted pan: To AS/NZS 4403.
- Slotted raised countersunk (oval – common head style): To AS/NZS 4405.

**Blind rivets**

Description: Expanding end type with snap mandrill.

Type: Closed end for external application, open end for internal application.

End material:

- Aluminium base alloy for metallic coated or colourbond coated steel.
- Stainless steel for stainless steel sheet.
- Copper for copper sheet.

Size:

- For sheet metal to sheet metal: 3 mm.
- For sheet metal to supports, brackets and rolled steel angles: 4.8 mm.

#### **Performance**

Loads: Provide fasteners capable of transmitting the loads imposed, and sufficient to ensure the rigidity of the assembly.

### **E4.3 EXECUTION**

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#### **E4.3.1 ADHESIVES**

##### **Preparation**

Substrates: Ensure substrates are:

- Clean and free of any deposit or finish which may impair adhesion.
- If framed or discontinuous, support members are in full lengths without splicing.
- If solid or continuous, excessive projections are removed.
- If previously painted, cracked or flaking paint is removed and the surface lightly sanded.

##### **Contact adhesive**

Precautions: Do not use if:

- A substrate is polystyrene foam.
- A PVC substrate may allow plasticiser migration.
- The adhesive solvent can discolour the finished surface.
- Dispersal of the adhesive solvent is impaired.

Two way method: Immediately after application press firmly to transfer adhesive and then pull both surfaces apart. Allow to tack off and then reposition and press firmly together. Tap areas in contact with a hammer and padded block.

One way method: Immediately after application bring substrates together and maintain maximum surface contact for 24 hours by clamps, nails or screws as appropriate. If highly stressed employ permanent mechanical fasteners.

##### **High strength adhesive tape**

Preparation:

- Non-porous surfaces: Clean with surface cleaning solvents such as isopropyl alcohol/water, wash down and allow to dry.
- Porous surfaces: Prime the surface with a contact adhesive compatible with the tape adhesive system.

Follow the recommendations of the manufacturer for application to the following: Copper, brass, plasticized vinyl and hydrophilic surfaces such as glass and ceramics in a high humidity environment.

Applied lamination pressure: Ensure the tape experiences 100 kPa.

Application temperature: Generally above 10°C, consult the manufacturer.

Completion: Do not apply loads to the assembly for 72 hours at 21°C.

#### **E4.3.2 SEALANT JOINTING**

##### **Preparation for jointing**

Cleaning: Cut flush joint surface protrusions and make good. Mechanically clean joint surfaces free of any deposit or finish which may impair adhesion of the sealant. Immediately before jointing remove loose particles from the joint, using oil-free compressed air.

Bond breaking: Install bond breaking backing material.

**Taping:** Protect the surface on each side of the joint using 50 mm wide masking tape or equivalent means. On completion of pointing remove the tape and remove any stains or marks from the surface.

**Primer:** Apply the recommended primer to the surfaces in contact with sealant materials.

**Sealant joint proportions**

General weatherproofing joints (width:depth):

- 1:1 for joint widths < 12 mm.
- 2:1 for joint widths > 12 mm.

**Sealant application**

**General:** Apply the sealant to dry joint surfaces using a pneumatic applicator gun. Ensure the sealant completely fills the joint to the required depth; that it is in good contact with the full depth of the sides and that there is no air trapped in the joint. Do not apply the sealant outside the recommended working time for the material or the primer.

**Weather conditions**

Two pack polyurethanes: Do not apply the sealant if ambient conditions are outside the following:

- Temperature: < 5°C or > 40°C.
- Humidity: To the manufacturer's recommendations.

**Joint finish**

**General:** Force the sealant into the joint and finish with a smooth, slightly concave surface using a tool designed for the purpose.

**Protection**

**General:** Protect the joint from inclement weather during the setting or curing period of the material.

## E5 FIRE-STOPPING

### E5.1 GENERAL

#### E5.1.1 CROSS REFERENCES

##### General

General: Conform to the *General requirements* worksection.

#### E5.1.2 PRECEDENCE

##### General

Worksections and referenced documents:

- The requirements of other worksections of the specification override conflicting requirements of this worksection.
- The requirements of this worksection overrides conflicting requirements of its referenced documents.
- The requirements of the referenced documents are minimum requirements.

#### E5.1.3 STANDARDS

##### General

Service penetration fire-stopping systems: To BCA C3.15.

Control joint fire-stopping systems: To AS 4072.1.

#### E5.1.4 INSPECTION

##### Notice

Inspection: Give sufficient notice so that inspection may be made of the following:

- Service penetrations completed and ready for fire-stopping.
- Finished fire-stopping, before being concealed.

### E5.2 PRODUCTS

#### E5.2.1 MATERIALS

##### General

Shelf life: Ensure materials used have not exceeded their shelf life.

Toxic materials: Free of asbestos and lead and free of, nor requiring the use of, toxic solvents.

Toxicity in fire: Non-toxic.

##### Fire-stop mortars

Type: Re-enterable cement-based compound, mixed with water. Non-shrinking, moisture resistant.

Insoluble in water after setting.

##### Formulated compound of incombustible fibres

Material: Formulated compound mixed with mineral fibres, non-shrinking, moisture resistant. Insoluble in water after setting.

##### Fibre stuffing

Material: Mineral fibre stuffing insulation, dry and free of other contaminants.

Standard: AS/NZS 4859.1 Section 8.

##### Fire-stop sealants

Material: Elastomeric sealant. Soft, permanently flexible, non-sag, non-shrinking, moisture resistant.

Capable of providing a smoke-tight, gas-tight and waterproof seal when properly installed. Insoluble in water after setting.

##### Fire-stop foams

Material: Single component compound of reactive foam ingredients, non-shrinking, moisture resistant.

Insoluble in water after setting.

**Fire-stop putty**

Material: Single component, mouldable, permanently flexible, non-shrinking, moisture resistant, intumescent compound which expands on exposure to surface heat gain, forming a high-volume thermally insulating char that closes gaps and voids, resists the turbulence of a severe fire. Capable of being placed by hand to form an immediate fire seal. Insoluble in water after setting.

**Product certification**

Certifier: Certifire or other approved certifier.

**E5.2.2 COMPONENTS**

**Fire-stop collars**

Material: Mechanical device with incombustible intumescent fillers covered with sheet steel jacket. Airtight and watertight.

**Fire-stop pillows**

Material: Formed self-contained compressible flexible mineral fibre in cloth bags, rated to permit frequent changes in service.

**Accessories**

Primer: As recommended by manufacturer for substrates

Permanent dam material: Non-combustible.

- Type: Mineral fibreboard or other approved material as required.

Metal lath: Provide where required to keep fire-stop pillows in place and to prevent unauthorised or accidental removal of fire-stopping.

Installation accessories: Provide clips, collars, fasteners, temporary stops and dams, and other devices required to position, support and contain fire-stopping and accessories.

**Product certification**

Certifier: Certifire or other approved certifier.

**E5.3 EXECUTION**

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**E5.3.1 EXECUTION GENERALLY**

**General**

Extent: Fire-stop and smoke-stop interruptions to fire-rated assemblies, materials and components, including penetrations through fire-rated elements, breaks within fire-rated elements (e.g. expansion joints), and junctions between fire-rated elements. The **Fire-stopping systems schedule** is not necessarily comprehensive.

Sequence: Fire-stop after services have been installed through penetrations and properly spaced and supported, after sleeving where appropriate, and after removal of temporary lines, but before restricting access to the penetrations, including before dry lining.

Installer qualifications: Minimum 5 years in the installation of fire-stopping that is similar in material, design and extent to that being installed.

Ventilation: Supply ventilation for non-aqueous solvent-cured materials.

Density: Apply fire-stopping material to uniform density.

Fire-stopping exposed to view: Finish surfaces to a uniform and level condition.

Cable separation: Maintain.

Protection: Protect adjacent surfaces from damage arising through installation of fire-stopping. Protect completed fire-stopping from damage arising from other work.

Loose or damaged fire-stopping material: Remove and replace.

Penetrations by pipes and ducts: Allow for thermal movement of the pipes and ducts.

Preventing displacement: Reinforce or support fire-stopping materials with non-combustible materials when:

- The unsupported span of the fire-stopping materials > 100 mm.
- The fire-stopping materials are non-rigid (unless shown to be satisfactory by test).

Large openings: Provide fire-stopping capable of supporting the same loads as the surrounding element or provide similar structural support around the opening.

**Installation certification**

Certifier: Certifire or other approved certifier

**Preparation**

Cleaning: Clean substrates of dirt, dust, grease, oil, loose material, and other matter which may affect bond of fire-stop material.

Primer: Clean and dry substrates for primers and sealants.

Restraint: Install backing and/or damming materials to arrest liquid material leakage. Remove temporary dams after material has cured.

**E5.3.2 SYSTEMS**

**Fire-stop mortars**

Ambient conditions: Do not install below 5°C.

**Formulated compound of incombustible fibres**

Installation: In accordance with the manufacturer's requirements, adapted as required to completely close openings.

**Fibre stuffing**

Installation: Compress to 40% of its uncompressed volume.

**Fire-stop composite sheets**

Installation: In accordance with the manufacturer's requirements, adapted as required to completely close openings.

Adapt manufacturer's instructions to project requirements to completely close openings.

**Fire-stop sealants**

Ambient conditions: Do not store above 32°C. Do not install outside the temperature range recommended by the sealant manufacturer. Do not install when humidity exceeds that recommended by the sealant manufacturer for safe installation.

**Fire-stop foams**

Ambient conditions: Do not store above 32°C. Do not install below 15°C or above 32°C. Do not apply when temperature of substrate and air is below 15°C. Maintain this minimum temperature before, during and for 3 days after installation.

Installation: Test substrates for adhesion and prime if necessary. Place in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.

**Fire-stop putty**

Ambient conditions: Do not install below 5°C. Do not allow the material to freeze.

Installation: In accordance with the manufacturer's requirements, adapted as required to completely close openings.

**Fire-stop collars**

Installation: In accordance with the manufacturer's requirements, adapted as required to completely close openings.

**Fire-stop pillows**

Ambient conditions: Do not install in conditions outside of the manufacturer's recommendations.

**Fire-stopping systems schedule**

Provide fire stopping systems as required to fire resistant construction for new Communications Room and storage cupboards below existing stairs.

**Labelling**

Label each fire-stopping installation with a permanently fixed tag or sticker containing the following information:

- Manufacturer's name.
- Name and address of installer.
- Date of installation.

**E5.3.3 COMPLETION SUBMISSIONS**

**Certification**

General: Submit evidence of compliance, in accordance with the recommendations of AS 4072.1 Appendix B.

Certification: Submit a completed certification document for installed fire-stopped penetrations and control joints.

- Form: To Figure B2 of AS 4072.1.

Schedule: Submit a schedule of installed fire-stopped penetrations and control joints.

- Form: To Figure B1 of AS 4072.1.

**User manual**

For fire-stopping systems which are intended to be modified in service, submit user manual.

**E5.3.4 MAINTENANCE**

**Cleaning**

Remove spilled and excess fire-stopping materials without damaging other work.

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**E6 METALS AND PREFINISHES**

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**E6.1 GENERAL**

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**E6.1.1 PRECEDENCE**

**General**

Worksections and referenced documents:

- The requirements of other worksections of the specification override conflicting requirements of this worksection.
- The requirements of this worksection overrides conflicting requirements of its referenced documents.
- The requirements of the referenced documents are minimum requirements.

**E6.1.2 CROSS REFERENCES**

**General**

Requirement: Conform to the following:

- *General requirements.*
- *Windows*
- *Fabricated Metalwork*

**E6.2 PRODUCTS**

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**E6.2.1 METALS**

**Metals**

Performance: Provide metals in sections of strength and stiffness suited to their required function, finish and method of fabrication.

**Aluminium and aluminium alloys**

Drawn pipe: To AS/NZS 1867.

Drawn rod, bar and strip: To AS/NZS 1865.

Extrusions: To AS/NZS 1866.

Plate and sheets: To AS/NZS 1734.

**Coated steel**

Electrogalvanizing ferrous hollow and open sections: To AS 4750.

Hot-dip galvanizing (zinc):

- Ferrous open sections by an in-line process: To AS/NZS 4791.
- Ferrous hollow sections by a continuous or specialised process: To AS/NZS 4792.

Metallic-coated steel:

- Ferrous open sections zinc coated by an in-line process: To AS/NZS 4791.
- Ferrous hollow sections zinc coated by a continuous or specialised process: To AS/NZS 4792.

Metallic-coated steel sheet: To AS 1397. Metal thicknesses specified are base metal thicknesses.

Steel wire: To AS/NZS 4534.

**Copper and copper alloys**

Casting: To AS 1565.

Plate, sheet and strip: To AS 1566.

Rods, bars and sections: To AS/NZS 1567.

Composition and designations: To AS 2738.

**Stainless steel**

Bars: To ASTM A276.

Plate, sheet and strip: To ASTM A240/A240M.

Welded pipe (round): To AS 1769.

Welded pipe (square): To ASTM A554.

**Steel**

Sheet: To AS/NZS 1595.

Structural bars and sections: To AS/NZS 3679.1.

Structural hollow section: AS/NZS 1163.

**Steel for prefinishes**

Cold rolled bar: To AS 1443 – Bright.

Cold rolled sheet: To AS/NZS 1595.

- Designation: CA2S-E.

Electric resistance welded tube: To AS 1450.

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**E6.3 EXECUTION**

**E6.3.1 GENERAL**

**Metal separation**

Incompatible sheet metals: Provide separation by one of the following:

- Apply an anti-corrosion low moisture transmission coating such as alkyd zinc phosphate primer or aluminium pigmented bituminous paint to contact surfaces.
- Insert a concealed separation layer such as polyethylene film, adhesive tape, or bituminous felt.

Incompatible fixings: Do not use.

Incompatible service pipes: Install lagging or grommets. Do not use absorbent, fibrous or paper products.

**Brazing**

General: Make sure brazed joints have sufficient lap to provide a mechanically sound joint.

Butt joints: Do not use butt jointing for joints subject to load. If butt joints are used, do not rely on the filler metal fillet only.

Filler metal: To AS/NZS 1167.1.

**Finishing**

Visible joints: Finish visible joints made by welding, brazing or soldering using methods appropriate to the class of work (including grinding or buffing) before further treatment such as painting, galvanizing or electroplating. Make sure self-finished metals are without surface colour variations after jointing.

**Preparation**

General: Before applying decorative or protective prefinishes to metal components, complete welding, cutting, drilling and other fabrication, and prepare the surface using a suitable method.

Standard: To AS 1627.

Priming steel surfaces: If site painting is documented to otherwise uncoated mild steel or similar surfaces, prime as follows:

- After fabrication and before delivery to the works.
- After installation, repair damaged priming and complete the coverage to unprimed surfaces.

**Welding**

Aluminium: To AS 1665.

Stainless steel: To AS/NZS 1554.6.

Steel: To AS/NZS 1554.1.

**E6.3.2 NON-FERROUS FINISHING**

**Mechanical finishes**

Bright finished copper alloy surfaces: For indoor applications, apply a clear lacquer protecting coating.

**E6.3.3 ELECTROPLATING**

**Electroplated coatings**

Chromium on metals: To AS 1192.

- Service condition number: At least 2.

Nickel on metals: To AS 1192.

- Service condition number: At least 2.
- Zinc on iron or steel: To AS 1789..

#### **E6.3.4 ANODISING**

##### **Sample**

General: Provide a finish to match the sample in terms of colour and finishing options.

##### **Anodising**

Standard: To AS 1231.

Thickness grade: To AS 1231 Table H1.

Application:

Indoor applications: At least AA15

Outdoor Applications: At least AA20

Colour: Refer to the Finishes Schedule.

Warranty: As offered by the aluminium finisher.

#### **E6.3.5 METAL SPRAYING**

##### **Metal spray**

Standard: To ISO 2063.

Minimum thicknesses:

- Indoor applications: 125 µm.
- Outdoor applications: 175 µm.

Process: Electric arc.

Seal coat: Cover the metal spray finish with two coats of vinyl seal to a total dry film thickness of 80 µm.

#### **E6.3.6 POWDER COATING**

##### **General**

General: Provide powder coating systems to substrates as follows:

- Consistent in colour, gloss level, texture and dry film thickness.
- Fully bonded.
- Resistant to environmental degradation within the manufacturer's stated life span for the product type.

##### **Substrates**

Application to aluminium and aluminium alloy substrates for architectural applications: To AS 3715.

Application to substrates other than aluminium for architectural applications: To AS 4506.

##### **Definitions**

General: For the purposes of this worksection the following definitions apply:

- HSS: Heat sensitive substrate; e.g. medium density fibreboard (MDF)
- Substrate: The surface to which a material or product is applied.
  - Thermoset powder coat: A mixture of finely ground particles of pigment and resin sprayed on to the surface to be coated. The charged powder particles adhere to the electrically grounded surfaces until heated and fused into a smooth coating in a curing oven.
  - Thermoset polyester powder coating utilises an enhanced polyester resin.
  - Thermoset fluoropolymer coating, for factory applied spray coatings on aluminium products, includes PVF<sub>2</sub> and PTFE coatings (poly tetra fluoro ethylene).

##### **Powder coated samples**

General: Submit, on representative substrates, samples of each coating system showing surface preparation, colour, gloss level, texture, and physical properties.

##### **Manufacturer's documents**

General: Submit the selected manufacturer's details at least 3 weeks before the material is required for fabrication, as follows:

- Recommended coating system for the nominated service condition.
- Brand name.

- Storage and handling recommendations.
- Maintenance recommendations.

**Specialist applicators**

General: Submit name and contact details of proposed specialist applicators as registered by the coating manufacturer.

Accreditation: To the Australasian Institute of Surface Finishing.

**Warranties**

General: Submit the coating manufacturer's warranties.

**Cleaning**

Completed assembly: Clean to AS 3715 Appendix C.

**E6.3.7 PREPAINTING**

**Air-drying enamel**

Application: Spray or brush.

Finish: Full gloss.

General use:

- Primer: Two-pack epoxy primer to AS/NZS 3750.13.
- Top coats: 2 coats to AS 3730.6.

Oil resistant use:

- Primer: Two-pack epoxy primer to AS/NZS 3750.13.
- Top coats: 2 coats to AS/NZS 3750.22.

**Equipment paint system**

Description: Brush or spray application using paint as follows:

- Full gloss enamel finish coats, oil and petrol resistant: To AS/NZS 3750.22, two coats.
- Prime coat to metal surfaces generally: To AS/NZS 3750.19 or AS/NZS 3750.20.
- Prime coat to zinc-coated steel: To AS 3730.15.
- Undercoat: To AS/NZS 3750.21.

**Prepainted metal products**

Standard: To AS/NZS 2728.

Product type as noted in AS/NZS 2728: Not lower than the type appropriate to the field of application.

**Stoving enamel**

Application: Spray or dip.

**Two-pack liquid coating**

Application: Spray.

Finish: Full gloss.

Primer: Two pack epoxy primer to AS/NZS 3750.13.

Topcoat:

- Internal use: Proprietary polyurethane or epoxy acrylic system.
- External use: Proprietary polyurethane system.

**E6.3.8 COMPLETION**

**Damage**

General: If prefinishes are damaged, including damage caused by unauthorised site cutting or drilling, remove and replace the damaged item.

**Repair**

General: If a repair is required to metallic coated sheet or electrogalvanizing on inline galvanized steel products, clean the affected area and apply a two-pack organic primer to AS/NZS 3750.9.

**E7 SUNDRY ITEMS**

**E7.1 GENERAL**

**E7.1.1 RESPONSIBILITIES**

**General**

General: Provide sundry items that are:

- Undamaged and free of surface defects or distortions.
- Correctly located and aligned, plumb, level and straight.
- Connected to the nominated service(s), if required.

Selections: Conform to the **Selections**.

**E7.1.2 CROSS REFERENCES**

**General**

Requirement: Conform to the following:

- *General requirements*.

**E7.1.3 INTERPRETATIONS**

**Abbreviations**

General: For the purposes of this worksection the following abbreviations apply:

**E7.1.4 INSPECTIONS**

**Notice**

Inspection: Give notice so inspection can be made of the following:

- Set out of item locations before fixing.
- Completion of installation.

**E7.1.5 SUBMISSIONS**

**Shop drawings**

General: Submit shop drawings showing the following information:

- Details of fabrication and components.
- Details of fabrication involving other trades or components.
- Information necessary for site assembly.
- Proposals for the break-up of large items as required for delivery to the site.
- Proposed method of joining the modules of large items.
- Fixing locations and types.

**Samples**

General: Submit samples of the following:

- Each type of joint.
- Each type of finish.
- Sections for use in fabricated work.

Labelling: Label each sample, giving the brand and product name, manufacturer's code reference, date of manufacture and intended building location.

**Sealant compatibility**

Compatibility statements: Submit statements from all parties to the installation that certify the compatibility of sealants with items.

**E7.2****E7.3 +SELECTIONS****E7.3.1 GENERAL**

Supply and install miscellaneous fittings as shown on drawings and detailed below.

Co-ordinate with wall framing subcontractor to ensure that adequate provisions are made in the wall framing to provide suitable fixing points for all fittings, particularly grab rails.

**E7.3.2 TOILET AREA FITTINGS****Location**

Staff Toilet, Family Accessible Toilet in new Platform Building.

**Grab Rails**

Manufacturer: Bradley Australia

Standard: AS 1428.1

Item identification code: Each toilet to be fitted with Item 001 and Item 005 or 006 as appropriate to suit right or left hand installation.

Material: Stainless steel

Finish: Satin finish

Fixing: Concealed

**Hand dryers**

Proprietary item: Dyson Airblades

Item identification code: A01

Finish: Silver

**Soap dispensers**

Manufacturer: Kimberley Clark

Item identification code: Code 6340

Colour: White

**Coat hooks**

Proprietary item: JDMcDonald

Item identification code: 7340

Material: Stainless steel

**Toilet paper holders**

(a) Family Accessible Toilet

Manufacturer: Kimberley Clark

Item identification code: Jumbo – Code 4972

Material: Stainless steel

(b) Staff Toilet

Manufacturer: Bradley Australia

Item identification code: Single roll 5084

Material: Stainless steel

**Shelves**

Manufacturer: Bradley Australia

Item identification code: Model 755

Size: 300mm long x 125mm deep

Material: Stainless steel

**Baby Change Unit**

Manufacturer: Koala Care

Item identification code: Countertop recessed, model KB112-01RE

Installation: Install in countertop as specified in Joinery.

### E7.3.3 CLEANERS ROOM

#### Location

Cleaners Room

#### Mop and broom holder rack

Manufacturer: JDMcDonald

Item identification code: 8215-3

Material: Stainless steel

#### Storage cupboard

Refer to Joinery section

#### Lockers

Re-install the existing lockers in the new building.

### E7.3.4 PLATFORMS

#### Seating

Install seating in the locations shown on drawings. Seating to include:

- Existing seating re-installed in new locations
- New floor mounted seating supplied by TfNSW to match existing seating.
- New wall mounted seating supplied by TfNSW

#### Bins

Supply and install new platform bins to match existing.

### E7.3.5 ITEMS CONNECTED TO HYDRAULIC SERVICES

#### General

Provide and install sanitaryware and tapware as detailed in the Finishes Schedule, including

- WC suites
- Hand basins
- Cleaner's sink
- Kitchen sink
- All associated tapware.

#### Kitchen sink

Manufacturer: Clark

Type: single bowl and draining board

Length: 930mm

Item identification code: 1003.1 (1th LHB)

Material: Stainless steel

#### Tap to kitchen sink

Manufacturer: Enware

Type: Single lever sink mixer with extended lever

Item identification code: SLM607D

Finish: Chrome

Other: 5 Star WELS rating model

#### Accessible WC

Manufacturer: Caroma

Type: Caroma Care 800 Wall Faced Invisi Series II Suite with buttons and panels

Item identification code: 718100W

Colour: White

#### Accessible Basin

Manufacturer: Caroma

Type: Caroma Care Integra 500 with one tap hole

Item identification code: 648210W

Colour: White

**Taps to Accessible basins**

Manufacturer: Caroma

Type: Caroma Nordic Care basin mixer

Item identification code: 90965C5A

Finish: Chrome

Other: 5 Star WELS rating model

**Cleaners sink**

Manufacturer: Caroma

Type: Cleaners sink with 1521 wall mounted bracket

Item identification code: 811592W

Colour: White

**Taps to cleaners sink**

Manufacturer: Caroma

Type: G Series Standard wall sink set 150mm

Item identification code: G91842C4A

Finish: Chrome

## E8 ROOF ACCESS SAFETY SYSTEMS

### E8.1 GENERAL

#### E8.1.1 RESPONSIBILITIES

##### General

General: Provide the fall protection system in conformance with **Selections**.

Outcomes: Maintain the waterproofing integrity of roofing and cladding without damage or distortion.  
Maintain the structural integrity of the supporting elements.

##### Supply

Design: The design, supply, installation, testing, certification, user manuals and training.

Delivery: Deliver the fall protection assembly ready for installation as follows:

- Clearly labelled to show the intended location.
- In a separate dust and moisture proof package.
- Including the necessary templates, fixings and fixing instructions.

#### E8.1.2 CROSS REFERENCES

##### General

Requirement: Conform to the following:

- General requirements.

#### E8.1.3 DESIGN BY CONTRACTOR

##### General

Designer: The roof safety access system shall be designed by the contractor/subcontractor.

##### Requirements

Responsibility: The contractor shall be responsible for coordination with other trades, including Light Steel Framing, Structural Steel and Roofing.

Performance requirements: To AS/NZS 1891.2 Section 4 System acceptance criteria.

Authority requirements: The installation shall comply with the requirements of the relevant WorkCover authority.

Access: Make provision for three workers to access the system at any one time, and provide access as follows:

- Full extent of gutters.
- Roof mounted plant and equipment.
- Roof areas within 2.5 m of fall hazards not otherwise protected by parapets or guard rails.

Means of access: Nominate permanent means of access as appropriate.

##### Documentation

Submit drawings showing location of fixing points and manufacturers and suppliers documents related to this worksection.

##### Certification

The complete system shall be designed and certified by a structural engineer and copies of the certification shall be provided to the Principal's Representative.

#### E8.1.4 STANDARDS

##### General

Standard: To AS/NZS 1891.

#### E8.1.5 INSPECTION

##### Notice

Inspection: Give notice so that inspection may be made of the following:

- Shop fabricated or assembled items ready for delivery to the site.

- Commencement of shop or site welding.
- All equipment attachments with concealed fixings, before they are covered.
- Site erected assemblies on completion of erection, before applying finishes.
- Steel surfaces prepared for, and immediately before, site applied finishes.

Installation inspector: Registered Height Safety Inspector.

#### **E8.1.6 SUBMISSIONS**

##### **Design**

Documentation: Submit design documentation.

##### **Product data sheets**

Installation: Submit the manufacture's Installation Data Sheets/Specification Manual.

### **E8.2 PRODUCTS**

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#### **E8.2.1 FALL PROTECTION SYSTEMS**

##### **Fall restraint systems**

Description: Cable based systems positioned so that the user cannot reach a fall hazard when continuously connected to the system using a standard 2 m shock absorbing lanyard. Adjustment of the Personnel Protective Equipment (PPE) is not required whilst connected to the system.

Demonstrators: Use only manufacturer's representatives competent in connecting the appropriate travelling device to and from the cable.

##### **Fall arrest systems**

Description: Either cable based where the user is continuously attached to the system, rope based series of anchor points or a single anchor point from which the users can attach themselves when working at height. Whilst attached to these systems they are at risk of falling. The system relies on a rescue plan being in place.

##### **Ladder access**

Product: Vertical systems comprising top, intermediate and bottom anchor sets and 8 mm 1 x 19 grade 316 stainless steel cables.

##### **Personal protective equipment (PPE)**

Harness: Supply two full body harnesses with shock absorbing lanyards to AS/NZS 1891.1.

Cable attachment:

Storage: PPE storage holdall supplied by the manufacture.

### **E8.3 EXECUTION**

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#### **E8.3.1 INSTALLATION**

##### **Standard**

Installation: To AS/NZS 1891.2.

##### **Contractor**

Installer: Registered Installer approved by the manufacture.

#### **E8.3.2 MAINTENANCE**

##### **General**

Preventative and mandatory system maintenance: By competent or Accredited Height Safety Inspector/Certifier, in conformance with AS/NZS 1891.4 Section 9 and manufacturer's maintenance/recertification recommendations.

Check list for all inspections: To AS/NZS 1891.2 Table 8.

The installer/competent person: To AS/NZS 1891.2 clause 1.3.1.

##### **Routine inspections**

Standard: To AS/NZS 1891.2 clause 9.2.

Completion certificate:

- Provide inspection, testing and certification by an Accredited Installer and/or Accredited Height Safety Inspector:
  - . Upon completion of the installation
  - . Upon the expiry of the defects liability period or 12 months after completion of the installation whichever is the lesser, and valid for a further 12 months period.
- Note the date of the next system inspection and period of validity and display the certificate at the access points of the work area or on the individual system components where provision is made.

**Inspection after a fall or other event**

Standard: To AS/NZS 1891.2 clause 9.3.

**Proof testing of drilled-in anchorages**

Standard: To AS/NZS 1891.2 clause 9.4.

**On-going maintenance**

Certificate: Submit the completion certificates and notify the proprietor of the requirement for continued interval testing.

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**E8.4 SELECTIONS**

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**E8.4.1 ROOF ACCESS AND FALL PROTECTION**

**Roof safety access system**

Provide a safety access system to the roof of the new Platform Building to allow for future maintenance to the roof. The system shall incorporate ladder brackets and roof anchor points, and shall include a safe system of access from the ladder fixing point to the first anchor point.

The system shall be supplied by Sala Group Pty Ltd or approved equivalent.

Ladder fixing points are to be located to minimise visual impact. The location shall also be compatible with TfNSW maintenance and operational requirements. Submit the proposed location to the Principal's Representative for approval prior to installation.

**Extent**

Roof of new Platform building

Roofs over existing canopies

Roofs of lift shafts

**E9 DEMOLITION****E9.1 GENERAL****E9.1.1 RESPONSIBILITIES****General**

General: Carry out demolition, as documented.

**E9.1.2 CROSS REFERENCES****General**

Requirement: Conform to the following:

- *General requirements.*
- Site Management

**E9.1.3 STANDARD****General**

Demolition: To AS 2601.

**E9.1.4 INTERPRETATION****Definitions**

For the purposes of this worksection, the following definitions apply:

- Demolition: The complete or partial dismantling of a building or structure, by pre-planned and controlled methods or procedures.
- Dilapidation record: The photographic or video and written record made before commencement of demolition work of the condition of the portion of the existing building being retained, adjacent buildings, and other relevant structures or facilities.
- Dismantle: The reduction of an item to its components in a manner to allow re-assembly.
- Recover: The disconnection and removal of an item in a manner to allow re-installation.

**E9.1.5 INSPECTION****Notice**

Inspection: Give notice so that inspection may be made of the following:

- Adjacent structures before commencement of demolition.
- Services before disconnection or diversion.
- Trees as documented to be retained, before commencement of demolition.
- Contents of building before commencement of demolition.
- Structure after stripping and removal of roof coverings and external cladding.
- Underground structures after demolition above them.
- Excavations remaining after removal of underground work.
- Site after removal of demolished materials.
- Services after reconnection or diversion.

**E9.1.6 SUBMISSIONS****Authorities**

Evidence of compliance: Before commencing demolition, submit evidence of the following:

- Requirements of authorities relating to the work under the contract have been ascertained.
- A permit to demolish has been obtained from the appropriate authority.
- A scaffold permit has been obtained from the appropriate authority (if scaffolding is proposed to be used).
- Certification that each person having access to the construction site has completed an OHS induction training procedure which is site-specific.

- Precautions necessary for protection of persons and property have been taken and suitable protective and safety devices have been provided to the approval of the relevant authority.
- Treatment for rodent infestation has been carried out and a certificate has been obtained from the appropriate authority.
- Fees and other costs have been paid.

#### Investigation and work plan

Work plan: Submit the work plan before demolition or stripping work. Include the check list items appropriate to the project from AS 2601 Appendix A, and the following information:

- The method of protection and support for adjacent property.
- Locations and details of necessary service deviations and terminations.
- Confirmation of the sequence of work.
- Requirements of AS 2601 Section 2 Planning and execution.
- If the demolition program results in components temporarily cantilevered, provide a certificate from a professional engineer.
- Proposals for the safe use of mobile plant on suspended structural members including provisions for the protection of lower floors in the event of structural failure.
- If implosion methods are proposed, provide a separate report of methods and safeguards.
- Wheel loads of tipping or loading vehicles.

#### Hazardous materials

Audit: Prepare a Hazardous substances management plan to AS 2601 clause 1.6. Include the following:

- Asbestos or material containing asbestos.
- Flammable or explosive liquids or gases.
- Toxic, infective or contaminated materials.
- Radiation or radioactive materials.
- Noxious or explosive chemicals.
- Tanks or other containers which have been used for storage of explosive, toxic, infective or contaminated substances.

#### Records

Dilapidation record: Submit a copy of the dilapidation record for inspection. Submit to each owner of each adjacent property a copy of the part of the record relating to that property and obtain their written agreement to the contents of the record, before commencement of demolition.

#### Stockpiles

Location: Submit the locations for on-site stockpiles for demolished materials for recycling in the works. Coordinate with the locations of storage for other waste streams and prevent mixing or pollution.

#### Off site disposal

Disposal location: Submit the locations and evidence of compliance with the relevant authorities for the disposal of material required to be removed from the site.

#### Recycling

Delivery location: Submit the name and address of the proposed recycling facility.

Certification: Provide evidence of delivery to the nominated recycling facility.

## E9.2 PRODUCTS

### E9.2.1 DEMOLISHED MATERIALS

#### Demolished materials classes

Ownership and implementation: Comply with the **Demolished materials classes table**.

#### Demolished materials classes table

Class	Requirement	Ownership
Recovered items for re-use in the works	Recover without damage items identified in the <b>Recovered</b>	Principal/proprietor

Class	Requirement	Ownership
	<b>items for re-use in the works schedule</b>	
Recovered items for delivery to the principal	Recover without damage items identified in the <b>Recovered items for delivery to the principal schedule</b>	Principal/proprietor
Demolished material for recycling off site	Demolish and deliver for recycling material identified in the <b>Demolished material for recycling off-site schedule</b>	Contractor
Demolished for removal	Remove from the site demolished materials identified in the <b>Demolish for removal schedule</b> . Do not burn or bury on site Transit: Prevent spillage of demolished materials in transit	Contractor

### E9.3 EXECUTION

#### E9.3.1 SUPPORT

##### Temporary support

General: If temporary support is required, certification for its design and installation is required from a professional engineer engaged by the contractor.

Existing buildings: Until permanent support is provided, provide temporary support for sections of existing buildings which are to be altered and which normally rely for support on work to be demolished.

Ground support: Support excavations for demolition of underground structures.

Adjacent structures: Provide supports to adjacent structures where necessary, sufficient to prevent damage resulting from the works.

- Lateral supports: Provide lateral support equal to that given by the structure to be demolished.
- Vertical supports: Provide vertical support equal to that given by the structure to be demolished.

##### Permanent supports

General: If permanent supports for adjacent structures are necessary and are not documented, give notice and obtain instructions.

#### E9.3.2 PROTECTION

##### Encroachment

General: Prevent the encroachment of demolished materials onto adjoining property, including public places.

##### Weather protection

General: If walls or roofs are opened for alterations and additions or the surfaces of adjoining buildings are exposed, provide temporary covers to prevent water penetration. Provide covers to protect existing plant, equipment and materials intended for re-use.

##### Dust protection

General: Provide dust-proof screens, bulkheads and covers to protect existing finishes and the immediate environment from dust and debris.

##### Security

General: If a wall or roof is opened for alterations and additions, provide security against unauthorised entry to the building.

##### Temporary screens

General: Fill the whole of designated temporary openings or other spaces using dustproof and weatherproof temporary screens, fixed securely to the existing structure, and install to ensure appropriate shedding of water to avoid damage to retained existing elements or adjacent structures and contents.

Type: Timber framed screens sheeted with 12 mm plywood and painted. Seal the junctions between the screens and the openings.

**Temporary access**

General: If required, provide a substantial temporary doorset fitted with a rim deadlock, and remove on completion of demolition.

**Exposed surfaces**

General: Where necessary, protect and weatherproof the surfaces of adjacent structures exposed by demolition.

**Existing services**

Location: Before commencing demolition, locate and mark existing underground services in the areas which will be affected by the demolition operations.

Utility services: Contact DIAL BEFORE YOU DIG to identify location of underground utility services pipes and cables.

Excavation: Do not excavate by machine within 1 m of existing underground services.

**Fixed items**

Individual protection: Protect any items that are to be retained in their existing positions.

**Recovered items**

General: Recover all components associated with the listed items that are essential for their re-use. Minimise damage during removal.

**E9.3.3 DEMOLITION – BUILDING WORKS**

**Dilapidation record**

Purpose: Use the dilapidation record to assess the damage and making good arising out of demolition work.

Availability: Keep the records of the investigations on site and available for inspection until the date of practical completion of the contract.

**Encroachment**

General: If encroachments from adjacent structures are encountered and are not documented, give notice and obtain instructions.

**Sequence**

Sequence of demolition: All demolition is to be staged to conform to the Project staging as described in Section E2 – Scope of Work

**Concrete slabs**

General: Using a diamond saw, neatly cut back or trim to new alignment with a clean true face existing concrete slabs to be partially demolished or penetrated.

Recycling: If concrete crushing is proposed on site, submit details of plant and environmental controls.

**Material below grade**

Extent: Demolish the following:

- Demolish any materials as required to complete the building works.

Remaining voids: Stabilise and provide barriers.

**Explosives**

General: Do not use explosives.

**E9.3.4 DEMOLITION – BUILDING SERVICES**

**General**

General: Decommission, isolate, demolish and remove from the site all existing redundant equipment including associated components that become redundant as a result of the demolition.

Breaking down: Disassemble or cut up equipment where necessary to allow removal.

Recovered materials: Recover all components associated with the listed items. Minimise damage during removal and deliver to the locations scheduled.

**Refrigeration systems**

General: Undertake demolition work on refrigeration systems in conformance with:

- AS/NZS 1677.2 Appendix F.

- The recommendations of SAA HB 40.1 and SAA HB 40.2.

#### Re-used components

General: Clean re-used components and test for compliance with current Australian Standards before returning to service. Provide results of compliance tests.

#### E9.3.5 HAZARDOUS MATERIALS

Register: Hazardous materials have been identified as present on site and a Hazardous materials register has been prepared.

Availability: [complete/delete]

#### Hazardous materials removal

Standard: To AS 2601 clause 1.6.2.

#### E9.3.6 COMPLETION

##### Notice of completion

General: Give at least 7 working days notice of completion of demolition so that adjacent structures may be inspected following completion of demolition.

Making good: Make good any damage arising out of demolition work. Obtain written acceptance from the owner of each adjoining property of completeness and standard of making good.

##### Temporary support

General: Clear away at completion of demolition.

#### E9.4 SELECTIONS

##### E9.4.1 DEMOLITION

###### General

Demolish all materials as noted on the drawings, in Section 2 Scope of Work and as may be required to complete the contract works

###### Recovered items for re-use in the works schedule

Item	Location for re-use
Platform seats generally	Re-install in same location or as advised by TfNSW
Platform seats under awning that is being demolished	As advised by TfNSW
Platform garbage bins	Re-install in similar position after platform level has been raised.

###### Demolished material for recycling off-site schedule

Material
Platform awning <ul style="list-style-type: none"> <li>• Steel structure</li> <li>• Roof cladding</li> <li>• Frames to glazing</li> <li>• Glazing</li> </ul>
Ticket Office Building: <ul style="list-style-type: none"> <li>• External columns</li> <li>• Steel framing to walls and roof</li> <li>• Roof sheeting</li> <li>• Partition and ceiling linings</li> <li>• Services</li> <li>• Joinery</li> <li>• Sanitary items</li> <li>• Any other materials suitable for recycling</li> </ul>
Store under Stair to platform <ul style="list-style-type: none"> <li>• Steel framing to walls</li> </ul>

<b>Material</b>
<ul style="list-style-type: none"><li>• All linings</li><li>• Any other materials suitable for recycling</li></ul>
Stair to footbridge <ul style="list-style-type: none"><li>• Concrete</li><li>• Metal balustrade</li><li>• Any other materials suitable for recycling</li></ul>
Footbridge <ul style="list-style-type: none"><li>• Balustrade</li><li>• Lights</li></ul>
Platform <ul style="list-style-type: none"><li>• Tactile tiles</li><li>• Bricks from planter at south end</li></ul>
Site generally <ul style="list-style-type: none"><li>• Stair to Lower Car Park</li><li>• Paving and kerbs as indicated and as required to complete the works</li><li>• Fencing</li><li>• Trees</li></ul>

**Demolish for removal schedule**

<b>Item</b>
Generally <ul style="list-style-type: none"><li>• Any materials not suitable for recycling</li></ul>

<b>E10 SITE MANAGEMENT</b>
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**E10.1 GENERAL****E10.1.1 RESPONSIBILITIES****General**

Designated areas for protection: Refer to TfNSW Part E, Technical Requirements

Outline of the works: Refer to TfNSW Part E, Technical Requirements

**Incidental works**

Generally: Undertake the following:

- Reinstatement: Reinstatement undeveloped ground surfaces to the condition existing at the commencement of the contract.
- Minor trimming: As required to complete the works as documented.

**E10.1.2 CROSS REFERENCES****General**

Requirement: Conform to the following:

- *General requirements.*
- Demolition
- Earthwork

**E10.1.3 INTERPRETATION****Definitions**

General: For the purposes of this worksection the following definitions apply:

- Clearance authority: Any authority covering statutory requirements relating to the project and requiring clearances for work in that particular area.
- Clearances: A formal certificate, approval or condition issued by a statutory authority to allow work to be carried out in a particular area.
- Contamination of land: The presence of a substance in, on or under the land which is a designated hazardous material and/or is at a concentration above that which is normally found in that locality, such that there presents a risk of harm to human health or to the environment.
- Green and organic waste: Includes all food wastes, vegetative wastes from land clearing and pruning operations, biosolids produced from the treatment of liquid wastes, garden wastes and forestry waste (bark and saw dust) and paper and cardboard products.
- Environment: The physical factors of the surroundings of human beings including the land, waters, atmosphere, climate, sound, odours, tastes, the biological factors of animals and plants and the social factor of aesthetics.
- Environmental audits: A review of environment management practices, in particular the evaluation of a site for environmental liability.
- Environmental impact assessment: A method for predicting environmental impacts of a proposed development including minimising identified impacts.
- Environmental management plan (EMP): A plan describing the management of the environmental issues and considerations for the activity being undertaken. This applies to the design, construction and operation of the buildings and infrastructure.
- Pollution incident: An incident or set of circumstances during or as a consequence of which there is, or is likely to be a leak, spill or other escape of a substance as a result of which pollution has occurred, is occurring or is likely to occur.
- Weed: An invasive plant that degrades our natural areas, reduces the sustainability or affects the health of people and animals.

#### **E10.1.4 MANAGEMENT AND CONTROL**

##### **Plans submitted by the contractor**

Implementation: Approved management plans documented in **Submissions**.

##### **Management and control measures**

Implementation: Management and control measures documented in **Execution**.

#### **E10.1.5 SUBMISSIONS**

##### **Submissions program**

Time for submissions: Before work is commenced on site.

Training program: Submit a program to familiarise staff regarding the site environmental management plan, environmentally sensitive areas and responsibilities.

##### **Environmental management plan (EMP)**

EMP: Submit an environmental management plan and include the following details:

- Assignment of responsibility for environmental controls.
- Conditions of approvals, licences and permits to meet statutory requirements.
- Details of potential environmental impacts and operational control measures for implementation including:
  - . Heritage.
  - . Preservation of visual values.
  - . Protection of endangered species.
  - . Preservation of habitat.
- Details of environmental protection for each activity.
- Locations of environmental controls and environmentally sensitive areas.
- Communication procedures.
- Emergency response procedures including response time.
- Environmental training plan and procedures.
- Environmental auditing program.
- Other items necessary to protect the surrounding environment.

Address the phases of activity, as appropriate:

- Before construction and site establishment.
- During construction.
- After construction, including rehabilitation activities and maintenance of erosion and sedimentation controls.

Preliminary environmental management plan: Submit with the tender documentation.

Completed environmental management plan: Submit before work commences on site.

##### **Soil erosion and sediment control plan**

Plan: Submit a soil erosion and sediment control plan and include the following details:

- Staging of operations and sequence of works.
- Diversion of upstream water around the site.
- Provision of temporary drains and catch drains.
- Application of diversion, dispersal and/or retention measures to concentrate flows to control and dissipate stormwater through the site without damage.
- Spreader banks or other structures to disperse concentrated runoff.
- Temporary grassing or other treatments such as contour ploughing or bunding to disturbed areas and long-term stockpiles.
- Restoration of disturbed areas in progress with the works.
- Use of mulch materials to protect disturbed or exposed areas where suitable.

Areas: Include all site areas and access and haulage tracks, borrow pits, stockpile and storage areas and compound areas.

### **Waste management plan**

Plan: Submit a waste management plan and identify major waste streams that will be generated during the contract including:

- Green waste and organic waste.
- Construction waste, including:
  - . Spoil.
  - . Demolition waste.
  - . Asphalt or bitumen.
  - . Concrete
  - . Metal.
  - . Paint materials and empty containers.
  - . Office waste.
  - . Kitchen waste.
  - . Sewage effluent.
- For each waste stream indicate:
  - . How and where the waste is to be re-used, recycled, stockpiled or disposed off.
  - . Indicate how the waste will be transported between the site and point of re-use, recycling, stockpiling, treating or disposal and who will be responsible.

Plan: Submit details of location, labelling and protection of separate skips for the identified waste stream.

### **Ground contamination control plan**

Plan: Submit a ground contamination plan and include the following details:

- If the land is identified as contaminated, or the presence of acid sulphate soils is found, prepare a Remediation Action Plan (RAP) in accordance with the Environmental Protection Authority (EPA) guidelines.

### **Weed management plan**

Plan: Submit a weed management plan and include the following details:

- Identify weeds and infestation zones within the work site/investigation period.
- Method of cleaning vehicles and machinery and cleaning date.
- Cleaning bay location and treatment date.
- Contaminated fill stockpile, treatment type and treatment date.

### **Site preparation**

Mulching: Submit details of provisions for mulching cleared vegetation.

### **Internal monitoring**

Documents: Provide documented procedures describing:

- How environmental monitoring is to be planned, implemented and recorded.
- Non-conformance control and corrective action procedures for all of the control measures that are to be implemented.

Records: Maintain records of the results of environmental monitoring, including the effectiveness of any remedial action taken.

Internal monitoring personnel: Provide staff member's names and contact details.

Machinery and equipment: Provide details of proposed plant.

### **Emergency response**

Emergency response personnel: Provide staff member's names and contact details.

### **Weed management personnel**

Requirement: Submit details of the following:

- Subcontractors who will treat weed infestations.
- Chemical handlers, qualifications, date, and spray type.

### **E10.1.6 INSPECTION**

#### **Notice**

Inspection: Give notice so that inspection may be made of the following:

- Enclosures to trees to be retained.
- Trees to be removed.

### **E10.2 EXECUTION**

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#### **E10.2.1 GENERAL**

##### **Community liaison**

General: Notify residents about new or changed construction activities which will affect access to, or disrupt the use of, their properties.

Notice: 5 working days unless the work is of an urgent nature with safety implications.

Notification content:

- The nature of the work.
- The reason for it being undertaken.
- The expected duration.
- Changes to traffic arrangements and property access.
- The 24-hour contact number of the responsible representative.

##### **Legislative requirements**

Comply with the requirement of the Review of Environmental Factors.

##### **Complaints**

Report: Within 1 working day of receiving a complaint about any environmental issue, including pollution, submit a written report detailing the complaint and action taken.

Register: Keep a register of all environmental complaints and action taken.

##### **Cultural heritage**

Training: Ensure that all personnel working on site have received training relating to their responsibilities regarding cultural heritage and are made aware of any sites/areas, which must be avoided. Mark-up such sites/areas on a site map and make available to all relevant personnel during the works.

Notice: Give notice if any item is encountered which is suspected to be an artefact of heritage value or any relic or material suspected of being of Aboriginal or early settlement origin.

Action: Stop construction work that might affect the item and protect the item from damage or disturbance.

##### **Aboriginal sacred sites protection**

Refer to the Review of Environmental Factors.

No Indigenous heritage items have been recorded within the footprint of the proposal.

If previously unidentified Indigenous heritage items are uncovered during the work, all work in the vicinity of the find is to cease and appropriate advice be sought from DECCW in order to mitigate potential impacts

##### **Clearances**

If required obtain clearances from the relevant authorities.

#### **E10.2.2 CONTROL AND PROTECTION**

##### **Air quality control**

General: Protect adjoining owners, residents and the public against dust, dirt and water nuisance and injury. Use dust screens and watering to reduce the dust nuisance.

##### **Lighting of fires**

Prohibition: Do not light fires.

##### **Noise control and vibration**

Maximum noise level at the site boundary: Refer to REF

Noise control measures: Refer to REF

Monitoring: Measure vibration levels of the peak particle velocity to AS 2187.2.

Limits: Do not exceed the vibration or airblast overpressure recommended in AS 2187.2 Appendix J.

**Dust control**

Dust control measures: Refer to REF

**Vegetation and fauna**

Wild life protected: All native.

Trees to be removed: Inspect to establish if nesting native fauna are present. If present give notice.

Pruning: To AS 4373.

**Water quality**

Wash out: Ensure that wash out does not enter waterways or stormwater drains.

Cross connection: Ensure that there are no cross connections between the stormwater and the public sewerage system.

**Dewatering**

General: Keep earthworks free of water. Provide and maintain slopes, crowns and drains on excavations and embankments to ensure free drainage. Place construction, including fill, masonry, concrete and services, on ground from which free water has been removed. Prevent water flow over freshly laid work.

Disposal: Dispose of water off-site.

**E10.2.3 MANAGEMENT AND CONTROL MEASURES**

**Environmental management plan (EMP)**

Assignment of responsibility for environmental controls: The Contractor shall undertake works under the Contract in such a manner that impacts on the environment are mitigated. The Contractor shall ensure that the environmental objectives and attainment measures outlined in the relevant State Environmental Protection Policies and all other relevant State and Commonwealth legislation are complied with at all times. Where different objectives are nominated, the more stringent requirement shall be adopted.

The Contractor shall comply with the requirements of the latest edition of the NSW Government Environmental Management System Guidelines (EMS Guidelines). A copy of the EMS Guidelines can be obtained at <http://www.construction.nsw.gov.au>.

The Contractor shall prepare an Environmental Management Strategy and associated Plans for the management of environmental impacts of works under the Contract, including but not limited to those listed below. Environmental Management Plans shall be prepared, implemented, managed and monitored by an environmental specialist meeting the following requirements:

(a) Development, Implementation and Maintenance of the Environmental Management Strategy

The Contractor shall engage an individual/s to develop, implement and maintain the Environmental Management Strategy and the relevant Plans identified in this section of the Specification. Such persons shall:

- (i) have demonstrated competence and suitable experience in environmental management in a construction environment;
- (ii) be employed by an ISO 14000 certified company; and
- (iii) be a member of the Environment Institute of Australia, Institute of Engineers (Australia), Environment Business Australia, or other appropriate affiliation.

(b) Design, Implementation and Monitoring of Environmental Management

The Contractor shall engage competent individuals or companies to work on the Contract to design, implement and monitor all environmental issues and environmental management treatments

implemented on Site during construction. The individual shall have a minimum of five years experience in environmental management

The Environmental Management Strategy shall be a single document for the Whole of the Works and shall include as a minimum:

- o the Contractor's methodology for ensuring compliance with the EMS Guidelines, and the purpose and objectives of the Environmental Management Strategy;
- o a listing of the environmental aspects and impacts associated with the works under the Contract including an outline of proposed mitigation treatments and proposed timeframes;
- o processes and responsibilities for:
  - reviewing and updating the Environmental Management Strategy, and site specific plans;
  - the development, implementation, onsite review and maintenance of the Environmental Management Strategy and associated plans/controls;
  - independent verification and auditing of Environmental Management Strategy;
  - reporting and investigation of environmental incidents or complaints relating to any environmental issue under the Contract;
  - an adaptive approach for the review and update of the Plans as works progress and/or following non-conformances, complaints, or previously unidentified issues; and
  - after hours response including arrangements for containing environmental damage and attendance on site in the event of an emergency; and
- o requirements of all relevant statutory authorities including necessary approvals and permits;
- o arrangements for site induction and training to ensure that all relevant personnel are aware of the requirements of the Environmental Management Plan; and
- o arrangements to ensure that all subcontractors comply with the requirements of the Plans.

In preparing the Environmental Management Strategy, the Contractor shall consult with the Environment Protection Authority (EPA) and other relevant authorities, where relevant, and the Plan shall be developed with reference to the specific requirements of the EPA and other relevant authorities.

The Contractor shall develop and implement the following Plans, which detail the Contractor's proposals for the management of individual stages of work (defined by work activity and/or location) that impact on the environment. Site specific environmental management plans shall be prepared to mitigate all impacts on the environment. They shall address the impacts of activities on elements of the environment and shall include, but not be limited to:

- o Construction Environmental Management Plan, which includes:
  - Soil erosion and sediment control plan, which covers:
    - o Staging of operations and sequence of works
    - o Diversion of upstream water around the site:
    - o Provision of temporary drains and catch drains:
  - Stormwater control:
    - o Diversion.
    - o Dispersal
    - o Retention
    - o Contour ploughing or bunding to disturbed areas and long-term stockpiles
    - o Restoration of disturbed areas in progress with the works:
    - o Use of mulch materials to protect disturbed or exposed areas where suitable:
    - o Areas: Include all site areas and access and haulage tracks, borrow pits, stockpile and storage areas and compound areas.

- **Waste management plan**  
Establish major waste streams that will be generated during the contract including:
  - Green waste and organic waste.
  - Construction waste, including spoil, demolition waste, asphalt or bitumen, concrete, metal, paint materials and empty containers, office waste, kitchen waste, sewage effluent and hazardous materials.
- **Weed management plan**
  - Construction Compounds and Ancillary Facilities Management Plan;
  - Construction Noise and Vibration Management Plan;
  - Construction Traffic Management Plan;
  - Earthworks and Water Quality Management Plan;
  - Waste Management Plan;
  - Flora and Fauna Management Plan;
  - Community Communication Strategy;

The Contractor shall submit to the Superintendent for review the above Plans for each stage of the work, e.g. by geographical area or by construction activity not less than fourteen days prior to the commencement of that stage of the work and not less than 7 business days prior to any proposed change to the Plan unless otherwise specified. Work relevant to that stage shall not commence until the Superintendent is satisfied that the Plan meets the requirements of this specification.

Where, in the opinion of the Superintendent, the Plan does not comply, operate or function in accordance with the performance requirements specified, the Contractor shall cease all activities associated with the Plan until a suitable Plan is developed. Should there be no cessation of activities, the Superintendent reserves the right to take action to provide environmental protection and make good the site. The costs incurred by the Superintendent in undertaking such action will be deducted from progress payments due to the Contractor.

Training program: Submit a program to familiarise staff regarding the site Environmental Management Plan, environmentally sensitive areas and responsibilities.

#### **E10.2.4 TRUCK CONTAMINATION**

##### **Truck contamination precautions**

Covers: Use tarpaulins to prevent the dropping of materials on public roads.

Washing: Wash the underside of all vehicles leaving the site as follows:

- Mud: Do not carry mud on to adjacent paved streets or other areas.
- Noxious plants: If noxious plants, as designated by the local authority, are present on the site ensure seeds are not carried on to adjacent paved streets or other areas.

##### **Wheel wash/shaker bay**

Facilities: Provide the following:

- Surface: Crushed concrete or rock of between 100 mm and 200 mm rough diameter.
- Services: High pressure hose water supply.
- Location: Site the shaker bay and provide berms as required to drain to grassed areas of the site and allow infiltration to the subsurface.

#### **E10.2.5 MANAGEMENT AND CONTROL PLAN IMPLEMENTATION**

##### **Reporting**

General: Compile the environment management plan (EMP) reports regularly to report the progress in relation to:

- Performance against statutory requirements.
- Performance against the EMP and the EMP policy, ecologically sustainable development outcomes and targets.
- Summary of monitoring, inspection and audits.

- Summary of reports required to meet the statutory requirements.
- Summary of environmental emergencies, incidents, non-compliance and complaints.

#### **E10.2.6 TEMPORARY LANDSCAPE FENCING**

##### **Fence dimensions**

Height: 1200 mm.

Maximum post spacing: 5000 mm.

##### **Components sizes**

Corner and gate posts: Hardwood or preservative-treated softwood, 250 mm diameter.

Intermediate posts: Star picket.

Gate: Provide a suitable hinged gate with a gate latch.

Wire: Top, intermediate and bottom rows of 3.2 mm plain galvanized steel wire. Thread the top wire through pieces of plastic tube and through corner posts.

##### **Removal**

Completion: Remove the fence at the end of the planting establishment period.

#### **E10.2.7 TREE PROTECTION**

##### **Standard**

General: Comply with the recommendations of those parts of AS 4970 which are referenced in this worksection.

##### **General**

Warning sign: Display a sign in a prominent position at each entrance to the site, warning that trees and plantings are to be protected during the contract. Remove on completion.

Lettering: Road sign type sans serif letters, 100 mm high to AS 4970 Appendix C.

Protection measures program: Before commencement of earthworks.

##### **Trees to be retained**

Extent: All trees NOT marked for removal.

##### **Tree protection**

Tree protection zone: To AS 4970 Section 3.

Tree protective measures: To AS 4970 Section 4.

Monitoring and certification: To AS 4970 Section 5.

##### **Work near trees**

Harmful materials: Keep the area within the dripline free of sheds and paths, construction material and debris. Do not place bulk materials and harmful materials under or near trees. Do not place spoil from excavations against tree trunks. Prevent wind-blown materials such as cement from harming trees and plants.

Damage: Prevent damage to tree bark. Do not attach stays, guys and the like to trees.

Work under trees: Do not remove topsoil from, or add topsoil to, the area within the dripline of the trees.

Excavation: If excavation is required near trees to be retained, give notice and obtain instructions. Open up excavations under tree canopies for as short a period as possible.

Hand methods: Use hand methods to locate, expose and cleanly remove the roots on the line of excavation. If it is necessary to excavate within the drip line, use hand methods such that root systems are preserved intact and undamaged.

Roots: Do not cut tree roots exceeding 50 mm diameter. Where it is necessary to cut tree roots, use means such that the cutting does not unduly disturb the remaining root system. Immediately after cutting, water the tree and apply a liquid rooting hormone to stimulate the growth of new roots.

Backfilling: Backfill to excavations around tree roots with a mixture consisting of three parts by volume of topsoil and one part of well rotted compost with a neutral pH value, free from weed growth and harmful materials. Place the backfill layers, each of 300 mm maximum depth, compacted to a dry density similar to that of the original or surrounding soil. Do not backfill around tree trunks to a height greater than 200 mm above the original ground surface. Immediately after backfilling, thoroughly water the root zone surrounding the tree.

Compacted ground: Do not compact the ground or use skid-steel vehicles under the tree dripline. If compaction occurs, give notice and obtain instructions.

Compaction protection: Protect areas adjacent the tree dripline. Submit proposals for an elevated platform to suit the proposed earthworks machinery.

Watering: Water trees as necessary, including where roots are exposed at ambient temperature > 35°C.

Mulching: Spread 100 mm thick organic mulch to the whole of the area covered by the drip line of all protected trees.

#### **E10.2.8 EXISTING SERVICES**

##### **Location**

Requirement: Before commencing earthworks, locate and mark existing underground services in the areas which will be affected by the earthworks operations including clearing, excavating and trenching.

Utility services: Contact DIAL BEFORE YOU DIG to identify location of underground utility services pipes and cables.

##### **Excavation**

General: Do not excavate by machine within 1 m of existing underground services.

#### **E10.2.9 TREES TO BE REMOVED**

##### **Designation**

Extent: As agreed with the Superintendent.

Marking: Mark trees and shrubs to be removed as follows:

- Tags: Surveyor's ribbon
- Location: 1000 mm above ground level.

#### **E10.2.10 SITE CLEARING**

##### **Extent**

General: Clear only the following site areas:

- Areas to be occupied by works such as structures, paving, excavation, regrading and landscaping.
- Other areas designated to be cleared.

Contractor's site areas: If not included within the areas documented above, clear generally only to the extent necessary for the performance of the works.

##### **Clearing and grubbing**

Clearing: Remove everything on or above the site surface, including rubbish, scrap, grass, vegetable matter and organic debris, scrub, trees, timber, stumps, boulders and rubble.

Grubbing: Grub out stumps and roots over 75 mm diameter to a minimum depth of 500 mm below subgrade under buildings, embankments or paving, or 300 mm below finished surface in unpaved areas. Backfill holes remaining after grubbing with sand material to prevent ponding of water. Compact the material to the relative density of the existing adjacent ground material.

Old works: Remove old works, including slabs, foundations, pavings, drains and access chambers covers found on the surface.

#### **E10.2.11 TREE MAINTENANCE**

##### **General**

Notice: Give notice before commencing tree maintenance.

Work on trees: If it is necessary to perform any work on trees to be retained, give notice.

Pruning requirements: Carry out all pruning in conformance with AS 4373 and Occupational Health and Safety Act 1983 and the relevant industry code of practice by a fully qualified and experienced arborist. Carry out all required works in a safe and progressive manner.

##### **Execution**

Repair: Undertake tree surgery and make good damage to existing trees noted to be retained.

Operations: Remove dead and decayed wood or limbs that have been broken. Make all cuts at branch collars. If trees show signs of deterioration after the work has been done, carry out a program of soil

amelioration such as soil aeration, irrigation or incorporation of organic material. Continue this program until the end of the plant establishment period.

**Root pruning:** Do not unduly disturb the remaining root system. Cut off damaged roots cleanly inside the exposed or damaged area. Cover exposed root area with soil immediately. Do not leave roots exposed.

**Wetting and new root stimulation:** Form a water collecting basin and apply a rooting hormone and wetting agent to the rootball.

**Precautions:** Avoid damage to trees being treated or to nearby trees and surroundings. Do not use trees as anchors for winching operations or bracing. Provide bracing as necessary before cutting to prevent uncontrolled breakages and damage to surroundings.

**Failure:** If repair work is impracticable, or is attempted and is rejected, remove the tree and root system and make good.

#### **E10.2.12 SEDIMENT FILTERS**

##### **General**

**Inspection:** Inspect for displacement, undercutting, over-topping and soil build-up, after each rain event. Effect repairs immediately.

**Removal:** When the upslope areas have been permanently stabilised.

##### **Straw bale filters**

**Description:** Temporary structures made of straw bales (cereal straw) laid end to end across direction of stormwater flow in order to filter sediment.

**Location:** to be determined by the Contractor's environmental specialist.

**Slopes:** If filter is at toe of a slope, place bales 1500 – 2000 mm away from slope, to provide access for maintenance and to allow coarse sediment to drop out of suspension before reaching sediment filter.

**Binding:** Wire-bound or with string-tied bindings wrapped around the bale sides.

**Installation:**

- Trench: 100 mm deep trench the width of a bale and the length of the proposed sediment filter.
- Placement: Lengthwise in the trench with ends tightly abutting and corners lapped.
- Fixing: Drive two 50 x 50 mm wooden stakes or metal star pickets through each bale. Ensure bales are packed closely and staked securely. Eliminate gaps with loose straw wedged between tight.

**Backfilling:** Compacted excavated soil to ground level on downhill side of barrier, and 100 mm above ground level on the uphill side of the bales.

##### **Silt fence**

**Description:** A temporary barrier of geotextile, supported on wire or mesh fencing in order to filter sediment from stormwater flow.

**Location:** to be determined by the Contractor's environmental specialist.

**Slopes:** If filter is at toe of a slope, locate fence 1500 – 2000 mm away from slope, to provide access for maintenance and to allow coarse sediment to drop out of suspension before reaching sediment filter.

**Contours:** Locate fence line and posts along contours curving upstream at the sides to direct flow toward middle of the fence.

**Installation:**

- Trench: 100 mm wide x 200 mm deep along line of posts and upslope from barrier.
- Posts: 1200 mm long pre drilled steel star picket posts at 3000 mm centres, driven 600 mm and fitted with plastic safety caps.
- Wire mesh:  $\geq 14$  gauge x  $\leq 150$  mm mesh spacing. Fasten wire mesh to upslope side of posts with 25 mm long heavy-duty wire staples and tie wire. Extend wire mesh 150 mm into trench.
- Filter: Geotextile selected to suit local soil conditions cut from a continuous roll to minimise joints.
- Fixing: Wire ties to the uphill side of fence posts, and extended 200 mm into the trench. Do not staple onto trees.
- Joints: 150 mm overlap at a support post, with both ends fastened to the post.

Performance: Retain soil found on site but with openings large enough to permit drainage and prevent clogging.

Fence height: 600 mm average.

Backfilling: Backfill trench over toe of geotextile and compact soil.

#### **Straw bale – geotextile filters**

Description: Sediment filter comprising straw bales and geotextile.

Location: to be determined by the Contractor's environmental specialist.

Slopes: If filter is at toe of a slope, place bales 1500 – 2000 mm away from slope, to provide access for maintenance and to allow coarse sediment to drop out of suspension before reaching sediment filter.

Binding: Wire-bound or with string-tied bindings wrapped around the bale sides.

Bale installation:

- Trench: 100 mm deep trench the width of a bale and the length of the proposed sediment filter.
- Placing: Lengthwise in the trench with ends tightly abutting and corners lapped.
- Fixing: Drive two 50 x 50 mm wooden stakes or metal star pickets through each bale. Ensure bales are packed closely and staked securely. Eliminate gaps with loose straw wedged between tight.

Geotextile installation:

- Geotextile selected to suit local soil conditions cut from a continuous roll to minimise joints.
- Fixing: Staple geotextile to top of straw bale and extend down the uphill face of the bale into the trench. Stretch the geotextile and peg securely into the subgrade.
- Joints: 150 mm overlap at a support post, with both ends fastened to the post.

Performance: Retain soil found on site but with openings large enough to permit drainage and prevent clogging.

Backfilling: Compacted excavated soil to ground level on downhill side of barrier, and 100 mm above ground level on the uphill side of the bales against and over toe of the fabric.

### **E10.2.13 DISPOSAL OF MATERIALS**

#### **Disposal**

Spoil: Remove cleared and grubbed material from the site and dispose of legally.

Surplus material: Remove all surplus material from site.

Burial: Bury concrete and other inorganic fragments as follows:

- Location: Beyond built or paved areas.
- Depth: > 600 mm from finished ground level to the top of the object.
- Compaction: Eliminate voids.

#### **Mulch**

Seed free aerial vegetative matter: Put through a chipper. Reduce to pieces not larger than 75 x 50 x 15 mm and stockpile for re-use as mulch.

Material not permitted: Leaf matter and tree loppings from privet, camphor laurel, coral tree, poplar, willow and noxious weeds.

### **E10.2.14 COMPLETION**

#### **Temporary works**

Remove at completion: Remove all temporary works on completion.

#### **Joining up**

Abutments: Join new and existing work including cutting if required, in the manner appropriate to the materials and make good to existing work.

#### **Clean up**

Progressive cleaning: Keep the work under the contract clean and tidy as it proceeds and regularly remove from the site rubbish and surplus material arising from the execution of the work including any work performed during the defects liability period or the plant establishment period.

Removal of plant: Within fourteen days of the date of practical completion, remove temporary works, construction plant, buildings, workshops and equipment not forming part of the works, except what is

required for work during the defects liability period or the plant establishment period. Remove these on completion.

**E10.2.15 VERMIN**

**Vermin management**

Requirement: Employ an approved firm of pest exterminators and provide a certificate from the firm stating that the completed building is free of vermin.

**E11 EARTHWORK****E11.1 GENERAL****E11.1.1 RESPONSIBILITIES****General**

Requirement: Provide earthworks to the dimensions and tolerances, as documented.

**Design**

Geotechnical and environmental reports are not available.

**E11.1.2 CROSS REFERENCES****General**

Requirement: Conform to the following:

- *General requirements.*
- *Site management.*
- *Civil works.*
- *Landscaping.*
- *Structural.*
- *Electrical.*
- *Architectural*

**E11.1.3 STANDARDS****General**

Earthworks: To AS 3798.

General: Comply with the recommendations of those parts of AS 3798 which are referenced in this worksection.

**E11.1.4 INTERPRETATION****Abbreviations**

General: For the purposes of this worksection the following abbreviations apply:

GITA: Geotechnical inspection and testing authority.

GTA: Geotechnical testing authority.

**Definitions**

General: For the purposes of this worksection the definitions given in AS 1348, AS 3798 and the following apply:

- Description and classification of soils: To AS 1726.
- Site classification: To BCA 3.2.4.
- Bad ground: Ground unsuitable for the purposes of the works, including fill liable to subsidence, ground containing cavities, faults or fissures, ground contaminated by harmful substances and ground which is or becomes soft, wet or unstable.
- Base: One or more layers of material usually constituting the uppermost structural element of a pavement and on which the surfacing may be placed, which may be composed of fine crushed rock, natural gravel, broken stone, stabilised material, asphalt or Portland cement concrete.
- Discrepancy: A difference between contract information about the site and conditions encountered on the site, including but not limited to discrepancies concerning the following:
  - . The nature or quantity of the material to be excavated or placed.
  - . Existing site levels.
  - . Services or other obstructions beneath the site surface.
- Rock: Monolithic material with volume greater than 0.5 m<sup>3</sup> which cannot be removed until broken up either by explosives or by rippers or percussion tools.

- Site topsoil: Soil excavated from the site which contains organic matter, supports plant life, conforms generally to the fine to medium texture classification to AS 4419 (loam, silt, clay loam) and is free from:
  - . Stones > 25 mm diameter.
  - . Clay lumps > 75 mm diameter.
  - . Weeds and tree roots.
  - . Sticks and rubbish.
  - . Material toxic to plants.
- Subbase: The material laid on the subgrade below the base either for the purpose of making up additional pavement thickness required, to prevent intrusion of the subgrade into the base, or to provide a working platform.
- Subgrade: The trimmed or prepared portion of the formation on which the pavement or slab is constructed. Generally taken to relate to the upper line of the formation.
- Zone of influence: A foundation zone bounded by planes extending downward and outward from the bottom edge of a footing, slab or pavement and defining the extent of foundation material having influence on the stability or support of the footings, slab or pavement.

#### **E11.1.5 INSPECTION**

##### **Notice**

Inspection: Give notice so that inspection may be made of the following:

- Items to be measured as listed in **Records of measurement**.
- Areas to be cleared and/or stripped of topsoil.
- Areas stripped of topsoil.
- Excavation completed to contract levels or founding material.
- Proof roll subgrade before placing fill.
- Filling completed to contract levels.
- Stockpiled topsoil before spreading.

#### **E11.1.6 TOLERANCES**

##### **General**

Finish: Finish the surface to the required level, grade and shape within the following tolerances:

- Under building slabs and load bearing elements: + 0, - 25 mm.
- Pavement subgrades; + 0, - 40 mm.
- Batters: No steeper than the slope shown on the drawings. Ensure flatter slopes do not impact on boundaries or required clearances to buildings, pavements or landscaping.
- Other ground surfaces:  $\pm 50$  mm, provided the area remains free draining and matches adjacent construction where required. Provide smoothness as normally produced by a scraper blade.

#### **E11.1.7 SUBMISSIONS**

##### **Design**

Calculations: Submit calculations by a professional engineer to show that proposed excavations and temporary supports, including where applicable supports for adjacent structures, will be stable and safe.

##### **Tests**

Compaction: Submit certification and/or test results in conformance with the specified level of responsibility to AS 3798.

##### **Materials**

Imported fill: Submit certification or test results by a GTA registered laboratory which establish the compliance of imported fill with the contract including the source.

##### **Execution details**

Report: Submit a time based schedule noting the methods and equipment proposed for the groundworks, including the following:

- Dewatering and groundwater control and disposal of surface water.

- Excavation methods, stages, clearances, batters and temporary supports.
- Stockpiles and borrow pits.
- Placing and compaction methods and stages.

Geotechnical site investigations: Provide a geotechnical report supporting the procedures proposed for excavation.

Disposal location: Submit the locations and evidence of compliance with the relevant authorities for the disposal of material required to be removed from site.

Explosives: Submit proposal for any explosives required. Include name of specialist subcontractor, type of explosives, protection and safety measures to AS 2187.1 and AS 2187.2.

Temporary shoring: Provide a proposal for any temporary shoring or underpinning required including the progressive removal.

Proof rolling: Submit method and equipment for proof rolling.

Certified records of measurement: Submit a certified copy of the agreed records of measurement.

Construction records: Submit the following to AS 3798 clause 3.4 and Appendix B:

- Geotechnical site visit record; and
- Earthworks summary report or daily geotechnical reports.

## **E11.2 PRODUCTS**

### **E11.2.1 FILL MATERIALS**

#### **General**

Suitable material: To AS 3798 clause 4.4 including inorganic, non-perishable material suitably graded and capable of compaction to the documented density.

Unsuitable materials: Do not use unsuitable material for fill in conformance with AS 3798 clause 4.3.

Sulphur content: Do not provide filling with sulphur content exceeding 0.5 % within 500 mm of cement bound elements (for example concrete structures or masonry) unless such elements are protected by impermeable membranes or equivalent means.

Re-use of excavated material: Only re-use suitable material in conformance with AS 3798 clause 4.4.

Stockpiles: Segregate the earth and rock material and stockpile, for reuse in backfilling operations.

Locations: Do not stockpile excavated material against tree trunks, buildings, fences or obstruct the free flow of water along gutters where stockpiling is permitted along the line of the trench excavation.

Disposal: If stockpiling is not permitted under the contract, dispose of excavated material off-site to AS 3798 clause 6.1.8.

### **E11.2.2 BORROW OR IMPORTED FILL**

Borrow or imported material: Only when no suitable excavated material is available.

- Suitable material: To AS 3798 clause 4.4.

Borrow pits:

- Location: > 3 m from any fence line, boundary, edge of excavation or embankment.
- Strip and stockpile topsoil.
- Provide erosion protection during winning operations of material and ensure drainage is maintained.
- On completion of winning operations grade abrupt changes of slope, respread topsoil and apply and maintain hydroseeded grassing.

## **E11.3 EXECUTION**

### **E11.3.1 SITE PREPARATION**

#### **Erosion and sedimentation control**

Drainage, erosion and sedimentation control: To the *Site management* worksection.

### **E11.3.2 GEOTECHNICAL**

#### **As found site conditions**

General: If the following are encountered, give notice immediately and obtain instructions before carrying out any further work in the affected area:

- Bad ground.
- Discrepancies.
- Rock.
- Springs, seepages.
- Topsoil > 100 mm deep.

#### **Inspection and testing**

Inspection and testing: Conform to the following:

- Level 1 GITA required to AS 3798 clause 8.2.
- Level 2 GTA required to AS 3798 clause 8.3.

### **E11.3.3 RECORDS OF MEASUREMENT**

#### **Excavation and backfilling**

Agreed quantities: If a schedule of rates applies, provisional quantities are specified, or there are variations to the contract levels or dimensions of excavations, do not commence backfilling or place permanent works in the excavation until the following have been agreed and recorded:

- Depths of excavations related to the datum.
- Final plan dimensions of excavations.
- Quantities of excavations in rock.

Method of measurement: By registered surveyor unless otherwise agreed.

#### **Rock**

Level and class: If rock is measured for payment purposes, whether as extra over excavation of material other than rock or for adjustment of provisional measurements, do not remove the rock until the commencing levels and the classes of rock have been determined.

### **E11.3.4 REMOVAL OF TOPSOIL**

#### **General**

Extent: Areas of cut or fill and areas occupied by structures, pavements and embankments.

Maximum depth: 200 mm.

#### **Topsoil stockpiles**

General: Stockpile site topsoil intended for re-use and imported topsoil where necessary.

Stockpile heights: Establish stockpiles to maximum height of 1.5 m.

Mark: Identify stockpiles of different soil types.

Vegetation: Do not burn off or remove plant growth which may occur during storage.

Protection: Provide the following:

- Drainage and erosion protection.
- Do not allow traffic on stockpiles.
- If a stockpile is to remain for more than four weeks, sow with temporary grass.
- Protect the topsoil stockpiles from contamination by other excavated material, weeds and building debris.

Remove: Remove topsoil that is unsuitable for re-use from the site to AS 3798 clause 6.1.8.

### **E11.3.5 EXCAVATION**

#### **Extent**

Site surface: Excavate over the site to give correct levels and profiles as the basis for structures, pavements, filling and landscaping. Make allowance for compaction, settlement or heaving.

Footings: Excavate for footings, pits, wells and shafts, to the required sizes and depths. Confirm that the foundation conditions meet the design bearing capacity.

**Rock**

General: Do not use explosives.

**Existing footings**

Requirement: If excavation is required within the zone of influence of an existing footing, use methods including (temporary) shoring or underpinning which maintain the support of the footing and ensure that the structure and finishes supported by the footing are not damaged.

**Existing services**

Location: Before commencing earthworks, locate and mark existing underground services in the areas which will be affected by the earthworks operations including clearing, excavating and trenching.

Utility services: Contact DIAL BEFORE YOU DIG to identify location of underground utility services pipes and cables. See [www.1100.com.au](http://www.1100.com.au).

Excavation: Identify existing underground services and give notice. Do not excavate by machine within 1 m of existing underground services.

**Proof rolling**

Extent: Proof roll excavations for pavements, filling and non-spanning slabs on ground to determine the presence of any bad ground.

Proof rolling method and equipment: To AS 3798 clause 5.5.

Outcome: If excessive settlement, rebound or heaving is encountered, provide test pits or trenching to determine the extent of bad ground.

**Disposal of excess excavated material**

General: Remove excess excavated material from site not required or unsuitable for fill.

- Standard: To AS 3798 clause 6.1.8.

**E11.3.6 SUBGRADES AFFECTED BY MOISTURE****General**

General: If the subgrade is unable to support construction equipment, or it is not possible to compact the overlying pavement only because of a high moisture content, perform one or more of the following:

- Allow the subgrade to dry until it will support equipment and allow compaction.
- Scarify the subgrade to a depth of 150 mm, work as necessary to accelerate drying, and recompact when the moisture content is satisfactory.
- Excavate the wet material and remove to spoil, and backfill excavated areas.

**E11.3.7 BEARING SURFACES****General**

General: Provide even plane bearing surfaces for loadbearing elements including footings. Step to accommodate level changes. Make the steps to the appropriate courses if supporting masonry.

**Deterioration**

General: If the bearing surface deteriorates because of water or other cause, excavate further to a sound surface before placing the loadbearing element.

**E11.3.8 REINSTATEMENT OF EXCAVATION****General**

Requirement: If the excavation exceeds the required depth, or deteriorates, reinstate to the correct depth, level and bearing value.

Fill adjacent structures and trenches: To AS 3798 clause 6.2.6.

Zone of influence: Within the zone of influence of footings, beams, or other structural elements, use concrete of strength equal to the structural element, minimum 15 Mpa. Ensure that remedial concrete does not create differential bearing conditions.

Below slabs or pavements: Provide selected fill compacted to the specified density.

Cut subgrades: Where the over excavation is less than 100 mm, do not backfill. Make good by increasing the thickness of the layer above.

Rock depressions and subsoil drains: Backfill rock depressions and over excavation of subsoil drains using coarse subsoil filter.

### E11.3.9 SUPPORTING EXCAVATIONS

#### Removal of supports

General: Remove temporary supports progressively as backfilling proceeds.

#### Voids

General: Guard against the formation of voids outside sheeting or sheet piling if used. Fill and compact voids to a dry density similar to that of the surrounding material.

### E11.3.10 ADJACENT STRUCTURES

#### Temporary supports

General: Provide supports to adjacent structures where necessary, sufficient to prevent damage arising from the works.

Lateral supports: Provide lateral support using shoring.

Vertical supports: Provide vertical support where necessary using piling or underpinning or both.

#### Permanent supports

General: If permanent supports for adjacent structures are necessary and are not described, give notice and obtain instructions.

#### Encroachments

General: If encroachments from adjacent structures are encountered and are not shown on the drawings, give notice and obtain instructions.

### E11.3.11 ROCK BOLTING

#### General

General: Provide proprietary high strength steel bars or tubes anchored into holes drilled in the rock and tensioned against plates bearing on the rock face to provide temporary or permanent support for the rock face. Schedule the installation to conform to systematic bolting or calculated relief, as documented.

Standard: To AS 4678.

#### Protection

General: Protect permanent rock bolts by grouting the drilled hole with cement grout after tensioning the rock bolt. Protect the bearing plate and the exposed portion of rock bolt and anchorage with a protective coating or by embedment in concrete.

### E11.3.12 PREPARATION FOR FILLING

#### Preparation

Stripping: Prepare the ground surface before placing fill (including topsoil fill), ground slabs or load bearing elements to AS 3798 clause 6.1.5. Remove materials which will inhibit or prevent satisfactory placement of fill layers, loose material, debris and organic matter.

Foundation preparation: To AS 3798 clause 6.1.7.

Compaction: Compact the ground exposed after stripping or excavation to the minimum relative compaction in AS 3798 Section 5 and the **Compaction table**.

Scarify method: Loosen exposed excavation by scarifying to a minimum of 150 mm, moisture condition and compact to AS 3798 Section 5 and the **Compaction table**.

Impact roller compaction: Use an approved impact roller or impact completion.

Slope preparation: If fill is placed on a surface which slopes steeper than 4 H:1 V, bench the surface to form a key for the fill. As each layer of fill is placed, cut the existing ground surface progressively to form a series of horizontal steps > 1 m in width and > 100 mm deep. Recompact the excavated material as part of the filling. Shape to provide free drainage.

#### Under earth mounds

General: Cultivate the ground to a depth of 200 mm before mound formation.

#### Under slabs, paving and embankments

General: Compact the ground to achieve the densities specified in the **Compaction schedule**. If necessary loosen the ground to a depth of > 200 mm and adjust the moisture content before compaction to a density consistent with subsequent filling.

**Rock ledges**

General: Remove overhanging rock ledges.

**E11.3.13 GEOTEXTILE****General**

Geotextile: N/A

Material: UV stabilised polymeric fabric formed from a plastic yarn composed of at least 85% by weight.

Identification and marking: To AS 3705.

Product: N/A

Properties: N/A

Preparation: Trim the ground to a smooth surface free from cavities and projecting rocks.

Placing: Lay the fabric flat, but not stretched tight, and secure it with anchor pins. Overlap joints 300 mm minimum.

**E11.3.14 PLACING FILL****General**

Layers: Place fill in near-horizontal layers of uniform thickness, deposited systematically across the fill area.

Extent: Place and compact fill to the designated dimensions, levels, grades, and cross sections so that the surface is always self draining.

Edges: At junctions of fill and existing surfaces, do not feather the edges.

Mix: Place fill in a uniform mixture.

Previous fill: Before placing subsequent fill layers, ensure that previously accepted layers still conform to requirements, including moisture content.

Protection: Protect the works from damage due to compaction operations. Where necessary, limit the size of compaction equipment or compact by hand. Commence compacting each layer at the structure and proceed away from it.

Protective covering: Do not disturb or damage the protective covering of membranes during backfilling.

**Placing at structures**

General: Place and compact fill in layers simultaneously on both sides of structures, culverts and pipelines to avoid differential loading. Carefully place first layers of fill over the top of structures.

Concrete: Do not place fill against concrete retaining walls until the concrete has been in place for 28 days unless the structure is supported by struts.

**E11.3.15 PLACING TOPSOIL****Stockpiled topsoil**

Cultivation: Rip to a depth of 100 mm or to the depth of rippable subgrade if less. Cultivate around services and tree roots by hand. Trim to allow for the required topsoil depth.

Herbicide: Apply before placing topsoil.

Placing: Spread and grade evenly.

**Disposal of excess topsoil**

On site: Dispose of surplus topsoil remaining on site by spreading evenly over the areas already placed.

Off site: Remove excess topsoil from the site and dispose of legally.

Compaction: Lightly compact topsoil so that the finished surface is smooth, free from lumps of soil, at the required level, ready for cultivation and planting.

Edges: Finish topsoil flush with abutting kerbs, mowing strips and paved surfaces. Feather edges into adjoining undisturbed ground.

**E11.3.16 FILL MOISTURE CONTROL****General**

Moisture content: Adjust the moisture content of fill during compaction within the range of 85 – 115% of the optimum moisture content determined by AS 1289.5.1.1 or AS 1289.5.2.1 as appropriate, in order to achieve the required density.

**E11.3.17 COMPACTION REQUIREMENTS FOR FILL AND SUBGRADE****Density**

General: Other than rolled fill to AS 2870 clause 6.4.2(b). Compact the subgrade and each layer of fill to the required depth and density, as a systematic construction operation and to conform to the **Compaction table**. Shape surfaces to provide drainage and prevent ponding.

**Compaction table**

Location	Cohesive soils. Minimum dry density ratio (standard compaction) to AS 1289.5.4.1	Cohesionless soils. Minimum density index to AS 1289.5.6.1
Residential: Lot fill, house sites.	95	70
Commercial: Fills to support minor loadings incl. floor loadings < 20 kPa and isolated pad or strip footings < 100 kPa.	98	75
Pavements: Fill to support pavements Subgrade to 300 mm deep	95 98	70 75

Excavated and stripped ground surface: After excavation and/or stripping, compact these surfaces in conformance with the **Compaction table** to a minimum depth of 150 mm.

Maximum rock and lump size in layer after compaction: 2/3 compacted layer thickness.

Fill batter faces: Either compact separately, or overfill and cut back. Form roughened surfaces to the faces.

**Compaction control tests**

Compaction control tests: To AS 1289.5.4.1 or AS 1289.5.7.1.

**Compaction control test frequency**

Standard: To AS 3798 Table 8.1.

Confined operations: 1 test per 2 layers per 50 m<sup>2</sup>.

**E11.3.18 COMPLETION****Grading**

External areas: Grade to give falls away from buildings, minimum 1:100.

Subfloor areas: Grade the ground surface under suspended floors to drain ground or surface water away from buildings without ponding.

**Temporary works**

Tree enclosures: Remove temporary tree enclosures at completion.

Tree marking: Remove temporary marks and tags at completion.

Temporary supports: Remove temporary supports to adjacent structures at completion.

**Site restoration**

Requirement: Where variation of existing ground surfaces is not required as part of the works, restore surfaces to the condition existing at the commencement of the contract.

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**E12 STORMWATER – SITE**

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**E12.1 GENERAL**

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**E12.1.1 RESPONSIBILITIES**

**General**

General: Provide stormwater drainage as documented.

Selections: As documented.

**E12.1.2 CROSS REFERENCES**

**General**

Requirement: Conform to the following:

- *General requirements.*
- *Earthwork.*

**E12.1.3 INTERPRETATION**

**Definitions**

General: For the purposes of this worksection the following definition applies:

- Pipe surround: Includes pipe overlay, pipe side support, side zone and haunch zone.

**E12.1.4 STANDARDS**

**Stormwater drainage**

Standard: To AS/NZS 3500.3.

**E12.1.5 INSPECTION**

**Notice**

Inspection: Give notice so that inspection may be made of the following:

- Excavated surfaces before placing pipe bedding material.
- Formwork and reinforcement before placing cast in situ concrete.
- Pipe joints before covering.
- Placing of cast in situ concrete.
- Upon completion.

**E12.1.6 SUBMISSIONS**

**Samples**

General: Submit samples of the following:

- Each type of imported pipe bedding material.
- Each type of filter material.

**Products – documentation**

Conformance: Produce documentary evidence that the pipes conform to the requirements of this worksection.

**E12.2 PRODUCTS**

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**E12.2.1 MATERIALS**

**Concrete and mortar**

Concrete: To AS 1379 and the following:

- Grade: N20.
- Cement: To AS 3972.
- Type: GP or GB.

Steel reinforcement:

- Bars and machine welded mesh: To AS/NZS 4671.

#### Joints

Solvent cement and priming fluid: To AS/NZS 3879.

#### Pipe and fittings

Fibre reinforced cement (FRC): To AS 4139 and the following:

- ≤ 450 mm diameter: Rubber ring joints to AS 4139.
- > 450 mm diameter: With a purpose machined internal spigot and socket system within the pipe wall.

Glass-reinforced polyester (GRP): To AS 3571.1.

Cast iron access chamber covers and frames: To AS 1830 and AS 1831, as appropriate.

Polyvinyl chloride (PVC): To AS/NZS 1254, AS/NZS 1260, AS 1273, as appropriate.

Polyethylene (PE): To AS/NZS 4129, AS/NZS 4130, ISO 8770, or AS/NZS 2033.

Precast concrete: To AS/NZS 4058.

Rubber ring joints/elastomeric seals: To AS 1646.

Subsoil: To AS 2439.1.

Vitrified clay or ceramic: To AS 1741.

#### Bedding material

Bed and haunch zones: Provide granular material graded to AS 1141.

Conformance: Conform to the **Bedding material grading table**.

#### Bedding material grading table

Sieve size ( mm )	Weight passing %	
	Bed and haunch	Side zones
75.0	-	100
19.0	100	-
9.5	-	50-100
2.36	50-100	30-100
0.60	20-90	15-50
0.30	10-60	-
0.15	0-25	-
0.075	0-10	0-25

### E12.3 EXECUTION

#### E12.3.1 TOLERANCES

##### General

General: Conform to the **Pipeline tolerances table**. These tolerances are conditional on falls to outlets being maintained and no part of a pipeline being at less than the designated gradient.

#### Pipeline tolerances table

	Permissible angular deviation from alignment	Permissible displacement from alignment
Horizontal	1 in 300	15 mm
Vertical	1 in 500	5 mm

#### E12.3.2 STORMWATER DRAINS

##### Location

General: Provide stormwater drains to connect downpipes, surface drains, subsoil drains and drainage pits to the outlet point or point of connection. Make sure that location of piping will not interfere with

other services and building elements not yet installed or built. Subject to the preceding and documented layouts, follow the most direct route with the least number of changes in direction.

Downpipe connections: Turn up branch pipelines with bends to meet the downpipe, finishing 50 mm (nominal) above finished ground or pavement level. Seal joints between downpipes and drains.

#### Laying

General: Lay in straight lines between changes in direction or grade with socket end placed upstream. If other pipes are adjacent, set each pipe true to line and complete each joint before laying the next pipe. If work is not continuous cap open ends to prevent entry of foreign matter.

#### Bedding

General: Grade the underlay evenly to the gradient of the pipeline.

Standard: To AS/NZS 3725 and AS/NZS 3725 Supp 1.

Layers: Compact all material in layers not exceeding 150 mm compacted thickness.

#### Lifting holes

General: Seal lifting holes in all pipes with plastic preformed plugs or 3:1 sand:cement mortar, before the commencement of backfilling.

#### Trench backfill

General: Backfill the remainder of the trench to the underside of the subgrade with fill material in conformance with the *Earthwork* worksection.

#### Anchor blocks

General: If necessary to restrain lateral and axial movement of the stormwater pipes, provide anchor blocks at junctions and changes of grade or direction.

#### Encasement

General: Conform to the **Stormwater pipeline schedule**.

Location: Encase the pipeline in concrete at least 150 mm above and below the pipe, and 150 mm each side or the width of the trench, whichever is the greater.

### E12.3.3 SUBSOIL DRAINS

#### General

General: Provide subsoil drains to intercept groundwater seepage and prevent water build-up behind walls and under floors and pavements. Connect subsoil drains to surface drains or to the stormwater drainage system as applicable. Conform to the **Subsoil pipeline schedule**.

Trench width:  $\geq 450$  mm.

Pipe depth: Provide the following minimum clear depths, measured to the crown of the pipe, where the pipe passes below the following elements:

- 100 mm below subgrade level of the pavement, kerb or channel.
- 100 mm below the average gradient of the bottom of footings.
- 450 mm below the finished surface of unpaved ground.

#### Jointing

General: At junctions of subsoil pipes, provide tees, couplings or adaptors to AS 2439.1.

#### Pipe underlay

General: Grade the trench floor evenly to the gradient of the pipeline. If the trench floor is rock, correct any irregularities with compacted bedding material. Bed piping on a continuous underlay of bedding material, at least 75 mm thick after compaction. Lay the pipe with one line of perforations at the bottom.

Chases: If necessary, form chases to prevent projections such as sockets and flanges from bearing on the trench bottom or underlay.

#### Pipe surrounds

General: Place the material in the pipe surround in layers  $\leq 200$  mm loose thickness, and compact without damaging or displacing the piping.

Depth of overlay:

- To the underside of the bases of overlying structures such as pavements, slabs and channels.
- To within 150 mm of the finished surface of unpaved or landscaped areas.

**Geotextile**

General: Provide polymeric fabric formed from plastic yarn composed of at least 85% by weight propylene, ethylene, amide or vinylidenechloride, and containing stabilisers or inhibitors which provide resistance to deterioration due to ultraviolet light.

Marking: To AS 3705.

Protection: Provide heavy duty protective covering. Store clear of the ground and out of direct sunlight. During installation do not expose the filter fabric to sunlight for more than 14 days.

**Filter socks**

General: Provide polyester permeable socks capable of retaining particles of 0.25 mm size. Securely fit or join the sock at each joint.

**E12.3.4 PITS**

**Finish to exposed surfaces**

General: Provide a smooth, seamless finish, using steel trowelled render or concrete cast in steel forms.

Corners: Cove or splay internal corners.

**Metal access covers and grates**

Standard: To AS 3996.

Cover levels: Top of cover or grate, including frame:

- In paved areas: Flush with the paving surface.
- In landscaped areas: 25 mm above finished surface.
- Gratings taking surface water runoff: Locate to receive runoff without ponding.

**E12.3.5 TESTING**

**Pre-completion tests**

General: Before backfilling or concealing, carry out the following tests:

- Site stormwater drains and main internal drains: Air or water pressure test to AS/NZS 3500.3 Section 10.

Leaks: If leaks are found, rectify and re-test.

**E12.3.6 COMPLETION**

**Cleaning**

General: Clean and flush the whole installation.

**E12.4 SELECTIONS**

**E12.4.1 STORMWATER**

Stormwater pipeline schedule – Refer to Drawings for drainage pit location

Properties	Location		
	A	B	C
Pipe material and nominal size			
Grates			
Joining			
Bedding			
Pipe support			
Concrete encasement			

Pipe bedding schedule Refer to Drawings

Properties	Location		
	A	B	C
Bedding application			

Properties	Location		
	A	B	C
Bedding zone			
Material and grading			
Required density			

**Lined surface drain schedule**

Properties	Location		
	A	B	C
Lining material			
Gravel			

**Subsoil pipeline schedule**

Properties	Location		
	A	B	C
Trench depth ( mm)			
Pipe size (nominal)			
Pipe class			
Other requirements			

**Pit schedule Refer to Drawings**

Properties	Location		
	A	B	C
Size (mm)			
Remarks			

**E13 PAVEMENT BASE AND SUBBASE**

**E13.1 GENERAL**

**E13.1.1 RESPONSIBILITIES**

**General**

General: Provide base and subbase courses that are as follows:

- In conformance with the level tolerances, as documented.
- Tested by a geotechnical testing authority.
- In conformance with the compaction requirements documented.

The existing pavement for the Upper Accessway shall be removed by cold milling in accordance with the requirements of RTA Specification R101 Cold Milling of Asphalt, Base Course and Cement Concrete, and in accordance with the Contract Drawings.

The new pavement shall be constructed to comprise the following pavement composition:

- Tack Coat and 30 mm Asphalt Wearing Course to RTA Specification R116,
- Prime Coat to RTA Specification R106,
- 150 mm DGB20 to RTA Specification 3051 and R71 compacted to 102% Standard Compaction,
- 200 mm DGS40 to RTA Specification 3051 and R71 compacted to 102% Standard Compaction,
- Select Fill to RTA Spec 3071 and R44 (minimum soaked CBR of 15%) placed onto subgrade in 150 mm layers to provide a platform to construct the subbase, and
- 150 mm Rip and Recompact In-situ at Optimum Moisture Content (OMC -3% + 1%) to 100% Standard Compaction.

**E13.1.2 CROSS REFERENCES**

**General**

Requirement: Conform to the following:

- *General requirements.*
- *Site management.*
- *Earthwork.*
- *Stormwater – site.*
- *Pavement ancillaries.*

**E13.1.3 INTERPRETATION**

**Abbreviations**

General: For the purposes of this worksection the following abbreviations apply:

- CBR: California bearing ratio.
- DGB: Densely graded base.
- DGS: Densely graded subbase.
- ESA: Equivalent standard axle.
- GMB: Graded macadam base.
- GMS: Graded macadam subbase.
- NGB: Natural gravel base.
- NGS: Natural gravel subbase.

**Definitions**

General: For the purposes of this worksection the definitions given in AS 1348 and the following apply:

- Absolute level tolerance: Maximum deviation from design levels.
- Base: One or more layers of material usually constituting the uppermost structural element of a pavement and on which the surfacing may be placed, which may be composed of fine crushed rock, natural gravel, broken stone, stabilised material, asphalt or Portland cement concrete.
- Flexible pavement: Consists of a base and a subbase constructed of unbound materials.
- Relative level tolerance: Maximum deviation from a 3 m straight edge laid on the surface.
- Subbase: The material laid on the subgrade below the base either for the purpose of making up additional pavement thickness required, to prevent intrusion of the subgrade into the base, or to provide a working platform.

**E13.1.4 INSPECTION**

**Notice**

Inspection: Give notice so that inspection may be made of the following:

- Prepared subgrade.
- Proof rolling of subbase before spreading of base.
- Proof rolling of base before sealing.

**E13.1.5 TESTS**

**Compaction control tests**

Standard: To AS 1289.5.4.1 and AS 1289.5.4.2.

**E13.1.6 SUBMISSIONS**

**Frequency of compaction control tests**

General: Not less than the following (whichever requires the most tests):

- 1 test per layer per 25 lineal metres for 2-lane roads.
- 1 test per layer per 1000 m<sup>2</sup> for carpark.
- 3 tests per layer.
- 3 tests per visit.

**Materials**

Source of material: Submit the supplier name, nature of material (crushed rock, natural gravel, recycled concrete aggregate) and source quarry or recycling site.

Compliance of material: Provide certification and test results from a NATA registered laboratory confirming that the material conforms to the requirements of the specification.

**Execution**

General: Submit details of the methods and equipment proposed for each pathway and roadworks operation, including the following:

- Staging of the work, access and traffic control methods.
- Disposal of surface water, control of erosion, contamination and sedimentation of the site, surrounding areas and drainage systems.
- Sources of materials.
- Material stockpiles.

Compaction: If it is proposed that a layer is to exceed 150 mm in thickness, submit evidence demonstrating that the proposed compaction equipment can achieve the required density throughout the layer.

**E13.2 PRODUCTS**

**E13.2.1 TRAFFIC CATEGORY**

**E13.2.2 BASE AND SUBBASE MATERIAL**

**General**

Compliance: To the **Base and subbase compliance table**.

**Base and subbase compliance table**

Course	Source	Compliance requirement
--------	--------	------------------------

Course	Source	Compliance requirement
Base	Crushed rock or natural gravel	To the <b>Pavement material traffic categories table</b> , <b>Acceptable pavement material types table</b> , and <b>Unbound base material properties table</b>
	Recycled concrete aggregate	To SAA HB 155 Table 19
Subbase	Crushed rock or natural gravel	To the <b>Pavement material traffic categories table</b> , <b>Acceptable pavement material types table</b> , and <b>Unbound subbase material properties table</b>
	Recycled concrete aggregate	To SAA HB 155 Table 19

**Granular material**

Requirement: Provide unbound materials, including blends of two or more different materials, consisting of granular material which does not develop significant structural stiffness when compacted, and is uniform in grading and physical characteristics.

**Crushed rock**

General: Provide unbound crushed rock materials designated as follows:

- DGB20: 20 mm nominal sized densely graded base.
- DGS20: 20 mm nominal sized densely graded subbase.
- DGS40: 40 mm nominal sized densely graded subbase.
- GMB20: 2 mm nominal sized graded macadam base.
- GMS40: 40 mm nominal sized graded macadam subbase.

**Natural gravel**

General: Provide unbound natural gravel materials designated as follows:

- NGB20-2c: 20 mm nominal sized natural gravel base for Traffic Category 2c.
- NGB20-2d: 20 mm nominal sized natural gravel base for Traffic Category 2d.
- NGS20: 20 mm nominal sized natural gravel subbase.
- NGS40: 40 mm nominal sized natural gravel subbase.

**E13.3 EXECUTION**

**E13.3.1 SUBGRADE PREPARATION**

**General**

Requirement: Prepare the subgrade in conformance with the *Earthwork* worksection.

**E13.3.2 TOLERANCES**

**Surface level**

General: Provide a finished surface which is free draining and evenly graded between level points.

Edges abutting gutters: Within  $\pm 5$  mm of the level of the actual gutter edge.

Tolerances: The tolerances in the **Surface level tolerances table** apply to the finished level of each layer, unless overridden by the requirements (including tolerances) for the finished level and thickness of the wearing course.

**Surface level tolerances table**

Item	Level tolerance	
	Absolute	Relative
Subbase surface	$\pm 10$ mm	10 mm
Base surface	$\pm 10$ mm	10 mm

**E13.3.3 SUBBASE AND BASE COMPACTION****General**

General: Compact each layer of fill to the required depth and density, as a systematic construction operation and to conform to the **Minimum relative compaction table**.

**Minimum relative compaction table**

Item description	Minimum dry density ratio (modified compaction) to AS 1289.5.2.1
Subbase	95
Base	98

Unstable areas: Remove any unstable areas which develop during rolling or identified by proof rolling for the full depth of the layer and dispose of and replace with fresh material.

**Compaction requirements**

General: Apply uniform and sufficient compactive effort over the whole area to be compacted. Use rollers appropriate to the materials and compaction requirements.

**Moisture content**

General: During spreading and compaction, maintain materials at the optimum moisture content (modified compaction) within the range of -2% to +1% from the optimum moisture content.

Spraying: Maintain moisture content. Use water spraying equipment capable of distributing water uniformly in controlled quantities over uniform lane widths.

**Rectification**

General: If a section of pavement material fails to meet the required density or moisture content after compaction, remove the non-complying material, dispose of off-site or condition for re-use, and replace with fresh material, and recompact.

**Level corrections**

General: Rectify incorrect levels as follows:

- High areas: Grade off.
- Low areas: Remove layers to a minimum depth of 75 mm, replace with new material and recompact.

**E13.3.4 PLACING BASE AND SUBBASE****General**

Weak surfaces: Do not place material on a surface which has been so weakened by moisture that it will not support, without damage, the constructional plant required to perform the work.

Spreading: Spread material in uniform layers without segregation.

Moisture content: Maintain wet mixed materials at the required moisture content before and during spreading. Add water to dry mixed materials through fine sprays to the entire surface of the layer after spreading, to bring the material to the required moisture content.

Layer thickness: 150 mm maximum and 75 mm minimum (after compaction). Provide equal layers in multilayer courses.

**Joints**

General: Plan spreading and delivery to minimise the number of joints. Offset joints in successive layers by at least 300 mm.

**Final trimming**

General: Trim and grade the base course to produce a tight even surface without loose stones or a slurry of fines.

## E14 ASPHALTIC CONCRETE

### E14.1 GENERAL

#### E14.1.1 RESPONSIBILITIES

##### General

General: Provide a finished asphaltic concrete surface which is as follows:

- Free draining and evenly graded between level points.
- Even and smooth riding.

Selections: As documented.

##### Performance

Requirements:

Tack Coat and 30 mm Asphalt Wearing Course to RTA Specification R116

Prior to tack coating and placement of the wearing course, the Contractor shall place a Prime Coat to the prepared pavement in accordance with RTA Specification R106.

The Contractor shall undertake the removal of pavement materials from the Upper Accessway road pavement by cold milling in accordance with the requirements of RTA Specification R101 Cold Milling of Asphalt, Base Course and Cement Concrete, and in accordance with the Contract Drawings.

Selections: As documented.

#### E14.1.2 CROSS REFERENCES

##### General

Requirement: Conform to the following:

- *General requirements.*
- *Site management.*
- *Earthwork.*
- *Stormwater – site.*
- *Pavement base and subbase.*
- *Pavement ancillaries.*

#### E14.1.3 STANDARDS

Hot mix asphalt: To AS 2150.

#### E14.1.4 INTERPRETATION

##### Definitions

General: For the purposes of this worksection the definitions given below apply:

- **Levelness:** Absolute level tolerance – maximum deviation from design levels.
- **Lot:** A lot consists of any part of the works which has been constructed/manufactured under a continuous operation of uniform conditions and is essentially homogeneous with respect to material and general appearance. The whole of the work included in a lot is of a uniform quality without obvious changes in attribute values.
- **Flatness:** Relative level tolerance – maximum deviation from a 3 m straightedge laid on the surface.
- **Relative compaction:** The ratio between the field bulk density and the bulk density of the job mix when compacted in the laboratory.

#### E14.1.5 INSPECTION

##### Notice

Inspection: Give notice so that inspection may be made of the following:

- Surface prepared for priming, sealing or asphalt surfacing.

- Commencement of asphalt surfacing.
- Completion of asphalt surfacing.

#### E14.1.6 TOLERANCES

General: Conform to the **Tolerances table** which applies to the finished level of each layer, unless overridden by the requirements (including tolerances) for the finished level and thickness of the surface course.

##### Tolerances table

Item	Level tolerance	
Level (Longitudinal)	± 10 mm Absolute	5 mm Relative
Level (Transverse)	± 10 mm Absolute	10 mm Relative
Compacted layer thickness (Any one sample)	+ 10 mm, - 5 mm.	
Edges abutting gutters	Within ± 5 mm of the level of the actual gutter edge.	
Shape	Conform to AS 2150 Table 15.	
Roughness	Conform to AS 2150 Table 16.	

#### E14.1.7 SUBMISSIONS

##### Execution details

General: Submit proposals for work methods and equipment including the following:

- Survey control.
- Staging of the work, access and traffic control methods.
- Disposal of surface water, control of erosion, contamination and sedimentation of the site, surrounding areas and drainage systems.
- Methods and equipment for each operation.
- Material stockpiles.

Trial: Submit trial paving using the proposed job mix and all equipment as proposed. Trial may be incorporated into the final works, if satisfactory.

##### Products

Certificate of compliance: As an alternative to testing a product, submit the manufacturer's certificate together with the results of recent tests undertaken by the manufacturer, showing conformance with test criteria.

Proposals: Submit the following details before commencing production:

- Combined aggregate particle size distribution.
- Binder content expressed as a percentage of the total mix.
- The filler content expressed as a percentage by mass of the combined aggregates.
- The asphalt mix properties.
- The proposed mixing temperature.
- Sources of materials.
- Reclaimed asphalt pavement stockpile and proportion.

##### Samples

Samples: Submit samples to AS 1141.3.1 at least one month before use:

- Granular materials: Submit samples of each proposed type and size of asphalt and cover aggregate.

Identification: Attach a tag to each sample showing relevant information including description, source and nominal size of material.

## E14.2 PRODUCTS

### E14.2.1 AGGREGATE

#### Properties

Description: Clean, sound, hard, angular, of uniform quality, free from deleterious matter in conformance with the **Aggregate properties table**.

Standard: To AS 2758.5.

Mineral filler: To AS 2150 clause 4.2.

Combined aggregate grading: To AS 2150 clause 5.2.

Crushed slag: Air-cooled blast furnace slag of uniform quality, generally free from vesicular, glassy or other brittle pieces.

Fine aggregate: Clean, sound, hard, durable particles of natural sand or particles derived from crushed stone, gravel or slag, free from injurious coating or particles of clay, silt, loam or other deleterious matter.

#### Aggregate properties table

Property	Test method	Value
Particle shape	AS 1141.14	≤ 25 for wearing course ≤ 30 for binder course and corrective course
Wet strength	AS 1141.22	≥ 100 kN
Wet/dry strength variation	-	≤ 35%

### E14.2.2 TACK COATING

#### Properties

Bitumen emulsion: Rapid setting to AS 1160.

Tack coat mix: In accordance with RTA Specification R116.

### E14.2.3 ASPHALT

#### General

Hot mix asphalt: To AS 2150.

Medium cut back bitumen: To AS 2157.

Bitumen emulsion: To AS 1160.

Bitumen binder: Class 170.

#### Mix design

Design: To AS 2891.5 and AS 2150 and the Marshall method:

- Marshall stability: > 4.5 kN.
- Marshall flow: 2 – 4 mm.
- Voids in total mix (maximum theoretical density based on apparent specific gravity of aggregates):
  - . Wearing courses: 3% – 5%.
  - . Binder courses and 7 mm mixes: 4% – 6%.
- Voids in aggregate filled with bitumen:
  - . Wearing courses: 75% – 85%.
  - . Binder courses and 7 mm mixes: 70% – 80%.

Reclaimed asphalt pavement: To AS 2150 clause 4.6.

#### Product tests

General: Take samples from trucks at the mixing plant and test for mix properties using one of the following methods as applicable:

Standard: To AS 2150 Table 9 and AS 2891.5.

- Marshall stability of compacted mix:
  - . Compactive effort:

- \* 35 blows for light traffic,
- \* 50 blows for general conditions
- \* 75 blows for heavy traffic or deep lifts.

#### Variations in mix properties

General: Ensure that the maximum variation between the mix property of each sample and the job mix value conforms to the **Mix property table**.

#### Mix property table

Mix property	Maximum variation from job mix value
Aggregate passing 4.75 mm sieve or larger	± 7% by mass
Aggregate passing 2.36 mm to 300 µm sieves	± 5% by mass
Aggregate passing 150 µm sieve	± 2.5% by mass
Aggregate passing 75 µm sieve	± 1.5% by mass
Bitumen content	± 0.3% by mass
Added filler content	± 0.3% by mass
Mixing temperature	± 10°C

#### E14.2.4 OTHER MATERIALS

##### Tactile ground surface indicators

Standard: To AS/NZS 1428.4.1.

#### E14.3 EXECUTION

##### E14.3.1 PREPARATION

###### Cleaning

Remove: Immediately before priming or tack coating remove loose stones, dust and foreign material from the base surface using a power broom or blower. Keep traffic off the cleaned surface.

###### Priming

Protection: Prime the base surface as soon as possible after compaction and finishing.

###### Potholes

Patching: Trim to a regular shape and a uniform depth of at least 75 mm, tack coat the edges and patch with asphaltic concrete.

###### Level anomalies

Final levels: Flush kerbing, gutter or other concrete or metal components may require level modification to achieve safe foot surfaces or drainage. Prepare adjacent asphaltic areas as for potholes to achieve uniform or tapered depth to match final levels.

Pre-treatment: Regulate to AS 2150 clause 14.3.2.

###### Protection

Adjacent surfaces: Protect adjacent surfaces during spraying. Protect freshly sprayed surfaces from contamination.

###### Tack coating

Application rate: Apply tack coat 30 – 120 minutes before asphalt surfacing is placed. Cover the surface uniformly at an application rate of 0.20 – 0.40 L/m<sup>2</sup> of residual bitumen.

##### E14.3.2 SURFACING

###### Spreading

Conditions: Place asphalt surfacing in dry weather on a dry pavement surface at a pavement temperature of at least 10°C.

Operations: Spread the mix in layers covering the full width of the pavement, or, in the case of carriageways and wide pavements, in lanes of minimum width 3 m. Place layers in adjoining lanes to the same compacted thickness.

Method: Spreading by self propelled paving machine to AS 2150 clause 12.2.

Hand spreading: To AS 2150 clause 12.3.

Thickness tolerance:

- Thickness ≤ 50 mm tolerance is either an average or a minimum.

- Thickness > 50 mm tolerance  $\pm 10\%$  of total thickness up to  $\pm 15$  mm.

Frequently check thickness: Measure uncompacted and compacted layer to conform with AS 2150.

#### **Abutting structures**

**Level:** Place asphalt surfacing to match the level of abutting surfaces such as kerbs, gutters, edge strips, access chamber covers, or adjoining pavement in the same manner as for longitudinal and transverse joints. **Fill:** Fill spaces left unfilled between the spreader run and abutting edges with sufficient material to the proper height before compaction.

**Assess:** On site level anomalies to determine the need to raise the surface level of a structure where the use of infill or tapered asphalt would create a local pedestrian trip hazard or effect the durability.

#### **Matched junctions**

**Smooth joints:** If asphalt surfacing is to match an existing pavement, bridge deck, rail or other fixture, place the material to provide a smooth riding surface across the junction.

**As required:** Remove existing pavement or taper the thickness of layers.

**Junction:** Terminate layers at a 20 mm deep and 400 mm wide chase cut into the existing pavement.

**Remove:** Coarse particles from a layer of tapering thickness using hand raking.

**Tack coat:** Where the thickness of the layer tapers to less than twice the nominal size of the mix, tack coat the area upon which material of such thickness is to be placed uniformly at an application rate  $0.50 - 0.75 \text{ L/m}^2$ .

#### **Joints**

**Standard:** To AS 2150 clause 12.6.

**Minimise the number of joints:** Make joints that are well bonded and sealed and provide a smooth riding surface across the joint.

**Transverse joints:** Construct a transverse joint if the operation is stopped for more than 20 minutes or the pavement temperature falls below  $90^\circ\text{C}$ . Construct to a straight vertical face for the full depth of the layer, and offset in adjoining spreader runs and layer to layer by at least 1 m.

**Longitudinal joints:** Offset joints from layer to layer by at least 150 mm. Position longitudinal joints in the wearing course to coincide with the lane line.

**Edges:** Form exposed edges of each spreader run while hot to a straight line with a dense face inclined between vertical and  $45^\circ$ .

**Cold joints:** Tack coat the surface of cold longitudinal and transverse joint before placing the adjoining asphalt.

#### **Compaction**

**Trimming:** Before commencing compaction, correct any irregularities in line or level. Trim lane edges to a straight line.

**Rolling:** Compact asphalt surfacing uniformly as soon as it will support rollers without undue displacement, and complete rolling while the mix temperature is above  $90^\circ\text{C}$ .

**Density tests:** Perform a field bulk density test for each test site from either of the following:

- On a core sample taken from the asphalt surfacing layer.
- If the nominal layer thickness is  $\geq 50$  mm, measured in situ using a nuclear gauge.

**Sample preparation:** To AS 2891.2.1 and AS 2891.2.2, as applicable.

**Number of tests per lot:** To AS 2150, generally 6 tests per lot for simple/small works.

**Nuclear gauge tests:** To AS/NZS 2891.14.2.

**Density criteria:** In accordance with RTA Specification R116.

### **E14.3.3 COMPLETION**

#### **Rejection**

**Extent:** Remove areas of rejected asphalt surfacing, including defective joints and finish, to the full depth of the layer, and replace with complying pavement.

**Joints:** Treat edges of remedial work as specified for cold joints.

#### **Reinstating adjacent surfaces**

**General:** Reinstating surfaces next to new pavements and associated elements. Where an existing flexible road pavement has been disturbed, trim it back to a straight and undisturbed edge 250 –

300 mm from and parallel to the new concrete for the full depth of the slab. Backfill with asphalt rammed solid, using suitable rammers.

Removal: Disposal of any residual or rejected material to a location off site.

**Traffic on pavement**

General: Give notice before opening the pavement to traffic before the work is completed. Provide protection.

**Junctions with existing pavements**

Trimming: Where the pavement is to be joined to an existing pavement remove a strip of the existing pavement at least 300 mm wide for its full depth and trim the edge to an angle of approximately 45 in steps of maximum height 150 mm before placing new pavement material.

Existing sealed pavement: Trim the seal to a neat edge.

**Finished pavement properties**

Tolerances: Check finished pavement levels, thickness and shape with the **Tolerances table**.

Reject surfaces: Where tolerances are exceeded reject surface.

**E14.3.4 TESTING**

**General**

- Project lot: In accordance with RTA Specification R116.

Tests: Perform tests of the type and frequency necessary to control the materials and processes used in the construction of the works and in conformance with the Tests schedule.

**Process control tests**

Records: Show the results of process control tests on control charts or graphs displayed on site in a readily accessible location and updated daily.

Methods: Use wet preparation methods where applicable.

Sampling: Timing and location to AS 2891.1.1.

**Compliance assessment tests**

Timing: Obtain materials samples at the time of delivery to the site.

Location: Sample from selected sample sites within designated uniform test lots, consisting of an area placed, or compacted or both in one day. Test lots must be uniform in terms of material properties and density.

**E15 SPRAYED BITUMINOUS SURFACING**

**E15.1 GENERAL**

**E15.1.1 RESPONSIBILITIES**

**General**

General: Provide a sprayed bituminous surfacing as follows:

- Free draining and uniformly graded.
- Even and smooth riding.

**E15.1.2 CROSS REFERENCES**

**General**

Requirement: Conform to the following:

- *General requirements.*
- The application of a prime to the prepared pavement prior to the application of a tack coat and asphalt wearing course shall be in accordance with RTA Specification R106.

**E15.1.3 INTERPRETATION**

**Definitions**

General: For the purposes of this worksection the glossary of terms in AS 1348 and the definitions given below apply:

- Absolute level tolerance: Maximum deviation from design levels.
- Relative level tolerance: Maximum deviation from a 3 m straightedge laid on the surface.

**E15.1.4 INSPECTION**

**Notice**

Inspection: Give notice so that inspection may be made of the following:

- Surfaces prepared for priming, sealing or surfacing.
- Commencement of bituminous spraying.

**E15.1.5 SUBMISSIONS**

**Execution**

General: Submit proposals for the methods and equipment used, including the following:

- Staging of the work, access and internal traffic control methods.
- Disposal of surface water, control of erosion, removal of contaminated material and sedimentation control on the site, surrounding areas and drainage systems.
- Methods and equipment for each operation.
- Sources of materials.
- Material stockpiles.

Spraying equipment: Submit a current certificate and calibration chart issued by the State Road Authority.

Hand spraying: If intended, submit proposals.

Spraying operations: Submit proposals for start, finish and width of each spray run.

Bituminous surfacing records: Submit certified records of the works completed in accordance with RTA Specification R106

Records of measurement: Submit certified records of work performed.

**Materials**

General: Submit information including the following:

- Cutback bitumen field mix/proprietary mix.
- Binder proposal.

- Adhesion agent: Proof of previous conformance with test criteria.
- Aggregates: Source.

**Tests**

Compliance assessment: Compliance assessment tests are to be carried out by an independent testing authority. Submit 3 copies of each test result.

Certificate of compliance: A certificate of compliance is acceptable as an alternative to testing a manufactured material. Submit the manufacturer's certificate together with the results of recent tests undertaken by the manufacturer, showing compliance with test criteria.

**E15.1.6 TOLERANCES**

**Finished levels**

General: Provide a finished surface which is free draining and evenly graded between level points.

Edges abutting gutters: Within  $\pm 5$  mm of the level of the actual gutter edge.

**E15.2 PRODUCTS**

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**E15.2.1 BITUMINOUS MATERIALS**

**Material grades**

Bitumen: To AS 2008 Class 170.

Bitumen emulsion: To AS 1160.

Cut back bitumen classification and grading: To AS 2157 and the **Selections**.

Proprietary grades of cutback bitumen: To the manufacturer's specification.

Cutter oil and flux oil: To AS 3568.

**Aggregate precoating materials**

Precoating agent: Provide precoating agents capable of satisfying plate stripping tests.

Allowable percentage of stripping: Less than 10% in accordance with AS 1141.50.

**Measuring bitumen and cutter**

General: Measure by volume at 15°C.

Volume correction factors: Conform to the following for converting volume of bituminous binders

- From 15°C to elevated temperature to AAPA National sprayed sealing specification Table D8, or
- From elevated temperature back to 15°C to AAPA National sprayed sealing specification Table D9.

**E15.2.2 AGGREGATE**

Standard: To AS 2758.2.

Class of aggregate: N/A

Resistance to polishing: N/A

Method of determination of aggregate shape: N/A

Combination of hardness and durability: N/A

**E15.2.3 OTHER MATERIALS**

**Protective paper**

Start, finish and taper operations: Apply heavy duty protective paper of minimum weight 120g/m<sup>2</sup>, and wide enough to prevent over spray.

**Geotextile**

Type: Non woven, needle punched fabric with minimum melting point 165°C and minimum mass 130g/m<sup>2</sup>.

Application: To AUSTRoads AP-T37.

**Tactile ground surface indicators**

Standard: To AS/NZS 1428.4.1.

## **E15.3 EXECUTION**

### **E15.3.1 APPLICATION**

#### **Precoating**

Supply: Precoat aggregates immediately before the aggregate is loaded into the spreader trucks.

7 mm cover aggregate: Precoat at least 48 hours in advance of spreading.

Target application: Apply precoating agent thinly and evenly using a fine pressure spray to a moving stream of aggregate, or by other approved means, so that particles are fully coated but without excess material.

Wet aggregate: If the aggregate is too wet to precoat, or contains enough moisture to cause uneven distribution of the precoating agent, dry the aggregate by turning the stockpile over. Do not precoat aggregate until the moisture has evaporated sufficiently for the precoating agent to adhere evenly.

Target application rate: In the range 4 – 14 L/m<sup>3</sup> of aggregate.

#### **Cutting bitumen**

Temperature: Heat sufficient bitumen for immediate needs only. Do not keep the material at spraying temperature for longer than 10 hours. Do not reheat.

Mixing and heating (on site): Heat the bitumen at a rate not exceeding 40°C/h, and circulate cutback bitumen for 20 minutes to ensure thorough mixing.

Heating devices: Use devices capable of uniform heating without damaging bituminous materials.

#### **Spraying equipment**

Areas not accessible to the mechanical sprayer: Spray using hand spray equipment attached to the mechanical sprayer.

### **E15.3.2 PREPARATION FOR SPRAYING**

#### **Cleaning**

General: Immediately before spraying, remove loose and foreign material on the finished base surface, including dust, debris and sand spread on primed surfaces, until a mosaic of well embedded aggregate shows on the surface. Keep traffic off the cleaned surface.

Method: Use suitable power blowers or power brooms (or using hand methods where inaccessible to the power equipment).

Preconditions: Prime and seal in dry and reasonably calm weather, on a dry pavement surface at a temperature of at least 10°C in accordance with Table D1 AAPA.

#### **Potholes**

General: Trim to a regular shape and a uniform depth of at least 75 mm. Tack coat the sides, and patch with bituminous premix, sanded after completion. Allow sufficient time for the premix to cure before spraying the surface, in accordance with Table DB1 AAPA.

### **E15.3.3 SPRAYING OPERATIONS**

#### **Protection**

General: Protect adjacent surfaces during spraying. Place drip trays under spray bars when the sprayer is stationary. Clean bituminous materials from adjacent surfaces or, if this is not possible, replace and make good the surface. Protect freshly sprayed surfaces from contamination.

Primed surface: Keep traffic off the primed surface for at least 3 days after spraying. If required commence sanding 4 – 24 hours after spraying.

#### **Priming**

General: Prime the granular pavement to achieve and maintain a strong bond between granular surface and pavement treatment seal.

Edges: At underbed edges, extend the primer 150 mm beyond the edge of the seal.

#### **Junctions with existing pavements**

Pavement base: Protect using a suitable temporary seal or primerseal.

#### **Spraying**

General: Completely and uniformly cover the surface to be treated. Prevent the spray overlapping previously treated areas, except that where part-width spraying is used, lap the longitudinal joint between adjacent runs by at least 50 mm.

**Primersealing and sealing**

Process: Allow at least 3 days between priming and sealing and between first and second binder application in double seals. Incorporate the first course of aggregate thoroughly into the binder before a second course is applied.

Spraying temperature ranges:

- Bitumen without cutter: 160°C – 190°C.
- Priming Grade AMC1: 60 °C – 80°C.
- Primerbinder Grade AMC3: 95°C – 115°C.
- Bitumen emulsion binder: Ambient temperature.

**Application rates**

General: To the **Bituminous materials schedule**.

Grade or class: To AS 2157 and AS 1160.

**E15.3.4 PLACING COVER AGGREGATE**

**Placing cover aggregate**

Spreading: Immediately after the binder or primerbinder has been sprayed, cover with a uniform layer of dry aggregate.

Rolling: Immediately after spreading roll and drag broom the area until it is uniformly covered with aggregate thoroughly embedded in the binder. Roll uniformly over the whole area. Complete rolling as soon as possible but not later than 3 days after spraying.

**Steel rolling**

General: Roll using a maximum of two coverages of a steel-wheeled roller of maximum axle load 5 tonne. Discontinue steel rolling if aggregate shows signs of breaking down.

**Pneumatic tyred rolling**

Roller: After steel rolling, roll the area using a pneumatic-tyred roller of minimum mass 10 t and with tyre pressures adjustable in the range 550 – 700 kPa.

Rolling:

- Minimum rate: 4 roller hours per 4500 L of binder or primerbinder sprayed.
- Timing: At least one roller pass within 2 minutes of covering, over the whole of the area. After an initial slow pass increase the speed of rolling to the maximum practicable for the area being sealed. Complete at least 25% of the rolling within 2 hours of covering, and 50% within 24 hours of covering.

**Loose aggregate**

General: When the aggregate has been evenly spread and embedded, remove loose particles remaining on the pavement by sweeping lightly, without disturbing embedded aggregate. Apply additional aggregate to achieve the required surface finish.

**Surface finish**

General: Provide an even, smooth riding and free draining surface to the grades and levels, as documented.

**E15.3.5 DEFECTIVE SURFACING**

**Primer**

Actual rate of application < 90% of that ordered: Make up the deficiency with a second spray run.

Actual rate of application > 110% of that ordered: Cover the surface with sand which is chemically inert and free of salts.

**Binder and primerbinder**

Actual rate of application < 90% or > 110% of that ordered: Reseal the surface.

**Minimum criteria for retention**

Actual rate of application: Between 95 and 105% of the target application rate.

**E15.3.6 COMPLETION**

**Traffic on pavement**

Removal: Dispose of any residual or rejected material off-site.

**Notice: Give notice before opening the pavement to traffic before the work is completed. Provide protection.**

## E16 CONCRETE PAVEMENT

### E16.1 GENERAL

#### E16.1.1 RESPONSIBILITIES

##### General

General: Provide finished surfaces that are:

- Free draining and evenly graded between level points.
- Even and smooth riding.

##### Performance

Conformance: Comply with the local authority in respect of the levels, grades and the minimum details of thickness, reinforcement and concrete strength for pavements within the kerb-and-gutter property boundaries.

Selections: As documented.

##### Design

Coordination: Determine the local authority requirements initially as they may affect grades, transition, zones for the works. Considerations include:

- Drainage.
- Tree's (due to settlement).
- Adjacent structures.

#### E16.1.2 CROSS REFERENCES

##### General

Requirement: Conform to the following:

- *General requirements.*
- *Site management.*
- *Earthwork.*
- *Stormwater – site.*
- *Pavement base and subbase.*
- *Pavement ancillaries.*
- *Concrete finishes.*

#### E16.1.3 STANDARDS

##### Concrete

Specification and supply: To AS 1379.

Materials and construction: To AS 3600.

#### E16.1.4 INTERPRETATION

##### Definitions

General: For the purposes of this worksection the definitions given in AS 1348 and the following apply.

- Levelness: Absolute level tolerance – maximum deviation from design levels.
- Ambient temperature: The air temperature at the time of mixing and placing of concrete, and the predicted or likely air temperature at any time during the 48 hours following concrete placement.
- Concrete class:
  - Normal: Concrete which is specified primarily by a standard compressive strength grade and otherwise in accordance with AS 1379 clause 1.5.3.
  - Special: Concrete which is specified to have certain properties or characteristics different from, or additional to, those of normal-class concrete and otherwise in accordance with AS 1379 clause 1.5.4.
- Early age: A mean compressive strength at 7 days exceeding the values shown in AS 1379 Table 1.2.

- Green concrete: Concrete which has set but not appreciably hardened.
- Flatness: Relative level tolerance – maximum deviation from a 3 m straightedge laid on the surface.
- Weather:
  - Cold: Ambient shade temperature < 10°C.
  - Hot: Ambient shade temperature > 32°C.

#### **E16.1.5 INSPECTION**

##### **Notice**

Inspection: Give notice so that inspection may be made of the following:

- Base or subgrade before covering.
- Membrane or film underlay installed on the base or subgrade.
- Concrete formwork, reinforcement and dowels in position.
- Commencement of concrete placing.
- Completion of concrete placing.
- Evaluation of surface finish.

#### **E16.1.6 TOLERANCES**

##### **General**

Edges abutting gutters: Within  $\pm 5$  mm of the level of the actual gutter edge.

Rigid pavement surface:

- Absolute tolerance: + 10 mm, - 0 mm.
- Relative tolerance:  $\pm 5$  mm.

Joint locations in plan (rigid pavement):  $\pm 15$  mm.

#### **E16.1.7 SUBMISSIONS**

##### **Products**

Compliance certificate: As an alternative to testing a product, submit the manufacturer's certificate together with the results of recent tests undertaken by the manufacturer, showing compliance with test criteria.

Aggregates: Nominate the source for all aggregates proposed.

Reinforcement: Submit the manufacturer's certificate of compliance with AS/NZS 4671, or submit test certificates from an independent testing authority.

Liquid curing compounds: Submit certified test results, including the application rate and the efficiency index to AS 3799 Appendix B.

Curing by covering: Submit details of the proposed covering material.

Repair materials: Submit proposals for epoxy resin/grout and elastomeric sealant.

Concrete: Submit the concrete supply delivery dockets.

Subcontractors: Submit names and contact details of proposed pre-mixed concrete suppliers, and alternative source of supply in the event of breakdown of pre-mixed or site mixed supply.

Trial mix design report: Six weeks before commencing production, submit a report for each mix design containing the information required in AS 1012.2, the individual and combined aggregate particle size distribution, and the records and reports for the tests.

##### **Execution**

Work method statements: Submit proposals for the methods and equipment to be used for the pavement works, including the following:

- Staging of the work, access and traffic control methods.
- Disposal of surface water, control of erosion, contamination and sedimentation of the site, surrounding areas and drainage systems.
- Methods and equipment for each operation.
- Sources of materials.
- Material stockpiles.
- Methods of concrete manufacture.

- Temperature control, curing and protection methods for concrete.

Mix design variation: If a variation is proposed, submit a further mix design report.

Concrete: Submit proposals for mixing, placing, finishing and curing concrete including the following:

- Addition of water at the site.
- Changes to the plastic concrete mix.
- Curing and protection methods.
- Cutting or displacing reinforcement, or cutting hardened concrete.
- Handling, placing, compaction and finishing methods and equipment, including pumping.
- Sequence and times for concrete pours, and construction joint locations and relocations.

Cores, fixings and embedded items: If required, submit shop drawings showing the proposed locations, clearances and cover, and indicate any proposed repositioning of reinforcement.

Cutting or coring: If cutting or coring of hardened concrete is proposed, provide details.

Sawn joints: Submit proposed methods, timing and sequence of sawing joints.

Damaged galvanizing: If repair is required, submit proposals to AS/NZS 4680 Section 8.

Splicing: If splicing not documented is proposed, submit details.

Welding: If welding of reinforcement is proposed, provide details and give notice before welding reinforcement.

Joint sealants: Submit proposals for installation methods and sealant performance.

Concrete placing: Submit proposals for size of the area to be placed and the spacing of planned construction joints before placement commences.

Crack assessment: If unplanned cracks occur in the finished pavement, submit proposals for investigation.

Surface repair method: If required, submit details of the proposed method before commencing repairs.

Trial section: Submit trial pavement.

### Testing

Test certificates and records: Submit test certificates, and also retain results on site.

## E16.2 PRODUCTS

### E16.2.1 REINFORCEMENT

#### General

- Steel reinforcement: Steel bars or mesh to AS/NZS 4671.
- Ductility class: L or N.

Identification: Supply reinforcement which is readily identifiable as to grade and origin.

Reinforcement and joint requirements: in accordance with the Drawings.

Surface condition: Free of loose mill scale, rust, oil, grease, mud or other material which would reduce the bond between the reinforcement and concrete.

#### Protective coatings

Protective coating: Coatings to reinforcement must not reduce the performance of the reinforcement. Do not galvanize reinforcement steel. For pavements containing protective coated reinforcement, provide the same coating type to all reinforcement and embedded ferrous metal items, including tie wires, stools, spacers, stirrups, plates and ferrules.

Epoxy coating: Provide high build, high solids chemically resistant coating.

- Thickness: 200  $\mu\text{m}$  minimum.

#### Steel fibres

Fibre reinforcement: Reference CIA CPN35.

Steel fibre content: 75  $\text{kg}/\text{m}^3$ .

#### Accessories

Bar chairs: Use plastic tipped wire bar chairs.

Tie wire: Galvanized annealed steel 1.25 mm diameter (minimum).

**Dowels**

General: Provide each dowel in one piece, straight, cut accurately to length with ends square and free from burrs.

Standard: To AS/NZS 4671.

Grade: 250R steel bars 450 mm long.

Diameter: in accordance with the Drawings

End tolerances: Ensure that deformation of an end from its true circular shape does not exceed 1 mm nor extend more than 1 mm from the end.

**Tie bars**

Type: Deformed bar, 12 mm diameter, grade 500N, 1 m long.

**E16.2.2 AGGREGATE****Characteristics**

Standards: AS 2758.1.

Quality: Provide at least 40% by mass of the total aggregates in the concrete mix of quartz sand aggregate having a nominal size of < 5 mm and containing at least 70% quartz by mass.

Durability: All constituent, fraction of constituent or aggregates to conform to AS 1141.22 and the following:

- Wet strength not less than 80 kN.
- 10% Fines Wet/Dry Variation not to exceed 35%.

Recycled concrete aggregate (RCA): Use coarse aggregates from demolition concrete or RCA.

Blending: If blending coarse RCA with natural aggregates ensure substitution rates are below 30%.

Slipform grading requirements: For concrete mixes proposed for slipforming, conform to the Combined aggregate grading table for the combined total aggregates proportion by mass passing the Australian Standard sieves.

**Combined aggregate grading table**

Australian Standard sieve	% passing by mass of sample
19.00 mm	95–100
9.50 mm	55–75
4.75 mm	36–48
2.36 mm	30–42
1.18 mm	22–34
600 µm	16–27
300 µm	5–12
150 µm	0–3
75 µm	0–2

**E16.2.3 CEMENT****Standard**

GP Portland cement: To AS 3972.

Transport: Cement in watertight packaging and protect from moisture until used. Do not use caked or lumpy cement.

- Age: Less than 6 months old.
- Storage: Store cement bags under cover and above ground.

**E16.2.4 FLY ASH****General**

Standard: Fine grade fly ash to AS 3582.1.

Fly ash quantity: Nil to 70 kg/m<sup>3</sup>.

Minimum binder content (fly ash plus cement): 300 to 330 kg/m<sup>3</sup>.

## E16.2.5 WATER

### General

Standard: Chloride ion to AS 3583.13 and sulphate ion to AS 1289.4.2.1.

Quality: Water used in the production of concrete to be potable, free from materials harmful to concrete or reinforcement, and be neither salty nor brackish.

Limits: Not containing more than:

- 600 parts per million of chloride ion, as determined to AS 3583.13.
- 400 parts per million of sulphate ion, as determined to AS 1289.4.2.1.

## E16.2.6 ADMIXTURES

### General

Standard: Chemical admixtures to AS 1478.1.

Quality: Provide admixtures free from calcium chloride, calcium formate, or triethanolamine or any other accelerator. Do not use admixtures or combinations of admixtures without prior written approval.

Dosage: Vary the dosage of chemical admixture to account for air temperature and setting time in accordance with the manufacturer's recommendations.

### Types of admixtures

Air entraining agent: Adjust mix for workability allowing up to 5% air entrainment.

Warm season retarder: During the warm season, (October to March inclusive), use a lignin or lignin-based ('ligpol') set-retarding admixture (Type Re or Type WRRe) as approved to control slump within the limits stated in Concrete mix, properties.

Cool season retarder: During the cool season, (April to September inclusive), use only a lignin or lignin based set-retarding admixture containing not more than 6% reducing sugars (Type WRRe complying with AS 1478.1).

## E16.2.7 CURING COMPOUNDS

### General

Curing compounds: To AS 3799 and AS 1160, Type 2, white pigmented or containing aluminium reflective pigments.

Covering with sheet materials: To ASTM C171, white opaque or clear polyethylene film, or white burlap-polyethylene sheet, or equivalent material.

## E16.2.8 OTHER MATERIALS

### Tactile ground surface indicators

Standard: To AS 1428.4.

## E16.3 EXECUTION

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### E16.3.1 SUBGRADE

#### Preparation

Conformance: Prepare subgrade in accordance with the *Earthwork* worksection.

Extent: Prepare a uniform subgrade for the full pavement formation, extending at least to the back of kerbs.

Reinstatement: Ensure uniformity for backfilling of any utility trenches.

### E16.3.2 SUBBASE

#### Thickness

Subbase thickness: in accordance with the Drawings.

#### Width

Subbase width: Extend the subbase at its full depth to at least the back of kerbs or other edge stops before their installation.

No integral kerbs: Extend granular unbound subbase at least 300 mm beyond each side of the carriageway.

Unbound subbase materials and installation: Conform to *Pavement base and subbase* worksection.

Bound subbase materials and installation: Conform to the *Pavement base and subbase* worksection.

#### **Tolerance and friction reduction**

Tolerance: Subbase finished surface level + 0 mm to – 10 mm to ensure full base layer is cast.

Friction reduction: Provide 0.2 mm thick polyethylene sheeting with 200 mm taped minimum laps and/or a 20 mm thick layer of sand (silt and clay material < 5%) directly beneath the concrete pavement.

#### **E16.3.3 TRIAL PAVEMENT**

Trial pavement: Demonstrate by placing a test section that the proposed method of placement will produce a conforming pavement. Remove test sections which do not comply with requirements and dispose of as directed.

Minimum area of test section: N/A

Location: N/A

#### **E16.3.4 CONCRETE MIX**

##### **Standard**

Concrete mix and supply: To AS 3600 Section 17 and AS 1379.

##### **Properties**

Concrete pavement thickness: in accordance with the Drawings

Concrete pavement strength: in accordance with the Drawings

Workability: Slump values to conform with the following:

- Fixed form paving with manual operated vibration: 50 – 60 mm.
- For slip form with no side forms: 30 – 50 mm.
- Drying shrinkage: Maximum 450 µε after 21 days of air drying.

##### **Special class concrete additional properties**

Colour: N/A

Aggregates: N/A

Cement colour: N/A

##### **Elapsed delivery time**

General: Ensure that the elapsed time between the wetting of the mix and the discharge of the mix at the site is in conformance with the Elapsed delivery time table. Do not discharge at ambient temperature below 10°C or above 30°C.

##### **Elapsed delivery time table**

Concrete temperature at time of discharge (°C)	Maximum elapsed time (hours)
10 – 24	2.00
24 – 27	1.50
27 – 30	1.00
30 – 32	0.75

##### **Site mixed supply**

Emergencies: If mixing by hand is carried out, provide details.

Plant: Mix concrete in a plant located on the construction site.

##### **Pre-mixed supply**

Addition of water: Do not add water.

Transport: Make sure that the mode of transport prevents segregation, loss of material and contamination of the environment, and does not adversely affect placing or compaction.

Concrete delivery docket: For each batch, submit a docket listing the information required by AS 1379 clause 1.7.3, and the following information:

- Any binders or additives.
- Method of placement and climate conditions during pour.
- Name of concrete delivery supervisor.

- The concrete element or part of the works for which the concrete was ordered, and where it was placed.

### E16.3.5 TESTING

#### Standards

Sampling, identification, testing and recording: To AS 1012.

Specimens: Sample the concrete on site, at the point of discharge from the agitator.

Type and frequency: Conform to AS 1379.

Sampling frequency: To the **Project assessment sampling table**.

Test authority: Concrete supplier or NATA registered laboratory.

#### Concrete testing methods

Slump: Test at least one sample from each batch before placing concrete from that batch in the work.

- Standard: To AS 1012.3.1.
- Maximum slump variation:  $\pm 10$  mm.

Compressive strength: Test to AS 1012.8.1.

Drying shrinkage: Test to AS 1012.13.

Flexural strength: To AS 1012.8.2 and AS 1012.11.

#### Project assessment sampling table

Number of batches for each type and grade of concrete per day	Minimum number of samples
1	1
2-5	2
6-10	3
11-20	4
each additional 10	1 additional

Acceptance criterion: The average strength of any set of 3 consecutive project samples must be equal to or greater than the specified minimum value.

### E16.3.6 INSTALLATION

#### Junctions with existing pavements

Trimming: Where the pavement is to be joined to an existing pavement remove a strip of the existing pavement at least 300 mm wide for its full depth and trim the edge vertically before placing new pavement material.

Existing sealed pavement: Trim the seal to a neat edge.

#### Fixed formwork

Description:

- Steel forms.
- Seasoned, dressed timber planks, free of warps, bends or kinks, with the full width of their top edges covered with steel angle sections finishing flush with the form face.

Depth: Equal to the edge thickness of the slab and in one piece.

Tolerances on position:

- Absolute level tolerance:  $\pm 5$  mm (maximum departure of top surface from the required level).
- Relative level tolerance:  $\pm 5$  mm (maximum departure of top surface from a 3 m straightedge).
- Horizontal tolerance:  $\pm 10$  mm (maximum departure of face from a plane surface).
- Verticality: 3 mm departure from vertical.

Staking: Stake forms in position using at least 3 steel stakes per form, not more than 1.5 m apart. Lock joints between form sections to prevent movement.

Release agent: Before placing reinforcement, apply a release agent compatible with the contact surfaces, to the interior of the formwork, except where the concrete is to receive an applied finish for which there is no compatible release agent. Clean the reinforcement to remove all traces of release agent.

Re-use: Clean and recoat the forms each time before placing concrete.

Keyways: Form the keyways of keyed construction joints using steel form strips accurately located at the mid-depth of the slab and securely fastened flush against the formwork face.

### Reinforcement

Tolerances in fabrication and fixing: To AS 3600.

Locate reinforcement: Place reinforcement in the top half of the pavement.

Minimum cover to reinforcement: 30 mm.

Splicing mesh: Overlap a minimum of 2 crosswires.

Supports: Provide proprietary concrete, metal or plastic supports to reinforcement in the form of chairs, spacers, stools, hangers and ties, as follows:

- To withstand construction and traffic loads and maintain the concrete cover, as documented.
- With a protective coating if they are ferrous metal extending to the surface of the concrete, or are used with galvanized or zinc-coated reinforcement.
- Minimum spacing:
  - . Bars:  $\leq 60$  diameters.
  - . Fabric:  $\leq 800$  mm.
- Supports over membranes: Prevent damage to waterproofing membranes or vapour barriers. If appropriate, place a metal or plastic plate under each support.
- Projecting reinforcement: If 'starter' or other bars project beyond reinforcement mats or cages, through formwork or from cast concrete, provide a plastic protective cap to each bar until it is incorporated into subsequent work.
- Tying: Secure the reinforcement against displacement by tying at intersections with either wire ties, or clips. Bend the ends of wire ties away from nearby faces of forms so that the ties do not project into the concrete cover.
- Mats: For bar reinforcement in the form of a mat, secure each bar at alternate intersections.

### Cores, fixings and embedded items

Position: Fix cores and embedded items to prevent movement during concrete placing. In locating cores, fixings and embedded items, reposition but do not cut reinforcement, and maintain cover to reinforcement.

Isolation: Isolate embedded items so that water cannot track to concrete providing minimum cover to reinforcement.

## E16.3.7 CONCRETE PLACING AND COMPACTION

### Concrete placing

General: Place concrete uniformly over the width of the slab or lane and so that the face is generally vertical and normal to the direction of placing. Hand spread concrete using shovels, not rakes.

Remove: Any water ponding on the ground.

Placing sequence: Commence from one corner (usually the lowest point) and proceed continuously out from that point.

Weather: Do not place concrete in temperatures above 30°C or below 10°C without adequate precautions.

### Compaction

Thickness 100 mm or less: Compaction through placing screeding and finishing processes. If required use a hand-held vibrating screed at the surface. Do not use immersion vibrators.

Thickness > 100 mm and downturns: Use an immersion vibrator.

### Placing records

General: Keep on site and make available for inspection a log book recording each placement of concrete, including the following:

- Date of concrete placement.
- Delivery docket noting the specified grade and source of concrete.
- Slump measurements to AS 1012.3.1.
- The portion of work.
- Volume placed.

**Rain**

General: During placement and before setting, do not expose concrete to rain.

Protection: Protect surface from damage by covering until hardened.

**Concrete placing in cold weather**

Cement: Do not use high alumina cement.

Placing concrete: Maintain the temperature of the freshly mixed concrete at 5°C.

Formwork and reinforcement: Before and during placing maintain temperature at 5°C.

Severe weather: If severe weather conditions are predicted, use high early strength cement.

Temperature control: Heat the concrete materials, other than cement, to the minimum temperature necessary to ensure that the temperature of the placed concrete is within the limits specified.

Admixtures: Do not use calcium chloride, salts, chemicals or other material in the mix to lower the freezing point of the concrete.

Frozen materials: Do not allow frozen materials or materials containing ice to enter the mixer, and keep free of frost and ice any forms, materials, and equipment coming in contact with the concrete.

Maximum temperature of water: 60°C when it is placed in the mixer.

Plastic concrete: Prevent plastic concrete from freezing, without using salts or chemicals.

**Concrete placing in hot weather**

Handling: Prevent premature stiffening of the fresh mix and reduce water absorption and evaporation losses. Mix, transport, place and compact the concrete in conformance with the **Elapsed delivery time table**.

Placing concrete: Maintain the temperature of the freshly mixed concrete in conformance with the **Hot weather placing table**.

Formwork and reinforcement: Before and during placing maintain temperature at 35°C.

Severe weather: If ambient shade temperature > 38°C, do not mix concrete.

Temperature control: Select one or more of the following methods of maintaining the specified temperature of the placed concrete:

- Cool the concrete using liquid nitrogen injection before placing.
- Cover the container in which the concrete is transported to the forms.
- Spray the coarse aggregate using cold water before mixing.
- Use chilled mixing water.

**Hot weather placing table**

Concrete element	Temperature limit
Normal concrete in footings, beams, columns, walls and slabs	35°C
Concrete in sections $\geq 1$ m in all dimensions except for concrete of strength 40 Mpa or greater, in sections exceeding 600 mm in thickness	27°C

Evaporation control barriers: Erect barriers to protect freshly placed concrete from drying winds.

**E16.3.8 CONCRETE PRIMARY FINISH****General**

Finishing: Do not commence finishing until all bleed water has evaporated from the surface.

Commence: Immediately after placement and spreading and compaction of the plastic concrete, start finishing operations to achieve the documented finish.

Finish: Brushed

**Unformed surfaces**

General: Strike off, screed and level slab surfaces to finished levels, to the tolerance class and finish noted in the Unformed surface finishes schedule.

**Formed surfaces**

Damage: Do not damage concrete works through premature removal of formwork.

Curing: If forms are stripped when concrete is at an age less than the minimum curing period, commence curing exposed faces as soon as the stripping is completed.

### E16.3.9 CONCRETE CURING

#### General

Curing: Commence curing as soon as possible after finishing and extend for a minimum period of 3 days.

End of curing period: Prevent rapid drying out at the end of the curing period.

Protection: Maintain at a reasonably constant temperature with minimum moisture loss, during the curing period.

#### Cold weather curing

General: Maintain concrete temperature between 10 – 20°C for curing period.

#### Hot weather curing

Curing compounds: If it is proposed to use curing compounds, provide details.

Protection: Select a protection method as applicable.

- If the concrete temperature exceeds 25°C or if not protected against drying winds, protect the concrete using a fog spray application of aliphatic alcohol evaporation retardant.
- If ambient shade temperature is > 35°C, protect from wind and sun using an evaporative retarder until curing is commenced.
- Immediately after finishing, either cover exposed surfaces using an impervious membrane or hessian kept wet until curing begins, or apply a curing compound.

#### Curing methods

Covering sheet method: Immediately after finishing operations cover concrete using damp hessian or cotton mats overlapped at least 150 mm and anchored against displacement by wind or other interference. Keep the mats continuously damp until covered by the covering sheet material. Repair tears immediately.

Moist curing method: Immediately after finishing operations and once concrete has set sufficiently to be not damaged by the curing process keep the concrete surface continuously damp by ponding or spraying constantly with water, fog, or mist, using suitable spraying equipment. Continue wetting for the curing period.

Self levelling toppings: To AS 3799, if also used for curing.

Coloured concrete: Do not cure with plastic sheeting, damp sand or wet hessian. Use only chemical curing compounds compatible with the sealer or simply use a sealer (It must then comply with the requirements of a chemical compound sealer).

#### Curing compound

Application: Provide a uniform continuous flexible coating to AS 3799 without visible breaks or pinholes. Ensure coating remains unbroken at least for the required curing period after application. Respray defective areas within 30 minutes. Respray within 3 hours after heavy rain.

### E16.3.10 JOINTS

#### General

General: Construct expansion, contraction and construction joints straight and plumb. Make transverse joints normal to longitudinal joints. Extend transverse expansion and contraction joints continuously from edge to edge of the pavement through interconnected slabs.

Joint layout: Install joints as documented.

Joint spacings: in accordance with the Drawings

Joint widths: in accordance with the Drawings

#### Contraction joints

Installation: Construct transverse and longitudinal contraction joints by early age power sawing or by placing an insert in the fresh concrete.

#### Dowelled joints

Dowelled contraction joint: Place dowels at 300 mm centres orthogonal to the joint direction and parallel to the pavement surface, accurate alignment is critical, ensure proper field supervision.

Dowel assembly: Use a dowel-assembly support frame firmly secured to the subbase during concrete placement. Prevent the dowel assembly support frame from passing through the joint. Do not insert dowels during the placement of concrete.

Debond dowel: Coat with a debonding coating to 0.5 length + 25 mm. Embed the unpainted half of the dowels in the slab placed first.

Movement: Do not distort or displace beyond the alignment tolerances under testing or during construction. Do not remove and replace dowels in pre-formed holes.

#### **Tie bar joints**

Longitudinal contraction joints: Place tie bars at 800 mm centres. Alignment accuracy of tie bars is not critical.

#### **Construction joints**

Installation: Place header board on the subbase or subgrade at right angles to the pavement centre line.

- Planned location: Terminate each day's placing operation at a transverse construction joint located to coincide with a planned contraction or expansion joint.
- Unplanned joints: If placement is interrupted for 30 minutes or longer, form a tied transverse construction joint within the middle third of the distance between planned joints but no closer than 1.5 m to the nearest planned joint. If necessary remove placed concrete back to the required location.

#### **Expansion joints**

Expansion joints: Provide formed full depth joints around structures and features which project through, into or against the pavement, and elsewhere as required.

Doweled expansion joints: Cap dowels at one end with a compressible material.

#### **Formed joints**

Full depth joints: Form the edge of the concrete placed first to provide a smooth, vertical face. After stripping and cleaning fix the joint filler with a suitable waterproof adhesive to the face of the slab, and place the adjoining concrete after the adhesive has set.

Weakened plane joint: Cut a crack-inducing groove by using a suitable tool into the plastic concrete during finishing of the concrete surface. Compact and refinish the plastic concrete around the groove after forming the joint.

Rebated groove joints: Form the rebate by securely fixing removable steel or timber form strips to the form or forms on the slab which is placed first, so that the top of the steel strip is flush with the top of the form. After stripping and cleaning, fix the joint filler in the rebate after placing the adjoining concrete.

#### **Sawn joints**

Weakened plane joint: Saw the hardened concrete to depth at least  $\frac{1}{4}$  to  $\frac{1}{3}$  of the pavement thickness and to a uniform width in the range of 3 – 5 mm as follows:

- Timing: Commence sawing, regardless of time or weather conditions, as soon as the concrete has hardened sufficiently to permit cutting with only minor raveling of the edges of the saw cut. Complete sawing no later than 24 hours after concrete placement.
- Sequence: If possible, saw every third transverse joint initially, then saw the intermediate joints. Start where concrete placement has commenced.
- Cracking: If the concrete has already cracked near the location chosen for a joint, do not saw a joint in that location. If a crack develops ahead of the saw cut, discontinue sawing and submit proposals for extra sawn joints. If uncontrolled cracking occurs, suspend concrete placing.
- Stand-by machines: Provide one stand-by sawing machine for each machine planned to be used.
- Cleaning and protection: Immediately after each joint is sawn, flush the saw cut and adjacent concrete surface using water, until the waste from sawing is removed from the joint. Temporarily caulk the joint using plastic or rubber tubing, or a suitable 'Tee' shaped extrusion. Leave the caulking in place until grooving and sealing.

Rebated groove joints: Saw straight, parallel sided grooves for joint seals on top of and centred on the sawn weakened plane joints.

- Timing: Commence sawing after the curing period has ended, immediately before joint sealing. Saw during daylight hours.

Protection: Where there is a time elapse after sawing and before joint sealing, install a thin-spined rubber strip with a free width slightly larger than the saw cut at the bottom of the saw cut after washing slurry from sawn groove to temporarily prevent ingress of solid material.

### Preparing joints

Stripping time: At least 12 hours.

Clean: Immediately before installation of the sealer ensure that the joint space is dry, clean and free from loose material. Remove laitance, curing compound and protrusions of hardened concrete from the sides and upper edges of the joint.

### Joint sealing

Install backer rod: Install backer rod of closed cell polyethylene strip to the bottom of the sealant groove.

Sealant installation: Use a field moulded sealant gunned into the joint above the backing rod in a semi-liquid form.

Sealant type: Silicone sealant, in accordance with manufacturer's recommendations.

## E16.3.11 SURFACE SEALERS

Thoroughly clean the surface of all concrete before the application of finishes. Remove formwork wax, heavy duty polymer finishes and clear resin sealers etc using a seal stripper.

Transparent acrylic resin sealer, resistant to ultraviolet rays, suitable for exterior or interior applications, rendering the surface impervious to stains of oils, grease, water and acids, non-yellowing, non-discolouring to the base surfaces, cut with a combination of hydrocarbon solvents to give good penetration into the surface.

Total solids: At least 14%.

### Surface hardeners

Suitable for cementitious toppings or as laid surfaces. Apply to clean surfaces. Do not apply to non-slip topping.

Sealer: Apply surface sealer after the curing period and when concrete has dried to allow the sealer to penetrate into the concrete surface.

Curing sealer compound: If using the sealer as a curing compound, apply directly after finishing.

### Concrete finishes

Conform to: *Concrete finishes* worksection.

### Surface repairs

Surface repair method: If surface repairs are required, submit proposals.

## E16.3.12 COMPLETION

### Protection

General: Keep traffic, including construction plant, off the pavement entirely during curing, and thereafter permit access only to necessary construction plant vehicles that conform to the predetermined load limits appropriate to the use of the concrete.

### Reinstating adjacent surfaces

General: Reinstate surfaces next to new pavements and associated elements. Where an existing flexible road pavement has been disturbed, trim it back to a straight and undisturbed edge 250 – 300 mm from and parallel to the new concrete for the full depth of the slab. Backfill with asphalt rammed solid, using suitable rammers.

### Traffic on pavement

General: Give notice before opening the pavement to traffic before the work is completed. Provide protection.

### Testing

Concrete pavement: Check tolerance criteria for flatness and levelness. Where pavement does not conform submit rectification proposal.

Unplanned cracking:

- 0.3 mm wide crack is acceptable.
- > 1 mm must be assessed, submit a proposal for possible cause and rectification processes.

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**E16.4 SELECTIONS**

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**E16.4.1 SCHEDULE**

**Unformed surface finishes schedule**  
Refer to the Schedule of Finishes

## E17 SEGMENTAL PAVERS

### E17.1 GENERAL

#### E17.1.1 RESPONSIBILITIES

##### General

General: Supply and install external paving:

- Consistent in colour and finish.
- Firmly bonded to substrates for the expected life of the installation.
- Resistant to expected impacts in use.
- Set out with joints accurately aligned in both directions.
- To direct all water flowing from supply points to drainage outlets without leakage to the substrate or adjacent areas.

Selections: Conform to the **Selections**.

#### E17.1.2 CROSS REFERENCES

##### General

Requirement: Conform to the following:

- *General requirements.*
- *Landscaping specification*
- *Stormwater – site.*

#### E17.1.3 INTERPRETATION

##### Definitions

General: For the purposes of this worksection the definitions given below apply.

- Adhesives:
  - . Cementitious I: Adhesives in which the binders are hydraulic, e.g. Portland cement, with aggregates and organic additives.
  - . Dispersion (D): Adhesives in which the binders are in the form of aqueous polymer dispersion with mineral fillers and organic additives.
  - . Reaction resin I: Adhesives in which the binders are synthetic resins with mineral fillers and organic additives. The curing occurs by chemical reaction.
- Substrates: The surface to which a material or product is applied.
- Bedding: Mixtures of materials which are applied to substrates in a plastic state and dry and cure to adhere tiles to substrates.
  - . Adhesive bedding: Tiling adhered by adhesives.
  - . Mortar bedding: Tiling adhered in a cementitious mortar bed.
- Pavers: Slabs made from clays, stone, precast concrete and/or other inorganic raw materials generally over 20 mm thick used as coverings for floors and supported over continuous substrates.
  - . Terrazzo tiles – cementitious: Manufactured cementitious terrazzo tiles formed in a suitable machine to give sufficient compaction and density to the finished surface, and moisture cured before grinding and honed at the place of manufacture. Thickness usually 35 mm.
- Lippage: Height deviation between adjacent pavers.

#### E17.1.4 INSPECTION

##### Notice

Inspection: Give notice so that inspection may be made of the following:

- Substrate immediately before paving.
- Trial set-outs before execution.
- Control joints before sealing and grouting.

### **E17.1.5 STANDARDS**

#### **Slip resistance**

Classification: To AS/NZS 4586 for the classifications as documented.

Slip resistance measurement of existing installations: To AS/NZS 4663.

#### **Testing authority**

General: Independent third party Registered testing authority.

### **E17.1.6 SUBMISSIONS**

#### **Samples**

General: Submit labelled samples of pavers, grout and sealants, illustrating the range of variation in colour and finish.

#### **Sample panels**

General: Prepare a sample panel of each type of finish as follows:

- Size: As noted in the Samples Schedule.
- Include samples of junction details and trim.
- Preserve each panel until related work is complete.

The sample panel shall be the benchmark of quality of execution for the project.

#### **Sample schedule**

Provide a 3m long sample of the platform edge, including coping, yellow warning pavers and tactile indicators.

#### **Execution**

Grouting: Submit proposals for grouting methods and materials.

Margins: If it appears that minor variations in joint widths or overall dimensions will avoid cut pavers, submit a proposal.

### **E17.1.7 TESTS**

#### **General**

Type tests: Submit as follows:

- Slip resistance to AS/NZS 4586: R11
- Field tests of completed pavement: Slip resistance to AS/NZS 4663.
- Program: Conduct field tests immediately before the date of practical completion.

Flood tests: Submit a report of flood tests conducted on site as follows.

Salt efflorescence: Provide prototype testing of cementitious tiles for salt efflorescence.

Luminance contrast test on:

- Stair nosing to stair paving
- Each type of tactile tiles vs PV-1 and PV-2

#### **Slip resistance**

Carry out slip resistance tests on all types of paving. Tests shall be carried out on loose tile samples with sealer, on sample installation, on Stair installation and on concourse and platform installation.

### **E17.1.8 PRODUCT CONFORMITY**

#### **General**

General: Submit current assessments of conformity as follows:

- Declaration of conformity by an ISO 9001 quality management system certified supplier:
  - . Slip resistance of tiles to AS/NZS 4586.
  - . Marking and Classification of tile adhesive to AS 4992.1.

### **E17.1.9 TOLERANCES**

#### **Completed paving**

Paving units must have the surfaces of adjacent units align to within 5mm.

Horizontal and vertical joint alignment tolerances are not to exceed 5mm.

General: Conform to the **Surface level tolerances table**:

Lippage:

- Unpolished pavers: < 2 mm.
- Polished pavers 300 x 300 mm or less: < 1 mm, with 5% not exceeding 1.5%.
- Polished pavers over 300 x 300 mm: < 1.5 mm, with 5% not exceeding 2%.

## **E17.2 PRODUCTS**

### **E17.2.1 ADHESIVES**

#### **General**

Standard: To AS 2358 or AS 4992.1.

#### **Type**

General: Provide adhesives compatible with the materials and surfaces to be adhered.

Prohibited uses: Do not provide the following combinations:

- Organic PVC-based adhesives and organic natural rubber latex adhesives in damp or wet conditions.
- PVA (polyvinyl acetate) based adhesives in wet areas or externally.

### **E17.2.2 MORTAR**

#### **Materials**

Cement: To AS 3972.

- Type: GP or GB.
- White cement: Iron salts content  $\leq$  1%.
- Off-white cement: Iron salts content  $\leq$  2.5%.

Lime: To AS 1672.1.

Sand: Fine aggregate with a low clay content selected for grading, sharp and free from efflorescing salts.

Water: To the recommendations of AS 3958.1.

Measurement of volume: Measure binders and sand by volume using buckets or boxes. Do not allow sand to bulk by absorption of water.

#### **Bedding mortar**

Proportioning: Select proportions from the range 1 cement:3 sand – 1 cement:4 sand to obtain satisfactory adhesion. Provide minimum water.

Mixing: To AS 3958.1.

Gauging: Site gauged by volume.

### **E17.2.3 GROUT**

#### **Type**

Cement based proprietary grout: Mix with water. Fine sand may be added as a filler in wider joints.

Portland cement based grout: Mix with fine sand. Provide minimum water to achieve workability.

- For joints < 3 mm: 1 cement:2 sand.
- For joints  $\geq$  3 mm: 1 cement:3 sand.

#### **Pigments**

Pigments for coloured grout: Provide colourfast pigments compatible with the grout material. For cement-based grouts, provide inorganic mineral pigments or lime-proof synthetic metallic oxides compatible with cement.

#### **Water**

General: Clean and free from any deleterious matter.

Grout to resin terrazzo tiles: Resinous material supplied by the tile supplier.

### **E17.2.4 PAVERS**

#### **Standard**

Masonry units, pavers and flags: To AS/NZS 4455.2.

Salt attack resistance grade to: AS/NZS 4455.1 Table 2.3: Exposure grade

### **E17.2.5 OTHER MATERIALS**

#### **Tactile ground surface indicators**

Standard: To AS/NZS 1428.4.1.

### **E17.3 EXECUTION**

#### **E17.3.1 SUBSTRATES**

##### **Drying and shrinkage**

General: Before paving, allow at least the following times to elapse (for curing and initial shrinkage) for these substrates:

- Concrete slabs: 28 days.
- Toppings on slabs: A further 21 days.

#### **E17.3.2 PREPARATION**

##### **Trial set-out**

General: Prepare a trial paving set-out to each area as follows to:

- Maximise the size of equal margins of cut pavers.
- Locate control joints.
- Note minor variations in joint widths to eliminate cut tiles at margins.

##### **Ambient temperature**

General: If the ambient temperature is  $< 5$  or  $> 35^{\circ}\text{C}$ , do not lay pavers.

##### **Substrates**

General: Ensure substrates are as follows:

- Clean and free of any deposit or finish which may impair adhesion or location of pavers.
- Excessive projections are hacked off and voids and hollows are filled with a cement:sand mix not stronger than the substrate nor weaker than the bedding.

Absorbent substrates: If suction is excessive, control it by dampening but avoid over-wetting and do not apply mortar bedding to substrates showing surface moisture.

Concrete: If not sufficiently rough to provide a mechanical key, roughen by scabbling or the like to remove 3 mm of the surface and expose the aggregate; then apply a bonding treatment.

##### **Fixtures**

General: Before paving ensure that fixtures interrupting the surface are accurately positioned in their designed or optimum locations relative to the paving layout.

#### **E17.3.3 PAVING GENERALLY**

##### **Variations**

General: If necessary, distribute variations in hue, colour, or pattern uniformly, by mixing pavers or paving batches before laying.

##### **Paving joints**

Joint widths: Set out pavers to give uniform joint widths of 6 to 12 mm.

##### **Margins**

General: Provide whole or purpose-made pavers at margins where practicable, otherwise set out to give equal margins of cut pavers. If margins less than half paver width are unavoidable, locate the cut pavers where they are least conspicuous.

##### **Protection**

Traffic: Keep pedestrian and vehicular traffic off paving until the bedding has set and attained its working strength.

Cleaning: Keep the work clean as it proceeds and protect finished work from damage.

**E17.3.4 MORTAR BEDDING****Preparation of pavers**

Suction: Soak porous pavers in water for half an hour and then drain until the surface water has disappeared.

**Bedding**

General: Use bedding methods and materials which are appropriate to the paver, the substrate, the conditions of service, and which leave the paver firmly and solidly bedded in the bedding material and adhered to the substrate. Form falls integral with the substrate.

**Mortar beds**

Substrate preparation: Either lightly dust the screeded bed surface with dry cement and trowel level until the cement is damp, or spread a thin slurry of neat cement, or cement-based thin bed adhesive, on to the tile back. Do not provide mortar after initial set has occurred.

**Sealer**

Sealer to paving shall be Sure Seal sure sealer 24/7 Stone impregnator in a clear finish.

**E17.3.5 MOVEMENT JOINTS****General**

General: Provide control joints as follows:

- Location:
  - . Over structural control joints.
  - . At internal corners.
  - . Close to external corners in large paved areas.
  - . Around the perimeter at abutments.
  - . At junctions between different substrates.
  - . To divide large paved areas into bays, maximum 5 m wide, maximum area 16 m<sup>2</sup>.
  - . At abutments with the building structural frame and over supporting walls or beams where flexing of the substrate is anticipated.
- Depth of joint: Right through to the substrate.
- Sealant width: 6 – 25 mm.
- Depth of elastomeric sealant: One half the joint width, or 6 mm, whichever is the greater.

**Control joint types**

Divider strip: A proprietary expansion joint consisting of a neoprene filler sandwiched between plates with lugs or ribs for mechanical keying. Set flush with the finished surface.

Proprietary slide plate divider strip: An arrangement of interlocking metal plates grouted into pockets formed in the concrete joint edges.

Sealant: Two-pack self-levelling flexible mould resistant, one-part silicone or polyurethane sealant applied over a backing rod. Finish flush with the tile surface.

- Floors: Trafficable, shore hardness > 35.

Backing rod: Compressible closed cell polyethylene foam with a bond-breaking surface.

**E17.3.6 GROUTED AND SEALANT JOINTS****Grouted joints**

General: Commence grouting as soon as practicable after bedding has set and hardened sufficiently. Clean out joints as necessary before grouting.

Face grouting: Fill the joints solid and tool flush. Clean off surplus grout. Wash down when the grout has set. When grout is dry, polish the surface with a clean cloth.

**E17.3.7 ACCESS COVERS****General**

Where access covers to pits are located in paved areas, lay pavers in the metal cover to achieve a level surface with the surrounding paving. Cut and trim pavers as required to fit within the frame of the cover and to match the pattern of the surrounding pavers.

**E17.3.8 COMPLETION****Spare pavers**

General: Supply spare matching pavers of each type for future replacement purposes. Store the spare materials on site.

Quantity: At least 1% of the quantity installed.

**Cleaning**

Completion: Clean progressively and leave pavements clean on completion.

**Operation and maintenance manuals**

General: Submit a manual describing care and maintenance of the tiling, including procedures for maintaining the slip-resistance grading stating the expected life of the slip-resistance grade.

**E17.4 SELECTIONS****E17.4.1 PAVER SCHEDULE****Platform Coping**

Location	Existing platforms and extensions
Tiles	
- Type	Exposed aggregate concrete pavers
- Supplier	Urbanstone
- Size	400mm x 300mm x 40mm thick
- Colour	As noted in the Finishes Schedule
- Pattern	Tiles to be laid in 2 rows of stack bond to provide a continuous strip 800mm wide
- Bedding	Thick cement based bedding
- Grout	Proprietary, cement based, natural colour
- Slip resistance classification	R13
Sealer	SureSeal stone sealer 24/7 stone impregnator – clear

**Tactile ground surfaces indicators**

Location	Existing platforms and extensions
Tiles	
- Type	Exposed aggregate concrete pavers
- Supplier	Stone directions
- Size	300mm x 300mm x 40mm thick
- Colour	As noted in the Finishes Schedule
- Pattern	Tiles to be laid in 2 rows of stack bond to provide a continuous strip 600mm wide
- Finish	Shotblast or off-form
- Bedding	Thick cement based bedding
- Grout	Proprietary, cement based, natural colour
- Slip resistance classification	R13
Sealer	SureSeal stone sealer 24/7 stone impregnator – clear

**Yellow warning strip**

<b>Location</b>	<b>Existing platforms and extensions</b>
Tiles	
- Type	Pigmented concrete pavers
- Supplier	Urbanstone
- Size	100mm x 300mm x 40mm thick
- Colour	As noted in the Finishes Schedule
- Bedding	Thick cement based bedding
- Grout	Proprietary, cement based, natural colour
- Slip resistance classification	R13
Sealer	SureSeal stone sealer 24/7 stone impregnator – clear

## E18 PAVEMENT ANCILLARIES

### E18.1 GENERAL

#### E18.1.1 RESPONSIBILITIES

##### General

General: Provide channels, kerbs and linemarking.

Selections: Conform to **Execution**.

#### E18.1.2 CROSS REFERENCES

##### General

Requirement: Conform to the following:

- *General requirements.*
- *Site management.*
- *Earthwork.*
- *Pavement base and subbase.*

#### E18.1.3 INTERPRETATION

##### Definitions

General: For the purposes of this worksection the definitions of AS 1348 and those given below apply.

- Absolute level tolerance: Maximum deviation from design levels.
- Relative level tolerance: Maximum deviation from a 3 m straightedge laid on the surface
- Channels and kerbs: Includes all forms of concrete gutters, dish drains, grated drains and mountable median and barrier kerbing.

#### E18.1.4 SUBMISSIONS

##### Linemarking materials

General: Submit NATA Registered Laboratory Test Reports, at least seven days before work is scheduled to commence, on the properties of the materials, including paint.

### E18.2 PRODUCTS

#### E18.2.1 MATERIALS

##### Concrete

Standard: To AS 1379 – Grade N20.

##### Pavement marking paint

Standard: To AS 4049.1, AS 4049.3 and AS 4049.4.

#### E18.2.2 VEHICLE BARRIERS

##### Log barriers

General: Hazard class 4 to AS 1604.1.

Size: Diameter range 125 – 150 mm.

##### Precast concrete wheel stops

Material: Precast concrete units with predrilled holes located 300 mm from each end for fixing to ground surface.

Size: 2000 x 150 x 100 mm high.

##### Steel tube bollards

Type: Bollards fabricated from heavy steel tube, to minimum nominal size DN 100, to AS 1074. Seal free ends with fabricated end caps, spot welded and ground smooth.

Finish: Galvanize after fabrication.

### **E18.2.3 BICYCLE RACKS**

#### **General**

Standards: Layout and location to AS 2890.3.

Product: Contractor to submit details of proprietary product for approval by the Client.

Style: Contractor to submit details for approval by the Client. Finish shall be stainless steel finish.

Material: Contractor to submit details for approval by the Client

Location: In accordance with the Drawings

### **E18.2.4 VEHICULAR GUARDRAILS / CRASH BARRIERS**

Provide fabricated guardrails / crash barriers where indicated in the Drawings.

Steel guardrails and barriers shall be galvanised.

Vehicular guardrails shall be in accordance with RTA Specification R132.

Manufactured steel barriers and guardrails shall be equal to Ingal:

- Spring Buffa with Classic or Standard post to suit application
- Flexi Post
- Rigid Post with surface bolted or in-ground fixings to suit application.

Guardrail shall be installed in accordance with the manufacturer's recommendations and RTA Specification R132.

## **E18.3 EXECUTION**

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### **E18.3.1 LINEMARKING**

#### **Setting out**

General: Set out the work to ensure that all markings are placed in accordance with the drawings and as agreed with the Superintendent.

The Contractor shall linemark the car spaces of the Upper Accessway south of the Shared Zone in order to provide 2.4 metre wide by 5.4 metre long car spaces.

#### **Surface preparation**

Surface: Clean, dry and free of any deposit which may impair adhesion of the paint finish.

Wet weather: Do not apply pavement marking during wet weather or if rain is likely to fall during the process or paint drying time.

Scabbling: Scabble the full area of concrete wearing surfaces to raised pavement markers and remove fine mortar material.

Provision for traffic: Allow for traffic during application and protect pavement markings until the material has hardened sufficiently to carry traffic without damage.

Mixing of paint: Mix all paint in its original container before use and produce a smooth uniform product consistent with the freshly manufactured product.

#### **Application of paint**

Longitudinal lines: Spray all longitudinal lines with a self propelled machine. Spray concurrently the two sets of lines forming a one-way or two-way barrier line pattern.

Hand spraying: Hand spray transverse lines, symbols, legends, arrows and chevrons with templates.

Paint thickness: Uniform wet film thickness:  $\geq 0.35$  mm to  $\leq 0.40$  mm.

Pavement markings: Straight or with smooth, even curves where intended.

Edges: Clean with a, sharp cut off. Remove any marking material applied beyond the defined edge of the marking and leave a neat and smooth marking on the wearing surface of the pavement.

Paint shall be water based – colour 'White'.

### **Tolerances**

Longitudinal line lengths: Do not vary by more than 20 mm from the lengths shown in AS 1742.2.

Longitudinal line widths: Do not vary by more than 10 mm from the widths shown in AS 1742.2.

Transverse line lengths and widths: Do not vary by more than 10 mm from the lengths and widths shown in AS 1742.2.

Dimensions: Do not vary the dimensions of arrows, chevrons, painted medians, painted left turn islands and speed markings by more than 50 mm from the dimensions shown on the drawings or in AS 1742.2 as appropriate. Place arrows and speed markings square with the centreline of the traffic lane.

### **Removal of pavement markings**

General: Remove pavement markings, no longer required, from the wearing surface of pavements without significant damage to the surface.

## **E18.3.2 CHANNELS AND KERBS**

### **Foundation preparation**

Foundation material: Shape and compact to form a firm base before placing any kerb and/or gutter. Construction not on a pavement course: Relative compaction To AS 2876.

Construction on a pavement course: To the requirements of the *Pavement base and subbase* worksection.

Standard: Construct kerb and/or gutters in fixed forms, by extrusion or by slip forming to AS 2876 Foundation, concrete quality, curing and testing details: To AS 2876.

### **Tolerances**

Design level deviation at any point on the surface of gutters:  $\pm 10$  mm .

Surface deviation to top or face of kerbs, and to the surface of gutters: 5 mm in 3000 mm.

Design alignment deviation: 25 mm.

Exception: Kerb laybacks, grade changes or curves, or at gully pits requiring gutter depression.

### **Joints**

Standard: To AS 2876.

Concrete pavement: Where kerbs and/or gutters are cast adjacent with a concrete pavement, continue the same type of expansion, contraction and construction joints documented for the concrete pavement across the kerb and/or gutter.

### **Backfill**

Timing: Not earlier than three days after placing kerb and gutter concrete, backfill and reinstate the spaces on both sides of the kerb and/or gutters.

Material: Granular material, free of organic material, clay and rock in excess of 50 mm diameter.

Compaction: Compact backfilling in layers not greater than 150 mm thick, to a relative compaction of 95% when tested in accordance with AS 1289.5.4.1, for standard compactive effort.

Pavement: Backfill pavement material adjacent to new gutter in accordance with the drawings and the *Pavement base and subbase* worksection.

## **E18.3.3 VEHICLE BARRIERS**

### **Log barriers**

Installation: Check out the posts to receive the rails. Set each post 600 mm into the ground and surround with compacted fine crushed rock, gravel or cement stabilised rammed earth. Bolt rails to posts with M12 diameter galvanized bolts and washers, with bolt heads and nuts recessed.

### **Precast concrete wheel stops**

Installation: Drive 12 mm diameter galvanized steel rods 600 mm into the ground to finish 25 mm below the top of the wheel stop, or bolt the stop to masonry anchors in concrete slabs. Grout the holes flush to match the concrete finish.

Provide proprietary wheel stops suitable for B99 vehicles. Wheel stops shall be manufactured from recycled rubber similar to "Ingal Wheel Stop" by Ingal Civil or approved equivalent.

Colour shall be yellow and black.

Locate wheel stops at each car space of the Upper Accessway as indicated on the Drawings.

Fix wheel stops in accordance with the manufacturer's recommendations.

**Steel tube bollards**

Footing: Encase in a concrete footing at least 600 mm deep x 250 mm diameter.

On slabs: Weld on a 10 mm thick baseplate drilled for 4 bolts, and bolt to masonry anchors.

Filling: Fill the tube with 15 Mpa concrete.

**E18.3.4 BICYCLE RACKS**

**Installation**

To concrete pavements: Install in accordance with the recommendations of the manufacturer.

Provide racks in multiples to provide the required number of bicycle storage positions indicated on the drawings.

**E18.3.5 REMOVAL OF REDUNDANT PITS**

The Contractor shall be responsible for demolition and disposal of existing redundant structures where they interfere with proposed works as indicated in the Drawings.

**E18.4 SELECTIONS**

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**E18.4.1 BOLLARDS**

**General**

Location: Shared area of proposed accessible parking spaces at Lower Ground Level

Manufacturer: Leda Security

Type: Fixed aluminium bollard with heavy duty galvanised pipe.

Code Number: AAE 150NB

Finish and colour: Powdercoated Precious Silver Pearl

**E18.4.2 BICYCLE RACKS**

**General**

Location: As shown on drawings

Manufacturer: Leda Security

Type: 5 Secure racks allowing storage for 10 bicycles.

Code Number: BR85F

Material: Stainless steel

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**E19 SERVICE TRENCHING**

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**E19.1 GENERAL**

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**E19.1.1 RESPONSIBILITIES**

**General**

General: Provide trenching for underground services.

Authority requirements: Refer to Services and Civil Engineers specifications and drawings.

**Design**

Steel shoring and trench lining systems: To AS 4744.1.

Hydraulic shoring and trench lining equipment: To AS 5047.

**E19.1.2 CROSS REFERENCES**

**General**

Requirement: Conform to the following:

- *General requirements.*
- *Earthwork.*
- *Pavement base and subbase.*
- *Asphaltic concrete.*
- *Services specifications.*

**E19.1.3 STANDARDS**

**General**

Earthworks: To AS 3798.

**E19.1.4 INTERPRETATION**

**Abbreviations**

General: For the purposes of this worksection the following abbreviations apply:

- CBR value: California Bearing Ratio value.

**E19.1.5 INSPECTION**

**Notice**

Inspection: Give notice so that inspection may be made at the following stages:

- Service trenches excavated before laying the service.
- Services laid in trenches and ready for backfilling.

**E19.1.6 TOLERANCES**

**General**

Earthworks: To **Tolerances** in the *Earthwork* worksection.

**E19.1.7 SUBMISSIONS**

**General**

Extent: Submit a plan of trench works noting the location and type of service.

Notice: Advise proposed duration of open excavation.

Construction: Submit details of proposed equipment and method of excavation.

Stability: If shuttering and/or bracing of the sides of a trench is required for safety and stability, provide proposals.

Geotechnical data: Provide a geotechnical report supporting the procedures proposed for trenching and/or boring.

Hazards: Identify OH&S hazards that may be encountered with deep trenches including toxic gases and liquids.

Boring: Submit proposals for the following:

- Limits on length.
- Existence of other services and method of protection.
- Pressure grouting to voids.
- The effect of pressure grouting on other services, ground heave and proposals for minimising such effects.
- Access to properties outside the site.
- Council permits.
- Service interruptions including a plan for minimising unintended interruptions.

#### **Off site disposal**

Disposal location: Submit the locations and evidence of compliance with the relevant authorities for the disposal of material required to be removed from the site.

### **E19.2 PRODUCTS**

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#### **E19.2.1 FILL MATERIALS**

##### **General**

Requirement: Provide fill materials including borrow or imported fill to **Fill materials** and **Borrow or imported fill** in the *Earthwork* worksection.

### **E19.3 EXECUTION**

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#### **E19.3.1 EXISTING SERVICES**

##### **Location**

Requirement: Before commencing service trenching, locate and mark existing underground services in the areas which will be affected by the service trenching operations.

Utility services: Contact DIAL BEFORE YOU DIG to identify location of underground utility services pipes and cables.

##### **Excavation**

General: Do not excavate by machine within 1 m of existing underground services.

#### **E19.3.2 EXISTING SURFACES**

##### **Concrete and asphalt pavements**

Method: Sawcut trench set out lines for the full depths of the bound pavement layers except where the set out line is located along expansion joints.

Removal of concrete and asphalt: Break out concrete or asphalt pavement material between the trench set out lines, remove and dispose of off-site.

##### **Segmental paving units**

Removal: Take up segmental paving units both full and cut by hand, between the trench set out lines, and neatly stack on wooden pallets.

Concrete edging: Break out, remove and dispose of off-site.

Concrete subbase: If present, sawcut along the trench set out lines.

##### **Grass**

Method: Neatly cut grass turf between trench set out lines into 300 mm squares. If the grass is suitable for re-use, take up and store the turf and water during the storage period, otherwise remove and dispose of it off-site.

##### **Small plants, shrubs and trees**

Storage: If required for re-planting, take up small plants and store. Wrap the root ball in a hessian or plastic bag with drain holes and water during the storage period.

Unsuitable vegetation: Remove and dispose of off-site.

#### **E19.3.3 EXCAVATING**

##### **Site preparation**

As found site conditions: To **Geotechnical** in the *Earthwork* worksection.

Records of measurement: If Records of measurement are required, to **Records of measurement** in the *Earthwork* worksection.

Remove topsoil: To **Removal of topsoil** in the *Earthwork* worksection.

#### **Excavation**

General: Excavate for underground services in conformance with the following:

- To required lines and levels, with uniform grades.
- Straight between access chambers, inspection points and junctions.
- With stable sides.
- To a width tolerance of  $\pm 50$  mm unless constrained by adjacent structures.
- Excavation: To the *Earthwork* worksection **Excavation and Adjacent structures**.

#### **Trench widths**

General: Keep trench widths to the minimum consistent with the laying and bedding of the relevant service and construction of access chambers and pits.

#### **Trench depths**

General: As required by the relevant service and its bedding method.

Adjacent to footings: If excavation is necessary below the zone of influence of the underside of adjacent footings, give notice, and provide support for the footings as instructed.

#### **Obstructions**

General: Clear trenches of sharp projections. Cut back roots encountered in trenches to at least 600 mm clear of services. Remove other obstructions including stumps and boulders which may interfere with services or bedding.

Tree protection: To AS 4970.

#### **Dewatering**

General: Keep trenches free of water. Place bedding material, services and backfilling on firm ground free of surface water.

Pumping: Provide pump-out from adjacent sumps or install well points.

Adjacent subsidence: Provide recharge points to isolate the dewatering zone.

#### **Excess excavation**

General: If trench excavation exceeds the correct depth, reinstate to the correct depth and bearing value using compacted bedding material or sand stabilised with 1 part of cement to 20 parts of sand by volume.

#### **Stockpiles**

Excavated material for backfill: If required, segregate the earth and rock material and stockpile, for re-use in backfilling operations.

Locations: Do not stockpile excavated material against tree trunks, buildings, fences or obstruct the free flow of water along gutters where stockpiling is permitted along the line of the trench excavation.

Disposal: If stockpiling is not permitted, dispose of excavated material off-site.

#### **Unsuitable material**

Disposal: Remove unsuitable material from the bottom of the trench or at foundation level and dispose of off-site. Replace with backfill material to **Backfill material**.

#### **Boring**

Subcontractor: If under road boring is required in lieu of trenches, engage a suitably qualified subcontractor to do the work.

### **E19.3.4 TRENCH BACKFILL**

#### **General**

Timing: Backfill service trenches as soon as possible after laying and bedding the service, if possible on the same working day.

Marking services: Underground marking tape to AS/NZS 2648.1.

Place fill: To **Placing fill** in the *Earthwork* worksection.

#### **Bedding, haunch, side and overlay zones**

Installation and material: To the particular utility authority or utility service requirements. Secure pipes against floatation.

Overlay zone thickness: Maximum of 300 mm immediately over the utility service.

Topsoil areas: Complete the backfilling with at least 100 mm of topsoil.

Material in reactive clay areas: In sites classified M, M-D, H1, H1-D, H2, H2-D, E or E-D to AS 2870, re-use excavated site material at a moisture content within  $\pm 1\%$  of that of the adjoining in situ clay.

#### **Selected material zone**

Extent: The section of trench within the zone, if applicable.

Backfill material: Selected material free from stones larger than 100 mm maximum dimension and the fraction passing a 19 mm Australian Standard sieve to have a 4 day soaked CBR value, in conformance with AS 1289.6.1.2, and not less than that of the adjacent selected material zone.

#### **Trees**

General: Backfill at trees, for a minimum 300 mm thickness, around tree roots with a topsoil mixture, placed and compacted in layers of 150 mm minimum depth to a dry density equal to that of the surrounding soil.

Backfill level: Do not place backfill material above the original ground surface around tree trunks or over the root zone.

Watering: Thoroughly water immediately after backfilling the tree root zone.

#### **Compaction**

Control moisture within backfill: To **Fill moisture control** in the *Earthwork* worksection.

Layers: Compact all material in layers not exceeding 150 mm compacted thickness. Compact each layer to the relative compaction specified before the next layer is commenced.

Compaction: To **Compaction requirements for fill and subgrade** in the *Earthwork* worksection and AS 3798 Section 5.

Frequency of testing: To AS 3798 clause 8.7.

Precautions: If compacting adjacent to utility services, use compaction methods which do not cause damage or misalignment.

#### **Density tests**

Testing authority: Have density tests of pipe bedding and backfilling carried out by a Registered testing authority.

Test methods:

- Compaction control tests: To AS 1289.5.4.1 or AS 1289.5.7.1.
- Field dry density: AS 1289.5.3.2 or AS 1289.5.3.5.
- Standard maximum dry density: AS 1289.5.1.1.
- Dry density ratio: AS 1289.5.4.1.
- Density index: AS 1289.5.6.1.

### **E19.3.5 SURFACE RESTORATION**

#### **Subbase and base**

Material: Provide crushed rock, DGS20 or DGB20 material and configure in layers and depths to match existing and adjacent work.

Supply and installation: To the *Pavement base and subbase* worksection.

Compaction: Uniformly compact each layer of the subbase and base courses over the full area and depth within the trench to a relative compaction of 100 per cent when tested in conformance with AS 1289.5.4.1.

Tests: Test for compaction at a minimum frequency of 1/ every second layer/50 m<sup>2</sup> of restoration surface area.

#### **Pathways and paved areas generally**

Materials: Provide material consistent with the surface existing before commencement of the works.

Unless shown otherwise on the drawings, pathways and paved areas shall be constructed on subbase: 150 mm crushed stone DGB20 compacted to 100 percent relative compaction in conformance with AS 1289.5.4.1.

Lippage at patches: Match the surface level at any point along the patch's edge with the adjoining footpath surface within  $\pm 5$  mm.

**Concrete surfaces**

Construction: Conform to the following:

- Prime coat the cut edges of the existing surfaces with cement slurry. Lay and compact concrete so that the edges are flush and the centre is cambered 10 mm above the adjoining existing surfaces.
- Material: 25 Mpa concrete
- Surface finish and pattern: Match existing adjoining work.
- Minimum thickness: 75 mm or the adjacent pavement thickness, whichever is thicker.
- Reinforcement and dowels: If required, provide steel reinforcement with dowels into the adjacent concrete.
- Expansion joints: 15 mm thick preformed jointing material of bituminous fibreboard placed where new concrete abuts existing concrete and in line with joints in existing concrete.
- Control joints:
  - . Form control joints strictly in line with the control joints in existing concrete.
  - . Around electricity supply poles: Terminate the concrete paving 200 mm from the pole and fill the resulting space with cold mix asphalt.

Curing: Cure by keeping continuously wet for 7 days.

**Landscaped areas**

In topsoil areas: Complete the backfilling with topsoil for at least the top 100 mm.

Lawn: Re-lay stockpiled turf. If existing turf is no longer viable, re-sow the lawn over the trench and other disturbed areas.

Planted areas: Overfill to allow for settlement.

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**E20 FENCES AND BARRIERS**

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**E20.1 GENERAL**

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**E20.1.1 RESPONSIBILITIES**

**General**

General: Provide fences and barrier systems:

- Complete for their function.
- Conforming to the detail and location drawings.
- Firmly fixed in position.

**E20.1.2 CROSS REFERENCES**

**General**

Requirement: Conform to the following:

- *General requirements.*

**Notice**

Inspection: Give notice so inspection may be made of the following:

- Boundary survey location if applicable.
- Setout before construction.
- Foundation conditions before placing concrete in footings.

**E20.2 PRODUCTS**

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**E20.2.1 STEEL**

**Steel tubes**

Posts, rails, stays and pickets: To AS/NZS 1163.

- Grade: C 350 L0.

**Wire**

Cable wire, tie wire and barbed wire: To AS 2423.

Coating: Powdercoat

**E20.2.2 CONCRETE**

**General**

Standard: To AS 1379.

Exposure classification: To AS 3600 Table 4.3.

**E20.3 EXECUTION**

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**E20.3.1 CONSTRUCTION GENERALLY**

**Set out**

General: Set out the fence line and mark the positions of posts, gates and bracing panels.

Property boundaries: Confirm by survey.

**Clearing**

Fence line: Except trees or shrubs to be retained, clear vegetation within 1 metre of the fence alignment. Grub out the stumps and roots of removed trees or shrubs and trim the grass to ground level, but do not remove the topsoil.

**Excavation**

Posts: Excavate post holes so that they have vertical sides and a firm base. Spread surplus material on the principal's side of the fence.

**Erection**

Line and level: Erect posts vertically. Set heights to follow the contours of natural ground.

### Concrete footings

In ground: Place mass concrete around posts to protect posts from waterlogged conditions and finish with a weathered top falling 25 mm from the post to ground level.

On slabs: Provide welded and drilled post base flanges for fixing with masonry anchors to the concrete.

### E20.3.2 GATES

#### Hardware

Provide the following:

- Drop bolt and ferrule to each leaf of double gates.
- Latch to one leaf of double gates.
- Provision for locking by padlock.
- Hinges to ensure smooth operation and adjustment for future sagging.

#### Hand access

General: Where required, provide hand holes to give access from outside to reach locking provision.

Standard: To AS 1725.1.

### E20.3.3 WELDED MESH FENCING

#### Fence dimensions

Maximum post spacing: 2440 mm.

#### Component sizes

End, corner and intermediate posts: 42.4 mm diameter, 2.6 mm wall thickness.

Gate posts (personnel): 60.3 mm diameter, 2.9 mm wall thickness.

Gate posts (vehicle): 88.9 mm diameter, 3.2 mm wall thickness.

Panel wire:

- Horizontal: 4.95 mm diameter at 75 mm centres.
- Vertical: 4.95 mm diameter at 50 mm centres.

#### Installation

General: Fit tightly fittings caps to steel posts. Attach panels to posts with fixing clips and M8 x 75 mm hexagon head bolts before concreting footing.

Footing type: Concrete.

#### Gates

Frame tubes: 33.7 mm diameter, 2 mm wall thickness.

Wire: Match fence.

### E20.3.4 TEMPORARY FENCING

#### Fence dimensions

Height: 1200 mm.

Maximum post spacing: 5000 mm.

#### Component sizes

Corner and gate posts: Hardwood or preservative-treated softwood, 250 mm diameter.

Intermediate posts: Star picket.

Gate: Provide a suitable hinged gate with a gate latch.

Wire: Top, intermediate and bottom rows of 3.2 mm plain galvanized steel wire. Thread the top wire through pieces of plastic tube and through corner posts.

#### Removal

Completion: Remove the fence at the end of the planting establishment period.

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## E20.4 SELECTIONS

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### E20.4.1 FENCES

#### Design and install

Design and install various types of fencing throughout the site. The fencing shall be designed and installed in accordance with TfNSW Standards SPC 511 "Boundary Fences Version 1.1" issued December 2009 and ESC 510 "Boundary Fences Version 2.1" issued in December 2009 and TMC 511.

Approved Manufacturers: Leda Security or Bluedog Fences.

#### Carpark fencing (SF01)

Location: As shown on drawings to define the boundary of the commuter car park and road areas in the vicinity of the Station.

Type: Steel palisade security fence with 'W' profile palings with triple-point spear top.

Height: 2400mm

Installation: Install in accordance with the recommendations of the designer/manufacturer, including tamper resistant, security type fasteners.

Finish: Powdercoated

Colour: Black

#### Rail Corridor fencing (SF02)

Location: As shown on drawings to define the Operational Rail Corridor and Station Platform.

Type: Enhanced Urban Fence tubular steel fencing constructed from square sections of 2.5mm wall thickness, with crimped spear pointed top.

Height: 2400mm

Installation: Install in accordance with the recommendations of the designer/manufacturer, including tamper resistant, security type fasteners.

Finish: Powdercoated

Colour: Black

Gates: Provide lockable gates as shown on drawings and as required by TfNSW.

#### Garbage bin area (SF02)

Similar to Rail Corridor Fence.

Provide one lockable gate as shown.

#### Fences at Platform ends (SF03)

Supply and install proprietary Loop Style fencing to end of platforms.

Standard: AS 1725

Manufacturer: ARC

Design: To TfNSW standards

Height: 1200mm.

Material: Steel

Finish: Powdercoated

Colour: Refer to Schedule of Materials and Finishes

Gates: Supply and install gates to the fence at the end of each platform. The gates shall match the fence in design and height and shall be fitted with hinges, locks and all necessary hardware.

**E21 LANDSCAPE – GARDENING****E21.1 GENERAL****E21.1.1 RESPONSIBILITIES****General**

General: Provide plants that have been grown to a standard that allows them to establish rapidly and grow to maturity.

Maintenance: Encourage and maintain healthy growth for the duration of the contract.

Program: Provide a suitable irrigation, pruning, fertiliser and monitoring program for all plant materials held by the supplier. Take any other precautions required to safeguard the health and well-being of all plant materials before and including their delivery to site.

Selections: Conform to the **SELECTIONS**.

**E21.1.2 CROSS REFERENCES****General**

Requirement: Conform to the following:

- General requirements.

**E21.1.3 STANDARDS****Soils**

Site and imported topsoil: To AS 4419.

Potting mixes: To AS 3743.

Composts, soil conditioners and mulches: To AS 4454.

Tree supply: Follow the guidance given in NATSPEC Guide: *Specifying Trees – a guide to assessment of tree quality* (Clark R. 2003).

**E21.1.4 INTERPRETATION****Definitions**

General: For the purposes of this worksection the definitions given below apply.

Imported topsoil: Similar to naturally occurring local topsoil, suitable for the establishment and on-going viability of the selected vegetation, free of weed propagules and of contaminants, and classified by texture to AS 4419 Appendix 1, as follows:

- . Fine: Clay loam, fine sandy loam, sandy clay loam, silty loam, loam.
- . Medium: Sandy loam, fine sandy loam.
- . Coarse: Sand, loamy sand.

Site topsoil: Soil excavated from the site which contains organic matter, supports plant life, conforms generally to the fine to medium texture classification to AS 4419 (loam, silt, clay loam) and is free from:

- . Stones > 25 mm diameter.
- . Clay lumps > 75 mm diameter.
- . Weeds and tree roots.
- . Sticks and rubbish.
- . Material toxic to plants.

### **E21.1.5 INSPECTION**

#### **Notice – on site**

Inspection: Give notice so inspection may be made of the following:

- Setting out completed.
- Subgrades cultivated or prepared for placing topsoil.
- Topsoil spread before planting.
- Plant holes excavated and prepared for planting.
- Plant material set out before planting.
- Planting, staking and tying completed.
- Completion of planting establishment work.

#### **Hold points:**

- Practical completion
- Completion of planting establishment work.
- End of maintenance period

### **E21.1.6 SUBMISSIONS**

#### **Samples**

General: Submit representative samples of each material, packed to prevent contamination and labelled to indicate source and content.

Bulk materials: Submit a 5 kg sample of each type specified. Submit bulk material samples, with required test results, at least 5 working days before bulk deliveries.

#### **Suppliers**

Statements: Submit statements from suppliers, giving the following, where applicable:

- Particulars of the supplier's experience in the required type of work.
- Production capacity for material of the required type and quantity.
- Lead times for delivery of the material to the site.

#### **Materials**

Supplier's data: Submit supplier's data including the following:

- Material source of supply for topsoil, filling, stone and filter fabrics.

Compost: Submit a certificate of proof of compost pH value.

#### **Plant provenance**

Locality: Provide written certification that all plant material has been grown from local provenance stock. If this is not achievable give notice.

Species: Provide written certification that all plant material is true to the required species and type.

#### **Accreditation**

Proof: Submit evidence of accreditation as follows:

Accreditation body: **NSW Nurserymen's Industry Association.**

#### **Log book**

Records: Log the following on a weekly basis:

- Description, time and method of application of toxic material.
- Maintenance work details.
- Inclement weather to verify inability to carry out work within the specified time frame.

Availability: Upon request.

### **Replacement plants**

Species: Provide written certification that all plant material is true to the required species and type.

## **E21.2 PRODUCTS**

### **E21.2.1 TOPSOIL**

#### **Source**

General: Import topsoil to **Table 3 Imported/Site Topsoil Schedule and AS 4419** unless the topsoil type can be provided from material recovered from the site.

#### **Imported topsoil**

Particle size: Provide soil to the **Particle size table** for the textures nominated in **SELECTIONS**.

**Table 1 Topsoil particle size table (% passing by mass)**

AS sieve aperture to AS 1152	Soil textures		
	Fine	Medium	Coarse
2.36	100	100	100
1.18	90 – 100	90 – 100	90 – 100
0.60	75 – 100	75 – 100	70 – 90
0.30	57 – 90	55 – 85	30 – 46
0.15	45 – 70	38 – 55	10 – 22
0.075	35 – 55	25 – 35	5 – 10
0.002		2 – 15	2 – 8

Nutrient levels: Provide soil to the **Topsoil nutrient level table**.

**Table 2 Topsoil nutrient level table**

Nutrient	Unit	Sufficiency range
Nitrate-N (NO <sub>3</sub> )	mg/kg	> 25
Phosphate-P (PO <sub>4</sub> ) – P tolerant	mg/kg	43 – 63
Phosphate-P (PO <sub>4</sub> ) – P sensitive	mg/kg	< 28
Phosphate-P (PO <sub>4</sub> ) – P very sensitive	mg/kg	< 6
Potassium (K)	mg/kg	178 – 388

Sulphate-S (SO <sub>4</sub> )	mg/kg	39 – 68
Calcium (Ca)	mg/kg	1200 – 2400
Magnesium (Mg)	mg/kg	134 – 289
Iron (Fe)	mg/kg	279 – 552
Manganese (Mn)	mg/kg	18 – 44
Zinc (Zn)	mg/kg	2.6 – 5.1
Copper (Cu)	mg/kg	4.5 – 6.3
Boron (B)	mg/kg	1.4 – 2.7

#### **Method References**

pH in H<sub>2</sub>O (1:5), pH in CaCl<sub>2</sub> (1:5) and Electrical Conductivity (EC) by Rayment & Higginson (1992) method 4A2, 4B2, 3A1

Soluble Nitrate-N by APHA 4500

Soluble Chloride by Rayment & Higginson (1992) modified method 5A2

Extractable P by Mehlich 3 – ICP

Exchangeable cations – Ca, Mg, K, Na by Mehlich 3 – ICP

Extractable S by Mehlich 3 – ICP

Extractable trace elements (Fe, Mn, Zn, Cu, B) by Mehlich 3 – ICP

#### ***Site topsoil***

General: Import topsoil to **Table 3 Imported/Site Topsoil Schedule and AS 4419**, unless the topsoil type can be provided from material recovered from the site. Material recovered from site is to be treated to meet the requirements of the **Table 3 Imported/Site Topsoil Schedule and AS 4419**.

Soil blend: Stripped topsoil with ameliorants noted in **Table 3 Imported/Site Topsoil Schedule and AS 4419** to AS 4419 clause 4.6.

**Table 3 Imported/Site Topsoil Schedule**

Location	Type	Composition	Depth
Planting Onslab or constructed planters	Imported topsoil	45% coarse sand 15% blacksoil 10% mushroom compost 10% horticultural graded pine bark 20% screened ash	300mm
	Or site topsoil	Site topsoil blended with organic admixture as determined by testing results.	Below planting soil and turf topsoil at varied depths
	or Subsoil	75% coarse sand 25% blacksoil	Below planting soil and turf topsoil at various depths

**E21.2.2 FERTILISER****Fertiliser**

General: Provide proprietary fertilisers, delivered to the site in sealed bags marked to show manufacturer or vendor, weight, fertiliser type, N:P:K ratio, recommended uses and application rates.

**Fertiliser schedule**

Fertiliser key	Location	N:P:K ratio	Application rate
'Agriform' Slow release planting tablets. Refer CV0420811 – Rev 2	All garden bed and tree planting areas	Follow manufacturers specification for N:P:K ratios	Follow manufacturers specification for application rates

**E21.2.3 PLANTS****Labelling**

General: Clearly label individual plants and batches.

Label type: To withstand transit without erasure or misplacement.

Label frequency: Every 3<sup>rd</sup> plant

**Health and vigour**

Health: Supply plants with foliage size, texture and colour at time of delivery consistent with the size, texture and colour shown in healthy specimens of the nominated species.

Vigour: Supply plants with extension growth consistent with that exhibited in vigorous specimens of the species nominated.

Damage: Supply plants free from damage and from restricted habit due to growth in nursery rows.

Stress: Supply plants free from stress resulting from inadequate watering, excessive shade or excessive sunlight experienced at any time during their development.

Site environment: Supply plants that have been grown and hardened off to suit the conditions that could reasonably be anticipated to exist on site at the time of delivery.

**Root development**

Containers: Grow plants in their final containers for the following periods:

- Plants < 25 l size: > 6 weeks.
- Plants > 25 l size: > 12 weeks.

**Freedom from pests and disease**

Pests and disease: Supply plants with foliage free from attack by pests or disease.

Native species with a history of attack by native pests: Restrict plant supply to those with evidence of previous attack to < 15% of the foliage and ensure absence of actively feeding insects.

**Root system**

Requirement: Supply plant material with the root system:

- Well proportioned in relation to the size of the plant material.
- Conducive to successful transplantation.
- Free of any indication of having been restricted or damaged.

Root inspection by the removal of soil test as follows:

- For > 100 samples: Inspect 1%.

- For < 100 samples: Inspect 1 sample.

Sample plants: Replace.

**Defective samples: Reject the entire line represented by the defective sample.**

Rejection: Root bound stock.

### **E21.3 EXECUTION**

#### **E21.3.1 PREPARATION**

##### ***Weed eradication***

Herbicide: Eradicate weeds using environmentally acceptable methods, such as a non-residual glyphosate herbicide in any of its registered formulae, at the recommended maximum rate.

Manual weeding: Regularly remove, by hand, rubbish and weed growth throughout grassed, planted and mulched areas. Remove weed growth from an area 750 mm diameter around the base of the trees in grassed areas. Continue eradication throughout the course of the works and during the planting establishment period.

##### ***Vegetative spoil***

Remove vegetative spoil from site. Do not burn.

#### **E21.3.2 SUBSOIL**

##### ***Ripping***

General: Rip parallel to the final contours wherever possible. Do not rip when the subsoil is wet or plastic. Do not rip within the dripline of trees and shrubs to be retained.

Ripping depths: Rip the subsoil to the following typical depths:

- Compacted subsoil: 300 mm.
- Heavily compacted clay subsoil: 450 mm.

##### ***Planting beds***

Excavated: Excavate to bring the subsoil to at least 300 mm below finished design levels. Shape the subsoil to fall to subsoil drains where applicable. Break up the subsoil to a further depth of 100 mm.

Unexcavated: Remove weeds, roots, builder's rubbish and other debris. Bring the planting bed to 75 mm below finished design levels.

##### ***Cultivation***

Minimum depth: 100 mm.

Cultivation depths (mm): 150mm

Planting areas: 150mm

Services and roots: Do not disturb services or tree roots; if necessary cultivate these areas by hand.

Cultivation: Thoroughly mix in materials required to be incorporated into the subsoil. Cultivate manually within 300 mm of paths or structures. Remove stones exceeding 25 mm, clods of earth exceeding 50 mm, and weeds, rubbish or other deleterious material brought to the surface during cultivation. Trim the surface to design levels after cultivation.

##### ***Additives***

General: Test the subsoil by chemical and physical analysis to determine appropriate remediation methods. Apply additives after ripping or cultivation and incorporate into the upper 100 mm layer of the subsoil **ensure sub soil additives comply with the advice provided in test results.**

Gypsum: Incorporate at the rate of 0.25 kg/m<sup>2</sup>.

Herbicide: Prior to spreading topsoil apply a herbicide treatment as follows:

- Description: Knock Down Herbicide
- Attributes: Knock-down herbicide shall be a broad spectrum, non residual, glyphosate based herbicide that has been specifically manufactured for low aquatic toxicity.

***Placing topsoil***

Site topsoil: Do not incorporate site topsoil into the works until soil testing certification and remediation works have been approved. Remove unauthorised material from the site.

General: Spread the topsoil on the prepared subsoil and grade evenly, making the necessary allowances to permit the following:

Spreading: On steep batters, if using a chain drag, ensure there is no danger of batter disturbance.

Finishing: Feather edges into adjoining undisturbed ground.

***Consolidation***

General: Compact lightly and uniformly in 150 mm layers. Avoid differential subsidence and excess compaction and produce a finished topsoil surface which has the following characteristics:

- Finished to design levels.
- Smooth and free from stones or lumps of soil.
- Graded to drain freely, without pending, to catchment points.
- Graded evenly into adjoining ground surfaces.
- Ready for planting.

***Topsoil depths***

General: Spread topsoil to the following typical depths:

- Excavated planting areas: 300 mm.

***Surplus topsoil***

General: Dispose off site.

**E21.3.3 PLANTING**

***Individual plantings in grassed areas***

Method: Excavate a hole to twice the diameter of the root ball and at least 100 mm deeper than the root ball. Break up the base of the hole to a further depth of 100 mm, and loosen compacted sides of the hole to prevent confinement of root growth.

***Locations***

General: If it appears necessary to vary plant locations and spacings to avoid service lines, or to cover the area uniformly, or for other reasons, give notice.

***Planting conditions***

Weather: Do not plant in unsuitable weather conditions such as extreme heat, cold, wind or rain. In other than sandy soils, suspend excavation when the soil is wet, or during frost periods.

***Watering***

Timing: Thoroughly water the plants before planting, immediately after planting, and as required to maintain growth rates free of stress.

**Placing**

Method: Remove the plant from the container with minimum disturbance to the root ball, ensure that the root ball is moist and place it in its final position, in the centre of the hole and plumb, and with the top soil level of the plant root ball level with the finished surface of the surrounding soil.

**Fertilising – plants**

Pellets: In planting beds and individual plantings, place fertiliser pellets around the plants at the time of planting.

**Product:** 'Agriform' Slow release fertilizer or approved equivalent

**Application Rate:** Follow manufacturers specification for N:P:K ratios and application rates.

**Backfilling**

General: Backfill with topsoil mixture. Lightly tamp and water to eliminate air pockets. Ensure that topsoil is not placed over the top of the root ball, so that the plant stem remains the same height above ground as it was in the container.

**Watering basins for plants in grass**

Method: Except in irrigated grassed areas and normally moist areas, construct a watering basin around the base of each individual plant, consisting of a raised ring of soil capable of holding at least 10 L.

**E21.3.4 MULCHING****Placing mulch**

General: Place mulch to the required depth, clear of plant stems, and rake to an even surface flush with the surrounding finished levels. Spread and roll mulch so that after settling, or after rolling, it is smooth and evenly graded between design surface levels sloped towards the base of plant stems in plantation beds, and not closer to the stem than 50 mm in the case of gravel mulches.

In mass planted areas: Place after the preparation of the planting bed but before planting and other work.

In smaller areas (e.g. planter boxes): Place after the preparation of the planting bed, planting and other work.

Extent: To surrounds of plants planted in riplines and grass areas, provide mulch to 750 mm diameter.

Depths: Spread organic mulch to a depth of 75 mm, and gravel mulch to a depth of 50 mm.

**Table 4 Mulching Schedule**

Location	Mulch type	Depth	Stabilisation method
Garden Beds and Tree Planting	Hardwood chips or other chunky wood material with no more than 5% fines by volume 30 mm x 20 mm x 5 mm and the maximum length of chip is not to exceed 50 mm. It must be free of soil, weeds, stones, vermin, insects or other foreign material.	100mm	Mesh for slopes greater than 1:3

**E21.3.5 SPRAYING****Notice**

General: Immediately give notice of evidence of insect attack or disease amongst plant material.

**Spraying**

Product: Where required, spray with insecticide, fungicide or both.

### **E21.3.6 STAKES AND TIES**

#### **Stakes**

Material: Hardwood, straight, free from knots or twists, pointed at one end.

Installation: Drive stakes into the ground at least one third of their length, avoiding damage to the root system.

Stake sizes:

- For plants  $\geq 2.5$  m high: Three 50 x 50 x 2400 mm stakes per plant.
- For plants 1 – 2.5 m high: Two 50 x 50 x 1800 mm stakes per plant.
- For plants  $< 1$  m high: One 38 x 38 x 1200 mm stake per plant.

#### **Ties**

General: Provide ties fixed securely to the stakes, one tie at half the height of the main stem, others as necessary to stabilise the plant.

Tie types:

- For plants  $\geq 2.5$  m high: Two strands of 2.5 mm galvanized wire neatly twisted together, passed through reinforced rubber or plastic hose, and installed around stake and stem in a figure of eight pattern.
- For plants  $< 2.5$  m high: 50 mm hessian webbing stapled to the stake.

#### **Trunk protection**

Collar guards: 200 mm length of 100 mm diameter agricultural pipe split lengthways.

### **E21.3.7 COMPLETION**

#### **Product certification**

Certification: Submit the supplier's written statement certifying that plants are true to the required species and type, and are free from diseases, pests and weeds.

#### **Cleaning**

Stakes and ties: Remove those no longer required at the end of the planting establishment period.

Temporary fences: Remove temporary protective fences at the end of the planting establishment period.

#### **Warranty**

Parties: Supplier(s) to the principal.

Form: All the plants supplied under these works are true-to-species and type, and free of disease, fungal infection and/or any other impediment to their future growth and that they have been fully acclimatised for the conditions of the site.

Submission of warranty: At the time of each delivery.

### **E21.4 ESTABLISHMENT**

#### **E21.4.1 GENERAL**

#### **Responsibilities**

Plant establishment: Maintain the contract area during the plant establishment period.

Plant establishment period: **12 Weeks** after the date of practical completion and before the date of final completion.

### **Reporting**

Monthly report: Submit regular reports by the last Friday of each month:

- Of the general status of works.
- Include soil test results as required for the fertilising programs.
- Plant replacement requirements.

Incident reports: Report immediately verbally and confirmed in writing any disturbance or incidence affecting or likely to affect the day to day scheduling of works.

### **Disruption of works by others**

Other contractors: Make arrangements to work around the disturbance.

## **E21.4.2 PLANTING WORKS**

### **Planting**

Planting: Ensure the general appearance and presentation of the landscape and the quality of plant material at date of practical completion is maintained for the full planting establishment period.

Existing plant material: Maintain existing planting and grass within the landscape contract area as specified for the corresponding classifications of new grassland or planting.

Replacements: Replace failed, dead and/or damaged plants at minimum 3 week intervals as necessary throughout the full plant establishment period.

### **Pruning**

General: Prune to the **industry standards**.

Pruning: To conform to AS 4373.

### **Fertilising**

Soil tests: Take samples from both planting beds and lawn areas and conduct tests.

Fertilising: Base the fertilisation program on the soil testing results. Fertilise trees once every two years except where specific problems exist. Generally apply an all purpose fertiliser of N:P:K 10:4:6 at recommended rates. Alternatively apply 12 month slow release fertiliser (such as Nutricote) at the manufacturer's recommended rate. Apply all purpose fertiliser to shrubs annually in two bands and cultivated into the soil 100 mm deep.

Slow release fertiliser: Such as Nutricote.

Season: Fertilise shrubs and trees in September and March according to their seasonal growth requirement.

### **Insect and disease control**

Responsibility for insect and disease control: Contractor

Period for treatment: Until the problem has been eliminated.

Chemical spray: Apply outside of normal working hours.

### **Stakes and ties**

Generally: If plants are unable to be self supported or if stakes are damaged, stake or restake the plants as follows:

- Drive three hardwood stakes placed obliquely with the first stake on the opposite side to the prevailing winds.
- Do not single stake large plants.

Removal: If plants are robust with well developed systems and are strong enough to no longer require support, remove stakes and ties.

### **Weeding**

Weeds: Unwanted plants and grasses considered invasive to the locality.

Program:

- Trees and shrubs: As required for planted, paved and mulched areas to be weed free when observed at bi-weekly intervals.

Method: Clear and keep clear vigorous ground covers 200 mm from the base of any shrub or tree:

- Small areas: By hand.
- Large areas: Proprietary herbicides.

Herbicide application: Avoid windy days or if rain is likely to follow within 12 hours and apply:

- To the manufacturer's instructions and material data and safety sheets.
- When the weather is humid with moderate temperatures and maximum sunlight.
- When the ground has the recommended soil moisture level.

### **Rubbish removal**

Rubbish: Remove loose rubbish such as bottles, papers, and cigarette butts from the site. Execute this work regularly so that all areas are free from rubbish when observed at bi-weekly intervals.

Leaf litter: Remove from all path and lawn areas.

Leaf litter distribution: Evenly distribute over the mown areas, or removed from the mown areas and spread evenly over the planted and mulched areas or removed from site as directed.

### **Mulched surfaces**

Inspection: Bi-weekly to determine mulch requirements.

Mulch depth: Maintain 75 mm cover and ensure weed suppression and the quality of finish.

Re mulching: Maintain the original ground levels around the base of plants.

## **E21.4.3 WATERING**

### **Establishment**

Extent: All irrigated and non-irrigated plantings, lawn areas and street trees.

Water quality:

- pH between 5.5 and 7.5.
- Total soluble salts less than 1000 mg/litre.
- No substances that would be toxic to plant growth.

Watering program: Minimum three complete waterings soaking to a depth of 150 mm at fortnightly intervals for the first 6 weeks of plant establishment irrespective of natural rainfall.

Water restrictions: Coordinate the water supply and confirm the watering regime against federal, state and territory government legislation and restrictions at the time.

### **Irrigation**

#### **Hand watering**

General: Manually water all lawn and planting areas in the absence of an irrigation system or until the proposed irrigation system is fully operational, soaking to a depth of 150 mm for lawn and 300 mm for planting. Avoid frequent dampening of the surface. Allow the surface of the soil to partially dry out between waterings.

**E21.4.4 COMPLIANCE****Criteria**

Generally: Plant establishment shall be deemed complete, subject to the following:

- Repairs to planting media completed.
- Ground surfaces are covered with the specified treatment to the specified depths.
- Pests, disease, or nutrient deficiencies or toxicities are not evident.
- Organic and rock mulched surfaces have been maintained in a weed free and tidy condition and to the specified depth.
- Vegetation is established and well formed.
- Vegetation cover to cell, seeded and/or hydromulched areas to the **Plant establishment compliance schedule**.
- Plants have healthy root systems that have penetrated into the surrounding, undisturbed ground and not able to be lifted out of its planting hole.
- Vegetation is not restricting essential sight lines and signage.
- Only frangible species are growing within road side clear zones.
- Specified vegetation setbacks from services and road furniture are evident.
- All hard landscape works have been installed and are operating as specified.
- Collection and removal of litter.
- Removal of mulch from drainage and access areas.
- All non-conformance reports and defects notifications have been closed out.

**Table 5 Plant Establishment compliance table**

<b>Plant material</b>	<b>Acceptable failure per area</b>	<b>Acceptable concentration of failure</b>
Tube stock	< 10%	< 15% in any given location
140 mm	< 5%	< 15% in any given location
300 mm or larger	< Nil%	Nil %
Cells	< 5%	< 15% in any given location

**E22 LANDSCAPE – MAINTENANCE**

**E22.1 GENERAL**

**E22.1.1 RESPONSIBILITIES**

**General**

Selections: Conform to **Selections**.

Landscape maintenance: Maintain the contract area during the landscape maintenance period.

Landscape maintenance period: 52 Weeks

Summary of responsibilities:

- Watering of lawn, garden bed areas, pots.
- Weeding of lawn, garden bed areas, and pavement.
- Supply and spreading of fertiliser to lawn, garden bed areas and pots.
- Supply and installation of mulch to existing garden bed areas and pots.
- Pruning, trimming and tree surgery.
- Pest and disease control of lawn, shrubs and trees.
- Replacement of dead or failed plants.
- Maintenance of irrigation systems.
- Removal of rubbish and debris in garden areas.
- Keeping of a log book.
- Monthly reports.

Maintenance procedures: To accepted horticultural and arboricultural practice.

**E22.1.2 THE SITE**

**Record drawings**

Availability: Obtain from superintendent

**Site restrictions**

Entry permits: Make available, to persons entering designated secure areas, valid entry permits. Ensure these persons comply with conditions of entry.

List: At least 10 working days before entry is required, submit the full name, address, and date and place of birth of persons required to enter designated secure areas.

Access: Access onto and within the site, use of the site for temporary works and constructional plant, including working and storage areas, location of offices, workshops, sheds, roads and parking, is restricted to the following areas: To be determined

**Occupied premises**

General: For the parts of the site designated as occupied premises in the Occupied premises schedule:

- Allow occupants to continue in secure possession and occupancy of the premises for the required period.
- Make available safe access for occupants.
- Arrange work to minimise nuisance to occupants and ensure their safety.

- Protect occupants against weather, dust, dirt, water or other nuisance, by such means as temporary screens.

Proposals: Submit details of proposed methods.

***No smoking policy***

Policy: No smoking onsite.

***Protection of persons and property***

Temporary works: Provide and maintain required barricades, guards, fencing, shoring, temporary roadways, footpaths, signs, lighting, watching and traffic flagging.

Accessways, services: Do not obstruct or damage roadways and footpaths, drains and watercourses and other existing services in use on or adjacent to the site. Determine the location of such services.

Property: Do not interfere with or damage property which is to remain on or adjacent to the site, including adjoining property encroaching onto the site, and trees.

***Rectification***

Accessways, services: Rectify immediately any obstruction or damage to roadways and footpaths, drains and watercourses and other existing services in use on or adjacent to the site. Provide temporary services whilst repairs are carried out.

Property: Rectify immediately any interference or damage to property which is to remain on or adjacent to the site, including adjoining property encroaching onto the site, and trees.

**E22.1.3 GENERAL**

***Contract***

Form of contract: AS 4921 together with AS 2127.

Parties to the contract: The contractor and the principal.

Renegotiation: At the expiry of the contract and after reassessment of the specification.

***Payment***

Retention: The contract amount, for payment during the maintenance period.

Payment period: e.g. End of each calendar month.

Bond: Equal to one months maintenance.

Expenditure of the bond: By the principal upon unsatisfactory maintenance, to employ others to carry out such work.

***Contractor and staff***

Affiliation: Suitable professional qualifications acceptable to the principal.

Representative: Nominate a senior partner/personal experienced in maintenance nursery practices and horticulture, to be responsible for taking and carrying out instruction, and reporting to the principal.

***Special instructions***

Priority: If instructed by the principal attend to certain areas and procedures as a priority. Obtain approval for additional costs prior to commencement of works.

***Reporting***

Monthly report: Submit regular reports by the last Friday of each month:

- Of the general status of works.
- Include soil test results as required for the fertilising programs.
- Plant replacement requirements.

Incident reports: Report immediately verbally and confirmed in writing any disturbance or incidence affecting or likely to affect the day to day scheduling of works.

**Notice**

Inspection: Provide two days notice of the following operations:

- Application of herbicide.
- Application of fertiliser.
- Watering.
- Each site maintenance visit.
- Public amenity: Give notice of any work affecting public access or amenity on the Thursday of the week before the work is planned.

**Log book**

Records: Log the following on a weekly basis:

- Description, time and method of application of toxic material.
- Maintenance work details.
- Inclement weather to verify inability to carry out work within the specified time frame.

Availability: Upon request.

**Disruption of works by others**

Other contractors: Make arrangements to work around the disturbance.

**Warranty**

Parties: Supplier(s) to the principal.

Form: All the plants supplied under these works are true-to-species and type, and free of disease, fungal infection and/or any other impediment to their future growth and that they have been fully acclimatised for the conditions of the site.

Submission of warranty: At the time of each delivery.

**Plant hire**

Existing arrangements: Take responsibility for the re-hiring, installation, care and maintenance of all internal plant material currently under existing plant hire contract for the duration of the maintenance contract.

**E22.2 EXECUTION**

**E22.2.1 GENERALLY**

**Weeding**

Weeds: Unwanted broadleaf plants and grasses considered invasive to the locality.

Program:

- Trees and shrubs: As required for planted, paved and mulched areas to be weed free when observed at bi-weekly intervals.

Method: Clear and keep clear vigorous ground covers 200 mm from the base of any shrub or tree:

- Small areas: By hand.
- Large areas: Proprietary herbicides.

Herbicide application: Avoid windy days or if rain is likely to follow within 12 hours.

Apply:

- To the manufacturer's instructions and material data and safety sheets.
- When the weather is humid with moderate temperatures and maximum sunlight.
- When the ground has adequate soil moisture.

***Pest and disease control***

The contractor is responsible for the control of any pest or disease which may affect the lawn and garden bed areas.

Actions:

- Identify the problem.
- Execute the correct treatment until the problem has been eliminated.
- Apply hazardous material out of normal working hours.
- Protect staff and public.

**E22.2.2 TREES AND SHRUBS**

***Pruning and trimming***

General: Prune to reflect the natural growth flowering and regrowth habit of the individual species.

Shrubs: Prune after flowering.

Program: Spring and Summer and on a spot basis as required.

Hedge trimming: Schedule trimming at times which will maintain the character and design of hedges. Allow up to three times per season.

Tip pruning: Do not remove buds before the flowering season in those plants that have terminal flowers.

- Purpose: To encourage development of new shoots during the active growing season.
- Method: The removal of the top 25 mm or growing tip of each branch.

Radical pruning:

- Purpose: To maintain a hedge or formal shape or when a particular problem, growth habit, damage, or disease requires branch removal.
- Clear and keep clear vigorous groundcovers 200 mm from the base of any shrub or tree.
- Use only tools fit for purpose.

Trees: Prune to:

- Eliminate diseased or damaged growth, avoid inter-branch contact and thin out crowns in a natural manner.
- Maintain sight lines to signs and lights.
- Maintain visibility for personal security.

Tree branch removal:

- To AS 4373.
- Give notice and engage a suitably qualified 'arborist'.

***Fertilising***

Fertilising program: Base the program on soil testing results.

Soil testing: Undertake soil tests as follows:

- At the commencement of the contract.
- Take samples from a cross section of planting beds.

Soil pH adjustment: Apply additional fertilisers and soil conditioners as indicated from soil testing or from the physical soil structure. Maintain a pH range of 5.5 – 6.5.

Shrubs:

- N:P:K ratio: Balanced 10:4:6.
- e.g. 'Multigrow' or 'Shirley's No. 17'. Alternative: Apply 12 month slow release fertiliser (such as Nutricote).
- Rate: To the manufacturer's recommendation and cultivate two rows into the soil 100 mm deep.
- Regular application: Each September and March.
- Ensure the appropriate dosage for sensitive native species.

Trees:

Fertiliser type: Agriform 10 gram N:P:K 20:4:3:4:1.

Dose:

- 3 tablets/plant over 500 mm in height, or
- 2 tablets/plant over 300 mm in height, or
- 1 tablet/small plant and groundcover.

Application: Apply pill to the root zone at a distance from the trunk equal to the spread of the foliage. Make holes 400 mm deep to take the pill. Backfill with sand, equally spaced around the plant.

Micro nutrients: Apply 1 kg of urea in 20 litres of water per 100 m<sup>2</sup>, through a hose proportioner every four weeks during Summer.

#### **Stakes and ties**

Generally: If plants are unable to be self supported or if stakes are damaged, stake or restake the plants as follows:

- Drive three hardwood stakes placed obliquely with the first stake on the opposite side to the prevailing winds.
- Do not single stake large plants.

If plants are robust with well developed systems and are strong enough to no longer require support, remove stakes and ties.

#### **Plant replacements**

General: Replace all evergreen plants that have died or lost 50% of their normal foliage cover.

Provide replacement plants as follows:

- Of the same species and variety and of the closest commercially available size.
- Of uniformly high quality stock equal to the best commercially available.
- Representative of optimum growth for the species as restricted by the container size.
- With a balanced root system in relation to the size of the plant and conducive to successful transpiration. Inspect the root conditions of plants by knocking plants from their containers.
- Without signs of having been stressed at any stage during their development due to inadequate watering, excessive shade/sunlight, suffered physical damage or have restricted habit due to growth in nursery rows.
- Healthy, well grown, hardened off specimens of good shape and free from pests and disease.
- Well rooted and without any indication of having been restricted (pot bound) or damaged at any time.
- Been grown in their final containers for not less than twelve (12) weeks.

### **E22.2.3 WATERING**

#### ***Lawn and planted areas***

Generally: Maintain a vigorous healthy appearance.

Application rates: Soak to a depth of 150 mm for lawn and 300 mm for planting. Avoid frequent dampening of the surface. Allow the surface of the soil to partially dry out between waterings. Confirm soaked depth and record in the log book.

Timing: Water at times of day to minimise water evaporation loss. Do not water during the hottest period of Summer days.

Public areas without installed watering systems: Water only in excessive dry periods. Make available all necessary equipment to carry out hand and sprinkler watering as required.

Water restrictions: Coordinate the water supply and confirm the watering regime against federal and state government legislation and restrictions at the time.

#### ***Hand watering***

General: Manually water all planting areas in the absence of an irrigation system or until the proposed irrigation system is fully operational.

### **E22.2.4 MULCHING**

#### ***General***

Clean up: Remove all mulching materials off lawn or paved areas and maintain a clean and tidy appearance when viewed on a weekly basis.

Depth: Maintain a minimum depth of:

- 75 mm for organic mulch.
- 50 mm for gravel mulch.

Top up: Areas of excessive wear.

#### ***Pinebark***

Existing material: Hardwood chips or other chunky wood material with no more than 5% fines by volume 30 mm x 20 mm x 5 mm and the maximum length of chip is not to exceed 50 mm. It must be free of soil, weeds, stones, vermin, insects or other foreign material.

Appearance: Maintain to keep clean and tidy with no soil disturbance evident on the surface of the mulch.

### **E22.2.5 INCIDENTAL WORKS**

#### ***Undocumented work***

Separate contracts: Rubbish removal

#### ***Supplementary works***

General: Execute the following:

- Removal of rubbish arising from maintenance work.
- Removal of leaf litter fortnightly during leaf fall.
- Wash paving on completion of herbicide application.

#### ***Drains***

General: Inspect and clean all drainage structures and pit covers and ensure that they are in proper working order.

Frequency: As required so that all overflow drains are cleared when observed at fortnightly intervals.

**E22.3 SELECTIONS****E22.3.1 MAINTENANCE REPORT SCHEDULE****Monthly reports**

Minimum requirements: Check list.

**Table 6 Maintenance Report Schedule**

Item	Action
Plant material	Replace failed plants
	Additional planting
	Treat for disease or insect attack
	Tree surgery
	Fertilising generally
	Fertilising for specific nutrient deficiencies
	Thin out planting
	Pruning/trimming
Soil	Erosion/bank stabilisation
	Additional soil
	Soil conditioner
	Weeding
Mulch	Top up mulch
Rubbish removal	Generally remove bottles, paper, cigarette butts etc.
	Remove leaf, litter from path and paved areas

**E22.3.2 MAINTENANCE PROCEDURE SCHEDULE****Maintenance scope of works**

Minimum attendance: Check list.

**Table 7 Maintenance Scope of works**

WEEK	SPRING (Sept, Oct, Nov)	SUMMER (Dec, Jan, Feb)	AUTUMN (Mar, Apr, May)	WINTER (Jun, Jul, Aug)
1		weed		Weed
2	Weed; trim and adjust trees and shrubs	Weed; trim and adjust trees and shrubs	Weed; trim and adjust trees and shrubs	Trim and adjust trees and shrubs

**Landscape – maintenance**

3	treat plant material for insects and disease	weed; treat plant material for insects and disease		Weed
4	Weed; issue maintenance report	Weed; issue maintenance report	Weed; issue maintenance report	issue maintenance report
5	Fertilise all trees and shrubs in garden beds;	weed		
6	Weed; inspect mulch for deficiencies in cover;		Weed; inspect mulch for deficiencies in cover;	treat for insects and disease;
7	Reinstate mulch as required; treat plant material for insects and disease;	weed	Reinstate mulch as required;	Weed
8	Weed; issue maintenance report	issue maintenance report	Weed; issue maintenance report	issue maintenance report
9		treat plant material for insects and disease		Weed
10	Weed;		Weed; treat plant material for insects and disease	
11	trim and adjust trees and shrubs	weed	trim and adjust trees and shrubs	Prune back trees and shrubs after flowering
12	Weed; treat plant material for insects and disease		Weed	treat plant material for insects and disease
13	issue maintenance report	weed; issue maintenance report	weed; issue maintenance report	weed; issue maintenance report



<b>E23 PILING</b>
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### **E23.1 GENERAL**

#### **E23.1.1 SCOPE OF WORKS**

##### **General**

Work in this section shall include, without necessarily being limited to, the supply of all labour and materials for the installation of bored piles.

- "RTA QA Specification B59 Bored Cast-In-Place Reinforced Concrete Piles (Without Permanent Casing)",

#### **E23.1.2 CROSS REFERENCES**

##### **General**

Requirement: Conform to the following:

- General requirements.
- Concrete in situ.
- Concrete formwork.
- Concrete finishes.
- Concrete reinforcement

#### **E23.1.3 STANDARD**

##### **General**

Standard: To AS 2159.

#### **E23.1.4 INSPECTION**

##### **Notice**

Inspection: Give notice so that inspection may be made of the following:

- Setting out.
- Piles and piling material after delivery to site and before installation.
- Installation of piling.
- Pile heads after preparation.
- Pile load tests.

Concrete piles: Give notice so that inspection may be made of the following:

- Reinforcement cages after assembly and before installation.
- Excavated shafts, including casings and sockets before placing reinforcement.
- Reinforcement in excavated shafts, before concreting.
- Concreting of piles.

#### **E23.1.5 TOLERANCES**

##### **General**

Standard: For positional tolerances, cut-off levels, dimensional tolerances, straightness and inclination, conform to AS 2159 Section 7.2 and to the Tolerances schedule.

#### **E23.1.6 SUBMISSIONS**

##### **Execution details**

Subcontractor: Submit name and contact details for the proposed subcontractor specialising in foundation engineering.

Equipment: Submit details of proposed piling methods, equipment and sequence.

Jetting and pre-boring: If jetting or pre-boring methods are proposed in conjunction with pile driving, submit details of the proposed equipment and methods.

Concrete piles: Submit proposal for using high alumina and early strength cements.

Warranty: Submit details of the proposed warranty for the piling.

Submit: Record of data for piles showing information in AS 2159 clause 7.7.

Preservative treated timber piles: Submit treatment records.

#### **Tests**

Load tests: Submit load test report.

Acid portland soil test: Ascertain actual and potential acid portland to AS 4482.1.

Site geotechnical investigations: Submit all findings including Cone penetration test (CPT), sampling analysis and water table information.

#### **Warranty**

Some piling contractors offer standard forms of guarantee. If these are unsatisfactory it may be possible to negotiate better terms. But bear in mind that a guarantee is only as reliable as the firm that gives it. If the piling system is specified prescriptively, the contractor's warranty would be merely in terms of faulty materials and workmanship.

Rectification: Submit details of proposed warranty to correct faults and make good damage which is caused by the pile installation or subsequent movement to that part of the superstructure supported on the piling, or to adjacent property, or to both.

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### **E23.2 PRODUCTS**

#### **E23.2.1 CONCRETE AND GROUT PILES**

##### **Standard**

Concrete: To AS 2159, AS 3600 and AS 1379.

Grout: To AS 3600 and AS 3972.

Steel reinforcement: To AS/NZS 4671.

##### **Durability**

Restrictions on chemical content in concrete pile: To AS 3600 and AS 5100.5 for 100 year design.

Crack width: < 0.3 mm.

##### **Tests**

Moisture content: Testing for grout to ASTM C566-97 with expansion < 4%.

##### **Minimum cement content**

Generally: 320 kg/m<sup>3</sup>.

##### **High alumina and high early strength cements**

General: Do not use.

##### **Reinforcement**

Standard: To AS/NZS 4671.

Cover: Provide spacers on the reinforcement cage to maintain the correct cover. During installation of reinforcement in uncased holes keep the reinforcement cage clear of the sides of the hole.

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### **E23.3 EXECUTION**

#### **E23.3.1 INSTALLATION**

##### **Adjoining property**

Damage: If damage is caused to adjoining property, stop piling operations and give notice.

##### **Setting out**

Requirement: Peg the position of each pile and establish a grid of recovery pegs to enable the setting out to be checked. Provide survey record of in situ piles.

##### **Inspection**

General: Provide facilities necessary for inspection of piling including safe access, lighting and ventilation.

Monitor: Maintain pile integrity during driving. Stop and re-assess hammer type/size/drop if damage is detected.

**Piling system**

Installation: To AS 2159 Section 7.

Concrete bored piles:

- Loose material: Do not allow loose material to fall down pile holes before or during concreting.
- Liner: Pack well into position.

**Pile capacity**

Requirements: Conform to the **Pile capacity schedule**.

**Overdriven piles**

General: If the pile is driven below the specified level, give notice.

**Records of data**

Ground level: Record the level of the surrounding ground at the time when the pile is installed.

Records: During installation, keep records to conform to AS 2159 clause 7.7.

**E23.3.2 TESTING**

**Load tests**

Strength reduction factor: If the basic geotechnical strength reduction factor  $\leq 0.4$  no load testing is required unless documented for the confirmation of construction methods or integrity testing.

Failure: If a test pile fails to meet the load test requirements, give notice.

**Concrete and grout**

During installation: Sample and test concrete/grout to AS 1012.

**E23.3.3 PREPARING PILE HEADS**

**General**

Requirement: Prepare pile heads for inclusion into the structure.

Defective material: If the pile at or below cut off level, is damaged by driving, or is otherwise unsound, give notice.

**Concrete piles**

Preparation: Roughen the surface at cut-off level. Clean and straighten any projecting reinforcement.

**E24 CONCRETE FORMWORK****E24.1 GENERAL****E24.1.1 SCOPE OF WORKS****General**

Work in this section shall include, without necessarily being limited to, the supply of all labour and materials for the supply and fixing of formwork, and reinforcement and the placement of insitu concrete.

All works to conform to the standard unedited version of:

- "RTA QA Specification B80 Concrete Works for Bridges", edition 5, revision 5, dated January 2010, and
- "TfNSW Engineering Specification – SPC301 Structures Construction" version 1.0, dated July 2010.

The most stringent requirement will be applied when two or more standards specify conflicting requirements.

**E24.1.2 RESPONSIBILITIES****General**

General: Construct formwork so that the concrete, when cast in the forms, has the required:

- Dimensions.
- Location.
- Profile.
- Shape.
- Finish.

Allowances: Allow for dimensional changes, deflections and cambers resulting from the following:

- Imposed actions.
- Concrete shrinkage and creep.
- Temperature changes.
- The application of prestressing forces (if any).

Selections: Conform to the **Selections**.

**Design**

General: The design of formwork, other than profiled steel sheeting composite formwork, is the contractor's responsibility.

**E24.1.3 CROSS REFERENCES****General**

Requirement: Conform to the following:

- *General requirements.*
- *Concrete in situ.*
- *Concrete finishes.*
- *Concrete reinforcement.*
- *Precast concrete.*

**E24.1.4 TOLERANCES****General**

Plumb of elements  $\geq 8$  m high: 1 in 1000.

Plumb of elements  $\geq 8$  m high: To AS 3610.1.

Position: Construct formwork so that finished concrete conforms to AS 3600 clause 17.5 and the **Dimensional deviations schedule**.

**E24.1.5 INSPECTION****Notice**

Inspection: Give notice so that inspection may be made of the following:

- Completed formwork before concrete placing.

**E24.2 EXECUTION****E24.2.1 CERTIFICATION****General**

All requested certification within structural specification to be issued by qualified Structural Engineer with NPER.

**E24.2.2 COMPLETION****Formwork removal**

Extent: Remove formwork, other than profiled steel sheeting composite formwork, including formwork in concealed locations, but excepting lost formwork.

Timing: Do not disturb forms until concrete is hardened enough to withstand formwork movements and removal without damage.

Stripping:

- General: To AS 3600 where it is more stringent than AS 3610.1.
- Vertical forms: Remove formwork that does not support weight of concrete from faces of beams, walls and columns not less than a cumulative 24 hours after placing concrete during which the ambient outdoor temperature has been greater than 10°C.

**Loading before stripping**

General: Do not erect masonry walls or other brittle elements on beams and slabs while they are still supported by formwork.

**E24.3 SELECTIONS****E24.3.1 SCHEDULE**

Dimension or measurement	Location or element	Deviation (mm)
Absolute position	Class 1 surface	10
	Class 2 surface	15
	Class 3 surface	20
	Class 4 surface	25
	Class 5 surface	30

**E25 CONCRETE REINFORCEMENT****E25.1 GENERAL****E25.1.1 SCOPE OF WORKS****General**

Work in this section shall include, without necessarily being limited to, the supply of all labour and materials for the installation of steel reinforcement in all structures as detailed.

All works to conform to the standard unedited version of:

- "RTA QA Specification B80 Concrete Works for Bridges", edition 5, revision 5, dated January 2010, and
- "TfNSW Engineering Specification – SPC301 Structures Construction" version 1.0, dated July 2010.

The most stringent requirement will be applied when two or more standards specify conflicting requirements.

**E25.1.2 RESPONSIBILITIES****General**

General: Provide concrete reinforcement and include the following:

- Supply.
- Fixing in place.
- Maintain position during concreting.

**E25.1.3 CROSS REFERENCES****General**

Requirement: Conform to the following:

- *General requirements.*
- *Concrete in situ.*

**E25.1.4 INSPECTION****Notice**

Inspection: Give notice so that inspection may be made of the following:

- Cores and embedments fixed in place.
- Reinforcement fixed in place, with formwork completed.

**E25.1.5 CONSTRUCTION****Dowels**

Fixing: If a dowel has an unpainted half, embed this in the concrete placed first.

Tolerances:

- Alignment: 2 mm in 300 mm.
- Location:  $\pm$  half the diameter of the dowel.

Grade: 250 N.

**Supports**

General: Provide proprietary concrete, metal or plastic supports to reinforcement in the form of chairs, spacers, stools, hangers and ties, as follows:

- Adequate to withstand construction and traffic loads.
- With a protective coating if they are ferrous metal extending to the surface of the concrete, or are used with galvanized or zinc-coated reinforcement.

Minimum spacing:

- Bars:  $\leq$  60 diameters.
- Mesh:  $\leq$  800 mm.

Supports over membranes: Prevent damage to waterproofing membranes or vapour barriers. If appropriate place a metal or plastic plate under each support.

**Projecting reinforcement**

General: If 'starter' or other bars project beyond reinforcement mats or cages, through formwork or from cast concrete, provide a plastic protective cap to each bar until it is incorporated into subsequent work.

**Tying**

General: Secure the reinforcement against displacement by tying at intersections with either wire ties, or clips. Bend the ends of wire ties away from nearby faces of forms so that the ties do not project into the concrete cover.

Beams: Tie stirrups to bars in each corner of each stirrup. Fix other longitudinal bars to stirrups at 1 m maximum intervals.

Bundled bars: Tie bundled bars together so that the bars are in closest possible contact. Provide tie wire at least 2.5 mm diameter at centres  $\leq 24$  times the diameter of the smallest bar in the bundle.

Columns: Secure longitudinal column reinforcement to all ties at every intersection.

Mats: For bar reinforcement in the form of a mat, secure each bar at alternate intersections

**Cleaning**

General: Remove all debris from the formed space.

**E25.1.6 CERTIFICATION**

**General**

All requested certification within structural specification to be issued by qualified Structural Engineer with NPER.

**E25.1.7 COMPLETION**

**Unencased reinforcement**

General: If 'starter bars' and other items project from cast concrete for future additions and are exposed to the weather, provide details of protection.

**E26 CONCRETE IN SITU****E26.1 GENERAL****E26.1.1 SCOPE OF WORK****General**

Work in this section shall include, without necessarily being limited to, the supply of all labour and materials for the placement and finish of concrete into forms following placement of reinforcement.

All works to conform to the standard unedited version of:

- "RTA QA Specification B80 Concrete Works for Bridges", edition 5, revision 5, dated January 2010, and
- "TfNSW Engineering Specification – SPC301 Structures Construction" version 1.0, dated July 2010.

The most stringent requirement will be applied when two or more standards specify conflicting requirements.

**E26.1.2 RESPONSIBILITIES****General**

Provide concrete in situ that:

- Conforms to design details.
- Satisfies quality and inspection requirements.
- Conforms to the **Selections**.

**E26.1.3 CROSS REFERENCES****General requirements**

Requirement: Conform to the following:

- *General requirements.*
- *Concrete formwork.*
- *Concrete reinforcement.*
- *Concrete finishes.*

**E26.1.4 INSPECTION****Notice**

Inspection: Give notice so that inspection may be made of the following:

- Base or subgrade before covering.
- Membrane or film underlay installed on the base or subgrade.
- Completed formwork, and reinforcement, cores, fixings and embedded items fixed in place.
- Surfaces or elements to be concealed in the final work before covering.
- Commencement of concrete placing.

**E26.1.5 CONCRETE****Site mixed supply**

Do not use.

**E26.1.6 PLACING AND COMPACTION****Time between adjacent placements**

General: Conform to the **Minimum time delay schedule**.

**E26.1.7 CURING****General**

Curing of all concrete to be "wet curing" as specified in RTA QA B80.

**E26.1.8 CERTIFICATION****General**

All requested certification within structural specification to be issued by qualified Structural Engineer with NPER.

**E26.1.9 COMPLETION****Loading**

Loading: Give notice before loading the concrete structure.

Protection: Protect the concrete from damage due to construction load overstresses, physical and thermal shocks, and excessive vibrations, particularly during the curing period.

Surface protection: Protect finished concrete surfaces and applied finishes from damage.

**E26.1.10 SCHEDULES****Properties schedule – performance**

	Location or element
Normal and special class	Refer to structural drawings
Maximum aggregate size (mm)	Refer to structural drawings
Slump (mm)	Refer to RTA QA B80
Strength grade/characteristic compressive strength $f$ (Mpa)	Refer to structural drawings
Cement type	Refer to structural drawings
Drying shrinkage	Refer to RTA QA B80
Water:cement ratio maximum	Refer to RTA QA B80

**Minimum time delay schedule**

Between (pour locations)	Minimum period between adjacent pours (days)
Adjacent pours abutting horizontal construction joints in walls or columns	1
Adjacent pours abutting vertical construction joints in walls	7
Columns and slabs	1
Floor slab construction joints	1
'Pour strips' and adjacent concrete	56
Retaining wall construction joints	1

**E27 CONCRETE FINISHES****E27.1 GENERAL****E27.1.1 SCOPE OF WORKS****General**

Work in this section shall include, without necessarily being limited to, the supply of all labour and materials for the finishing of concrete placed as specified before.

All works to conform to the standard unedited version of:

- "RTA QA Specification B80 Concrete Works for Bridges", edition 5, revision 5, dated January 2010, and
- "TfNSW Engineering Specification – SPC301 Structures Construction" version 1.0, dated July 2010.

The most stringent requirement will be applied when two or more standards specify conflicting requirements.

**E27.1.2 RESPONSIBILITIES****General**

General: Provide finishes to formed and unformed concrete surfaces as follows:

- Appropriate to the importance (visual or physical) of the concrete elements.
- Compatible with following trades and finishes.

**E27.1.3 CROSS REFERENCES****General**

Requirement: Conform to the following:

- *General requirements.*
- *Concrete formwork.*
- *Concrete in situ.*

**E27.1.4 STANDARDS****General**

Formed surfaces: To AS 3610.1.

**E27.1.5 INTERPRETATIONS****Definitions**

General: For the purposes of this worksection, the following definition applies:

- Green concrete: Concrete which has set but not appreciably hardened.

**E27.1.6 INSPECTION****Notice**

Inspection: Give notice so that inspection may be made of the following:

- Evaluation of the off-form finishes to formwork.

**E27.1.7 SUBMISSIONS****Execution documentation**

Shop drawings: Submit formwork shop drawings including details of proposed form linings, form bolt positions, form facings, release agents and, where applicable, reuse of formwork.

**E27.1.8 TOLERANCES****Surface quality**

Formed surfaces: Confirm conformance with the surface finish requirements of AS 3610.1 for the surface class nominated in the **Formed surface finishes schedule**.

**Flatness**

Unformed surfaces: Confirm conformance with the **Flatness tolerance classes table** for the class of finish nominated using a straight edge placed anywhere on the surface in any direction.

**Flatness tolerance class table**

Class	Measurement	Maximum deviation (mm)
A	3 m straight edge	3
B	3 m straight edge	6
C	600 mm straight edge	6

**E27.1.9 SURFACE TREATMENT****General**

Range: Do not proceed with the related work until the acceptable range of surface treatments has been determined.

**E27.2 PRODUCTS****E27.2.1 MATERIALS****Surface hardeners, sealants and protectors**

Supply: If required by the project documentation, provide proprietary products.

**E27.3 EXECUTION****E27.3.1 SURFACE MODIFIERS****General**

Application: Apply to clean surfaces in accordance with the manufacturer's requirements.

**E27.3.2 FORMED SURFACES****General**

General: Provide formed concrete finishes in conformance with the **Formed surface finishes schedule**.

Damage: Do not damage concrete works through premature removal of formwork.

**Curing**

General: If forms are stripped when concrete is at an age less than the minimum curing period, commence curing exposed faces as soon as the stripping is completed.

**Evaluation of formed surfaces**

General: If evaluation of formed surface tolerance or colour is required, complete the evaluation before surface treatment.

**Finishing methods**

General: If soffits of concrete elements or faces of concrete columns are to have a finish other than off the form, provide details of proposed procedures.

**Blasted finishes:**

- Abrasive: Blast the cured surface using hard, sharp graded abrasive particles until the coarse aggregate is in uniform relief.
- Light abrasive: Blast the cured surface using hard, sharp graded abrasive particles to provide a uniform matt finish without exposing the coarse aggregate.

Bush hammered finish: Remove the minimum matrix using bush hammering to expose the coarse aggregate, recessing the matrix no deeper than half the aggregate size, to give a uniform texture.

Exposed aggregate finish: Remove the vertical face forms while the concrete is green. Wet the surface and scrub using stiff fibre or wire brushes, using clean water freely, until the surface film of mortar is mechanically removed, and the aggregate uniformly exposed. Do not use acid etching. Rinse the surface with clean water.

**Floated finishes:**

- Sand floated finish: Remove the vertical face forms while the concrete is green. Wet the surface and rub using a wood float. Rub fine sand into the surface until a uniform colour and texture are produced.

- Grout floated finish: Remove the forms while the concrete is green. Dampen the surface and spread a slurry, using hessian pads or sponge rubber floats. Remove surplus slurry and work until a uniform colour and texture are produced.

Smooth rubbed finish: Remove the vertical face forms while the concrete is green. Wet the surface and rub using a carborundum or similar abrasive brick until a uniform colour and texture are produced.

#### Surface repairs

Surface repair method: If surface repairs are required, submit proposals.

### E27.3.3 UNFORMED SURFACES

#### General

General: Strike off, screed and level slab surfaces to finished levels, to the tolerance class noted in the **Unformed surface finishes schedule**.

#### Surface finishes

General: Provide surface finishes in conformance with the **Unformed surface finishes schedule**.

#### Surface repairs

Surface repair method: If surface repairs are required, submit proposals.

#### Finishing methods – primary finish

Machine float finish:

- After levelling, consolidate the surface using a machine float.
- Cut and fill and refloat immediately to a uniform, smooth, granular texture.
- Hand float in locations inaccessible to the machine float.

Steel trowel finish: After machine floating finish as follows:

- Use power or handsteel trowels to produce a smooth surface relatively free from defects.
- When the surface has hardened sufficiently, retrowel to produce the final consolidated finish free of trowel marks and uniform in texture and appearance.

Burnished finish: Continue steel trowelling until the concrete surface attains a polished or glossy appearance, uniform in texture, appearance and free of trowel marks and defects.

Wood float finish: After machine floating use wood or plastic hand floats to produce the final consolidated finish free of float marks and uniform in texture and appearance.

Broom finish: After machine floating and steel trowelling draw a broom or hessian belt across the surface to produce a coarse even-textured transverse-scored surface.

Scored or scratch finish: After screeding, give the surface a coarse scored texture using a stiff brush or rake drawn across the surface before final set.

Sponge finish: After machine floating and steel trowelling, produce an even textured sand finish by wiping the surface using a damp sponge.

#### Finishing methods – supplementary finish

Abrasive blast: After steel trowelling, abrasive blast the cured surface to provide texture or to form patterns without exposing the coarse aggregate using hard, sharp graded abrasive particles.

Exposed aggregate: After steel trowelling, grind the cured surface of the concrete to expose the coarse aggregate.

### E27.4 SELECTIONS

#### E27.4.1 SCHEDULES

##### Formed surface finishes schedule

Property	A	B
Type	All exposed surfaces	Unexposed surfaces
Location	Retaining walls, slab and stair soffits	Concealed surfaces generally
Surface finish class to AS 3610.1	Class 2	Class 4
Form lining type	New Ply	Ply
Colour control	Class 2	-

Property	A	B
Bolt hole filling	Required	-
Surface finish type	Class 2	-
Special requirements	Concrete surface of retaining walls shall incorporate 100mm wide x 30mm deep grooves as shown on drawings.	

## Unformed surface finishes schedule

Property	Type		
	A	B	C
Type	Exposed surface	Surfaces to be covered by vinyl or carpet	Unexposed surfaces
Location	Stairs, ramps, platforms	Various areas as scheduled	Concealed surfaces
Flatness tolerance class	A	A	-
Primary finish	Steel trowel	Steel trowel	-
Supplementary finish	Light broom	-	-
Slip resistance class to AS/NZS 4663: - Wet pendulum - Dry floor friction	Wet pendulum / V	-	-

**E28 STRUCTURAL STEEL****E28.1 GENERAL****E28.1.1 SCOPE OF WORKS****General**

Work in this section shall include, without necessarily being limited to, the supply of all labour and materials for the fabrication and erection of structural steel as detailed.

All works to conform to the standard unedited version of:

- "RTA QA Specification B240 Supply of Bolts, Nuts, Screws and Washers", edition 4, revision 0, dated August 2008,
- "RTA QA Specification B241 Manufacture and Supply of Minor Steel Items", edition 4, revision 0, dated December 2008, and
- "TfNSW Engineering Specification - SPC301 Structures Construction" version 1.0, dated July 2010.

Steelwork surface treatment:

- Hot dipped galvanised finish to comply with S25 in "TfNSW Engineering Specification - SPC301 Structures Construction" version 1.0, dated July 2010.
- Protective paint finish to comply with S24 in "TfNSW Engineering Specification - SPC301 Structures Construction" version 1.0, dated July 2010.

The most stringent requirement will be applied when two or more standards specify conflicting requirements.

**E28.1.2 RESPONSIBILITIES****General**

General: Provide structural steelwork that is integrated into the building construction.

**E28.1.3 CROSS REFERENCES****General**

Requirement: Conform to the following:

- *General requirements.*
- *Steel – hot-dip galvanized coatings.*

**E28.1.4 STANDARDS****General**

Materials, construction, fabrication and erection: To AS 4100.

Cold-formed steel: AS/NZS 4600.

**E28.1.5 INSPECTION****Notice – off site**

Inspection: Give notice so that inspection may be made of the following:

- Before placement of root runs of complete penetration butt welds.
- Completion of fabrication before surface preparation.
- Surface preparation before shop painting.
- Completion of protective coating before delivery to site.

**Notice – on site**

Inspection: Give notice so that inspection may be made of the following:

- Anchor bolts in position before casting in.
- Steelwork and column bases erected on site, before grouting, encasing, site painting or cladding.
- Tensioning of bolts in categories 8.8/TB and 8.8/TF.
- Reinforcement and formwork in place prior to any encasement.
- After any grouting, encasement, fire protection or site painting is completed.

**E28.1.6 TESTS****Non destructive weld examination**

Standard: To AS/NZS 1554.1.

Methods: Inspect welds in conformance with the **Non-destructive weld examination (NDE) table**.

Radiographic and ultrasonic inspection: Have the examination performed by an independent testing authority.

Repairs: Repair welds revealed as faulty by non-destructive examination and repeat the examination.

**Non-destructive weld examination (NDE) table**

Type of weld and category	Examination method	Extent (% of total length of weld type)
Shop fillet welds	Visual means	100
Site fillet welds	Visual means	100
Butt welds, GP	Visual means	100
Butt welds, SP	Visual means	100
Fillet and butt welds, SP	Radiographic or ultrasonic inspection	10

**E28.1.7 SUBMISSIONS****Origin of steel**

Requirement: If it is proposed to use steel not of Australian origin, submit documentation which demonstrates that the steel complies and is suitable for fabrication to Australian standards.

**Bolts**

Compliance: Submit a manufacturer's compliance/test certificate from an accredited testing organization confirming compliance with AS/NZS 1252.

Independent certification: If bolts manufactured from outside Australia, provide a local NATA-accredited laboratory independent compliance certificate based on appropriate testing and verification.

**Subcontractors**

General: Submit names and contact details of proposed fabricator and installer.

**Shop drawings**

General: Submit shop drawings showing the following information:

- Relevant details of each assembly, component and connection.
- Information relative to fabrication, surface treatment, transport and erection.

Particular: Include the following information:

- Marking plans.
- Identification:
- Steel type and grade.
- Dimensions of items.
- Required camber, where applicable.
- Fabrication methods including, where applicable, hot or cold forming and post weld heat treatment.
- Location, type and size of welds and/or bolts and bolt holes.
- Weld categories and bolting categories.
- Orientation of members.
- Surface preparation methods and coating system if shop applied.
- Best practice details in relation to application of protective coatings.
- Breather holes for hollow sections (with seal plates) being hot-dip galvanized.
- Procedures necessary for shop and site assembly, and erection.
- Location of and preparation for site welds.
- Temporary works such as lifting lugs, support points, temporary cleats and bracing which are required for transport and erection of the structural steelwork, and the procedure for final removal.
- Required fixings for adjoining building elements.

Substitution: If alternative sections or connections are proposed, provide details.

Purlins and girts: If it is proposed to support other than cladding on or from purlins and girts, provide details.

Splices: If variations to documented splice locations or if additional splices are proposed, submit details.

**Record drawings**

General: Supply as-built structural and shop drawings.

**Tests**

Steel: Submit evidence that the steel used in the work complies with the cited material standards.

Acceptable evidence: Certified mill test reports, or test certificates issued by the mill.

Alternative: Have the steel tested by an independent testing authority for compliance with the chemical composition and mechanical test requirements of the cited material standard.

**Materials and components**

Concrete or masonry anchors: If masonry anchors other than as shown on the drawings are required or proposed for the support or fixing of structural steel, submit evidence of the anchor capacity to carry the load.

**Execution**

Anchor bolts: If anchor bolts do not meet specified location tolerances, submit proposals that will allow steel erection to proceed.

Splicing: If splicing of structural members is intended, submit proposals.

Welding procedures: Submit details of proposed welding procedures, using the WPS form in Appendix C of AS/NZS 1554.1.

Identification marks: If members and/or connections are to be exposed to view submit details of proposed marking.

Distortions: Submit proposals for preventing or minimising distortion or galvanized components, welded components or welded and galvanized components; and proposals for restoration to design shape.

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**E28.2 EXECUTION**

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**E28.2.1 FABRICATION AND ERECTION**

**General**

Care: Shop detail and fabricate members so that they can be properly erected.

Substitution: If substitution of members is proposed, provide details.

**Beam camber**

General: If beam members have a natural camber within the straightness tolerance, fabricate and erect them with the camber up.

**Straightening**

Care: If correcting distorted members, conform to the submitted procedures and avoid damage.

**Work exposed to view**

Welds: Grind smooth but do not reduce the weld below its nominal size.

Corners and edges: Grind fair those corners and edges, which are sharp, marred, or roughened.

**Site work**

General: Other than work shown on the shop drawings as site work, do not fabricate, modify or weld structural steel on site.

**Identification marks**

General: Provide marks or other means of identifying each member compatible with the finish, for the setting out, location, erection and connection of the steelwork in accordance with the marking plans.

High strength bolting: If the work includes more than one bolting category, mark high-strength structural bolted connections with a 75 mm wide flash of colour, clear of holes.

Cold formed members: Clearly mark material thickness.

Monorail beams: Identify and mark rated capacity in accordance with AS 1418.18 clause 5.12.6.

### **Tolerances**

Measurement: Tolerances are to be checked by measurement after fabrication when corrosion protection has been applied.

Conformance: To AS 4100 clause 14.4.

### **E28.2.2 ERECTION**

#### **General**

Standard: To AS 3828.

Execution: Ensure that every part of the structure has sufficient design capacity and is stable under construction loads produced by the construction procedure or as a result of construction loads, which are applied.

Calculations: If required to justify the adequacy of the structure to sustain any loads and/or procedures, which may be imposed, provide calculations.

#### **Temporary work**

General: Provide all necessary temporary bracing or propping.

Temporary connections: If required cleats are not shown on shop drawings, submit details.

Temporary members: If temporary members are required, fix so as not to weaken or deface permanent steelwork.

#### **Hand flame cutting**

General: Do not hand flame cut bolt holes.

#### **Movements**

General: Allow for thermal movements during erection.

#### **Site welds**

Completion: Weld only when correct alignment and preset or camber have been achieved.

Overhead welding: If overhead welding is required, submit proposals.

#### **Clearances**

End clearances at connections (mm): 2mm

#### **Anchor bolts**

General: For each group of anchor bolts provide a template with setting out lines clearly marked for positioning the bolts when casting in.

#### **Grouting at supports**

Preparation: Before grouting steelwork to be supported by concrete or masonry, set steelwork on packing or wedges.

- Permanent packing or wedges: Form with solid steel or grout of similar strength to the permanent grout.
- Temporary packing or wedges: Remove before completion of grouting.

Timing: Grout at supports before the construction of any supported floors, walls, roofing, wall cladding or precast.

Temperature: Do not grout if the temperature of the base plate or the footing surface exceeds 35°C.

Method: Dry pack with stiff cement mortar

Type: High strength non-shrink grout

Minimum compressive strength (MPa): 40MPa

Minimum thickness (mm): 10

Maximum thickness (mm): 30

#### **Handling**

Care: Handle members or components without overstressing or deforming them.

Protection: Wrap or otherwise protect members or components to prevent damage to surface finishes during handling and erection.

#### **Drifting**

Limitation: Use drifting only to bring members into position, without enlarging holes or distorting components.

**E28.2.3 REPAIRS**

**General**

General: Repair finishes to ensure the full integrity of each phase and each coating.

**E28.2.4 COMPLETION**

**Tolerances**

Compliance: After erection is complete confirm compliance with AS 4100 clause 15.3.

**Temporary connections**

General: Remove temporary cleats on completion and restore the surface.

**E29 STEEL – PROTECTIVE PAINT COATINGS**

**E29.1 GENERAL**

**E29.1.1 RESPONSIBILITIES**

**General**

General: Provide protective paint coatings that control corrosion to structural steelwork and steel products in the time to first scheduled maintenance as documented.

**E29.1.2 CROSS REFERENCES**

**General**

Requirement: Conform to the following:

- *General requirements.*
- Painting

**E29.1.3 STANDARDS**

**General**

Surface preparation and coating: Conform to the recommendations of AS/NZS 2312.

**Site testing of protective coatings**

Test methods: To AS 3894.

**E29.1.4 INTERPRETATIONS**

**Abbreviations**

General: For the purposes of this worksection the following abbreviations apply:

DFT: Dry Film Thickness.

ITP: Inspection and Test Plan.

µm: micron ( $10^{-6}$ m).

**Definitions**

General: For the purposes of this worksection the definitions given in AS/NZS 2310 and those below apply.

- Coating contractor: The protective coatings application contractor conducting the on or off site coating application works.
- Coating manufacturer: The supplier and/or manufacturer of the protective coating materials used.
- ITP: A series of formal Inspection and Test Plans, prepared by the coating contractor to reflect the specific inspection and testing that will be carried out on the surface preparation, coating application and the record keeping tasks to be undertaken.
- MSDS: The formal Material Safety Data Sheet, prepared in accordance with Worksafe Australia's requirements and distributed by the coating manufacturer to provide information on the safe handling, storage, personal protective equipment requirements, use and disposal of a coating product.

**E29.1.5 INSPECTION**

**Notice**

Inspection: Give notice so that inspection may be made of the following:

- Items after fabrication before commencing surface cleaning and preparation.
- Surfaces after preparation before application of first coating.
- Coating stages:
  - . After application of primer or seal coats.
  - . After application of each subsequent coat.

## **E29.1.6 SUBMISSIONS**

### **Licence**

Requirement: Submit proof of currency of the applicator's Environmental Operating Licence.

### **Detailing of structural steelwork**

General: If design and fabrication features of the items to be coated may lead to difficulties, advise before commencing surface preparation.

### **Quality**

ITPs: Submit for each proposed coating system.

Quality supervisor: Submit the name and the experience record of the person nominated to oversee the implementation of the ITPs.

### **Removal of deleterious materials**

General: Submit advice on suitability of marking paints, and removal of materials deleterious to coating processes such as grease, oil and paint.

### **Repair of coating damage**

General: If the protective coating is damaged, submit a repair coating proposal, based on the coating manufacturer's technical data sheet, that will ensure that the full corrosion protection ability of the system is reinstated.

### **Reinstatement**

Final coat reinstatement: If required due to variance, submit proposals for reinstatement of the visible final coating system to match the original coating system samples.

### **Records**

General: Prepare and maintain records of all surface preparation and coating application works as follows:

- Standard: To AS 3894.10, AS 3894.11, AS 3894.12, AS 3894.13 and AS 3894.14.
- Reference the relevant parts of the ITPs, and record conformance.

### **Maintenance paint coating systems**

Existing systems: Itemise areas of corrosion, damage, and other degradation.

Recoating systems: Supply coating systems for maintenance painting of previously coated items and structural elements, including surface preparation, to the **Protective paint coating schedule**.

### **Warranties**

General: Submit details of the proposed warranty terms, form and period. If separate warranties are offered by the manufacturer and the applicator, ensure they are interlocking.

## **E29.1.7 SAMPLES**

### **Painting and coating colour**

General: Submit a sample of the finished product for each different coating system.

Size of each sample: 400 x 400 mm.

Retention: Retain half of each sample for comparison during coating application.

## **E29.1.8 TESTING**

### **General**

Conformance: All areas of any item must meet the required cleanliness standard.

### **Abrasive blast cleaning**

Assessment: To AS 1627.4 and ISO 8501-1.

### **Power tool cleaning**

Assessment: To AS 1627.2 and ISO 8501-2.

- Class 2.5.

### **Hand tool cleaning**

Visual assessment: To ISO 8501-2.

- Class 2.5.

### **Surface profile**

General: To AS 3894.5.

Profile grade: To AS 3894.5 Method A.

**Surface dust from abrasion**

General: To AS 3894.6 Method C.

**Chloride level testing**

Test: To AS 3894.6 Method A.

Maximum allowable chloride levels: 50 mg/m<sup>2</sup>.

Conformance: If this level is exceeded, rewash the affected surface area using fresh water until the chloride level is within acceptable limits. There are chloride neutralizing solutions commercially available. Jetwashing or steamcleaning is also acceptable before re testing and re-abrasive blasting.

Timing of testing: early in the blasting work so that removal procedures can be initiated before the blasting is completed.

**Wet film thickness**

Method of measurement: To AS 3894.3, Appendix C using an approved wet film gauge continuously during application.

**Dry film thickness**

Method of measurement: To AS 3894.3, clause 10.

Extent: All surfaces at the completion of each of the prime, intermediate and finish coats, in particular include areas of the structure which are difficult to paint, are masked by structure, or areas where double coating or light coating is likely due to the shape of the substrate.

Number of measurements: Perform a sufficient number of readings to ensure a representative account for the DFT compliance of the coated areas tested.

Deduction: If testing the DFT of coatings 150 µm and less, deduct the effect of the measured surface profile from all DFT readings.

Single readings: Single reading requirements are as follows:

- Check any single reading that is less than 80% of the specified DFT with three additional readings within 50 mm of the original reading. If these three readings average not less than 90% of the specified DFT, take the averaged readings to be the "point reading". If less than 90%, reject the DFT in that area.
- Check any single reading that is greater than 150% of the specified DFT with three additional readings within 50 mm of the original reading. If these three readings average not greater than 150% of the specified DFT, take the averaged readings to be the "point reading". If greater than 150%, reject the DFT in that area.

Rectification: Re-work areas rejected, using surface preparation and coatings in the same manner and order as the original work.

Defects including underthickness and overthickness : Mark with school grade chalk, adhesive inspection labels or masking tape. Do not use crayon, paint or spirit based ink pens.

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**E29.2 PRODUCTS**

**E29.2.1 GENERAL**

**General**

Care: Handle, store, mix and apply all protective coatings strictly in accordance with the manufacturer's instructions.

Original containers: Provide coating products in unopened containers bearing the brand name and name of the manufacturer with a clearly legible batch number.

Ambient temperature range for storage: 15°C to 25°C.

Use-by-date: Use products with limited shelf life before their use-by-date unless written authorisation from the coating manufacturer's technical services section is provided.

**Proprietary products**

Requirement: Provide all products in the **Protective paint coating schedule** from the one manufacturer's supply.

**Material safety data sheets (MSDS)**

Requirement: Keep on site copies of all relevant MSDSs.

## E29.3 EXECUTION

### E29.3.1 GENERAL

#### General

Product warnings: Conform to the requirements and recommendations of product MSDS.

### E29.3.2 PROTECTION

#### Surroundings

Protection: Prevent the release of abrasive, overspray or paint waste debris to air, ground or to any watercourse. Repair or clean affected surrounding areas.

Damage: Prevent damage to other assets, services or equipment.

#### Contamination

Coating contamination: Prevent contamination of coatings contaminated from abrasive or other foreign matter.

Surfaces: Prevent contamination of coated surfaces which are not yet dry from blasting dust, abrasive or surface preparation debris.

#### On site storage

General: Deliver coatings to site in the original unopened containers coatings and store in a cool shady place.

Sunlight: Protect coating materials from direct sunlight before mixing or adding the converter (catalyst).

#### Post application care

General: Provide protection to the coating against physical, chemical, or atmospheric damage until all components are fully cured.

Care: Stack and handle all coated items using fabric slings or padded chains. Adopt soft packaging, carpet strips or other deformable materials between all coated items.

Water ponding: Stack coated items to prevent water ponding.

### E29.3.3 SURFACE PREPARATION

#### General

Defects: Remove all surface defects, including cracks, laminations, deep pitting, weld spatter slag, burrs, fins, sharp edges and other defects before the preparation of the surface to be coated.

Temporary welds: Grind flush temporary welds.

Site welding: Where possible avoid site welding.

Porous, skip or stitch welds: Not acceptable.

Edges: De-burr and round all edges to a 2 mm radius.

Surface contaminants: Remove surface contaminants such as oil, grease, dirt and loose particles, using an alkaline oil emulsifier/degreaser to AS 1627.1.

Surface preparation: Prepare surfaces to the required finish to AS 1627.1 , AS 1627.2, AS 1627.4, AS 1627.5, AS 1627.6 and AS 1627.9.

Surface cleaning: Remove spent abrasive from the surface by blowing with clean, dry air and/or by vacuum cleaning.

Bolts: Provide washers at heads and nuts at replacement bolts.

#### Surface preparation for atmospheric steel

General: Comply to the following requirements:

- Wash and degrease all surfaces to be coated in accordance with AS 1627.1 with a free-rinsing, alkaline detergent, in strict accordance with the manufacturer's written instructions and all safety warnings.
- Wash with fresh potable water and ensure that all soluble salts are removed in accordance with AS 3894.6 Methods A and D.
- Grind all sharp edges with a power tool to a minimum radius of 2 mm.
- Power tool clean welds to AS 1627.2 Class 2 to remove roughness. Remove filings, preferably by vacuum or compressed air.

- Abrasive blast clean all steel surfaces to be painted in accordance with AS 1627.4 to visual standard AS 1627.9 Class 2.5 (equivalent to ISO 8501-1, Sa 2.5: Very Thorough Blast-Cleaning). Use a non-metallic medium that will generate a surface profile of 35 to 65 microns (as tested to AS 3894.5 Method A.).
- Commence application within 4 hours of abrasive blast cleaning or before surface becomes contaminated, otherwise repeat abrasive blasting step.
- Stripe coat welds, bolts, boltholes and all edges with primer before application of full primer coat nominated in the **PROTECTIVE PAINT COATING SYSTEMS**.
- Before application, ensure that the surface is free of contaminants including oil, grease, dirt, dust, salt and any other deleterious materials that will interfere with coating performance.

#### **Treatment of on-site welding**

On-site welding: If on site welding is performed, adopt the following procedures:

- Remove weld spatter.
- Power tool clean welds to AS 1627.2 Class 2 to remove roughness. Remove filings, preferably by vacuum or compressed air.
- Prime welds immediately with the nominated primer before contamination can reoccur. Ensure that the primer overlaps the sound adjacent coating by between 25 mm and 50 mm.
- Apply intermediate and topcoats over the primed welds to match the surrounding coating system, overlapping the sound adjacent coating by between 25 mm and 50 mm.

#### **Preparing galvanized and aluminium surfaces**

Remove grease, oil and other solvent-soluble contaminants by wiping with mineral turpentine or white spirit. Finally wipe with a clean solvent. Allow to dry and proceed with the next operation immediately. Abrade surfaces to a medium coarse type finish to provide an adhesion key.

#### **Primed zinc primed surfaces**

If present, remove zinc salts from zinc primers. Remove grease, oil and other solvent-soluble contaminants by wiping with mineral turpentine or white spirit. Finally wipe with a clean solvent. Allow to dry and proceed with the next operation immediately.

#### **Shop priming**

Dust off and apply a coat of primer, according to the technical specification.

#### **Site coating**

General: High pressure fresh water wash down all surfaces. Lightly sand down primer/intermediate coats, which have been shop applied, before site application of next coat.

### **E29.3.4 MIXING**

#### **General**

Mixing: Mix coatings thoroughly. Mix package sizes larger than 4 litres using powered agitators driven by air motors.

Multi-component coatings: Combine multi-component coatings as whole pack units. If partial mixing is proposed, submit details.

Thinners: If addition of thinners is proposed, conform to the Coating Manufacturers Technical Data Sheet for the specified product.

Colour consistency: If colour consistency is required, before the addition of the curing agent or converter and before coating application, pre-mix the components of coating products that have been tinted to ensure colour uniformity.

### **E29.3.5 COATING APPLICATION**

#### **General**

General: Conform to the Product Data Sheets.

Painting and coating colour: Verify all project finish colours with the retained samples.

#### **Final surface preparation or coating application**

Limits: If the following climatic/substrate conditions are present do not apply coating:

- The relative humidity is above 85%.
- The substrate temperature is less than 3C° above the dewpoint.
- The ambient air temperature is below 5°C or above 40°C.

- The substrate temperature is below 10°C or above 45°C.
- The surface to be coated is wet or damp.
- Where the full prime coat application cannot be carried out before the specified cleanliness of the surface deteriorates.
- For external or site applied coatings:
  - . The weather is clearly deteriorating or unfavourable for application or curing.
  - . High wind conditions.
- The surface preparation standard has not been achieved.
- The time between surface blast cleaning and the commencement of coating exceed 4 hours.
- Visual tarnishing or black spots develop on the surface of the metal.

Exception: Preliminary blast or other surface preparations may be performed in conditions that are outside the limits, providing the final surface preparation and all coating applications are undertaken under the limit conditions.

Prior coating: Before the spray application of each coating stripe coat by brush method all edges, welds, seams, rivets bolts and boltholes (including slots). Prime the underlying surfaces of replacement bolting, washers and nuts before installation.

Procedure: Conform to the order shown in the **PROTECTIVE PAINT COATING SYSTEMS**.

Timing: Conform to the minimum and maximum recoat intervals and curing times.

Detail: Stripe coat all welds, bolt holes, corners and difficult to spray areas by brushing in with the prime coat and intermediate coat material before the full coating application.

Subsequent coats: Ensure that before any subsequent coating layer is applied, the surface condition of the preceding coat is complete and correct in all respects, including its DFT achievement, cleanliness, freedom from defects.

Correction: Correct any defect in a coating layer before the subsequent coating layer is applied.

#### **Protection**

General: Perform all painting under cover and/or protected from rain, condensation, dew, excessive wind, overspray or wind-blown dust.

Period: Continue protection where any of these conditions exist before the coating has cured to a sufficient degree so as to be unaffected.

#### **E29.3.6 COATING REPAIR**

##### **Repair of coating damage**

Preparation: 'Feather back' by hand or machine sanding all leading edges of intact coating adjacent to the repair, to remove any sharp edge.

Surface contamination: Remove by dusting or blowing down before applying the first coat of paint.

Sequence: Apply the repair coating in the same sequence and manner as the original coating.

Areas damaged without exposing the primer: Wash with a proprietary detergent solution and rinse with fresh water, followed by abrading and ensuring that edges of sound paint are feathered. Then coat the area with the appropriate intermediate and finishing coat materials.

Areas damaged to the primer or steel surface: Blast clean to the original standard. Prepare at least 50 mm into the sound coating and to a further feathering zone of approximately 50 mm. Recoat with the specified system to restore the film thickness and integrity over the whole prepared surface including the feathered zone.

Aesthetic reinstatement: If required, repaint to a physical or discernable boundary line.

Defects: If corrosion pitting or areas of significant metal loss and defects are exposed by the blasting process, advise for inspection and have areas passed "fit for service" before proceeding with the coating system.

Timing: Apply the Protective Coating system within 4 hours of blast cleaning or in any case before visual tarnishing of the steel occurs.

#### **E29.3.7 COMPLETION**

##### **General**

Joints: On completion, seal all joints and mating surfaces with a compatible polyurethane sealant.

**Warranty**

General: Provide the approved warranty.

**E29.4 SELECTIONS****E29.4.1 PROTECTIVE PAINT COATING SYSTEMS****Polyurethane – AS/NZS 2312 Category A and B table**

Location	Primer	Second Coat	Third Coat
Interior non-decorative	75 µm Epoxy zinc phosphate conforming to AS/NZS 3750.13	Nil	Nil
Internal decorative	75 µm Epoxy zinc phosphate conforming to AS/NZS 3750.13	50 µm High Solids Polyurethane Conforming to AS/NZS 3750.6	Nil
External non-decorative conforming to AS/NZS 2312 PUR2	75 µm Epoxy Zinc phosphate conforming to AS/NZS 3750.13	50 µm High Solids Polyurethane Conforming to AS/NZS 3750.6	Nil
External decorative conforming to AS/NZS 2312 PUR2	75 µm Epoxy zinc phosphate conforming to AS/NZS 3750.13	50 µm High Solids Polyurethane Conforming to AS/NZS 3750.6	Nil

**Polyurethane – AS/NZS 2312 Category C, D and E table**

Location	Primer	Second Coat	Third Coat
Interior non-decorative	75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2	Nil	Nil
Internal decorative	75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2	75 µm High Solids Polyurethane Conforming to AS/NZS 3750.6	Nil
External non-decorative conforming to AS/NZS 2312 EHB4	75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2	200 µm High-Build Epoxy MIO Conforming to AS/NZS 3750.14	Nil
External decorative conforming to AS/NZS 2312 PUR 5	75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2	200 µm High-Build Epoxy MIO Conforming to AS/NZS 3750.14	75 µm High Solids Polyurethane Conforming to AS/NZS 3750.6

**Micaceous Iron Oxide – AS/NZS 2312 Category A and B table**

Location	Primer	Second Coat	Third Coat
Interior non-decorative	75 µm Alkyd zinc phosphate containing MIO and Aluminium pigment conforming to AS/NZS 3750.19 Type 2	Nil	Nil
Internal decorative	75 µm Alkyd zinc phosphate containing MIO and Aluminium pigment conforming to AS/NZS 3750.19 Type 2	50 µm Alkyd MIO finish Conforming to AS/NZS 3750.12	Nil
External non-decorative conforming	75 µm Alkyd zinc phosphate containing	Nil	Nil

Location	Primer	Second Coat	Third Coat
to AS/NZS 2312 ALK2	MIO and Aluminium pigment conforming to AS/NZS 3750.19 Type 2		
External decorative conforming to AS/NZS 2312 ALK6	75 µm Alkyd zinc phosphate containing MIO and Aluminium pigment conforming to AS/NZS 3750.19 type 2	40 µm Alkyd MIO finish Conforming to AS/NZS 3750.12	40 µm Alkyd MIO finish Conforming to AS/NZS 3750.12

**Micaceous Iron Oxide – AS/NZS 2312 Category C, D and E table**

Location	Primer	Second Coat	Third Coat
Interior non-decorative	75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2	Nil	Nil
Internal decorative	75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2	75 µm Epoxy MIO Conforming to AS/NZS 3750.14	Nil
External non-decorative conforming to AS/NZS 2312 EHB4	75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2	200 µm High-Build Epoxy MIO Conforming to AS/NZS 3750.14	Nil
External decorative conforming to AS/NZS 2312 EHB6	75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2	125 µm Epoxy MIO Conforming to AS/NZS 3750.14	125 µm Epoxy MIO Conforming to AS/NZS 3750.14

**Epoxy Acrylic – AS/NZS 2312 Category A and B table**

Location	Primer	Second Coat	Third Coat
Interior non-decorative	75 µm Epoxy zinc phosphate conforming to AS/NZS 3750.13	Nil	Nil
Internal decorative	75 µm Epoxy zinc phosphate conforming to AS/NZS 3750.13	50 µm Epoxy Acrylic Conforming to AS/NZS 3750.5	Nil
External non-decorative conforming to AS/NZS 2312 ACC2	75 µm Epoxy zinc phosphate conforming to AS/NZS 3750.13	50 µm Epoxy Acrylic Conforming to AS/NZS 3750.5	Nil
External decorative conforming to AS/NZS 2312 ACC2	75 µm Epoxy zinc phosphate conforming to AS/NZS 3750.13	50 µm Epoxy Acrylic Conforming to AS/NZS 3750.5	Nil

**Epoxy Acrylic – AS/NZS 2312 Category C, D and E table**

Location	Primer	Second Coat	Third Coat
Interior non-decorative	75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2	Nil	Nil
Internal decorative	75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2	50 µm Epoxy Acrylic Conforming to AS/NZS 3750.5	Nil
External non-decorative conforming to AS/NZS 2312 EHB4	75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2	200 µm High-Build Epoxy MIO Conforming to AS/NZS 3750.14	Nil
External decorative conforming to AS/NZS 2312 ACC6	75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2	200 µm High-Build Epoxy MIO Conforming to AS/NZS 3750.14	50 µm Epoxy Acrylic Conforming to AS/NZS 3750.5

**Steel protection and decoration for green buildings - AS/NZS 2312 Category A and B table**

Location	Primer	Second Coat	Third Coat
Interior non-decorative	50 µm waterborne inorganic zinc conforming to AS/NZS 3750.15 Type 3 VOC < 15 g/L	Nil	Nil
Internal decorative	50 µm waterborne inorganic zinc conforming to AS/NZS 3750.15 Type 3 VOC < 15 g/L	40 µm waterborne acrylic Conforming to AS/NZS 3750.16 VOC < 75 g/L	Nil
External non-decorative conforming to AS/NZS 2312 IZS2	75 µm waterborne inorganic zinc conforming to AS/NZS 3750.15 Type 3 VOC < 15 g/L	Nil	Nil
External decorative exceeding AS/NZS 2312 IZS2	75 µm waterborne inorganic zinc conforming to AS/NZS 3750.15 Type 3 VOC < 15 g/L	40 µm waterborne Acrylic Conforming to AS/NZS 3750.16 VOC < 75 g/L	Nil

**Steel protection and decoration for 'green buildings' – AS/NZS 2312 Category C, D and E table**

Location	Primer	Second Coat	Third Coat
Interior non-decorative	50 µm waterborne inorganic zinc conforming to AS/NZS 3750.15 Type 3 VOC < 15 g/L	Nil	Nil
Internal decorative	50 µm waterborne inorganic zinc conforming to AS/NZS 3750.15 Type 3 VOC < 15 g/L	40 µm waterborne Acrylic Conforming to AS/NZS 3750.16 VOC < 75 g/L	Nil
External non-decorative conforming to AS/NZS 2312 IZS2	75 µm waterborne inorganic zinc conforming to AS/NZS 3750.15 Type 3 VOC < 15 g/L	Nil	Nil
External decorative exceeding AS/NZS 2312 IZS2	75 µm waterborne inorganic zinc conforming to AS/NZS 3750.15 Type 3 VOC < 15 g/L	50 µm waterborne epoxy Conforming to AS/NZS 3750.13 VOC < 20 g/L	40 µm waterborne Acrylic Conforming to AS/NZS 3750.16 VOC < 75 g/L

**Industrial silicone enamel – AS/NZS 2312 Category A and B table**

Location	Primer	Second Coat	Third Coat
Interior non-decorative	75 µm Alkyd zinc phosphate containing	Nil	Nil

Location	Primer	Second Coat	Third Coat
	MIO and Aluminium pigment conforming to AS/NZS 3750.19 Type 2		
Internal decorative	75 µm Alkyd zinc phosphate containing MIO and Aluminium pigment conforming to AS/NZS 3750.19 Type 2	50 µm Silicone Enamel Conforming to AS/NZS 3750.22	Nil
External non-decorative conforming to AS/NZS 2312 ALK2	75 µm Alkyd zinc phosphate containing MIO and Aluminium pigment conforming to AS/NZS 3750.19 Type 2	Nil	Nil
External decorative conforming to AS/NZS 2312 ALK4	75 µm Alkyd zinc phosphate containing MIO and Aluminium pigment conforming to AS/NZS 3750.19 Type 2	50 µm Silicone Enamel Conforming to AS/NZS 3750.22	Nil

**E30 STEEL – HOT-DIP GALVANIZED COATINGS**

**E30.1 GENERAL**

**E30.1.1 RESPONSIBILITIES**

**General**

General: Provide hot-dip galvanized coatings that control corrosion to structural steelwork or steel products in the time to first maintenance.

All works to conform to the standard unedited version of:

- "TfNSW Engineering Specification - SPC301 Structures Construction" version 1.0, dated July 2010.

The most stringent requirement will be applied when two or more standards specify conflicting requirements.

**E30.1.2 CROSS REFERENCES**

**General**

Requirement: Conform to the following:

- *General requirements.*
- *Structural steel.*

**E30.1.3 STANDARDS**

**General**

Coating: Comply with the requirements of AS/NZS 4680.

Durability: Conform to the requirements of AS 2309.

**Metal finishing**

Methods: To AS 1627.

**E30.1.4 INSPECTION**

**Notice**

Inspection: Give notice so that inspection may be made of the following:

- Coating integrity, at the galvanizing plant.

**E30.1.5 SUBMISSIONS**

**Holes and lifting lugs**

General: If holes and lifting lugs are required to facilitate handling, filling, venting and draining during galvanizing, submit details on size and location.

**Detailing features**

General: If design and fabrication features of the articles to be galvanized may lead to difficulties during galvanizing, identify these and submit details for improvement.

## E31 LIGHT STEEL FRAMING

### E31.1 GENERAL

#### E31.1.1 RESPONSIBILITIES

##### General

General: Provide light steel floor, wall and roof framing that is:

- In conformance with the performance criteria documented.
- Integrated into the building.
- Suitable for the fixing to it of flooring, linings cladding and roofing.
- Independently designed and documented.
- Independently certified by a professional engineer for the design and the erected framing.

#### E31.1.2 CROSS REFERENCES

##### General

Requirement: Conform to the following:

- *General requirements.*
- *Structural steel*
- *Sundry items*
- *Lining*

#### E31.1.3 STANDARDS

##### General

Design, materials and protection: To AS/NZS 4600.

Residential and low-rise steel framing: To NASH-1 (National Association of Steel Housing) Standard.

#### E31.1.4 INSPECTION

##### Notice

Inspection: Give notice so that inspection may be made of steel framing erected on site before lining or cladding.

#### E31.1.5 SUBMISSIONS

##### Design

General: Where the structural drawings define performance criteria, submit independent design, documentation and certification from a professional engineer including for the erected work.

Reactions: Provide location and magnitude of reactions to be accommodated by the support structure.

Floor and wall frame member sizes: Submit a schedule of proposed member sizes, certified as meeting stated project and AS/NZS 4600 requirements for span, spacings and loadings.

##### Shop drawings

General: Submit shop detail drawings certified by a professional engineer stating that the design has been carried out in accordance with documented project and AS/NZS 4600 requirements for the configurations and loadings.

Roof beams: Prepare drawings to show:

- On a plan, the beam layout.
- On elevations, the arrangement of members allowing for the accommodation of in-roof services and the size and section type of each member.
- The method of assembly, connection, holding down and bracing.

Wall frames: If wall framing is to be pre-fabricated, prepare drawings to show:

- On plan, the wall layout.
- On elevations, the arrangement of members, and the size and section type of each member.
- The method of assembly, connection, holding down and bracing.

### **E31.1.6 TOLERANCES**

#### **General**

Manufacturing and assembly tolerances: To NASH-1 Standard, Appendix D.

Installation tolerances for attachments to supporting structures, walls, trusses, rafters, ceiling joists and floor members: To NASH-1 Standard, Appendix D.

### **E31.2 PRODUCTS**

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#### **E31.2.1 COMPONENTS**

##### **Cold-formed steel framing**

Cold-form sections from metallic-coated steel to AS 1397.

Corrosion protection: To BCA 3.4.2.2.

##### **Framing members**

Cold-formed steel framing: For a proprietary system, comply with NASH-1.

##### **Fascias and barge boards**

Refer to Roofing.

### **E31.3 EXECUTION**

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#### **E31.3.1 CONSTRUCTION GENERALLY**

##### **Fabrication**

Length: Cut members accurately to length so that they fit firmly against abutting members.

Service holes: Form holes by drilling or punching.

Bushes: Provide plastic bushes or grommets to site cut holes.

- Swarf: Remove swarf and other debris from cold-formed steel framing immediately.

Site work: Do not fabricate on site where welded connections are required.

##### **Fastening**

Type: Select from the following:

- Bolting.
- Self-drilling, self-tapping screws.
- Blind rivets.
- Proprietary clinching system.
- Structural adhesives.
- Welding.

##### **Welding**

Burning: Avoid procedures that result in greater than localised 'burning' of the sheets or framing members.

##### **Prefabricated frames**

General: Protect frames from damage or distortion during storage, transport and erection.

##### **Metal separation**

General: Install lagging to separate non-ferrous service pipes and accessories from the framing.

##### **Unseasoned or CCA treated timber**

General: Do not fix in contact with framing without fully painting the timber and/or the steel.

##### **Earthing**

Permanent earthing: Required.

Temporary earthing: Provide temporary earthing during erection until the permanent earthing is installed.

##### **Protection**

General: Restore coatings which have been damaged by welding or other causes. Thoroughly clean affected areas to base metal and coat with zinc rich organic primer.

Grommets: Provide grommets to isolate piping and wiring from cold-formed steel framing.

Swarf: Remove swarf and other debris from cold-formed steel framing immediately.

**Certification**

General: For components for which independent design certification has been required, provide independent certification for the erected components confirming compliance with the design intent.

**E31.3.2 WALL FRAMING**

**Wall studs**

General: Provide studs in single lengths without splices. Place a stud under, or within 40 mm from, each structural load point from roof or ceiling (except for openings). Provide multiple studs at points of concentrated load.

Maximum stud spacing: 600 mm.

**Heads to openings**

General: Provide lintels appropriate to load and span.

**Additional support**

General: Provide additional support in the form of noggings, trimmers and studs for support and fixing of lining, cladding, hardware, accessories, fixtures and fittings including grab rails in Toilets.

**Vermin barriers**

General: Provide vermin barriers as follows:

- Brick veneer barrier: Close nail 10 mm steel wire mesh to the underside of the bottom plate of external stud walls, extending across the cavity for building into brickwork.

**Damp-proof course**

General: Provide damp-proof courses under the bottom plate of stud walls built off slabs or masonry dwarf walls, as follows:

- External walls (not masonry veneer): Turn up at least 75 mm on the inside and tack. Project 10 mm beyond the external slab edge or dwarf wall and turn down at 45°.
- Walls of bathrooms, shower rooms and laundries: Turn up at least 150 mm on the 'wet' side and tack to studs.

Installation: Lay in long lengths. Lap full width at angles and intersections and at least 150 mm at joints.

Junctions: Preserve continuity of damp-proofing at junctions of damp-proof courses, sarking and waterproof membranes.

**Flashings**

Location: Provide flashings to external openings sufficient to prevent the entry of moisture. Form trays at the ends of sill flashings.

Masonry veneer construction: Extend across cavities and build into brickwork.

**E31.3.3 ROOF FRAMING**

**General**

Refer to structural engineer's drawings.

**Beam framing**

General: Construct framing for 'flat' or pitched roofs where the ceiling follows the roof line, consisting of rafters or purlins supporting both ceiling and roof covering.

**Antiponding**

Requirement: Fix appropriate members to the tops of framing at the rear of fascias, to prevent sagging of and ponding on the sarking.

**Additional support**

Provide a frame member behind every joint in fibre cement or plasterboard sheeting or lining.

**Battens**

Requirement: Supply and fix battens suitable for span, spacing and roofing.

**E31.3.4 ROOF TRIM**

**Fascia, valley gutter and barge boards**

Requirement: Supply and fix fascia, valley gutter and barge boards in accordance with the manufacturer's requirements.

**E31.3.5 COMPLETION**

**Cleaning**

General: On completion of framing remove debris from any gaps between members.

**E32 WATERPROOFING – EXTERNAL AND TANKING**

**E32.1 GENERAL**

**E32.1.1 RESPONSIBILITIES**

**General**

General: Provide roof and deck waterproofing systems to substrates, which are:

- Waterproof under five minutes duration rainfall intensity, which has an average recurrence interval of 100 years.
- Graded to falls to dispose of stormwater without ponding above the depth of lapped seams.
- Able to accommodate anticipated building movements.
- Able to accommodate its own shrinkage over the warranty life of the roofing system.

Selections: Conform to **Selections** as documented.

**E32.1.2 CROSS REFERENCES**

**General**

Requirement: Conform to the following:

- *General requirements.*

**E32.1.3 STANDARDS**

**Membrane materials**

Standard: To AS 4654.1.

**Membrane design and installation**

Standard: To AS 4654.2.

**Stormwater drainage**

Standard: To AS/NZS 3500.3.

**E32.1.4 INTERPRETATION**

**Definitions**

General: For the purposes of this worksection the definitions given in AS 4654.1 and AS 4654.2 and the following apply:

- Acrylic - liquid applied: Water based formulations which air dry to form plastic membranes.
- Bitumen: A viscous material from the distillation of crude oil comprising complex hydrocarbons, which is soluble in carbon disulphide, softens when it is heated, is waterproof and has good powers of adhesion. It is produced as a refined by-product of oil.
  - SBS bitumen: Bitumen modified with Styrene Butadiene Styrene, a thermoplastic rubber that undergoes a phase inversion at elevated temperature and converts to an elastomeric material. The membrane is reinforced with fibreglass or non-woven polyester (NWP).
  - APP bitumen: Bitumen modified with Atactic (meaning non-crystalline or amorphous) polypropylene wax to form a plastomeric sheet. The membrane is reinforced with fibreglass or non-woven polyester (NWP).
- Bond breakers: A system preventing a membrane bonding to the substrate, bedding or lining.
- Double detail joint: A joint formed by turning up and bonding the horizontal membrane to a vertical substrate and adding an overflashing of membrane material bonded to the vertical substrate and folded over and bonded to the horizontal membrane. In certain situations the 'double detail' can be achieved by bonding an angle profile of membrane material to the junction prior to laying the membrane.
- Elastomer: A polymer having elastic properties similar to rubber.
- Plasticised PVC: Rigid PVC made flexible with plasticisers to form a plastic sheet membrane (vinyl).
- Polyurethane - liquid applied: solvent based formulations which moisture cure to form an elastic rubber membrane.

- Seamless membranes: Membranes applied in liquid or gel form and air cured to form a seamless film.
- Slip sheets: Are used to isolate the membrane system from the supporting substrate or from the topping or mortar bedding above, are sometimes referred to as cleavage membranes, and are similar to bond breakers. The most common material is polyethylene sheeting.
- Substrate: The surface to which a material or product is applied.

#### **E32.1.5 INSPECTION**

##### **Notice**

Inspection: Give notice so that inspection may be made as follows:

- Substrate preparation completed.
- Secondary layers preparation completed.
- Before membranes are covered up or concealed.
- Underflashings complete before installation of overflashings.
- After flood testing.

#### **E32.1.6 SUBMISSIONS**

##### **Execution records**

Placing records: Photographically record the application of membranes and label with the following information :

- Date.
- Portion of work.
- Substrate preparation.
- Weather during application and curing.
- Protection provided from traffic and weather.

##### **Products documentation**

General: Submit copies of product manufacturer's:

- Product technical data sheets.
- Material safety data sheets (MSDS).
- Preventative maintenance procedures.
- Instructions and procedures for the repair of the membrane.

### **E32.2 PRODUCTS**

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#### **E32.2.1 MEMBRANES**

##### **Membrane systems**

Requirement: Provide a proprietary membrane systems certified as suitable for the intended external waterproofing by the following:

- Certificate: A current BRANZ Appraisal Certificate.

#### **E32.2.2 ACCESSORIES**

##### **Control joint covers**

Corners, crossovers, tees and bends: Factory mitred, welded and provided with 500 mm legs.

End closures: Factory folded and sealed to match joint cover profile.

#### **E32.2.3 DRAINAGE CELL PANELS**

##### **Walls**

Material: Atlantis 30mm wall panel with Atlantis 52mm Drainage Log.

Cell panel protection: [complete/delete]

Filter: Geotextile Fabric

Location:

- Behind walls of lift pits.

- Behind retaining walls

#### **E32.2.4 PROTECTION**

##### **Protection board**

Description: Provide protection board to membrane behind retaining walls.

Type: As recommended by the membrane manufacturer.

#### **E32.3 EXECUTION**

##### **E32.3.1 PREPARATION**

###### **General**

Substrates: Prepare substrates as follows:

- Fill all cracks in substrates wider than 1.5 mm with a filler compatible with the membrane system.
- Fill voids and hollows in concrete substrates with a concrete mix not stronger than the substrate.
- Remove projections.
- Remove deleterious and loose material.
- Remove all traces of a concrete curing compound if used.

Leave the surface free of contaminants, clean and dust free.

###### **Moisture content**

Concrete substrates: Cure for > 21 days.

Moisture content: Verify that the moisture content of the substrate is compatible with the water vapour transmission rate of the membrane system by testing to AS/NZS 2455.1 Appendix B.

Test type: select from the following:

- Hygrometer test: Seal a hygrometer to the substrate for > 16 hours and measure the relative humidity of the air between the instrument and the slab.

###### **Falls**

Verify that falls in substrates are >1.5%.

###### **Joints and fillets**

Internal corners: Provide 45° fillets 50 x 50 mm.

Fillet Material: Cement

External corners: Round or arris edges.

Control joints: Prepare all substrate joints to suit the membrane system.

###### **Priming**

Compatibility: If required, prime the substrates with compatible primers to ensure adhesion of membrane systems.

##### **E32.3.2 APPLICATION**

###### **Protection during installation**

Damage: Protect membrane from damage during installation and for the period after installation until the membrane achieves its service characteristics that resist damage.

###### **Drains**

General: Prevent moisture from tracking under the membranes at drainage locations.

Drains and cages: Provide removable grates or cages to prevent blockage from debris. If the finished surface is above the level of the membrane provide a slotted extension piece to bring the grate up to the level of the finished surface.

Overflows: Apply a bond breaker to the perimeter of the overflow outlet at its junction with the surface to which the membrane will be fixed. Turn the membranes into the overflow to prevent moisture from tracking behind the membrane.

###### **Sheet joints**

Orientation of laps: Lap sheets on the upslope side of the roof fall over sheets on the downslope side.

End laps generally: Stagger end lap joints.

Bituminous sheet membranes:

- Side laps: 75 mm.
- End laps: 100 mm.
- Method: Heat welded.

Synthetic rubber membranes:

- Factory–vulcanized laps > 40 mm.
- Field side laps > 50 mm for side laps.
- Field end-laps > 100 mm for end laps.

Plasticised PVC (Polyvinyl chloride) membranes:

- Factory welded laps > 30 mm.
- Field-welded laps:
  - . If used over insulation boards > 100 mm.
  - . Other instances > 75 mm overlaps.

#### **Curing of liquid applied systems**

General: To the manufacturers' instructions.

#### **Control of movement**

General: Provide control joints located over control joints in the substructure.

Fillets and bond breakers: Adequately size to allow the membrane to accommodate movement.

Control joint covers: Install after fixing hobs and membranes.

Bonded membranes: Carry control joints in the substrate through to and into the surface finish.

#### **Membrane terminations**

Membrane upturns: Provide upturns above the maximum water level expected from the exposure conditions of rainfall intensity and wind.

- Height: > 150 mm.
- Anchoring : Secure sheet membranes along the top edge.
- Edge protection: Protect edges of the membrane.
- Waterproofing above terminations: Waterproof the structure above the termination to prevent moisture entry behind the membrane using cavity flashings, capping, waterproof membranes or waterproof coatings.

Horizontal terminations: Do not provide..

#### **Overlaying finishes on membranes**

Compatibility: If a membrane is to be overlayed with another system such as tiles, pavers, ballast, insulation or soil, provide an overlaying system that is compatible with and will not cause damage to the membrane.

Bonded or partially bonded systems: If the topping or bedding mortar requires to be bonded to the membrane, provide sufficient control joints in the topping or bedding mortar to reduce the movement over the membrane.

Slip sheet: If the topping or bedding mortar is structurally sufficient not to require bonding to the substrate, lay a double slip sheet over the membrane to separate it from the topping or bedding mortar.

Paint coatings: If maintenance pathways are indicated by a paving paint, ensure compatibility with the membrane.

### **E32.3.3 FLOOD TEST**

#### **General**

Application: Perform a flood test before the installation of surface finishes.

Set-up:

- Measure for dryness the wall/floor junction of adjacent spaces to the slab soffit below using electrical resistance testing to AS/NZS 2455.1 Appendix B.
- Record the result for each area.
- Dam the access openings and seal drainage outlets to allow 50 mm water level but no higher than 25 mm below the weir level of the perimeter flashings.

- Provide temporary overflows of the same capacity as the roof outlets to maintain the flood level.
- Fill space with clean water and leave overnight.

**Evaluation:**

- Make a visual inspection of the wall/floor junction of adjacent spaces and of the slab soffit below for obvious water or moisture.
- Test the same areas for dryness using a moisture meter, and compare the results to the measurements taken before flooding.

**Compliance:**

- Evidence of water from the visual test: Failure.
- No visual evidence of water: Proceed with the moisture meter test.
- Increase in test results before and after flooding: Failure.

Records: Submit records of all flood tests.

**E32.3.4 COMPLETION**

**Protection**

General: Keep traffic off membrane surfaces until bonding has set or for 24 hours after laying, whichever period is the longer.

Reinstatement: Repair or replace faulty or damaged work. If the work cannot be repaired satisfactorily, replace the whole area affected.

**Warranty**

Waterproofing: Cover materials and workmanship in the terms of the warranty in the form of interlocking warranties from the supplier and the applicator.

- Form: Against failure of materials and execution under normal environment and use conditions.
- Period: As offered by the supplier, with a minimum of 15 years.

**E32.4 SELECTIONS**

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**E32.4.1 EXTERNAL WATERPROOFING SCHEDULES**

**Lift pits**

Supply and install a two component waterproofing coating to walls of lift pits.

Description: A flexible waterproof coating against positive and negative pressure, suitable for application on concrete and masonry.

Proprietary item: Maxseal Flex or approved equivalent.

Preparation: In accordance with the manufacturer's printed instructions

Application: In accordance with the manufacturer's printed instructions.

**Retaining walls**

Supply and install Tremco TREMproof 3300 self-adhering cold applied sheet waterproofing membrane to all retaining walls.

Prepare substrates and apply membrane in accordance with the instructions of the manufacturer.

Provide protection board and drainage cells behind all membranes.

**E33 ROOFING****E33.1 GENERAL****E33.1.1 RESPONSIBILITIES****General**

General: Provide a roofing system and associated work which:

- Satisfies the product performance requirements.

**E33.1.2 CROSS REFERENCES****General**

Requirement: Conform to the following:

- *General requirements.*
- Light steel framing
- Roof access system

**E33.1.3 PERFORMANCE CRITERIA****Ambient climatic conditions**

Design rainfall intensity ( mm/h) to AS/NZS 3500.3.

**Bushfire prone areas**

Level of construction to AS 3959.

**Roof access**

Type: Normal roof maintenance.

**E33.1.4 INSPECTION****Notice**

Inspection: Give notice so that inspection may be made of:

- Roof supports.
- Those parts of the roofing, sarking, vapour barrier, insulation and roof plumbing installation which will be covered up or concealed.

**E33.1.5 SUBMISSIONS****Tests**

Submit results of type tests as follows:

- Metal roofing general tests: Roof sheeting and fastenings to AS 1562.1 for resistance to concentrated load and to wind pressure.
- Metal roofing in cyclonic regions AS/NZS 1170.2: Roof sheeting and fastenings to AS 1562.1 clause 5.6.

Internal downpipes: Submit results of site tests to each stack hydrostatically in stages 2 storeys high for two hours. Remedy defects and retest if necessary.

**Samples**

Submit samples of:

- Sheet metal finishes.
- Custom profiled flashings and cappings.

**E33.2 PRODUCTS****E33.2.1 COMPONENTS****Fasteners**

Finish: Prefinish exposed fasteners with an oven baked polymer coating to match the roofing material.

Fastenings to timber battens: Provide fastenings just long enough to penetrate the thickness of the batten without piercing the underside.

**Profiled fillers**

Provide: Purpose-made closed cell polyethylene foam profiled to match the roofing profile.

Locate profiled fillers under flashings to:

- Ridges.
- Eaves.
- Lapped joints in roof sheeting.

**Safety mesh**

Standard: To AS/NZS 4389.

**E33.2.2 SHEET METAL ROOFING****Standards**

Design and installation: To AS 1562.1.

Prepainted and organic film/metal laminate products: To AS/NZS 2728.

**Roofing product**

Location:

- New Platform Building
- New Lift shafts
- New canopies

Product brand: Ritek Roof Systems

Description: Roofing panels comprising Custom Orb Colorbond sheeting bonded on both sides of EPS insulation.

Panel thickness:

- New Platform Building: 140mm
- New Lift shafts: 75mm
- New canopies: 100mm

Insulation rating

- New Platform Building: R3.2 minimum

Colour of sheeting: Colorbond shale grey.

**E33.2.3 ROOF PLUMBING****General**

Standard: To AS/NZS 3500.3.

Requirement: Provide the flashings, cappings, gutters, rainwater heads, outlets and downpipes necessary to complete the roof system.

**Materials**

Metal rainwater goods: To AS/NZS 2179.1.

Metal: To match roofing panels

PVC rainwater goods and accessories: To AS/NZS 3500.3.

**Proprietary flashings and cappings**

Standard: To AS/NZS 2904.

Material and colour: Match roof sheeting.

Rib notching: Match roof sheeting.

**Proprietary ridge and barge cappings**

Material and colour: Match roof sheeting.

**Eaves gutters**

Product: Steel gutter

Type: Half round

Material and colour: Match roof sheeting.

Matching fascia/arge: If the selected eaves gutter is a proprietary high front pattern forming part of a combined system of gutter, fascia and barge, provide the matching proprietary fascias and barge cappings to roof verges and edges.

**Downpipes**

Material: Colorbond steel

Colour: To match roofing

Profile: Circular

Size: 100mm diameter

**Gratings**

Gratings: Provide removable gratings over rainwater heads and sumps:

**Leaf screens**

Product: Leaf stopper or other approved equal.

Location: All outlets.

**E33.3 EXECUTION****E33.3.1 INSTALLATION****Protection**

General: Keep the roofing and rainwater system free of debris and loose material during construction, and leave them clean and unobstructed on completion. Repair damage to the roofing and rainwater system.

Touch up: If it is necessary to touch up minor damage to prepainted metal roofing, do not overspray onto undamaged surfaces.

**Thermal movement**

Requirement: Provide for thermal movement in the roof installation and the structure, including movement in joints and fastenings.

**Pan type sheets**

Removal: Capable of being de-indexed and removed without damage.

**Curved corrugated sheet**

General: Form by rolling from material recommended for curving or bullnosing. Minimise crimping or creasing across the face of the sheet. Trim off crimped or creased edges and ends.

**Metal separation**

Requirement: Prevent direct contact between incompatible metals, and between green hardwood or chemically treated timber and aluminium or coated steel, by either:

- Applying an anti-corrosion, low moisture transmission coating to contact surfaces.
- Inserting a separation layer.

**Tolerances**

Requirement: Conform to the **Tolerances table**.

**Tolerances table**

Property	Tolerance criteria: Permitted deviation (mm)
Spacing of supporting members	$\pm 5$ mm on the nominated support member spacing
Vertical or horizontal misalignment at the abutting ends of sheets	$\leq 2$ mm
Tops of supporting members in a plane parallel to the nominated roof slope	$\leq 7$ mm smooth deviation per metre length of supporting member

**E33.3.2 PANEL ROOFING****Installation**

Install roofing panels in accordance with the printed instructions of the manufacturer to achieve a complete watertight construction. Provide all screws and other fixing accessories.

Accessories: Provide material with the same finish as roofing sheets.

**E33.3.3 BUILDING ELEMENTS****Ridges and eaves**

Treat ends of sheets as follows:

- Project sheets 50 mm into gutters.
- Close off ribs at bottom of sheets using mechanical means or with purpose-made fillers or end caps.
- Turn pans of sheets up at tops and down into gutters by mechanical means.
- Provide pre-cut notched eaves flashing and birdproofing where necessary.
- Close off ridges with purpose-made ridge fillers of closed cell polyethylene.

#### **Ridge and barge**

Capping: Finish off along ridge and verge lines with purpose-made ridge capping or barge rolls.

#### **End laps**

Panels are to be in single lengths without end laps.

### **E33.3.4 ROOF PLUMBING**

#### **Jointing sheet metal rainwater goods**

Butt joints: Make joints over a backing strip of the same material.

Soldered joints: Do not solder aluminium or aluminium/zinc-coated steel.

Sealing: Seal fasteners and mechanically fastened joints. Fill the holes of blind rivets with silicone sealant.

#### **Flashings**

Installation: Flash roof junctions, upstands, abutments and projections through the roof. Preform to required shapes where possible. Notch, scribe, flute or dress down as necessary to follow the profile of adjacent surfaces. Mitre angles and lap joints 150 mm in running lengths. Provide matching expansion joints at 6 m maximum intervals.

Upstands: Flash projections above or through the roof with two part flashings, consisting of a base flashing and a cover flashing, with at least 100 mm vertical overlap. Provide for independent movement between the roof and the projection.

Large penetrations: To low pitch roofs extend the base flashing over the roofing ribs to the ridge to prevent ponding behind the penetrating element.

Wall abutments: Provide overflashings where roofs abut walls, stepped to the roof slope in masonry and planked cladding, otherwise raking and as follows:

- In masonry: Build into the full width of the outer leaf. Turn up within cavity, sloping inward across the cavity and fixed to or built in to the inner leaf at least 75 mm above.
- In concrete: Turn 25 mm into joints or grooves, wedge at 200 mm centres with compatible material and point up.

Fixing to masonry or concrete: Step in courses to the roof slope. Interleave with damp proof course, if any.

Fixing to pipes: Solder, or seal with neutral cured silicone rubber and either of the following:

- Secure with a clamping ring.
- Provide a proprietary flexible clamping shoe with attached metal surround flashing.

#### **Gutters**

General: Prefabricate box gutters. Form stop ends, downpipe nozzles, bends and returns. Dress downpipe nozzles into outlets. Provide overflows to prevent back-flooding.

Gutter and sump support: Provide framing and lining to support valley gutters, box gutters and sumps. Line the whole area under the gutters and sumps.

#### **Downpipes**

General: Prefabricate downpipes to the required section and shape where possible. Connect heads to gutter outlets and, if applicable, connect feet to rainwater drains.

Access cover: Provide a removable watertight access cover at the foot of each downpipe stack.

Downpipe support: Provide supports and fixings for downpipes.

#### **Rainwater disposal**

System: Connect new downpipes to existing rainwater disposal system.

### **E33.3.5 COMPLETION**

#### **Warranties**

Roofing materials: Submit the manufacturer's published product warranties.

**Maintenance manual**

On completion: Submit a manual of recommendations from the roof manufacturer or supplier for the maintenance of the roofing system including, frequency of inspection and recommended methods of access, inspection, cleaning, repair and replacement.

**E34 CLADDING****E34.1 GENERAL****E34.1.1 RESPONSIBILITIES****General**

General: Provide lightweight external wall cladding and associated work which is as follows:

- Satisfies the product performance requirements.

**E34.1.2 CROSS REFERENCES****General**

Requirement: Conform to the following:

- *General requirements.*
- *Light Steel framing*

**E34.1.3 INTERPRETATION****Abbreviations**

General: For the purposes of this worksection the following abbreviations apply:

- EIFS: External insulated finishing system.
- AAC: Autoclaved aerated concrete.

**E34.1.4 INSPECTION****Notice**

Inspection: Give sufficient notice so that the framing, sarking, vapour barrier and insulation may be inspected before they are covered up or concealed.

**E34.1.5 SUBMISSIONS****Samples**

Finish: Submit samples of the cladding material showing the range of variation available.

**Installation**

Seamed sheet metal cladding: Submit evidence of experience with non-ferrous cladding installation.

**Tests**

Submit results of type tests as follows:

- Metal cladding general tests: Sheeting and fastenings to AS 1562.1 for resistance to wind pressure.
- Metal cladding in cyclonic regions AS/NZS 1170.2: Metal cladding and fastenings to AS 1562.1 clause 5.6.
- Fibre cement cladding: Type test the wall sheeting and fixings to AS/NZS 1562.2 for resistance to wind forces.

**E34.2 PRODUCTS****E34.2.1 SHEET METAL CLADDING****Standards**

Design and installation: To AS 1562.1.

Prepainted and organic film/metal laminate products: To AS/NZS 2728.

**E34.2.2 FIBRE CEMENT CLADDING****Fibre cement**

Standard: To AS/NZS 2908.2.

Soffit linings: Type A Category 3 (modulus of rupture  $\geq 7$  MPa).

Compressed cladding: Type A Category 5 (modulus of rupture  $\geq 18$  MPa).

- Edges: Square.

**Sheet cladding**

General: Provide a proprietary system of single faced fibre cement sheets.

Arrangement: Set out in even panels with joints coinciding with framing.

Sheet thickness: 6 mm.

Joints, corners and edges: UPVC extrusion.

**Soffit lining**

Sheets: Single faced fibre cement.

Sheet thickness: 4.5 mm.

Joints: UPVC extrusion.

**Compressed fibre cement cladding**

Location: Storage Cupboard and TVM recess in Platform Building.

Sheet thickness: 9mm

Joints, corners and edges: Set.

Junctions with other cladding materials: As shown on drawings.

Fixings: as recommended by the sheet manufacturer.

**E34.2.3 PROPRIETARY SYSTEMS****Cladding product**

Location:

- Lift shaft walls
- Platform Building

Product brand: HH Robertson or approved equivalent

Product material type: Vitreous enamelled panel

Standard: The panels shall be in accordance with the current edition of the Specification "Architectural vitreous enamel on steel for exterior use PEI: S100 of the Porcelain Enamel Institute Inc, Washington DC, USA"

Material: 1.6mm thick steel sheet, manufactured to the shapes and sizes to withstand all loads as specified and to comply with the tolerances regarding thickness, straightness, finishing and flatness. All steel shall be decarburised (maximum carbon content (0.006%) suitable for coating on both sides

Backing material: 12mm thick calcium silicate board bonded to steel panel with a high performance epoxy resin compatible with the backing material to meet specified performance criteria.

Size of panels: Panels to be of varying sizes as shown on drawings

Colour: Range of 4 colours as detailed in the Finishes Schedule.

Pattern: Panels of different colours to be set out in the patterns shown on drawings.

Joints: Non-hardening sealant as recommended by the cladding system manufacturer.

**E34.2.4 COMPONENTS****Flashings**

Standard: To AS/NZS 2904.

Material: Colorbond steel

Colour: To match cladding

**E34.3 EXECUTION****E34.3.1 TOLERANCES****Tolerances**

Requirement: Conform to the **Tolerances table**.

**Tolerances table**

Property	Tolerance criteria: Permitted deviation ( mm)
Spacing of supporting members	± 5 mm on the nominated support member spacing

Property	Tolerance criteria: Permitted deviation ( mm)
Vertical or horizontal misalignment at the abutting ends of cladding	≤ 2 mm

### E34.3.2 CONSTRUCTION GENERALLY

#### Substrates or framing

Requirement: Before fixing cladding check and, if necessary, adjust the alignment of substrates or framing.

#### Fixing

Method: Nail to timber framing, screw to steel framing.

#### Accessories and trim

Requirement: Provide accessories and trim necessary to complete the installation.

#### Fixing eaves and soffit lining

Nailing: 150 mm centres to bearers at maximum 450 mm centres.

#### Metal separation

Requirement: Prevent direct contact between incompatible metals, and between green hardwood or chemically treated timber and aluminium or coated steel, by either:

- Applying an anti-corrosion, low moisture transmission coating to contact surfaces.
- Inserting a separation layer.

### E34.3.3 PROPRIETARY SYSTEMS OR PRODUCTS

#### Installation

Product fixings: Fix the following proprietary systems in accordance with the current written recommendations and instructions of the manufacturer or supplier:

- Complete cladding systems.
- Aluminium sandwich panel cladding systems.
- EIFS cladding systems.

### E34.3.4 SHEET METAL CLADDING

#### Cladding sheet installation

Install panels of various colours in the layout shown on drawings.

Fixing: Concealed fixing with silicone joints.

Swarf: Remove swarf and other debris as soon as it is deposited.

Accessories: Provide material with the same finish as cladding sheets.

Expansion joints: Provide in accordance with the recommendations of the manufacturer.

#### Corner flashing

Requirement: Finish off at corners with purpose-made folded flashing strips.

### E34.3.5 COMPLETION

#### Warranties

Cladding materials: Submit the manufacturer's published product warranties.

**E35 WINDOWS****E35.1 GENERAL****E35.1.1 RESPONSIBILITIES****General**

General: Conform to the **Selections**.

**Maintenance**

Product design: Provide windows with sashes capable of being opened to satisfy the documented maintenance requirements.

**E35.1.2 CROSS REFERENCES****General**

Requirement: Conform to the following:

- *General requirements*.

**E35.1.3 STANDARDS****General**

Selection and installation: To AS 2047.

- Building classification: Class 9B and Class 5.

**Glazing**

Glass type and thickness: To AS 1288, where no glass type or thickness is nominated.

Materials and installation: To AS 1288.

Quality requirements for cut-to-size and processed glass: To AS/NZS 4667.

Terminology for work on glass: To AS/NZS 4668.

**E35.1.4 INTERPRETATION****Definitions**

General: For the purposes of this worksection the following definitions apply:

- Louvres:
  - . Horizontal: Louvres that span between frames stiles, mullions or vertical supports.
  - . Continuous horizontal: Louvres that run continuously past, and are supported by, concealed framing or brackets.
  - . Vertical: Louvres that span between frame heads and sills, or horizontal supports.
- Window: The term 'window' used in this worksection also means 'louvre grille' where the grille forms part of the window assembly.
- U-value: Total U-Value as defined by BCA and determined in accordance with NFRC 100.
- SHGC: Solar heat gain coefficient as defined by BCA and determined in accordance with NFRC 200.

**E35.1.5 INSPECTION****Notice**

Inspection: Give notice so that inspection may be made of the following:

- Openings prepared to receive windows (where windows are to be installed in prepared openings).
- Fabricated window assemblies at the factory ready for delivery to the site.
- Fabricated window assemblies delivered to the site, before installation.
- Commencement of window installation.

**E35.1.6 SUBMISSIONS****Samples**

Submit samples of window and door framing as follows:

- Accessory and hardware items documented descriptively or by performance (i.e. not documented as proprietary items) including locks, latches, handles, catches, sash operators, anchor brackets and attachments, masonry anchors and weather seals (pile or extruded).
- Colour samples of prefinished production material (e.g. anodised or organic coated extrusions and sheet) showing the limits of the range of variation in the selected colour.
- Joints made by proposed techniques.
- Sections proposed to be used for frames, sashes, louvres and slats.
- Label each sample, giving the Series code reference and date of manufacture.

Submit samples of glazing materials, each at least 200 x 200 mm, showing documented visual properties and the range of variation, if any, for each of the following types of glass or glazing plastics:

- Tinted or coloured glass or glazing plastics.
- Surface modified or surface coated glass.
- Patterned or obscured glass or glazing plastics.
- Mirror glass.

#### **Sealant compatibility**

Compatibility statements: Submit statements from all parties to the installation that certify the compatibility of sealants and glazing systems to all substrates.

Samples in prototypes: Required samples may form part of prototypes.

#### **Shop drawings**

Submit shop drawings to a scale that best describes the detail, showing the following information:

- Full size sections of members.
- Hardware, fittings and accessories including fixing details.
- Junctions and trim to adjoining surfaces.
- Layout (sectional plan and elevation) of the window assembly.
- Lubrication requirements.
- Methods of assembly.
- Methods of installation, including fixing, caulking and flashing.
- Provision for vertical and horizontal expansion.
- Method of glazing, including the following:
  - . Rebate depth.
  - . Edge restraint.
  - . Clearances and tolerances.
  - . Glazing gaskets and sealant beads.

Certification: Submit an engineers' certificate confirming compliance with AS 2047.

#### **Subcontractors**

General: Submit names and contact details of proposed manufacturers and installers. Have windows and glazed doors installed by their manufacturer or by a subcontractor recommended by the manufacturer.

## **E35.2 PRODUCTS**

### **E35.2.1 GENERAL**

#### **Standards**

Flashings: To AS/NZS 2904.

Aluminium extrusions: To AS/NZS 1866.

### **E35.2.2 GLASS**

#### **Glass types and quality**

Standard: To AS/NZS 4667.

**Glazing plastics**

General: Free from surface abrasions, and warranted by the manufacturer for 10 years against yellowing or other colour change, loss of strength and impact resistance, and general deterioration.

**Bullet-resistant glazing panels**

Standard: To AS/NZS 2343.

Classification: Class G2

Panel materials: Glass

Panel opacity: Transparent

**Safety glasses**

Standard: To AS/NZS 2208.

Certification: Required.

Certification provider: An organisation accredited by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ).

Type: Grade A.

**Unacceptable blemishes in heat-treated flat glass (including tinted and coated glass)**

Standard: To AS/NZS 4667.

**E35.2.3 GLAZING MATERIALS**

**General**

Glazing materials (including putty, glazing compounds, sealants, gaskets, glazing tapes, spacing strips, spacing tapes, spacers, setting blocks and compression wedges): Appropriate for the conditions of application and the required performance.

**Jointing materials**

Requirement: Provide recommended jointing and pointing materials which are compatible with each other and with the contact surfaces and non staining to finished surfaces. Do not provide bituminous materials on absorbent surfaces.

**Priming**

Application: Apply the recommended primer to the surfaces in contact with sealant materials.

**Control joints**

Depth of elastomeric sealant: One half the joint width, or 6 mm, whichever is the greater.

Foamed materials (in compressible fillers and backing rods): Closed-cell or impregnated types which do not absorb water.

Bond breaking: Provide backing rods, and other back-up materials for sealants, which do not adhere to the sealant.

**E35.2.4 GLASS IDENTIFICATION**

**Safety glazing materials**

Identification: Identify each piece or panel, to AS 1288.

**Bullet-resistant panels**

Marking: To AS/NZS 2343.

**E35.2.5 LOUVRE WINDOW ASSEMBLIES**

**General**

General: Provide louvre blades mounted in a metal surround frame or subframe and able to withstand the permissible-stress-design wind pressure for that location without failure or permanent distortion of members, and without blade flutter.

**Framing**

Framing to Louvre assemblies shall be similar to window framing and installed as for metal window installations.

**LOUVRE**

**Screens**

Requirement: Provide metallic-coated steel wire or UPVC mesh screens behind louvres to prevent the entry of vermin, birds, rodents and wind blown leaves and papers.

### **E35.2.6 ALUMINIUM FRAME FINISHES**

#### **Powder coatings**

Standard: To AS 3715.

Grade: Architectural coating.

#### **Anodised**

Standard: To AS 1231.

Thickness:  $\geq$  15 microns to 20 microns.

Colour: Natural

### **E35.2.7 GLAZING FILM**

#### **Materials**

Anti-blast film to inside of glazing

Anti graffiti film on inside.

#### **Installation**

Adhesive fix in accordance with the manufacturer's recommendations.

### **E35.2.8 ANCILLARY MATERIALS**

#### **Trims**

Timber: Solid timber at least 19 mm thick, mitred at corners.

#### **Extruded gaskets and seals**

General: Provide seals to the **Window and glazed door seal schedule**.

Materials: Non cellular (solid) elastopressive seals as follows:

- Flexible polyvinyl chloride (PVC): To BS 2571, 100% solids with high consistency, ultra-violet stabilised.
- Rubber products (neoprene, ethylene propylene diene monomer (EPDM) or silicone rubber): To BS 4255-1.

#### **Flashings**

General: Corrosion resistant, compatible with the other materials in the installation, and coated with a non-staining compound where necessary.

Standard: To AS/NZS 2904.

#### **Jointing materials**

General: Compatible with each other and with the contact surfaces and non staining to finished surfaces. Do not provide bituminous materials on absorbent surfaces.

#### **Nylon brush seals**

General: Dense nylon bristles locked into galvanized steel strips and fixed in a groove in the edge of the door or in purpose-made anodised aluminium holders fixed to the door with double sided PVC foam tape.

#### **Pile weather strips**

General: Polypropylene or equivalent pile and backing, low friction silicone treated, ultra-violet stabilised.

Standard: To AAMA 701/702.

#### **Weather bars**

General: Provide a weather bar under hinged external doors, locate under the centres of closed doors.

### **E35.2.9 MIRRORS**

#### **General**

Type: Silver layer deposited on glass or glazing plastic.

Protective coatings: Electrolytic copper coating at least 5um thick and 2 coats of mirror backing and edge sealing paint having a total dry film thickness of at least 50um.

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**E35.3 EXECUTION**

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**E35.3.1 GLASS PROCESSING****General**

Processing: Perform required processes on glass, including cutting, obscuring, silvering and bending. Form necessary holes, including for fixings, equipment, access openings and speaking holes. Process exposed glass edges to a finish not inferior to ground arrised.

**E35.3.2 INSTALLATION****Glazing**

General: Install the glass so that:

- Each piece is held firmly in place by permanent means which enable it to withstand the normal loadings and ambient conditions at its location without distortion or damage to glass and glazing materials.
- Building movements are not transferred to the glass.
- External glazing is watertight and airtight.

Temporary marking: Use a method which does not harm the glass. Remove marking on completion.

Toughened glass: Do not cut, work, or permanently mark after toughening. Use installation methods which prevent the glass making direct contact with metals or other non-resilient materials.

Heat absorbing glass: In locations exposed to direct sunlight, provide wheel cut edges free from damage or blemishes, with minimum feather.

**Preglazing**

Window assemblies and glazed doors: Supply inclusive of glazing, shop preglazed.

**Windows**

General: Install windows so that the frames:

- Are plumb, level, straight and true within acceptable building tolerances.
- Are fixed or anchored to the building structure in conformance with the wind action loading requirements.
- Will not carry any building loads, including loads caused by structural deflection or shortening.
- Allow for thermal movement.

**Weatherproofing**

Flashing and weatherings: Install flashings, weather bars, drips, storm moulds, caulking and pointing so that water is prevented from penetrating the building between the window frame and the building structure under the prevailing service conditions, including normal structural movement of the building.

**Fixing**

Fasteners and fastener spacing: Conform to the recommendations of the manufacturer.

Fasteners: Conceal fasteners.

Packing: Pack behind fixing points with durable full width packing.

Prepared masonry openings: If fixing of timber windows to prepared anchorages needs fastening from the frame face, sink the fastener heads below the surface and fill the sinking flush with a material compatible with the surface finish.

**Joints**

General: Make accurately fitted tight joints so that neither fasteners nor fixing devices such as pins, screws, adhesives and pressure indentations are visible on exposed surfaces.

Sealants: If priming is recommended, prime surfaces in contact with jointing materials. If frames are powder coated apply a neutral cure sealant.

**Operation**

General: Ensure moving parts operate freely and smoothly, without binding or sticking, at correct tensions or operating forces and are lubricated.

**Protection**

Removal: Remove temporary protection measures from the following:

- Contact mating surfaces before joining up.

- Exposed surfaces.

#### In situ touch up

Polyester or fluoropolymer coatings: Contact supplier for approval to apply touch up products otherwise replace damaged material.

#### Trim

General: Provide mouldings, architraves, reveal linings, and other internal trim using materials and finishes matching the window frames. Install to make neat and clean junctions between frames and the adjoining building surfaces.

### E35.3.3 LOUVRE ASSEMBLIES

#### Installation

General: Screw fix stiles and mullions to the building structure. Provide weather strips to heads and sills.

#### Metal louvres

General: Provide metal louvre blades mounted in a metal surround frame or subframe, installed as for metal window installations.

### E35.3.4 COMPLETION

#### Trade clean

Method: Clean with soft clean cloths and clean water, finishing with a clean squeegee. Do not use abrasive or alkaline materials.

Extent: All frames and glass surfaces inside and out.

#### Maintenance manual

General: Submit the window and glazed door manufacturer's published instructions for operation, care and maintenance.

#### Warranties

Window and door assemblies: Submit the manufacturer's published product warranties.

### E35.4 SELECTIONS

#### E35.4.1 WINDOWS AND GLAZED DOORS

##### Window construction schedule

Location	Description	Value/description
<b>New Platform Building</b>		
	A - Windows	
	Product name	G James 475 series frames or approved equivalent
	Frame size	100mm, with 35mm rebates as required by TfNSW
	Suite description	Fixed glazing and fixed glazing combined with louvres
	Material	Aluminium
	Finish	Anodised
	Glazing	
	- Manufacturer	Viridian New World Glass
	- Type	"VFloat" Laminated annealed safety glass
	- Colour	Super Green
	- Thickness	10.38mm
	- Film	Anti-blast film on inside and anti-graffiti film on the outside
	B - Louvres	

Location	Description	Value/description
<b>New Platform Building</b>		
	- Supplier	Architectural Louvre Products and Services (ALPS)
	- Frame	As for glazing
	- Type	Aluminium Double Bank Louvres, Type 2UL/SH, with insect and vermin proofing
	- Blade material	Aluminium
	- Finish	Anodised
	- Ventilation	50% open area in accordance with the mechanical services drawings
<b>Lift Shafts</b>		
	A - Windows	
	Product name	G James 475 series frames or approved equivalent
	Frame size	100mm, with 35mm rebates as required by TfNSW
	Suite description	Fixed glazing and louvres
	Material	Aluminium
	Finish	Anodised
	Glazing	
	- Manufacturer	Viridian New World Glass
	- Type	"VFloat" Laminated annealed safety glass
	- Colour	Super Green
	- Thickness	10.38mm
	- Film	Anti-blast film on inside and anti-graffiti film on the outside
	B - Louvres	
	- Supplier	Architectural Louvre Products and Services (ALPS)
	- Frame	As for glazing
	- Type	Aluminium Double Bank Louvres, Type 2UL/SH, with insect and vermin proofing
	- Blade material	Aluminium
	- Finish	Anodised
	- Ventilation	50% open area in accordance with the mechanical services drawings
	- U Value	5.8

Location	Description	Value/description
New Platform Building Ticket Office	Ticket window	Refer to Metalwork

**Louvre screens**

Location	Description	Value/description
<b>Screens at Lift landings</b>		
	Louvre screens	Each screen is to be consist of 9 panels

Location	Description	Value/description
	- Supplier	CS Group
	- Frame	As for glazing
	- Type	Z shaped louvres, set vertically or horizontally as shown on drawings
	- Blade material	Aluminium
	- Finish	Anodised

#### E35.4.2 MIRRORS

##### Mirror schedule

Location: Family Access Toilet

- Type: Wall mounted frameless mirror extending from skirting tile to ceiling
- Size: Refer to drawings
- Fixing: Screw fixed to walls

Location: Staff Toilet

- Type: One wall mounted frameless mirror extending from skirting tile to ceiling, and one wall mounted frameless mirror above basin.
- Size: Refer to drawings
- Fixing: Screw fixed to walls

**E25 DOORS****E25.1 GENERAL****E25.1.1 RESPONSIBILITIES****General**

General: Provide doors, frames, doorsets, security screen doors and fire doorsets as documented.

**E25.1.2 CROSS REFERENCES****General**

Requirement: Conform to the following:

- *General requirements.*
- *Door hardware*

**E25.1.3 INTERPRETATION****Definitions**

General: For the purposes of this worksection the following definitions apply:

- **Balanced construction:** A construction of flush doors in which the facings on one side of the core are essentially equal in thickness, grain direction, properties and arrangement to those on the other side of the core. It is such that uniformly distributed changes in moisture content will not cause warpage.
- **Door frame:** Includes jamb linings.
- **Doorset:** An assembly comprising a door or doors and supporting frame, guides and tracks including the hardware and accessories necessary for operation.
  - . **Fire-doorset:** A doorset which retains its integrity, provides insulation and limits, if required, the transmittance of radiation in a fire.
  - . **Smoke-doorset:** A doorset which restricts the passage of smoke.
- **Flush door:** A door leaf having two plane faces which entirely cover and conceal its structure. It includes doors with intermediate rail, cellular, blockboard and particleboard cores.
  - . **Solid core door:** A flush door with a solid core continuous between stiles and rails or edge strips and fully bonded to the faces.
- **Joinery door:** A door leaf having either stiles and rails, or stiles, rails and muntins, framed together. A joinery door may also incorporate glazing bars.
  - . **Louvred door:** A joinery door in which the panel spaces are filled in with louvre blades.
  - . **Panelled door:** A joinery door with spaces filled in with panels including glass.

**E25.1.4 INSPECTION****Notice**

Inspection: Give notice so that inspection may be made of the following:

- Door frames in place before building in to masonry.
- Door frames installed before fixing trim.

**E25.1.5 SUBMISSIONS****General**

General: Submit 2 samples as follows:

- Colour range samples from prefinished production material (e.g. anodised or organic coated extrusions and sheet). When the colour selection has been made, submit 5 sets of samples showing the colour range.
- Door manufacturer's standard hardware items.
- Finishes to prepared surfaces.
- Joints made using proposed techniques.
- Sections proposed to be used for frames, louvres and slats.

**Type tests**

General: Submit type-test certification complying with the following standards to verify conformance with the **Doorsets performance schedule**:

- Fire and smoke doors: To AS 1905.1 and BCA Spec C3.4.
- Weighted sound reduction index ( $R_w$ ): To AS/NZS 1276.1, ISO 717-1 or AS/NZS ISO 717.1.

**Maintenance documentation**

Recommendations: Submit manufacturer's published recommendations for service use.

**E25.2 PRODUCTS****E25.2.1 FRAMES****Steel frames**

General: Continuously welded from metallic-coated steel sheet sections, including necessary accessories such as buffers, strike plates, spreaders, mortar guards, switch boxes, fixing ties or brackets, and cavity flashing with suitable provision for fixing hardware and electronic security assemblies, and prefinished with a protective coating.

Finish: Grind the welds smooth, cold galvanize the welded joints and shop prime.

Hardware and accessories: Provide for fixing hardware including hinges and closers, using 4 mm backplates and lugs. Screw fix the hinges into tapped holes in the back plates.

Base metal thickness:

- General:  $\geq 1.1$  mm.
- Fire rated doorsets:  $\geq 1.4$  mm.
- Security doorsets:  $\geq 1.6$  mm.

Metallic-coated steel sheet: To AS 1397.

- Coating class interior: Z275.
- Coating class exterior: Z450.

**E25.2.2 DOORS****Standards**

Materials: To the following:

- Decorative laminated sheets: To AS/NZS 2924.1.
- Wet processed fibreboard (including hardboard): To AS/NZS 1859.4.
- Dry processed fibreboard (including medium density fibreboard): To AS/NZS 1859.2.
- Particleboard: To AS/NZS 1859.1.
- Plywood and blockboard for interior use: To AS/NZS 2270.
- Plywood and blockboard for exterior use: To AS/NZS 2271.
- Seasoned cypress pine: To AS 1810.
- Timber – hardwood: To AS 2796.1.
- Timber – softwood: To AS 4785.1.

**Certification**

General: Brand panels under the authority of a recognised certification program applicable to the product. Locate the brand on faces or edges which will be concealed in the works.

**General**

Doors: Proprietary products manufactured for interior or exterior applications and for the finish required.

**Flush doors**

General: Of balanced construction.

Cellular core and intermediate rail core flush doors:

- Provide a subframe of 25 mm minimum width timber around openings for louvres and glazing.
- Provide additional material to take hardware, fastenings and grooves.

- Cut outs: If openings are required in flush doors (e.g. for louvres or glazing) make the cut outs not closer than the width of the styles at the edges of the doors.

Solid core: Solid flush doors as follows:

- Flush door with blockboard: Core plate of timber strips laid edge to edge, fully bonded to each other and to facings each side of no less than two sheets of timber veneer.
- Single thickness of moisture resistant general purpose medium density fibreboard.

Smoke doors: Solid core  $\geq 35$  mm thick.

#### Construction

Adhesives:

- Internal: To AS/NZS 2270.
- External: To AS/NZS 2271.

Door thickness:

- General: 35 mm.
- External doors and doors over 900 mm wide: 40 mm.

Edge strips: Fix to stiles. Minimum thickness 10 mm. Increase overall thickness to  $> 15$  mm to accommodate the full depth of the rebate in rebated doors. Form rebates to suit standard rebated hardware. Bevel square edged doors as necessary to prevent binding between the leaves.

Louvre grilles: Construct by inserting the louvre blades into a louvre frame, and fix the frame into the door.

#### Tolerance

Squareness: The difference between the lengths of diagonals of a door:  $\leq 3$  mm.

Twist: The difference between perpendicular measurements taken from diagonal corners:  $\leq 3$  mm.

Nominal size ( mm):

- Height: + 0, - 2.
- Width: + 0, - 2.

### E25.2.3 DOORSETS

#### Duct access panels

General: Proprietary products comprising metal-faced doors side hung to steel door frames, inclusive of the necessary hardware and accessories including hinges and lock and lugs or other suitable means for installation.

#### Fire-resistant doorsets

Standard: To AS 1905.1 and BCA Spec C3.4.

### E25.2.4 ANCILLARY MATERIALS

#### Trims

Timber: Solid timber at least 19 mm thick, mitred at corners.

#### Extruded gaskets and seals

General: Provide seals to the **Door seal schedule**.

Materials: Non cellular (solid) elastopressive seals as follows:

- Flexible polyvinyl chloride (PVC): To BS 2571, 100% solids with high consistency, ultra-violet stabilised.
- Rubber products (neoprene, ethylene propylene diene monomer (EPDM) or silicone rubber): To BS 4255-1.

#### Flashings

General: Corrosion resistant, compatible with the other materials in the installation, and coated with a non-staining compound where necessary.

Standard: To AS/NZS 2904.

#### Jointing materials

General: Compatible with each other and with the contact surfaces and non staining to finished surfaces. Do not provide bituminous materials on absorbent surfaces.

**Nylon brush seals**

General: Dense nylon bristles locked into galvanized steel strips and fixed in a groove in the edge of the door or in purpose-made anodised aluminium holders fixed to the door with double sided PVC foam tape.

**Pile weather strips**

General: Polypropylene or equivalent pile and backing, low friction silicone treated, ultra-violet stabilised.

Standard: To AAMA 701/702.

**Weather bars**

General: Provide a weather bar under hinged external doors, locate under the centres of closed doors.

**E25.3 EXECUTION****E25.3.1 FRAMES****General**

Frames: Install so that the frames are as follows:

- Plumb, level, straight and true.
- Fixed or anchored to the building structure.
- Will not carry any building loads, including loads caused by structural deflection or shortening.

**Frame fixing**

Brackets: Metallic-coated steel:

- Width:  $\geq 25$  mm.
- Thickness:  $\geq 1.5$  mm.

Depth of fixing for building into masonry:

- Brackets:  $\geq 200$  mm.
- Expansion anchors:  $\geq 50$  mm.
- Plugs:  $\geq 50$  mm.
- Rods:  $\geq 60$  mm.

Heads of fasteners: Conceal where possible, otherwise sink the head below the surface and fill the sinking flush with a material compatible with the surface finish.

Jamb fixing centres:  $\leq 600$  mm.

**Joints**

General: Make accurately fitted joints so that no fasteners, pins, screws, adhesives and pressure indentations are visible on exposed surfaces.

**Steel frames**

Building in to masonry: Attach galvanized steel rods to jambs, build in and grout up.

Fixing to masonry openings: Build in hairpin anchors and install locking bars, or use proprietary expansion anchors and screw twice through jambs at each fixing.

Fixing to stud frame openings: Attach galvanized steel brackets to jambs and screw twice to studs at each fixing.

**Weatherproofing**

Flashings and weatherings: Install flashings, weather bars, drips, storm moulds, caulking and pointing to prevent water from penetrating the building between the door frame and the building structure under the prevailing service conditions, including normal structural movement of the building.

**Finishing**

Trim: Provide mouldings, architraves, reveal linings, and other internal trim using materials and finishes matching the door frames. Install to make neat and clean junctions between the frame and the adjoining building surfaces.

**E25.3.2 DOORS****Priming**

General: Prime timber door leaves on top and bottom edges before installation.

**E25.3.3 COMPLETION****Operation**

General: Make sure moving parts operate freely and smoothly, without binding or sticking, at correct tensions or operating forces and that they are lubricated where appropriate.

**Protection**

Temporary coating: On or before completion of the works, or before joining up to other surfaces, remove all traces of temporary coatings used as a means of protection.

**E25.4 SELECTIONS****E25.4.1 DOOR SCHEDULE****Schedule**

<b>Door No</b>	<b>Door Location</b>	<b>Door Type</b>	<b>Leaf Size H x W x T</b>	<b>Leaf finish</b>	<b>Frame Type</b>	<b>Frame Finish</b>
D.01	Station Building Entry	External, single leaf, solid core with metal lining	2040 x 920 x 40	Paint	Steel Double rebate	Paint
D.02	Station Building Ticket Office	Internal, single leaf, solid core with plywood lining	2040 x 920 x 40	Paint	Steel Double rebate	Paint
D.03	Station Building Cleaners Room	Internal, single leaf, solid core with plywood lining	2040 x 920 x 40	Paint	Steel Double rebate	Paint
D.04	Station Building Staff Toilet	Internal, single leaf, solid core with plywood lining	2040 x 920 x 40	Paint	Steel Double rebate	Paint
D.05	Station Building Family Accessible Toilet	External, single leaf, solid core with metal lining	2040 x 920 x 40	Paint	Steel Double rebate	Paint
D.06	Storage Area	External, double leaf, solid core with metal lining	2040 x 1260 x 40	Paint	Steel Double rebate	Paint

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**E26 OVERHEAD DOORS**

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**E26.1 GENERAL**

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**E26.1.1 RESPONSIBILITIES**

**General**

General: Provide overhead doorsets as scheduled in **Selections**.

**E26.1.2 CROSS REFERENCES**

**General**

Requirement: Conform to the following:

- *General requirements.*

**E26.1.3 STANDARDS**

**General**

Garage doors: To AS/NZS 4505.

Bushfire screens and seals: To AS 3959.

**E26.1.4 INSPECTION**

**Notice**

Inspection: Give sufficient notice so that inspection may be made of the following:

- Tracks and guides installed before doors or shutters are hung.

**E26.2 PRODUCTS**

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**E26.2.1 WINDOW SHUTTER**

**Types**

Window shutter: Proprietary system comprising a flexible continuous curtain sliding between vertical guides, raised or lowered by rolling or unrolling around a horizontal drum (barrel) mounted above the opening, inclusive of the manufacturer's standard operating gear, hardware, and accessories necessary for satisfactory performance.

**Wind actions**

General: Install so that the shutter, in its closed position, withstands pressure on the surface without impairment of its ability to function.

**Curtain**

Continuous curtain: A single metal sheet pressed to a horizontal ribbed profile.

Slatted curtain: A curtain of horizontal interlocking slats, incorporating interlocking hinges extending the full width of the curtain.

Bottom curtain rail: A stiffening member interlocking with the bottom edge or lowest slat of the curtain, extending between the inner faces of the vertical guides, formed or adapted where necessary to follow the contour of a sloping floor or threshold. The rail may also be adapted to house the locking device.

**Drum**

Maximum drum deflection: 1/360th of the span.

Springs: Helical torsion springs housed in the drum and arranged to counterbalance the curtain weight without exceeding the safe working stress of the spring material.

**Operation**

Method of raising and lowering the curtain: Motorised

**Motorised operation**

General: Provide electric motor incorporating limit switches, manual safety stop and reversing mechanism, and overload cutout, operated by a battery-powered radio remote controller (supplied as part of the system), and also by a direct push-button or key switch. Provide a motorised system which is capable of manual operation in the event of power failure. Locate operating switch 1500 mm above floor level.

## E26.3 EXECUTION

### E26.3.1 FRAMES

#### General

Frames: Install so that the frames are as follows:

- Plumb, level, straight and true.
- Fixed or anchored to the building structure.
- Will not carry any building loads, including loads caused by structural deflection or shortening.

### E26.3.2 COMPLETION

#### Operation

General: Ensure moving parts operate freely and smoothly, without binding or sticking, at correct tensions or operating forces and that they are lubricated where appropriate.

#### Protection

Temporary coating: On or before completion of the works, or before joining up to other surfaces, remove all traces of temporary coatings used as a means of protection.

#### Maintenance manual

General: Submit the overhead door manufacturer's published instructions for operation, care and maintenance.

#### Warranties

Roller shutters: Submit the manufacturer's published product warranties.

## E26.4 SELECTIONS

### E26.4.1 SCHEDULES

#### Sectional overhead doors schedule

<b>Location</b>	<b>Ticket Office window</b>
Description	Security shutter
Size	As shown on drawings
Type	8/50 industrial slat
Slats	50mm wide x 0.8mm thick
Manufacturer	B&D or equivalent
Finish	Powdercoat

**E27 DOOR HARDWARE****E27.1 GENERAL****E27.1.1 RESPONSIBILITIES****General**

General: Provide door hardware as documented.

Handing: Before supply, verify on site, the correct handing of hardware items.

Hardware specified generically: Provide hardware of sufficient strength and quality to perform its function, appropriate to the intended conditions of use, suitable for use with associated hardware, and fabricated with fixed parts firmly joined.

Operation: Ensure working parts are accurately fitted to smooth close bearings, without binding or sticking, free from rattle or excessive play, lubricated where appropriate.

**Supply**

Delivery: Deliver door hardware items, ready for installation, in individual complete sets for each door, as follows:

- Clearly labelled to show the intended location.
- In a separate dust and moisture proof package.
- Including the necessary templates, fixings and fixing instructions.

**E27.1.2 REPLACEMENT ITEMS**

Door hardware: Match items being replaced with existing unless documented otherwise. Upgrade hinges as necessary to conform to **Hinges table A** and **Hinges table B**.

**E27.1.3 CROSS REFERENCES****General**

Requirement: Conform to the following:

- *General requirements*.
- Doors
- Overhead doors

**E27.1.4 INTERPRETATION****Abbreviations**

General: To AS 4145.1 Appendix D.

**Definitions**

Glossary of terms: To AS 4145.1 Section 2.

Lock functions: To AS 4145.1 Appendix E.

**E27.1.5 SUBMISSIONS****Door-by-door schedule**

General: Submit a door-by-door hardware schedule.

Information sources: This worksection and the contract drawings.

**Samples**

Generic items: Submit samples of hardware items offered as meeting the description of items not specified as proprietary items.

Refurbished items: Submit samples of hardware items offered as meeting the standard of cleaning, repair and testing of recovered items.

**Key control System**

New works: Submit details of the proprietary key control security system proposed by the lock manufacturer for locks required to accept a group key (master, grandmaster).

Alterations and additions: Submit details to extend the existing key control security system for locks required to accept a group key.

**Record documents**

Door hardware schedule: Submit an amended schedule, prepared by the door hardware supplier, showing changes to the contract door hardware schedule caused as follows:

- By the approval of a hardware sample.
- By the acceptance of an equivalent to a specified proprietary item.
- By a contract variation to a door hardware requirement.

**Keys**

Key codes: Submit the lock manufacturer's record of the key coding system showing each lock type, number and type of key supplied, key number for re-ordering, and name of supplier.

Keys: For locks keyed to differ and locks keyed alike, verify quantities against key records, and deliver to the Principal's Representative at practical completion.

**E27.2 PRODUCTS**

**E27.2.1 LOCKS AND LATCHES**

**Standard**

General: To AS 4145.2.

**Padlocks**

Standard: To AS 4145.4.

**E27.2.2 HINGES**

**Butt hinge sizes**

Size for door types: Conform to tables as follows:

- Timber doors in timber or metal frames: **Hinge table A.**

Measurement: Length (l) is the dimension along the knuckles, not including hinge tips, if any, and width (w) is the dimension across both hinge leaves when opened flat.

**Butt hinge materials**

Timber doors in timber or steel frames:

- Material: Refer to hardware Schedule.
- Product: Refer to Hardware Schedule

Doors fitted with closers: Provide low friction ball bearing hinges.

Fire doors: To AS 1905.1.

Power transfer hinges: Ensure they do not assume any load and are installed with other compatible hinges.

**E27.2.3 HINGE TABLES**

**Hinge table A**

Application: Solid core doors. The table can be used to determine the quantity of hinges required for the nominated door leaf sizes and weights only. For door leaf sizes not specified or with applied finishes use the weight of the door to determine the quantity of hinges required. For door leaves over 80 kg, nominate pivot hinges.

The size of the hinge is determined by the door leaf thickness:

- 35 - 43 mm thick door: 100 x 75 mm # butt hinges with a minimum thickness of 2.5 mm.
- 44 - 55 mm thick door: 100 x 100 mm # butt hinges with a minimum thickness of 2.5 mm.
- > 55 mm thick door: Refer to the door by door hardware schedule.

Hinge pin: The symbol # refers to the pin type. Supply fixed pins to doors opening out or designated as a security doors.

Wide throw: If necessary, provide wide throw hinges to achieve the required door swings in the presence of obstacles such as nibs, deep reveals and architraves.

**Hinge table A**

Nominal door leaf size (H x W x T) (mm)	Door leaf weight ( kg - approx)	Number of hinges
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Nominal door leaf size (H x W x T) (mm)	Door leaf weight ( kg - approx)	Number of hinges
2040 x 400 x 35	≤ 19	2
2040 x 600 x 35	≤ 29	2
2040 x 720 x 35	≤ 35	3
2040 x 820 x 35	≤ 39	3
2040 x 920 x 35	≤ 44	3
2040 x 1020 x 35	≤ 49	4
2040 x 720 x 40	≤ 37	3
2040 x 820 x 40	≤ 42	3
2040 x 920 x 40	≤ 48	3
2040 x 1020 x 40	≤ 52	4
2040 x 720 x 50	≤ 45	3
2040 x 820 x 50	≤ 50	3
2040 x 920 x 50	≤ 57	3
2040 x 1020 x 50	≤ 68	4
2400 x 720 x 40	≤ 50	4
2400 x 820 x 40	≤ 52	4
2400 x 920 x 40	≤ 55	4
2400 x 1020 x 40	≤ 60	4
2400 x 1220 x 50	≤ 72	5
2040 x 920 x 70	≤ 88	Nominate pivot hinges

#### E27.2.4 KEYING

##### Temporary construction keys and cylinders

Requirement: Provide one of the following:

- Loan cylinder: Install for construction locks and replace at practical completion.
- Construction keyed master key cylinder: Keep up-to-date records of keys issued including recipient's name, company and contact details, date issued and date returned.

##### Delivery of keys

Great grandmaster, grandmaster and master keys: Arrange for the manufacturer or supplier to deliver direct to the principal.

Number of keys: Conform to the **Number of keys table**.

##### Group keying

Keying system: Provide a group keying system in conformance with the **requirements of TfNSW**.

Existing system: Obtain the details of existing group or master key systems to which a new system is required to be an extension.

Future extensions: Provide master and grandmaster group keying systems which are capable of accommodating future extensions.

Keying control security system: If cylinder or pin-tumbler locks accept a group key (e.g. master key, maison key) provide to those locks a proprietary keying control security system.

Stamping: Stamp keys and lock cylinders to show the key codes and/or door number as scheduled.

##### Identification

Labelling: Supply each key with a purpose-made plastic or stamped metal label legibly marked to identify the key, attached to the key by a metal ring.

##### Key material

Lever locks: Malleable cast iron or mild steel.

Pin tumbler locks: Nickel alloy, not brass.

**Number of keys table**

Code	Key type	Minimum number of keys
GGMK	Great grandmaster keys	2
GMK	Grandmaster keys	2
MK	Master keys	2 per code group
KD	Locks keyed to differ	2 per lock
KA	Locks keyed alike:	
	2 locks in code group	4
	3 to 10 locks in code group	6
	11 to 40 locks in code group	10
	41 and over locks in code group	1 per 4 locks or part thereof

**E27.3 EXECUTION****E27.3.1 INSTALLATION****Mounting height**

Locks and latches: Centreline of the door knob or lever spindle above finished floor: Generally 1050mm above finished floor level.

**Door stops**

Fixing: Fix on the floor, skirting or wall, as appropriate, to prevent the door or door furniture striking the wall or other surface.

**Fasteners**

Materials: Provide materials compatible with the item being fixed, and of sufficient strength, size and quality to perform their function.

- Concealed fixings: Provide a corrosion resistant finish to concealed fixings.
- Exposed fixings: Match exposed fixings to the material being fixed.

Security: Locate exposed fixings to lock furniture on the inside faces of external doors and on the inside faces of internal doors to lockable rooms.

Support: Provide appropriate back support (for example lock stiles, blocking, wall noggings and backing plates) for hardware fixings.

- Hollow metal sections: Provide backing plates drilled and tapped for screw fixing, or provide rivet nuts with machine thread screws. Do not use self tapping screws or blind rivets.

**Floor springs**

General: Form a recess in the floor slab for the floor spring box and grout the box in place so that the cover plate is flush with the finished floor.

**Hinges**

Metal frames: Fix hinges using metal thread screws.

Timber doorsets: Install butt hinges in housings equal in depth to the thickness of the hinge leaf (except for hinges designed for mounting without housing), and fix with countersunk screws.

**E27.3.2 COMPLETION****Adjustment**

General: Leave the hardware properly adjusted with working parts in working order, and clean, undamaged, properly adjusted, and lubricated where appropriate.

Automatic door operators: Maintain and adjust the system throughout the defects liability period.

**Keys**

Contractor's keys: Immediately before practical completion, replace or reset cylinders to which the contractor has had key access during construction and ensure the exclusion of the contractor's keys.

**Maintenance**

Automatic door operators: Submit the installer's proposal for continuing maintenance after completion on an annual renewal basis.

Manual: Submit the manufacturer's published recommendations for use, care and maintenance of the hardware provided.

**Product warranties**

Warranty: Cover materials and workmanship in the terms of the warranty in the form of interlocking warranties from the manufacturer or distributor and the applicator.

Automatic door operators: Submit a warranty (or interlocking warranties) from the supplier and installer for the system and its installation, for a period of at least twelve months from the date of practical completion.

**E27.4 SELECTIONS**

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**Door hardware schedule**

Refer to the Door Hardware Schedule prepared by Fusion 2 Hardware Specifier.

## E28 INSULATION AND SARKING MEMBRANES

### E28.1 GENERAL

#### E28.1.1 RESPONSIBILITIES

##### General

General: Provide insulation and sarking membrane systems:

- Complete for their function.
- Conforming to the detail and location drawings.
- Firmly fixed in position.
- Maintain their performance for the life of the building.

#### E28.1.2 CROSS REFERENCES

##### General

Requirement: Conform to the following:

- *General requirements.*
- Lining
- Suspended ceilings

#### E28.1.3 STANDARDS

##### Installation of mineral wool insulation

Comply with the ICANZ Industry Code of Practice for the Safe Use of Glass Wool and Rock Wool Insulation.

Marking: Deliver mineral wool products to site in packaging labelled FBS1 BIOSOLUBLE INSULATION.

#### E28.1.4 INTERPRETATION

##### Definitions

General: For the purposes of this worksection the following definitions apply:

- Terminology: To AS/NZS 4859.1.
- Fire hazard properties: To BCA A2.4.
- Sarking membrane: Flexible membrane material normally used for waterproofing, vapour proofing or thermal reflectance.
- FBS-1 Glass wool: Spun fibres of molten glass, utilizing up to 60% recycled waste glass, thermally bonded to form batts, blankets and sheets for thermal and acoustic insulation.
- FBS-1 Rock wool: Spun fibres of molten rock thermally bonded to form batts and blankets for thermal and acoustic insulation.
- Polyester insulation: Polyester fibres thermally bonded to form batts and blankets.
- Vapour barrier: A material or system that adequately impedes the transmission of water vapour under specified conditions.
- Breathable (vapour permeable) membrane: A flexible membrane material normally used for secondary waterproofing that allows for the transmission of water vapour.

#### E28.1.5 INSPECTION

##### Notice

Inspection: Give notice so that inspection may be made of the sarking, vapour barrier and insulation before they are covered up or concealed.

#### E28.1.6 SUBMISSIONS

##### Fire hazard properties

General: Submit evidence of conformance with the following:

- Fire hazard indices for all materials when tested in conformance with AS/NZS 1530.3, including, if the material has a reflective facing, scoring and blackening to AS/NZS 1530.3 clause A6:
  - . Spread of flame index: 0.
  - . Smoke developed index:  $\leq 3$ .
- Facing materials: Flammability index  $< 5$  when tested in conformance with AS/NZS 1530.2.

**Thermal properties**

General: Submit evidence of conformance with AS/NZS 4859.1.

**E28.2 PRODUCTS**

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**E28.2.1 INSULATION MATERIALS**

**Fire hazard properties**

General: Fire hazard indices for all materials when tested in conformance with AS/NZS 1530.3:

- Spread of flame index: 0.
- Smoke developed index:  $\leq 3$ .
- Materials with reflective facing: Test to AS/NZS 1530.3 clause A6.

Facing materials: Flammability index  $< 5$  when tested in conformance with AS/NZS 1530.2.

**Bulk and reflective insulation**

Cellulosic fibre (loose fill): To AS/NZS 4859.1 Section 5.

Mineral wool blankets and cut pieces: To AS/NZS 4859.1 Section 8.

Polyester: To AS/NZS 4859.1 Section 7.

Polyisocyanurate (rigid cellular sheets RC/PIR): To AS 1366.2.

Polystyrene (extruded rigid cellular sheets RC/PS-E): To AS 1366.4.

Polystyrene (moulded rigid cellular sheets): To AS 1366.3.

Polyurethane (rigid cellular sheets): To AS 1366.1.

Polyurethane (sprayed): To ASTM D6694.

Reflective insulation: To AS/NZS 4859.1 Section 9.

Wet processed fibreboard (including softboard): To AS/NZS 1859.4.

Wool: To AS/NZS 4859.1 Section 6.

Certification: Required.

Certification provider: An organisation accredited by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ).

**Sarking membranes**

Standard: To AS/NZS 4200.1.

Thermal performance: To AS/NZS 4859.1 Section 9.

Breathable (vapour permeable) membrane: Vapour resistance of not more than 0.5 MNs/g when tested to AS/NZS 4200.1.

**Fasteners and supports**

General: Metallic-coated steel.

**Mesh support to roof insulation**

Metallic-coated steel wire netting: To AS 2423 Section 4.

- Size: 45 mm mesh x 1 mm diameter.

Welded safety mesh: To AS/NZS 4389.

**E28.3 EXECUTION**

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**E28.3.1 GENERAL**

**Framed wall thermal break strips**

Product type: Proprietary item.

Application: To steel or timber framing with lightweight external cladding.

R-value:  $\geq 0.2$ .

Screw fixing: Button head screws at 1 m centres.

Adhesive fixing: Wallboard adhesive 'walnuts' at 1 m centres.

**Bulk insulation**

Installation: To AS 3999 and BCA J1.2.

General: Ensure batts or blankets are firmly butted with no gaps except as follows:

- Access openings and vents: Do not obstruct.
- Light fittings: To AS/NZS 3000 clause 4.5.
- Electrical cables: Prevent contact with polystyrene insulation by wrapping the cable with foil tape.

**Sarking membrane**

Standard: To AS/NZS 4200.2.

**E28.3.2 WALL INSULATION**

**Bulk insulation to framed walls**

Product type: Fibre batts.

Batts: Friction fit between framing members. If support is not otherwise provided, staple nylon twine to the framing and stretch tight.

**E28.3.3 ROOF INSULATION**

**Roof insulation**

Insulation to roofs of new Platform Building and the lift shafts is comprised in the roof panel system specified in roofing.

**E28.3.4 COMPLETION**

**Warranties**

Insulation: Submit the manufacturer's published product warranties.

**E28.4 SELECTIONS**

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**E28.4.1 WALL INSULATION**

**Bulk thermal insulation to 90 mm framing**

Product: Bradford insulation batts

R-value: 2.5

Location: External walls of new Platform Building

**E29 LINING****E29.1 GENERAL****E29.1.1 RESPONSIBILITIES****General**

General: Provide internal lining systems to the **Selections**.

**E29.1.2 CROSS REFERENCES****General**

Requirement: Conform to the following:

- *General requirements.*
- *Light steel framing*
- *Cladding*
- *Suspended ceilings*

**E29.1.3 INSPECTION****Notice**

Inspection: Give sufficient notice so that inspection may be made of substrate or framing before installation of linings.

**E29.1.4 TOLERANCES****Surface**

Flatness, twist, winding and bow:  $\leq 1.5$  mm deviation from a 1.5 m straightedge placed in any position.

**E29.1.5 SUBMISSIONS****Type-test reports**

General: Submit type-test reports to verify conformance with the **Partition performance schedule** and as follows:

- Fire hazard properties:
  - Average specific extinction area (non-sprinklered buildings):  $< 250$  m<sup>2</sup>/kg to AS/NZS 3837.
  - Group number: To AS/NZS 3837 and BCA Spec A2.4, or AS ISO 9705.
  - Smoke growth rate index (non-sprinklered buildings):  $< 100$  to AS ISO 9705 and BCA Spec A2.4.
- Fire resistance level: To AS 1530.4.

**E29.2 PRODUCTS****E29.2.1 MATERIALS AND COMPONENTS****Plasterboard**

Standard: To AS/NZS 2588.

Location: Refer to drawings and Finishes Schedule.

Grade:

- Standard
- Impact resistant
- Fire resistant

**Fibre cement**

Standard: To AS/NZS 2908.2.

Wall and ceiling linings: Type B category 2.

Minimum thickness: 4.5 mm.

Location: Refer to drawings and Finishes Schedule.

Thickness (mm): 9mm

### **Coated steel**

Standard: To AS 1397.

- Coating class interior: Z275.
- Coating class exterior: Z450.

### **Fasteners**

Steel nails: Hot dip galvanized.

### **Adhesives**

For wallboards: Gunnable synthetic rubber/resin based mastic contact adhesive formulated for bonding flooring and wallboards to a variety of substrates.

### **Sealants**

Fire rated sealant: Non-hardening sealant compatible with the materials to be sealed and having a fire rating equal to that of the partition it seals.

Acoustic sealant: Non-hardening sealant compatible with the materials to be sealed and having a specific gravity of not less than 1.5 gm/cubic centimetre and of 100% polyurethane mastic.

## **E29.3 EXECUTION**

### **E29.3.1 CONSTRUCTION GENERALLY**

#### **Conditions**

Commencement: Do not commence lining work until such time as the building or zone in question is enclosed and weathertight and all wet trades have been completed.

#### **Substrates or framing**

General: Before fixing linings check and, if necessary, adjust the alignment of substrates or framing.

#### **Battens**

General: Fix at each crossing with structural framing members, or direct to solid walls or ceilings. Provide wall plugs in solid backgrounds.

#### **Ceiling linings**

General: Do not install until at least 14 days after the timber roof structure is fully loaded.

#### **Accessories and trim**

General: Provide accessories and trim necessary to complete the installation.

#### **Adhesives**

General: Provide adhesives of types appropriate to their purpose, and apply them so that they transmit the loads imposed, without causing discolouration of finished surfaces.

### **E29.3.2 PLASTERBOARD LINING**

#### **Supports**

General: Install timber battens or proprietary cold-formed galvanized steel furring channels as follows:

- Where framing member spacing exceeds the recommended spacing.
- Where direct fixing of the plasterboard is not possible due to the arrangement or alignment of the framing or substrate.
- Where the lining is the substrate for tiled finishes.

Transverse walls: Locate noggings as follows:

- At least 150 mm from the horizontal joint.
- Ensure that noggings do not protrude beyond the face of studs.

#### **Installation**

Gypsum plasterboard and fibre reinforced gypsum lining: To AS/NZS 2589.

#### **Multiple sheet layers**

Application: Fire rated and acoustic rated walls.

Joints: Fill and flush up all joints and fixings in each layer and caulk up perimeters and penetrations before commencing succeeding layers. Stagger all sheet joints by minimum 200 mm.

#### **Joints**

Flush joints: Provide recessed edge sheets and finish flush using perforated paper reinforcing tape.

Butt joints: Make joints over framing members or otherwise provide back blocking.

External corner joints: Make joints over metallic-coated steel corner beads.

Dry joints: Provide square edged sheet and finish with a UPVC joining section.

Control joints: Provide purpose-made metallic-coated control joint beads at not more than 12 m centres in walls and ceilings and to coincide with structural control joints.

Wet areas: Install additional supports, flashings, trim and sealants as required.

Joints in tiled areas: Do not apply a topping coat after bedding perforated paper tape in bedding compound.

### **E29.3.3 FIBRE CEMENT LINING**

#### **Supports**

General: Install timber battens or proprietary cold-formed galvanized steel furring channels as follows:

- Where framing member spacing exceeds the recommended spacing.
- Where direct fixing of the fibre cement is not possible due to the arrangement or alignment of the framing or substrate.
- Where the lining is the substrate for tiled finishes.

#### **Installation**

General: Run sheets across the framing members. In flush jointed applications, stagger end joints in a brick pattern and locate them on framing members, away from the corners of large openings. Provide supports at edges and joints.

Timber framed construction: Nail only or combined with adhesive.

Steel framed construction: Screw only or combined with adhesive.

Wall framing:

- Do not fix to top and bottom plates or noggings.
- In tiled areas: Provide an extra row of noggings immediately above wall-to-floor flashings. Fix sheet at 150 mm centres to each stud and around the perimeter of the sheet.

Masonry wall construction:

- Fix using adhesive direct to masonry, but do not fix direct to masonry as a substrate for tiled finish.
- Fix to furring channels using screw or screw and adhesive.

Ceilings: Fix using screw or screw and adhesive to ceiling furring members. Do not fix sheets to the bottom chords of trusses.

Wet areas: Do not use adhesive fixing alone.

#### **Multiple sheet layers**

Application: Fire rated and acoustic rated walls.

Joints: Fill and flush up all joints and fixings in each layer and caulk up perimeters and penetrations before commencing succeeding layers. Stagger all sheet joints by minimum 200 mm.

#### **Joints**

Flush joints: Provide recessed edge sheets and finish flush using perforated paper reinforcing tape.

External corner joints: Make joints over metallic-coated steel corner beads.

Dry joints: Provide square edged sheet and finish with a UPVC joining section.

Control joints: Provide control joints to coincide with structural control joints and as follows:

- Walls:  $\leq 7.2$  m centres.
- Ceilings: To divide into bays not larger than 10.8 x 7.2 m.
- Soffit linings: To divide into bays not larger than 4.2 x 4.2 m or 5.6 x 3.6 m.
- Control joint beads: Purpose-made metallic coated.
- Support: Provide framing parallel to the joint on each side. Do not fix the lining to abutting building surfaces.

Wet areas: Provide additional supports, flashings, trim and sealants as required.

Joints in tiled areas: Bed perforated paper tape in bedding compound. Do not apply a topping coat.

- Control joints: Space to suit joints required in tiling.

- Internal corners: Reinforce with metallic-coated steel angles. In corners subject to continuous moisture, flash over the angle and under the sheeting with continuous bitumen coated aluminium flashing.

#### E29.3.4 TRIM AND ACCESSORIES

##### General

General: Provide trim such as beads, mouldings and stops to make neat junctions between lining components, finishes and adjacent surfaces.

Proprietary items: Provide complete with installation accessories.

##### Timber trim

Hardwood: AS 2796.1.

Cypress pine: AS 1810.

Softwood: To AS 4785.1.

- Grade: To AS 4785.2.

#### E29.4 SELECTIONS

##### E29.4.1 SHEET LINING

Location	Platform Building
Supporting System:	Steel framing as specified in Light Steel Framing
Lining (internal)	
- Material	Generally: Impact resistant plasterboard Wet Areas: Water resistant plasterboard
- Proprietary item	N/A
- Thickness	13mm
- Joints	Flush
- Edge Type	Recessed edge
- Finish	Generally: Paint Wet Areas: Ceramic tiles
Lining (external)	Refer to Cladding Section
Trim	
- At junctions with ceilings	Rondo P50 Shadowline
- Skirting	Generally: 150mm high timber fixed to finish flush with plasterboard lining and with Rondo P50 Shadowline joint between skirting and wall lining Wet Areas: Coved ceramic tiles
- Other	Steel lining to ticket office to achieve G2 security rating as specified in Metalwork.

## E30 SUSPENDED CEILINGS

### E30.1 GENERAL

#### E30.1.1 RESPONSIBILITIES

##### General

General: Provide suspended ceilings to the **Selections** and as follows.

- Consistent in finish treatment.

#### E30.1.2 CROSS REFERENCES

##### General

Requirement: Conform to the following:

- *General requirements.*
- *Light steel framing*
- *Lining*
- *Cladding*

#### E30.1.3 STANDARDS

##### General

Suspended ceilings: To AS/NZS 2785.

#### E30.1.4 INSPECTION

##### Notice

Inspection: Give notice so that inspection may be made:

- Of the suspension system before the installation of lining.
- Of the completed ceiling before site painting.

#### E30.1.5 SUBMISSIONS

##### Samples

General: Submit samples as follows:

- Suspension system: Sections proposed for the suspension system, including wall angles and trim.
- Accessories including access panels and wall trims.

##### Type tests

General: Submit type-test reports to verify conformance with the **Suspended ceilings performance schedule** and as follows:

- Fire hazard properties:
  - . Average specific extinction area (non-sprinklered buildings): < 250 m<sup>2</sup>/kg to AS/NZS 3837.
  - . Group number: To AS/NZS 3837 and BCA Spec A2.4, or AS ISO 9705.
  - . Smoke growth rate index (non-sprinklered buildings): < 100 to AS ISO 9705 and BCA Spec A2.4.
- Fire resistance level: To AS 1530.4.
- Weighted suspended ceiling normalized level difference: To AS/NZS 1276.1, ISO 717-1 or AS/NZS ISO 717.1.
- Weighted sound absorption coefficient: To AS ISO 11654.

### E30.2 PRODUCTS

#### E30.2.1 SUSPENSION SYSTEM

##### Proprietary system

General: Provide in conformance with the **Proprietary suspended system schedule**.

Protective coatings for steel components: To AS/NZS 2785 Table F1.

### **E30.2.2 LININGS**

#### **Plasterboard**

Standard: To AS/NZS 2588.

#### **Fibre cement**

Standard: To AS/NZS 2908.2.

Wall and ceiling linings: Type B category 2.

Minimum thickness: 4.5 mm.

#### **Sealants**

Fire rated sealant: Non-hardening sealant compatible with the materials to be sealed and having a fire rating equal to that of the partition it seals.

Acoustic sealant: Non-hardening sealant compatible with the materials to be sealed and rated to  $R_w$  65.

### **E30.2.3 CORNICE**

#### **Plasterboard cornices**

Fixing: Adhesive fix with the supplier's cornice cement. Pin in place at cornice edges until adhesive sets, remove pins and fill holes.

#### **Fibrous plaster cornices and roses**

Accessible ceiling spaces: Pin or prop in place and fix with wet plaster of Paris and scrim straps over framing members.

#### **Fire rated walls**

Seal to soffit with sealant of matching fire rated level before fixing decorative cornices.

### **E30.3 EXECUTION**

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#### **E30.3.1 SUSPENSION SYSTEM**

##### **Alterations**

General: Dismantle and re-use ceiling suspension system members and supplement them with compatible members as required.

##### **Suspension system**

Failure: Provide a ceiling system such that failure of any one suspension point does not cause a progressive failure of the ceiling.

Height adjustment: Provide height adjustment by means of a length adjustment device at each suspension point, permitting length variation of at least 50 mm.

Grid members: If required, notch grid members at the junction with the perimeter trim to ensure the panels lie flat on the perimeter trim.

Restriction: Do not attach the suspension system to the lip of purlins.

##### **Services**

Support: Space the support members as required by the loads on the system and the type of ceiling, and allow for the installation of services and accessories, including ductwork, light fittings and diffusers. Provide additional back support or suspension members for the fixing of such items to ensure that distortion, overloading or excessive vertical deflection is prevented. Do not fix suspension members to services (e.g. ductwork) unless the service has been designed to accept the ceiling load. In locations where services obstruct the ceiling supports, provide bridging and suspension on each side of the services. Do not support services terminals on ceiling tiles or panels.

##### **Partitions**

General: If partitions are attached to the underside of the ceiling systems include the partition mass in the seismic mass of the ceiling.

##### **Protection**

General: Protect existing work from damage during the installation.

##### **Stability**

General: Install the ceilings level; and fix so that under normal conditions there is no looseness or rattling of ceiling components.

**Structure-borne sound**

General: Provide a ceiling system which does not amplify structure-borne sound. Provide suitable proprietary products or systems for reducing contact vibrations between structure and ceiling.

**Bracing**

General: Provide bracing to prevent lateral movement and to resist the imposed horizontal seismic force.

**Bulkheads**

General: Construct bulkheads and other similar ceiling formations as an integral part of the ceiling structure. Brace bulkheads to prevent lateral movement. If the ceiling is terminated at a bulkhead, provide for seismic requirements.

**External suspended soffits**

General: Support external suspended soffits on rigid members capable of carrying the loads from imposed actions. Install members to minimise any eccentricity, and ensure that the upward and downward loads from wind actions are carried through to the supporting structure.

**Fasteners**

General: Install fasteners so that they are not visible in the finished ceiling. Do not use screw fasteners in materials supporting hangers less than 3 mm thick.

**Control of movement**

Abutments: Install the ceiling to allow for differential movement at abutting surfaces.

Alignment: Install the ceiling with control joints to correspond in location and direction to the structural control joints. Do not bridge any structural control joint.

**Tolerance**

Suspension system bearing surface: To AS/NZS 2589 Table 4.2.2.

**Prefinishes**

General: Repair damaged prefinishes by recoating.

**E30.3.2 PLASTERBOARD LINING**

**Installation**

Gypsum plasterboard and fibre reinforced gypsum plaster: To AS/NZS 2589

Suspended flush ceilings: Fix using screw or screw and adhesive to ceiling members or support frame.

**Multiple sheet layers**

Application: Fire rated and acoustic rated walls.

Joints: Fill and flush up all joints and fixings in each layer and caulk up perimeters and penetrations before commencing succeeding layers. Stagger all sheet joints by minimum 200 mm.

**Joints**

Flush joints: Provide recessed edge sheets and finish flush using perforated paper reinforcing tape.

Butt joints: Make joints over framing members or otherwise provide back blocking.

External corner joints: Make joints over metallic-coated steel corner beads.

Control joints: Provide purpose-made metallic-coated control joint beads at not more than 12 m centres in ceilings and to coincide with structural control joints.

Wet areas: Install additional supports, flashings, trim and sealants as required.

**E30.3.3 FIBRE CEMENT LINING**

**Installation**

General: Run sheets across the framing members. In flush jointed applications, stagger end joints in a brick pattern and locate them on framing members, away from the corners of large openings. Provide supports at edges and joints.

Suspended flush ceilings: Fix using screw or screw and adhesive to ceiling members or support frame.

**Multiple sheet layers**

Application: Fire rated and acoustic rated walls.

Joints: Fill and flush up all joints and fixings in each layer and caulk up perimeters and penetrations before commencing succeeding layers. Stagger all sheet joints by minimum 200 mm.

**Joints**

Flush joints: Provide recessed edge sheets and finish flush using perforated paper reinforcing tape.

External corner joints: Make joints over metallic-coated steel corner beads.

Dry joints: Provide square edged sheet and finish with a PVC-U joining section.

Control joints: Provide control joints to coincide with structural control joints and as follows:

- Ceilings: To divide into bays not larger than 10.8 x 7.2 m.
- Soffit linings: To divide into bays not larger than 4.2 x 4.2 m or 5.6 x 3.6 m.
- Control joint beads: Purpose-made metallic coated.
- Support: Provide framing parallel to the joint on each side. Do not fix the lining to abutting building surfaces.

Wet areas: Provide additional supports, flashings, trim and sealants as required.

**E30.3.4 ACCESS PANELS****Finish**

General: Match the access panels to the ceiling in appearance and performance.

**Identification**

General: Provide each access panel with an identification mark.

**Non-demountable ceilings**

General: Provide access panels supported and anchored to permit ready removal and refixing.

**Reinforcement**

General: Reinforce the back of the access panel to prevent warping and facilitate handling.

**E30.3.5 TRIM****General**

General: Provide trim such as beads, mouldings and stops to make neat junctions between lining components, finishes and adjacent surfaces.

**E30.4 SELECTIONS****E30.4.1 SUSPENDED CEILINGS****Suspended ceilings schedule**

Location	New Platform Building
Supporting System:	
- Type	Concealed
- Material	Pressed steel
- Proprietary item	Rondo screw-up ceiling suspension system
Lining	
- Material	Generally: Standard grade plasterboard Wet Areas: Water resistant plasterboard
- Proprietary item	N/A
- Thickness	13mm
- Joints	Flush
- Edge Type	Recessed edge
- Finish	Paint
Trim	
- At junctions with walls	Rondo P50 Shadowline

**E31 JOINERY****E31.1 GENERAL****E31.1.1 RESPONSIBILITIES****General**

General: Fabricate and install joinery items to backgrounds undamaged, plumb, level, straight and free of distortion and to the **Tolerances table**.

**Tolerances table**

Property	Tolerance criteria
Plumb and level	1 mm in 800 mm
Offsets in flush adjoining surfaces	< 0.5 mm
Offsets in revealed adjoining surfaces	< 2 mm
Alignment of adjoining doors	< 0.5 mm
Difference in scribe thickness for joinery items centred between walls	< 2 mm
Doors centred in openings	zero
Joints in finished surfaces	zero

**E31.1.2 CROSS REFERENCES****General**

Requirement: Conform to the following:

- *General requirements.*

**E31.1.3 INSPECTION****Notice**

Inspection: Give sufficient notice so that inspection may be made of the following:

- Shop fabricated or assembled items ready for delivery to the site.
- Openings prepared to receive assemblies.
- Site erected assemblies on completion of erection, before covering up by cladding and encasing.
- Surfaces prepared for, and immediately before, site applied finishes.
- Completion of installation.

**E31.1.4 SUBMISSIONS****Samples generally**

General: Submit samples to the **Sample table**.

**Sample table**

Description	No. of samples
Each type of board to be used complete with finish and edge stripping	2
Each type of joint	2
Typical item of hardware indicating each finish	2
Samples of the selected stone cladding showing the maximum expected variation	2 x 3 variants
Samples of the selected timber veneer showing the maximum expected variation	2 x 3 variants
Patch of each nominated fabric	2
The finish to all stainless steel items	2
Complete timber bench cupboard door, including hardware	1
Complete drawer front, including hardware	1

### **Clear finished samples**

Initial submission:

- Veneered board: Three samples each 600 x 600 mm for each species.
- Solid timber: Three samples each 40 x 19 x 600 mm for each species.

Control sample: The approved selection from the initial submission.

Finished sample: Cut the control sample in half and apply the finish to half the remaining area.

### **Shop drawings**

General: Submit shop drawings to a scale that best describes the detail, showing the following:

- Overall dimensions.
- Materials, thicknesses and finishes of elements including doors, divisions, shelves and benches.
- Type of construction including mitre joints and junctions of members.
- Hardware type and location.
- Temporary bracing, if required.
- Procedures for shop and site assembly and fixing.
- Locations of benchtop joints.
- Stone benchtop layout including joint arrangement and penetrations.
- Locations of sanitary fixtures, stoves, ovens, sinks, and other items to be installed in the units.
- Relationship of fixture to adjacent building elements.
- Proposals for the break-up of large items as required for delivery to the site.
- Proposed method of joining the modules of large items.

Timing: Before fabrication.

Timing: Before fabrication.

## **E31.2 PRODUCTS**

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### **E31.2.1 JOINERY MATERIALS AND COMPONENTS**

#### **Visible work**

Clear finished timber and veneer: Ensure all visible surfaces are free of branding, crayon or chalk marks and of blemishes caused by handling.

#### **Joinery timber**

Hardwood: To AS 2796.3.

Seasoned cypress pine: To AS 1810.

Softwood: To AS 4785.3.

Finished sizes: For milled timbers actual dimensions which are at least the required dimensions, except for dimensions qualified by a term such as 'nominal' or 'out of' to which industry standards for finished sizes apply.

#### **Plywood**

Interior use generally: To AS/NZS 2270.

Interior use, exposed to moisture: To AS/NZS 2271.

Visible surface with a clear finish: Veneer quality A.

Other visible surfaces: Veneer quality C or D.

#### **Non-structural glued laminated timber**

Standard: AS 5067.

#### **Wet processed fibreboard (including hardboard)**

Standard: To AS/NZS 1859.4.

#### **Particleboard**

Standard: To AS/NZS 1859.1.

Melamine overlaid particleboard: Particleboard overlaid on both sides with low pressure melamine.

#### **Dry-processed fibreboard (including medium density fibreboard)**

Standard: To AS/NZS 1859.2.

Melamine overlaid medium density fibreboard: Medium density fibreboard (STD MDF) overlaid on both sides with low pressure melamine.

#### Decorative overlaid wood panels

Standard: To AS/NZS 1859.3.

#### Certification

General: Brand panels under the authority of a recognised certification program applicable to the product. Locate the brand on faces or edges which will be concealed in the works.

#### High-pressure decorative laminate sheets

Standard: To AS/NZS 2924.1.

Class	Definition	Typical applications
CG (S or F)	Compact general purpose	High performance, self supporting vertical or horizontal surfaces
HD (S or F)	Horizontal heavy duty	High performance horizontal surfaces
HG (S, or P)	Horizontal general purpose	General horizontal surfaces and high performance vertical surfaces
VG (S, or P)	Vertical general purpose	General vertical surfaces and light duty horizontal surfaces
VL (S)	Vertical light duty	Light duty vertical surfaces

Thickness (minimum):

- For horizontal surfaces fixed to a continuous background: 1.2 mm.
- For vertical surfaces fixed to a continuous background: 0.8 mm.
- For post formed laminate fixed to a continuous background: 0.8 mm.
- For vertical surfaces fixed intermittently (e.g. to studs): 3.0 mm.
- For edge strips: 0.4 mm.

#### E31.2.2 VENEERS

##### Timber veneer

Veneer quality: To AS/NZS 2270.

Grades (minimum requirement):

- Select grade, veneer quality A, for visible surfaces to have clear finish or to have no coated finish.
- General purpose grade, veneer quality B, for other visible surfaces.

Requirement: Provide veneers slip matched and flitch batched and falling within the visual range of the approved samples.

#### E31.2.3 JOINERY ITEMS

##### General

Refer to documents as follows:

- Drawings: Joinery units and their location, indicative construction details, scribes and trims, materials, dimensions and thicknesses, and finishes.
- Drawings: Confirm on site all dimensions noted, after the completion of partitions.
- Finishes schedules or drawings: Finishes Schedule.

#### E31.2.4 JOINERY ASSEMBLIES

##### Standard

General: To AS/NZS 4386.1.

##### Plinths

##### Carcasses

Material: Select from the following:

- Overlaid high moisture resistant particleboard.
- Overlaid high moisture resistant medium density fibreboard.

Thickness: 16 mm.

Joints: Select from the following:

- Proprietary mechanical connections.
- Dowels and glue.
- Screws and glue.
- Proprietary joining plates and glue.

Adjustable shelves: Support on proprietary pins in holes bored at equal centres vertically.

- Spacing: 32 mm.

Fasteners: Conceal with finish.

Installation: Secure to walls at not more than 600 mm centres.

#### **Drawer fronts and doors**

Material: Select from the following:

- Melamine overlaid high moisture resistant particleboard.
- Melamine overlaid high moisture resistant medium density fibreboard.

Thickness: 16 mm.

Maximum door size: 2400 mm high, 900 mm wide, 1.5 m<sup>2</sup> on face.

Drawer fronts: Rout for drawer bottoms.

#### **Drawer backs and sides**

Material: PVC film wrapped particleboard.

Thickness: 12 mm.

Colour: White

Installation: Mitre corners leaving outer skin of foil intact, finish with butt joints, glue to form carcass and screw to drawer front. Rout for drawer bottoms.

#### **Drawer bottoms**

Material: PVC film laminated hardboard.

PVC film faces: One

Thickness: 3 mm.

Colour: White

#### **Drawer and door hardware**

Hinge types: Concealed metal hinges with the following features:

- Adjustable for height, side and depth location of door.
- Self closing action.
- Hold open function.
- Nickel plated.

Piano hinges: Chrome plated steel, extending full height of doors.

Slides: Metal runners and plastic rollers with the following features:

- 30 kg loading capacity.
- Closure retention.
- White thermoset powder coating or nickel plated.

Pulls: Stainless steel D handles

### **E31.2.5 WORKING SURFACES**

#### **Laminated benchtops**

Material: HMR MDF

Finish: High-pressure decorative laminated sheet as detailed in the Finishes Schedule.

Exposed edges: Extend laminate over shaped nosing, finishing > 50 mm back on underside. Splay outside corners at 45°.

Balance underside: Extend laminate to the undersides of benchtops.

Installation: Scribe to walls. Fix to carcass at least twice per 600 mm length of benchtop.

Joint sealing: Fill joint with sealant matching finish and clamp with proprietary mechanical connectors.

Balance underside: Laminate undersides of benchtops.

### **E31.3 EXECUTION**

#### **E31.3.1 JOINERY**

##### **General**

Joints: Provide materials in single lengths whenever possible. If joints are necessary make them over supports.

Framing: Frame and trim where necessary for openings, including those required by other trades.

Openings: Provide openings for the following: Kitchen sink, plumbing and other services as required.

##### **Accessories and trim**

General: Provide accessories and trim necessary to complete the installation.

##### **Fasteners**

Visibility: Do not provide visible fixings except in the following locations:

- Inside cupboards and drawer units.
- Inside open units in which case provide proprietary caps to conceal fixings.

Visible fixings: Where fastenings are unavoidable on visible joinery faces, sink the heads below the surface and fill the sinking flush with a material compatible with the surface finish. In surfaces which are to have clear or tinted finish provide matching wood plugs showing face (not end) grain. In surfaces which are to have melamine finish provide proprietary screws and caps finished to match.

Fix joinery units to backgrounds as follows:

- Floor mounted units: 600 mm centres max.
- Wall mounted units: To each nogging and/or stud stiffener.

Fixings: Screws with washers into timber or steel framing, or masonry anchors.

##### **Adhesives**

General: Provide adhesives to transmit the loads imposed and to ensure the rigidity of the assembly, without causing discolouration of finished surfaces.

##### **Finishing**

Junctions with structure: Scribe, plinths, benchtops, splashbacks, ends of cupboards, kickboards and returns to follow the line of structure.

Joints: Scribe internal and mitre external joints.

Edge strips: Finish exposed edges of sheets with edge strips which match sheet faces.

Matching: For surfaces which are to have clear or tinted finish, arrange adjacent pieces to match the grain and colour.

Hygiene requirements: To all food handling areas and voids at the backs of units to all areas, seal all carcass junctions with walls and floors, and to cable entries, with silicone beads for vermin proofing. Apply water resistant sealants around all plumbing fixtures and ensure the sealants are fit for purpose.

##### **Benchtops**

Installation: Fix to carcass at least twice per 600 mm length of benchtop.

Joint sealing: Fill joints with sealant matching the finish colour and clamp with proprietary mechanical connectors.

Edge sealing: Seal to walls and carcasses with a sealant, which matches the finish colour.

##### **Splash backs**

Glass: Fix with non-acidic silicone adhesive. Apply at the rate recommended by the manufacturer.

Installation: Clean the back of the glass panel and apply 'wallnuts' of adhesive together with double sided adhesive tape for temporary support, and affix directly to the substrate.

##### **Labelling**

General: Permanently mark each unit of furniture with the manufacturer's name, on an interior surface.

### E31.3.2 DELIVERY AND STORAGE

#### General

General: Deliver joinery units to site in unbroken wrapping or containers and store so that its moisture content is not adversely affected. Do not store in areas of wet plaster. Keep storage to a minimum by delivering items only when required for installation.

Concealed surfaces: Prime surfaces concealed by backgrounds.

Deficiencies: Examine joinery units for completeness and remedy deficiencies.

#### Acclimatisation

General: Acclimatise the joinery items by stacking it in the in-service conditions with air circulation to all surfaces after the following construction operations are complete:

- Air conditioning operational.
- Lighting operational.
- Site drainage and stormwater works are complete.
- Space fully enclosed and secure.
- Wet work complete and dry.

#### Background

General: Damp clean and vacuum background surfaces that will be permanently concealed.

### E31.3.3 COMPLETION

#### Maintenance manual

General: Submit manufacturer's published recommendations for service use.

#### Cleaning

Temporary coatings: On or before completion of the works, or before joining up to other surfaces, remove all traces of temporary coatings used as a means of protection.

General: Remove all dust, marks and rubbish from all surfaces and internal spaces. Clean and polish all self finished surfaces such as anodised and powdercoated metals, sanitaryware, glass, tiles and laminates.

### E31.4 SCHEDULE OF JOINERY ITEMS

#### Schedule

Item	Ticket Office Counter
Location	Ticket Office in New Platform Building
Description	U shaped desktop with size as shown Mobile drawer unit below desktop. Unit to be 530mm wide by 450mm deep by 800mm high, with 3 drawers all as detailed
Materials	32mm thick MDF with heavy duty laminate to both surfaces
Laminate selection	Refer to Finishes Schedule

Item	Desk top
Location	Cash Counting area in New Platform Building
Description	L shaped desktop with size as shown
Materials	32mm thick MDF with heavy duty laminate to both surfaces
Laminate selection	Refer to Finishes Schedule

<b>Item</b>	<b>Kitchen cupboards</b>
Location	Kitchen in New Platform Building
Description	Floor cupboard unit with sink, two door cupboard and space for refrigerator. L shaped benchtop Wall cupboard unit
Materials	General: HMR MDF Carcass: Melamine coated to all exposed surfaces Doors: Laminated with selected laminate Benchtop: 32mm thick laminated with selected laminate.
Laminate selection	Refer to Finishes Schedule
Fittings	Single bowl stainless steel sink with draining board
Size	As shown on drawings

<b>Item</b>	<b>Storage cupboard</b>
Location	Cleaners Room in new Platform Building
Description	Floor cupboard with raised floor and skirting, two hinged doors, and one shelf at high level. Cupboard to incorporate EDB.
Materials	Laminated MDF to floor, doors and shelf as previously specified
Laminate selection	Refer to Finishes Schedule
Size	Coordinate length, depth and height with the dimensions of the existing metal lockers which are to be re-installed in the new building. Height: 2000mm approx. Width: 1100mm approx. Depth: 500mm approx.

<b>Item</b>	<b>Storage cupboard</b>
Location	Lobby in new Platform Building
Description	Built in cupboard with raised floor and skirting, one hinged door and one shelf at 1700mm above floor level.
Materials	Laminated MDF to floor, door and shelf as previously specified
Laminate selection	Refer to Finishes Schedule
Size	To fit within recess in wall. Height: 2100mm approx. Width: 400mm approx. Depth: 350mm approx.

<b>Item</b>	<b>Baby Change Unit and countertop</b>
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Location	Family accessible toilet
Description	Change table comprising countertop and apron (on all four sides) and supported on four steel legs.
Materials	HMR MDF. Countertop 32mm thick, carcass and apron 18mm thick. All visible surfaces laminated with selected laminate
Laminate selection	Refer to Finishes Schedule
Fittings	Baby change unit as specified in Sundry Items
Size	As shown on drawings

**E32 FABRICATED METALWORK**

**E32.1 GENERAL**

**E32.1.1 RESPONSIBILITIES**

**General**

General: Provide metal fixtures that are:

- Undamaged, plumb, level and straight.
- Free of surface defects or distortions.

**E32.1.2 CROSS REFERENCES**

**General**

Requirement: Conform to the following:

- *General requirements.*
- Metals and prefinishes
- Sundry items
- Structural steel

**E32.1.3 INSPECTION**

**Notice**

Inspection: Give notice so that inspection may be made of the following:

- Shop fabricated or assembled items ready for delivery to the site.
- Commencement of shop or site welding.
- Site erected assemblies on completion of erection, before covering up by cladding and encasing.
- Steel surfaces prepared for, and immediately before, site applied finishes.

**E32.1.4 SUBMISSIONS**

**Samples**

General: Submit samples of the following:

- Each type of joint.
- Each type of finish.
- Sections for use in fabricated work.

**Shop drawings**

General: Submit shop drawings showing the following information:

- Details of fabrication and components.
- Details of fabrication involving other trades or components.
- Information necessary for site assembly.
- Proposals for the break-up of large items as required for delivery to the site.
- Proposed method of joining the modules of large items.

Shop drawings are to be provided for the following metalwork items

- Balustrade and handrails
- Anti-throw screens
- End of platform stairs
- Ticket Office window

**Shop drawing certification**

General: Engage a Professional Engineer and submit certification for the design and installation of: Balustrades and provide a certificate of conformity with the structural requirements of Building Code of Australia.

### **Tests**

Stainless steel: Before fabrication commences, submit satisfactory evidence that relevant procedure test plates have passed the tests specified in AS/NZS 1554.6.

### **Materials**

Manufacturer's data: Submit manufacturers published product data including standard drawings and details.

Stainless steel: For each batch of stainless steel supplied to the works, submit the certificate of compliance or test certificate specified in the applicable standard.

### **Execution**

Welding procedures: Submit details of proposed welding procedures before fabrication.

Welding dissimilar metals: Submit the following details:

- Type and thickness of materials to be welded.
- Proposed joint preparation and welding procedures.
- Proposed filler metal.
- Expected dilution (proportion of fused parent metal in the weld metal).

Fastenings to aluminium (including aluminium alloys): Stainless steel or aluminium.

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## **E32.2 PRODUCTS**

### **E32.2.1 MATERIALS AND COMPONENTS**

#### **Metals and components**

Performance: Provide metals in sections of strength and stiffness suited to their required function, finish and method of fabrication.

### **E32.2.2 STAINLESS STEEL FINISHES**

#### **Sample**

General: Provide a finish to match the sample in terms of the mill grade and finish process.

#### **Pre assembly**

Mechanically polished and brushed finishes: Apply grit faced belts or fibre brushes that achieve uni-directional finishes with buffing as required to the following:

Bead blasted finish: Provide a uniform non-directional low reflective surface by bead blasting. Do not use sand, iron or carbon steel shot. Blast both sides of austenitic grades of stainless steel to equalise induced stress.

#### **Post assembly pre-treatment**

Heat discolouration: Remove by pickling.

Welds: Grind excess material, brush, and polish to match the pre assembly finish.

#### **Completion**

Cleaning: Clean and rinse to an acid free condition and allow to dry. Do not use carbon steel abrasives or materials containing chloride.

Protection: Secure packaging or strippable plastic sheet.

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## **E32.3 EXECUTION**

### **E32.3.1 CONSTRUCTION GENERALLY**

#### **Aluminium structures**

Standard: To AS/NZS 1664.1 or AS/NZS 1664.2.

#### **Metals**

Performance: Provide metals so that they transmit the loads imposed and ensure the rigidity of the assembly without causing deflection or distortion of finished surfaces.

Incompatible metals: Separate using concealed layers of suitable materials in appropriate thicknesses.

#### **Fasteners**

Performance: Provide non-galvanic corrosion fasteners.

Materials: Provide fasteners in materials of mechanical strength and corrosion resistance at least equal to that of the lowest resistant metal joined.

To copper and copper alloys: Provide copper or copper-alloy fixing devices only.

To aluminium and aluminium alloys: Provide aluminium alloy or non-magnetic stainless steel fixing devices only.

To stainless steel: Provide appropriate stainless steel materials only.

#### **Fabrication**

Workshop: Fabricate and pre-assemble items in the workshop wherever practicable.

Edges and surfaces: Keep clean, neat and free from burrs and indentations. Remove sharp edges without excessive radiusing.

Tube bends: Form bends in tube without visibly deforming the cross section.

Colour finished work: Match colours of sheets, extrusions and heads of fasteners.

Thermal movement: Accommodate thermal movement in joints and fastenings.

#### **Fabrication tolerances**

Structural work generally:  $\pm 2$  mm from design dimensions.

#### **Joints**

General: Fit joints to an accuracy appropriate to the class of work. Finish visible joints made by welding, brazing or soldering using grinding, buffing or other methods appropriate to the class of work, before further treatment.

Self-finished metals: Free of surface colour variations, after jointing.

Joints: Fit accurately to a fine hairline.

#### **Marking**

General: Provide suitable and sufficient marks or other means for identifying each member of site-erected assemblies, and for their correct setting out, location, erection and connection. Mark bolted connections to show the bolting category. Do not mark stainless steel by notching.

#### **Splicing**

General: Provide structural members in single lengths.

### **E32.3.2 WELDING AND BRAZING**

#### **General**

Quality: Provide finished welds which are free of surface and internal cracks, slag inclusion, and porosity.

Site welds: Avoid site welding wherever possible. If required locate site welds in positions for down hand welding.

Butt weld quality level: Not inferior to the appropriate level recommended in AS 1665 Appendix A.

#### **Brazing**

General: Ensure brazed joints have sufficient lap to provide a mechanically sound joint. Do not use butt joints relying on the filler metal fillet only.

### **E32.3.3 STAINLESS STEEL FABRICATION**

#### **Welding stainless steel**

Certification of welders: To AS 1796.

#### **Riveting**

General: Riveting may be used only to join stainless steel sheet or strip less than 1 mm thick. Drill (not punch) the rivet hole, and drive the rivet cold. On completion, clean and passivate the riveted assembly.

#### **Soldering**

General: Do not solder stainless steel.

### **E32.3.4 METAL FIXTURES**

#### **General**

General: Provide metal fixtures noted on drawings as follows:

- Components and their location, indicative construction details, scribes and trims, materials, dimensions and thicknesses, and finishes.

- Confirm on site all dimensions noted on drawings.
- Finishes selections as documented.
- Hardware and equipment.

### **E32.3.5 PIPE RAIL BALUSTRADES**

#### **Fabrication**

Method: Welding.

Joints: Produce smooth unbroken surfaces at joints. Scribe the joints between posts and rails. Make end-to-end joints over an internal sleeve.

Bends: Make changes of direction in rails by evenly curved pipe bends.

Free ends: Seal the free ends of pipes with fabricated or purpose-made end caps.

#### **Fixing to structure**

General: Provide fabricated predrilled or purpose-made brackets or post bases, and attach the piping to the building structure with fixings, including bolts into masonry anchors, and coach screws or bolts into timber, of metal compatible with the piping.

#### **Galvanizing**

General: If possible, complete fabrication before galvanizing; otherwise apply a zinc-rich primer to affected joint surfaces

### **E32.3.6 STAIR NOSINGS**

#### **Applied nosings**

Aluminium: Purpose-made extruded Slip resistant aluminium nosing.

Vinyl: Purpose-made moulded Slip resistant section.

Ceramic: Purpose-made moulded Slip resistant tiles.

Slip resistance classification to AS/NZS 4586:

Dry environment: Pendulum X and Ramp R10

Wet environment: Pendulum W and Ramp B or R11

#### **Tactile indicators**

Standard: To AS/NZS 1428.4.1.

### **E32.3.7 COMPLETION**

#### **Maintenance manual**

General: Submit manufacturer's published recommendations for service use.

#### **Cleaning**

Temporary coatings: On or before completion of the works, or before joining up to other surfaces, remove all traces of temporary coatings used as a means of protection.

## **E32.4 SCHEDULE OF METALWORK**

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### **E32.4.1 BALUSTRADES**

#### **General**

Provide balustrades to existing footbridge, existing and new stairs, Lift Lobbies, ramps and miscellaneous areas as shown on drawings.

Finish: All steel members, except stainless steel handrails and brackets, shall be galvanised and painted with epoxy paint as detailed in the Finishes Schedule.

#### **Balustrade Type A**

##### **Location**

- Open sides of new stairs and landings between the Footbridge Level and Upper Access Way
- Open sides of existing stairs and landings
- Lift lobbies
- Other areas as indicated on drawings

Description: Full balustrade with posts, top and bottom rails and balustrades at 100mm centres

Materials:

- Posts: 75 x 75mm x 3.0mm thick mild steel SHS, with 10mm thick mild steel baseplates located as shown on drawings and at maximum 1500mm centres.
- Top and bottom rails: 75 x 50mm x 3.0mm thick RHS
- Balusters: 20mm diameter mild steel rod
- Handrails: 42mm diameter x 3.2mm thick Grade 316 stainless steel CHS supported on brackets made from 16mm diameter stainless steel rods.

Handrails: Stainless steel handrail on the inner side of the balustrades, and fixed to wall at one side of the lower flights of Stair 1

**Balustrade Type B**

Location: Centrally in new stairs between Footbridge Level and Upper access Way.

Description: Open balustrade with posts and top and bottom rails.

Materials: Similar to Balustrade Type A.

Handrails: Stainless steel handrail on each side of the balustrade.

**Balustrade Type C**

Location: At minor changes in levels of Lower Car Park and where nominated on drawings.

Description: Open balustrade with posts and top and bottom rails.

Materials: Similar to Balustrade Type A.

Handrails: Not required

**Balustrade Type D**

Location: Ramp at Lower Car Park Level.

Description: Full balustrade with posts, top and bottom rails and balustrades at 100mm centres

Materials: Similar to Balustrade Type A.

Handrails: Stainless steel handrail on one side of the balustrade, and another handrail fixed to wall on the other side.

**Handrails**

Provide handrails to existing and new stairs and landings, Lobbies, footbridge and ramps as shown on drawings. Hand rails shall be made from 42mm diameter x 3.2mm thick Grade 316 stainless steel CHS supported on brackets made from 16mm diameter stainless steel rods.

**Installation**

- Where handrails are located in conjunction with a balustrade, Types A, b and D, weld handrail brackets to balustrade posts.
- Where handrails are located along concrete or masonry walls provide 60mm diameter by 6mm thick stainless steel plate at the end of each bracket and bolt fix to wall.

**E32.4.2 ANTI THROW SCREENS**

**General**

Provide Anti-throw screens to existing Footbridge and new extension as detailed. The screens to the existing footbridge shall be installed above the existing bridge slab, while the screens to the extension shall be fixed above the new concrete balustrade. All screens shall extend to a height of approximately 3000mm from the bridge floor level.

**Framing**

Construct mild steel framing consisting of curved vertical RHS posts and SHS horizontal rails. Posts shall be welded to mild steel angles bolted to top and side of concrete slab or balustrade wall. Size of members and fixing details shall be in accordance with the structural engineer's drawings.

**Screen mesh**

Material: Mild steel mesh fixed to steel framing as detailed.

Supplier: Locker Group

Type: Woven wire mesh

Aperture: Maximum 25mm x 25mm

Finish: Galvanised

### **Handrails**

Existing Footbridge: 42mm diameter x 3.2mm thick, Grade 316 stainless steel CHS supported on brackets welded to main framework.

New extension: 42mm diameter x 3.2mm thick Grade 316 stainless steel CHS supported on brackets fixed to concrete balustrade.

### **Finish**

Steel framing: Galvanised and painted with epoxy paint as specified in the Finishes Schedule.

Mesh: Galvanised.

### **E32.4.3 STAIR NOSINGS**

#### **General**

Supply and install stair nosings to all existing and new stairs.

Slip resistance: R11 and Pendulum 'W'

#### **New stairs**

Proprietary item: SafetyStride stair nosing

Product code: SN-CL4-MBN-TP5

Size: 75 x 26 mm (tread x riser)

Installation: Recessed

Material: Aluminium

Finish: Natural anodised with black inserts

#### **Existing Stairs**

Proprietary item: SafetyStride stair nosing

Product code: SN-CL4

Size: 104 x 26 mm (tread x riser)

Installation: Surface mounted

Material: Aluminium

Finish: Natural anodised with black inserts

### **E32.4.4 TACTILE INDICATORS**

#### **General**

Provide tactile indicators to the existing and new stairs and other areas as shown on drawings.

Standard: AS1428.4 and TfNSW requirements

#### **Stairs and ramps**

Extent: 600mm wide x the full width of the stair or ramp landing.

Proprietary Item: Tactile Indicators as supplied by Pathfinder Systems Australia.

Type: Hazard indicators on a 30mm star shaft.

Material: Stainless steel with coloured polyurethane insert.

### **E32.4.5 LOCKERS**

#### **General**

Location: Cleaners Room in new Platform Building.

Installation: Re-install lockers removed from existing Platform Building.

### **E32.4.6 TICKET OFFICE WINDOW AND WALL LINING**

#### **General**

Provide ticket window and security wall lining in accordance with TfNSW's requirements and details.

The installation must be carried out by an authorised security installer licensed under the NSW Security Protection Act and certification provided to TfNSW.

#### **Ticket window**

The Ticket window shall include steel frame, counter, money tray, glass panel and all trims and accessories as shown on drawings.

Glass: Bullet proof glass with a G2 rating.

Money Tray: Metal tray as detailed with a G2 rating.

**Wall lining**

Provide security steel wall lining to the front wall of the Ticket Office. The lining shall be fixed to the external side of the wall framing and shall extend the full width of the workstation unit and to the window head height.

The lining shall achieve a G2 rating.

**Security roller shutter**

Provide security roller shutter to Ticket Office window as specified in Overhead doors.

**E32.4.7 ITEMS SPECIFIED IN OTHER SECTIONS**

**General**

The following items are specified in other sections of this specification:

Toilet Area fittings and Platform seating and bins: Sundry items

Steel wall framing: Light steel framing

Fencing: Fences and barriers

**E33 EXTINGUISHERS AND BLANKETS**

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**E33.1 GENERAL**

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**E33.1.1 RESPONSIBILITIES**

**General**

General: Provide fire extinguishers and fire blankets as documented.

**E33.1.2 CROSS REFERENCES**

**General**

Requirement: Conform to the following:

- *General requirements.*

**E33.1.3 AUTHORISED PRODUCTS**

**General**

General: Provide equipment listed in the ActivFire Register of Fire Protection Equipment.

**E33.2 PRODUCTS**

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**E33.2.1 EXTINGUISHERS**

**Standards**

General: Provide portable fire extinguishers and location signs as follows:

- General requirements: AS/NZS 1841.1.
- Water: AS/NZS 1841.2.
- Wet chemical: AS/NZS 1841.3.
- Foam: AS/NZS 1841.4.
- Powder: AS/NZS 1841.5.
- Carbon dioxide: AS/NZS 1841.6.
- Non-rechargeable: To AS/NZS 1841.8.

Selection and location: To AS 2444

Certification: Required.

Certification provider: An organisation accredited by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ).

**Fire extinguishers schedule**

Location	Type	Number	Installation
New Platform Building	Tyco or equivalent CO <sub>2</sub>	1	Fix to wall where indicated

**E33.2.2 BLANKETS**

**Fire blankets**

General: To AS/NZS 3504.

Certification: Required.

Certification provider: An organisation accredited by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ).

Selection and location: To AS 2444.

**Fire blankets schedule**

Location	Number	Installation
New Platform Building	1	Fix to wall where indicated

**E33.3 EXECUTION**

**E33.3.1 COMPLETION**

**Maintenance**

Fire extinguishers: To AS 1851.

Fire blankets: To AS 1851.

**E34 CEMENTITIOUS TOPPINGS****E34.1 GENERAL****E34.1.1 RESPONSIBILITIES****General**

General: Provide cementitious toppings in conformance with **Selections** and as follows:

- If floating, without edge curl.
- If bonded, without drummy areas.
- Without obvious shrinkage cracks.

**E34.1.2 CROSS REFERENCES****General**

Requirement: Conform to the following:

- *General requirements.*

**E34.1.3 INTERPRETATION****Definitions**

General: For the purposes of this worksection the following definitions apply:

- Concrete class:
  - . Normal: Concrete which is specified primarily by a standard compressive strength grade and otherwise in accordance with AS 1379 clause 1.5.3.
- Granolithic topping: A topping mix with the coarse aggregate restricted to between 2 mm and 3 mm.
- Substrates: The surface to which a material or product is applied.
- Topping: Mixture of binders, aggregate and water applied to substrates in a plastic state and dried and cured to a hard surface.
- Topping function:
  - . Levelling: Topping placed to receive applied floor finishes.
  - . Wearing: Topping placed to act as the finished floor.
- Topping method:
  - . Bonded or post applied: Topping which is bonded to a hardened substrate from which laitance has been removed and to which a bonding agent has been applied.
  - . Floating: Topping which is separated from a hardened substrate by a resilient layer.
  - . Monolithic or wet applied: Topping placed on a plastic substrate so that a chemical bond is created between the substrate and the topping.
  - . Separated: Topping which is separated from a concrete subfloor by a membrane.

**E34.1.4 SUBMISSIONS****Product information**

General: Submit product data on the following:

- Admixtures.
- Bonding products.
- Colouring products.
- Curing products.
- Sealant products.
- Slip-resistant products.
- Surface treatment products.

**Product samples**

General: Submit samples of the following products:

- Colouring products.

- Control joint products.
- Surface treatment products.

**Prototypes**

General: Prepare prototypes of each topping type:

- Size: 1200 x 2400 mm.

**E34.1.5 INSPECTIONS AND TESTS**

**Construction inspections**

General: Give notice to allow inspections as follows:

- Substrates ready for laying of toppings.
- Prototypes ready for inspection.

**Construction tests**

General: Test and assess conformity of construction as follows:

- Flatness: If flatness properties are required:
  - . Method: To ASTM E1155.
- In situ crushing resistance/soundness: If a soundness category is required:
  - . Method: To BS 8204-1.
- Slip resistance: If a slip resistance classification is required:
  - . Method: To AS/NZS 4663.

**E34.1.6 TOLERANCES**

**General**

Thickness: Deviation from the stated thickness:

- Thickness < 15 mm: 2 mm.
- Thickness  $\geq 15 < 30$  mm: 5 mm.
- Thickness  $\geq 30$  mm: 10 mm.

Flatness deviation: Measured under a 3000 mm straightedge laid in any direction on a plane surface:

- Class A: < 3 mm.
- Class B:  $\geq 3 < 5$  mm.

**E34.2 PRODUCTS**

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**E34.2.1 PRODUCTS**

**Admixtures**

Standard: To AS 1478.1.

**Aggregates**

Standard: To AS 2758.1.

Coarse aggregate: Nominal single size  $\leq 1/3$  topping thickness.

Fine aggregate: Fine, sharp, well-graded sand with a low clay content and free from efflorescing salts.

**Bonding products**

General: Provide proprietary products manufactured for bonding cement-based toppings to concrete substrates.

**Cement**

Standard: To AS 3972.

- Type: SL.

**Colouring products**

General: Provide proprietary products manufactured for colouring cement toppings.

Integral pigment proportion:  $\leq 10\%$  by mass of cement.

**Concrete**

Standard: To AS 1379.

Unreinforced topping:

- Class: Normal.

Reinforced topping: Conform to the **Reinforced topping table**.

**Reinforced topping table**

Exposure location	Strength grade	Cover to reinforcement
Internal and External > 50 km inland and non-industrial and non-tropical	N25	20 mm
External > 50 km inland and tropical and External near coastal (> 1 km < 50 km)	N32	30 mm
External coastal < 1 km but not in the splash zone	N40	35 mm

**Reinforcement**

Standard: To AS/NZS 4671.

Mesh sizes for joint spacing as follows:

- SL 42: Up to 3 m internal, 2 m external.
- SL 62: Up to 6 m internal, 4 m external.

**Curing products**

General: Provide proprietary products manufactured for use with cement-based toppings and with the floor finish to be laid on the toppings.

**Mixes**

General: Provide toppings as follows or select mix proportions to the **Mixes table**:

- Air entrainment: ≤ 3%.
- Nominal coarse aggregate size: ≤ 0.3 x topping thickness.
- Slump: 80 mm.
- Standard strength grade: N25.

Water quantity: The minimum necessary to achieve full compaction and prevent excessive water being brought to the surface during compaction.

**Mixes table**

Mix type	Thickness (mm)	Upper and lower limits of proportion by weight		
		Cement	Fine aggregate	Coarse aggregate
Bonded – cement and sand	35	1	3	0
		1	4.5	0
Bonded – fine concrete	40	1	3	1
		1	3	2
Floating – fine concrete	100	1	3	1
		1	3	2
Granolithic	Floors: 25 Skirtings: 13	1	2	1, of 2 mm - 3 mm
Separated – fine concrete	70	1	3	1
		1	3	2

**Slip-resistance products**

General: Provide proprietary products manufactured to improve the wet-slip resistance of toppings.

- Silicon carbide granules:
  - . Granule size: ≥ 300 < 600 µm.
- Silicon carbide two-part resin:
  - . Granule size: ≥ 300 µm.

**Surface treatment products**

General: Provide proprietary products manufactured for use with cement-based toppings to change the characteristics of the surface of the finished topping.

**Water**

General: Clean and free from any deleterious matter.

**E34.2.2 CONTROL JOINTS**

**Control joint materials**

Control joint strip: A proprietary expansion joint consisting of a neoprene filler sandwiched between plates with lugs or ribs for mechanical keying. Set flush with the finished surface.

Proprietary slide plate divider strip: An arrangement of interlocking metal plates grouted into pockets formed in the concrete joint edges.

Sealant: One-part self-levelling non-hardening mould-resistant, silicone or polyurethane sealant applied over a backing rod. Finish flush with the terrazzo surface.

Floors: Trafficable, shore hardness > 35.

Backing rod: Compressible closed cell polyethylene foam with a bond-breaking surface.

**E34.3 EXECUTION**

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**E34.3.1 PREPARATION**

**Substrates**

General: Provide substrates as follows:

- Clean and free from any deposit which may impair adhesion of monolithic or bonded toppings.
- Remove excessive projections and voids and fill hollows with a mix not stronger than the substrate or weaker than the topping.
- Roughen hardened concrete by scabbling or the like to remove 2 mm of the laitance and expose the aggregate.

**Bonded toppings**

General: Before laying topping wash the substrate with water and provide a bonding product, or treat as follows:

- Keep wet for 2 hours or more.
- Remove surplus water and brush on neat cement or a clean slurry of cement and water.
- Place the topping while the slurry is wet.

**E34.3.2 APPLICATION**

**Laying**

General: Spread the mix and compact. Strike off, consolidate and level surfaces to finished levels.

Monolithic toppings: Lay while concrete subfloor is plastic and the surface water is no longer visible.

Toppings over 50 mm thick:

- Lay in two layers of equal thickness.
- Place a layer of reinforcement between the layers of toppings. Lap reinforcement 200 mm and tie. Do not create four way laps.

**E34.3.3 SURFACE FINISHES**

**Finishing methods – primary finish**

Machine float finish:

- After levelling, consolidate the surface using a machine float.
- Cut and fill and refloat immediately to a uniform, smooth, granular texture.
- Hand float in locations inaccessible to the machine float.

Steel trowel finish: After machine floating finish as follows:

- Produce a smooth surface relatively free from defects using power tools
- When the surface has hardened sufficiently, use steel hand trowels to produce the final consolidated finish free of trowel marks and uniform in texture and appearance.

Wood float finish: After machine floating, produce the final consolidated finish free of float marks and uniform in texture and appearance using wood or plastic hand floats.

**Broom finish:** After machine floating draw a broom or hessian belt across the surface to produce a coarse even-textured slip-resistant transverse-scored surface.

**Scored or scratch finish:** After screeding, give the surface a coarse scored texture using a stiff brush or rake drawn across the surface before final set.

**Sponge finish:** After machine floating, obtain an even textured sand finish by wiping the surface using a damp sponge.

**Surface finishes**

General: Provide surface finishes in conformance with the Drawings and Finishes Schedule.

**Slip resistant treatment**

Surface treatment: Apply silicon carbide granules after floating and before the topping surface has set, and trowel into the surface so that the granules remain exposed.

Application rate: 1 kg/m<sup>2</sup> evenly distributed.

**Surface colouring**

General: Apply the colouring product after floating and before the topping surface has set and trowel into the surface so that it is even in colour.

**Surface treatment**

General: Apply the surface treatment after floating and before the topping surface has set.

**Temperature**

General: Make sure that the temperature of mixes, substrates and reinforcement are, at the time of application,  $\geq 5^{\circ}\text{C}$  or  $\leq 35^{\circ}\text{C}$ .

Severe temperature: If the ambient shade temperature is greater than  $38^{\circ}\text{C}$ , do not mix topping.

**E34.3.4 CONTROL OF MOVEMENT**

**General**

General: Provide control joints to the **Control joints schedule** and as follows:

- Location:
  - . Over structural control joints.
  - . To divide complex room plans into rectangles.
  - . Around the perimeter of the floor.
  - . At junctions between different substrates.
  - . To divide large topping-finished areas into bays.
- At abutments with the building structural frame and over supporting walls or beams where flexing of the substrate is anticipated.

Control joints to divide topping into bays: Provide joints using one of the following methods:

- Form in situ using square edge steel forms and trowelling a 3 mm radius to edges.
- Form a groove, extending at least one quarter the depth of the section, either by using a grooving tool, by sawing, or by inserting a premoulded strip.
- Install a control joint product.

Depth of joint: Right through to the substrate.

Depth of elastomeric sealant: One half the joint width, or 6 mm, whichever is the greater.

Topping joints: Provide joints to divide toppings into bays as follows:

- Form in situ using square edge steel forms and trowelling a 3 mm radius to edges.
- Form a groove, extending at least one quarter the depth of the section, either by using a grooving tool, by sawing, or by inserting a premoulded strip.
- Install a control joint product.

Bay sizes:

- Area:  $\leq 15 \text{ m}^2$ .
- Length to width ratio:  $\leq 1:1.5$ .

### **E34.3.5 JOINT ACCESSORIES**

#### **Weather bars**

General: Provide a corrosion resistant metal weather bar under hinged external doors. Locate under the centres of closed doors.

#### **Floor finish dividers**

General: Finish cementitious toppings at junctions with differing floor finishes with a corrosion resistant metal dividing strip suitable fixed to the substrate, with top edge flush to the finished floor. If changes of floor finish occur at doorways make the junction directly below the centre of the closed door.

### **E34.3.6 COMPLETION**

#### **Curing**

General: Prevent premature or uneven drying out and protect from the sun and wind.

Curing: Use a curing product or, as soon as toppings have set sufficiently, keep them moist by covering with polyethylene film for seven days.

#### **Joint sealant**

General: If required, seal joints as follows:

- Formed joints  $\leq 25$  mm deep: With filler and bond-breaker.
- Sawn joints: Full depth of cut.

#### **Protection**

General: Protect finished work from damage during building operations.

#### **Slip resistance**

Field test of completed surface: To AS/NZS 4663.

**E35 WATERPROOFING – WET AREAS**

**E35.1 GENERAL**

**E35.1.1 RESPONSIBILITIES**

**General**

General: Provide wet area waterproofing systems which:

- Are graded to floor wastes to dispose of water without ponding.
- Prevent moisture entering the substrate or adjacent areas.

Selections: As documented.

**E35.1.2 CROSS REFERENCES**

**General**

Requirement: Conform to the following:

- *General requirements.*
- Tiling

**E35.1.3 STANDARDS**

**Wet areas**

Standard: To AS 3740.

**E35.1.4 INTERPRETATIONS**

**Definitions**

General: For the purposes of this worksection the definitions given in AS 3740 and the following apply:

- Substrates: The surface to which a material or product is applied.
- Bond breaker: A system preventing a membrane bonding to the substrate, bedding or lining.
- Membranes: Impervious barriers to liquid water which may be:
  - . Installed below floor finishes.
  - . Installed behind the wall sheeting or render and termed External.
  - . Installed to the face of the wall sheeting or render and termed Internal.
  - . Liquid applied in liquid or gel form and air cured to form a seamless film.
  - . Sheet in sheet form with joints lapped and sealed.
- Preformed shower base: A preformed, prefinished vessel (including integral upstands) installed as the finished floor of a shower compartment, and provided with a connection point to a sanitary drainage system.
- Shower tray: An internal or external liquid or sheet membrane system used to waterproof the floor and the wall/floor junctions of a shower area.
- Waterproof (WP): The property of a material that does not allow moisture to penetrate through it.
- Waterproofing systems: Combinations of membranes, flashings, drainage and accessories which form waterproof barriers and which may be:
  - . Loose-laid.
  - . Bonded to substrates.
- Water resistant (WR): The property of a material that restricts moisture movement and will not degrade under conditions of moisture.
- Wet area: An area within a building supplied with a floor waste.

**E35.1.5 INSPECTION**

**Notice**

Inspection: Give notice so inspection may be made of the following:

- Substrate preparation completed.
- Secondary layers preparation completed.

- Before membranes are covered up or concealed.

### **E35.1.6 SUBMISSIONS**

#### **Shop drawings**

Submit shop drawings showing:

- Junctions with vertical surfaces and upstands.
- Junctions at perimeters.
- Drainage details.
- Control joints.
- Flashings.
- Penetrations.
- Corners.
- Terminations and connections.

#### **Execution records**

Placing records: Photographically record the application of membranes and information as follows:

- Date.
- Portion of work.
- Substrate preparation.
- Protection provided from traffic.

For large or complex projects consider adding the following requirement:

- 'Personnel: Employ a suitably qualified person to monitor the placing and protection of the membrane and prepare a daily report.'

#### **Samples**

General: Submit 300 x 300 mm samples of each type of membrane.

#### **Products documentation**

General: Submit copies of product manufacturers:

- Product technical data sheets.
- Material safety data sheets (MSDS).
- Type tests certificates verifying conformance to AS/NZS 4858.

## **E35.2 PRODUCTS**

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### **E35.2.1 PRODUCTS**

#### **Membranes**

Standard: To AS/NZS 4858.

#### **Water stop angles**

Material: Rigid, corrosion resistant angles compatible with the waterproof membrane system.

#### **Bond breakers**

Requirement: Compatible with the flexibility class of the membrane to be used.

Material: Purpose made bond breaker tapes and closed cell foam backing rods or fillets of sealant.

#### **Flashings**

Requirement: Flexible waterproof flashings compatible with the waterproof membrane system.

#### **Liquid membrane reinforcement**

Requirement: Flexible fabric compatible with the waterproof membrane system.

#### **Sealants**

Requirement: Waterproof, flexible, mould-resistant and compatible with host materials.

#### **Adhesives**

Requirement: Waterproof and compatible with host materials.

## E35.3 EXECUTION

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### E35.3.1 PREPARATION

#### Substrates

General: Make sure substrates are as follows:

- Clean and free of any deposit or finish which may impair adhesion of membranes.
- If walls are plastered, remove loose sand.
- If walls or floors are framed or discontinuous, support members are in full lengths without splicing.
- If floors are solid or continuous:
  - . Excessive projections are removed.
  - . Voids and hollows > 10 mm with abrupt edges are filled with a cement:sand mix not stronger than the substrate nor weaker than the bedding.
  - . Depressions < 10 mm are filled with a latex modified cementitious product with feathering eliminated by scabbling the edges.
  - . Cracks in substrates wider than 1.5 mm are filled with a filler compatible with the membrane system.

External corners: Round or arris edges.

#### Moisture content

Concrete substrates: Cure for > 21 days.

Moisture content: Verify that the moisture content of the substrate is compatible with the water vapour transmission rate of the membrane system by testing to AS/NZS 2455.1 Appendix B.

Test type:

- Hygrometer test: Seal a hygrometer to the substrate for > 16 hours and measure the relative humidity of the air between the instrument and the slab.
- Electrical resistance test: Connect a resistance meter to the slab and read the moisture content.

#### Falls

Substrate: If the membrane is directly under the floor finish ensure the fall in the substrate conforms to the fall nominated for the finish.

#### Sheet substrate fastening

Requirement: Fasten or adequately fix to the supporting structure.

#### Control joints

Finishes: Align control joints in finishes and bedding with control joints or changes in materials in the substrate.

#### Water stop angles

Requirement: Provide water stop angles at door thresholds and shower enclosures to support the waterproof membrane at junctions between waterproofed and non-waterproofed areas.

Sizing: Size the vertical leg of the water stop angle to conform to the requirements of AS 3740.

Corners: Cut the horizontal leg and bend the vertical leg at corners instead of forming vertical joints between separate lengths of angle.

Fixing: Fix water stop angles to the substrate with compatible sealant or adhesive and corrosion-resistant countersunk or wafer head screws.

#### Priming

General: If required by the membrane manufacturer, prime the substrates with a primer compatible with the membrane system.

#### Bond breakers

Requirement: After the priming of surfaces, provide bond breakers at all wall/floor, hob/wall junctions and at control joints where the membrane is bonded to the substrate.

Sealant fillet bond breakers:

- Application: Form a triangular fillet or cove of sealant to internal corners within the period recommended by the membrane manufacturer after the application of the primer.
- Widths: 5 mm x 5 mm to vertical corners. 6 mm x 6 mm – 9 mm x 9 mm to horizontal corners.

Backing rod bond breakers: Retain in position with continuous length of tape pressed firmly in place against the surfaces on each side of the rod.

### **E35.3.2 APPLICATION**

#### **Protection**

General: Protect membrane from damage during installation and for the period after installation until the membrane achieves its service characteristics that resist damage.

#### **Extent of waterproofing**

Waterproof or water resistant surfaces: To the requirements of BCA 3.8.1.2.

#### **Sheet membrane joints**

Bituminous sheet membranes:

- Side laps > 75 mm.
- End laps > 100 mm.

Synthetic rubber membranes:

- Factory-vulcanized laps > 40 mm.
- Field side laps > 50 mm for side laps.
- Field end-laps > 100 mm for end laps.

PVC membranes:

- Factory welded laps > 30 mm.
- Field-welded laps > 75 mm.

#### **Vertical membrane terminations**

Upstands: At least 150 mm above the finished tile level of the floor or 25 mm above the maximum retained water level, whichever is the greater.

Anchoring: Secure sheet membranes along the top edge.

Edge protection: Protect edges of the membrane.

#### **Flashings**

Junctions between waterproof surfaces: Provide a bond breaker at internal corners behind flashings.

Junctions between waterproof surfaces and other surfaces: Provide a bead of sealant at the following junctions:

- Waterproof and water-resistant surfaces.
- Water-resistant and water-resistant surfaces.
- Water-resistant and non water-resistant surfaces.

Perimeter flashings: Provide continuous flashings to the full perimeter of waterproof areas at wall/floor junctions and to water stop angles.

Vertical flashings: Provide vertical corner flashings continuous across wall/wall junctions to at least 1800 mm above finished floor level.

Vertical liquid applied flashings:

- Return legs at least 40 mm on each wall.
- Overlap the vertical termination of the floor waterproofing membrane at least 20 mm.

Vertical sheet flashings:

- Return legs at least 50 mm on each wall.
- Overlap shower tray upstands at least 50 mm.
- Do not penetrate flashing with wall lining fasteners.

Reinforcement: At coves, corners and wall/floor junctions with gaps greater than 3 mm reinforce liquid applied membranes with reinforcement fabric tape recommended by the membrane manufacturer.

Fold the tape in half lengthways and imbed it in the first flashing coat of membrane with one half of the tape on each side of the corner or joint. Apply a second coat of liquid membrane to seal the fabric.

#### **Doorjambs and architraves**

Requirement: Where the bottom of doorjambs and architraves do not finish above the floor tiling, waterproof their surfaces below tile level to provide a continuous seal between the perimeter flashing to the wall/floor junction and the water stop angle.

### **Drainage connections**

Floor wastes: Provide floor wastes of sufficient height to accommodate the thickness of floor finishes and bedding at the outlet position. Position drainage flange to drain at membrane level. Turn membrane down 50 mm minimum into the floor waste drainage flanges, and adhere to form a waterproof connection.

Floor wastes in shower trays: Provide drainage of the tile bed and a waterproof connection between the tray and the drain.

Preformed drainage channels with continuous drainage flanges: Provide a continuous waterproof connection between the membrane and the channel.

Preformed drainage channels without drainage flanges: Provide continuous waterproofing under the channel and terminate the membrane at a floor waste with a recessed drainage flange.

### **Membrane horizontal penetrations**

Sleeves: Provide a flexible flange for all penetrations, bonded to the penetration and to the membrane.

### **Membrane vertical penetrations**

Pipes, ducts, and vents: Provide separate sleeves for all pipes, ducts, and vents and have fixed to the substrate.

### **Curing of liquid applied systems**

General: To the manufacturers instructions.

Curing: Allow membrane to fully cure before tiling.

### **Overlaying finishes on membranes**

Requirement: Protect waterproof membranes with compatible water-resistant surface materials that do not cause damage to the membrane.

Suitable materials: Conform to AS 3740.

Bonded or partially bonded systems: If the topping or bedding mortar is required to be bonded to the membrane, provide sufficient control joints in the topping or bedding mortar to reduce the movement over the membrane.

## **E35.3.3 FLOOD TEST**

### **General**

Application: Perform a flood test before the installation of surface finishes.

Moisture measurement method: Conform to AS/NZS 2455.1 Appendix B.

Set-up:

- Measure the wall/floor junction of adjacent spaces and the floor soffit below for dryness.
- Record the result for each area.
- Dam the doorway(s) and seal floor wastes and drainage outlets to allow 50 mm water level.
- Fill space with clean water and leave overnight.

Evaluation:

- Make a visual inspection of the wall/floor junction of adjacent spaces and of the floor soffit below for obvious water or moisture.
- Test the same areas for dryness and compare the results to the measurements taken prior to flooding.

Compliance:

- Evidence of water from the visual test: Failure.
- No visual evidence of water: Proceed with moisture measurements.
- Test results indicating an increase in moisture before and after flooding: Failure.

Records:

- Submit records of all flood tests.

## **E35.3.4 COMPLETION**

### **Protection**

General: Keep traffic off membrane surfaces until bonding has set or for 24 hours after laying, whichever period is the longer.

Reinstatement: Repair or replace faulty or damaged work. If the work cannot be repaired satisfactorily, replace the whole area affected.

**Warranty**

Waterproofing: Cover materials and workmanship in the terms of the warranty in the form of interlocking written warranties from the supplier and the applicator.

- Form: Against failure of materials and execution under normal environment and use conditions.
- Period: Fifteen (15) years.

**E35.4 SELECTIONS**

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**E35.4.1 SYSTEMS**

**Liquid membrane systems**

Location:

- Staff Toilet
- Family Accessible Toilet

Type: Proprietary liquid membrane

Proprietary item: Superflex 3 waterproofing system

**Certification**

The manufacturer must have a current Australian Building Products and Systems Scheme certificate; or a current technical opinion issued by the Australian Building Systems Appraisal Council stating that the system is suitable for use in wet areas, shower recesses and associated floors and wall/floor junctions which are to be tiled.

**E36 CERAMIC TILING****E36.1 GENERAL****E36.1.1 RESPONSIBILITIES****General**

General: Provide tiling systems to walls, floors and other substrates as follows and/or to the

**SELECTIONS:**

- Consistent in colour and finish.
- Firmly bonded to substrates for the expected life of the installation.
- Set out with joints accurately aligned in both directions and wall tiling joints level and plumb.
- To direct all water flowing from supply points to drainage outlets without leakage to the substrate or adjacent areas.

**E36.1.2 CROSS REFERENCES****General**

Requirement: Conform to the following:

- *General requirements.*

**E36.1.3 STANDARDS****Tiling**

General: Comply with the recommendations of those parts of AS 3958.1 which are referenced in this worksection.

**Slip Resistance**

Classification: To AS/NZS 4586 for the classifications noted in **SELECTIONS**.

Slip resistance measurement of existing installations: To AS/NZS 4663.

**E36.1.4 INTERPRETATION****Definitions**

General: For the purposes of this worksection the following definitions apply:

- Adhesives:
  - . Cementitious (C): Adhesives in which the binders are hydraulic, e.g. Portland cement, with aggregates and organic additives.
  - . Dispersion (D): Adhesives in which the binders are in the form of aqueous polymer dispersion with mineral fillers and organic additives.
  - . Reaction resin (R): Adhesives in which the binders are synthetic resins with mineral fillers and organic additives. The curing occurs by chemical reaction.
- Substrates: The surface to which a material or product is applied.
- Bedding: Mixtures of materials which are applied to substrates in a plastic state and which dry, cure and adhere tiles to substrates.
  - . Adhesive bedding: Tiling adhered by adhesives.
  - . Mortar bedding: Tiling adhered in a cementitious mortar bed.
- Pavers: Slabs made from clays, stone, precast concrete and/or other inorganic raw materials generally over 20 mm thick used as coverings for floors and supported over continuous substrates.
- Tiles: Thin slabs made from clays and/or other inorganic raw materials used generally as coverings for floors and walls and adhered to continuous supporting substrates.
  - . Cementitious: Cement based pre-finished tiles.
  - . Dry-pressed: Tiles made from a finely milled body mixture and shaped in moulds at high pressure. Also known as Type B.
  - . Extruded: Tiles whose body is shaped in the plastic state in an extruder then cut to size. Also known as Type A.

- Wet area: An area within a building supplied with a floor waste.
- Acoustic underlay: A resilient underlay providing acoustic isolation.
- Lippage: Height deviation between adjacent tiles.
- Stepping: The relative surface level of adjacent paving elements within the expanse of the main pavement.

### **E36.1.5 INSPECTION**

#### **Notice**

Inspection: Give notice so that inspection may be made of the following:

- Substrate immediately before tiling.
- Trial set-outs before execution.
- Control joints before sealing and grouting.
- Grout and sealant colours before application.

### **E36.1.6 SUBMISSIONS**

#### **Samples**

General: Submit labelled samples of tiles, including fittings, accessories, grout and sealants, illustrating the range of variation in colour and finish.

#### **Execution**

Grouting: Submit proposals for grouting methods and materials.

Margins: If it appears that variations in joint widths or overall dimensions will avoid cut tiles, submit a proposal.

#### **Product conformity**

Assessment: Submit current assessments of conformity as follows:

- Declaration of conformity by an AS/NZS ISO 9001 quality management system certified supplier:
  - . Slip resistance of the tiles specified in **Selections** to AS/NZS 4586.
- Marking and Classification of tiles with regard to water absorption and shaping to AS 4662.
- Marking and Classification of tile adhesive to AS 4992.1.
- Weighted normalised impact sound pressure level to AS ISO 717.2 as measured for the acoustic underlay as part of the entire tiling system.

### **E36.1.7 TESTS**

#### **General**

Tests: Submit tests as follows:

- Type test slip resistance of tiles to AS/NZS 4586.
- Site slip resistance test of completed surface to AS/NZS 4663.

### **E36.1.8 TOLERANCES**

#### **Completed tiling**

Standard: To AS 3958.1 clause 5.4.6.

## **E36.2 PRODUCTS**

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### **E36.2.1 MARKING**

#### **Identification**

General: Deliver materials to the site in the manufacturer's original sealed containers legibly marked to show the following:

- Manufacturer's identification.
- Product brand name.
- Product type.
- Dimensions and quantity.
- Product reference code and batch number.

- Date of manufacture.
- Material composition and characteristics such as volatility, flash point, light fastness, colour and pattern.
- Handling and installation instructions.

### **E36.2.2 TILES AND ACCESSORIES**

#### **Tiles**

Standard: To AS 4662.

Tactile ground surface indicators: To AS/NZS 1428.4.1.

Coves, nosings and skirtings: Provide matching stop-end and internal and external angle tiles moulded for that purpose.

Exposed edges: Purpose-made border tiles with the exposed edge (whether round, square or cushion) glazed to match the tile face. If such tiles are not available, mitre tiles on external corners.

#### **Accessories**

General: Provide tile accessories which match the composition, colour and finish of the surrounding tiles.

### **E36.2.3 ADHESIVES**

#### **General**

Standard: To AS 2358 and AS 4992.1.

#### **Type**

General: Provide adhesives to the **Wall tiling schedule** and to the **Floor tiling schedule** and compatible with the materials and surfaces to be adhered.

Prohibited uses: Do not provide the following combinations:

- Cement-based adhesives on wood, metal, painted or glazed surfaces, gypsum-based plaster.
- Organic solvent-based adhesives on painted surfaces.
- Organic PVC-based adhesives and organic natural rubber latex adhesives in damp or wet conditions.
- PVA (polyvinyl acetate) based adhesives in wet areas or externally.

### **E36.2.4 MORTAR**

#### **Materials**

Cement type to AS 3972: GP.

- White cement: Iron salts content  $\leq 1\%$ .
- Off-white cement: Iron salts content  $\leq 2.5\%$ .

Lime: To AS 1672.1.

Sand: Fine aggregate with a low clay content selected for grading, sharp and free from efflorescing salts.

Measurement of volume: Measure binders and sand by volume using buckets or boxes. Do not allow sand to bulk by absorption of water.

#### **Bedding mortar**

Proportioning: Select proportions from the range 1:3 – 1:4 cement: sand (by volume) to obtain satisfactory adhesion. Provide minimum water.

Terra cotta tiles: Use proprietary polymer modified mortar.

Mixing: To AS 3958.1 clause 2.15.

#### **Water**

General: Clean and free from any deleterious matter.

### **E36.2.5 GROUT**

#### **Type**

Cement based proprietary grout: Mix with water. Fine sand may be added as a filler in wider joints.

Terra cotta tiles: Use proprietary polymer modified grout.

Portland cement based grout: Mix with fine sand. Provide minimum water consistent with workability.

- For joints < 3 mm: 1 cement:2 sand (by volume).
- For joints ≤ 3 mm: 1 cement:3 sand (by volume).

#### **Pigments**

Pigments for coloured grout: Provide colourfast fillers compatible with the grout material. For cement-based grouts, provide lime-proof natural or synthetic metallic oxides compatible with cement.

### **E36.2.6 CONTROL JOINTS**

#### **Control joint materials**

Control joint strip: A proprietary expansion joint consisting of a neoprene filler sandwiched between plates with lugs or ribs for mechanical keying. Set flush with the finished surface.

Proprietary slide plate divider strip: An arrangement of interlocking metal plates grouted into pockets formed in the concrete joint edges.

Sealant: One-part self-levelling non-hardening mould resistant, silicone or polyurethane sealant applied over a backing rod. Finish flush with the finished surface.

- Floors: Trafficable, shore hardness > 35.

Backing rod: Compressible closed cell polyethylene foam with a bond-breaking surface.

### **E36.3 EXECUTION**

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#### **E36.3.1 SUBSTRATES**

##### **Drying and shrinkage**

General: Before tiling, allow at least the following times to elapse (for initial drying out and shrinkage) for these substrates:

- Concrete slabs: 42 days.
- Concrete blockwork: 28 days.
- Toppings on slabs and rendering on brick or blockwork: A further 21 days.
- Rendering on swimming pool shell: A further 28 days minimum.

#### **E36.3.2 PREPARATION**

##### **Standard**

Preparation: To AS 3958.1 Section 4.

##### **Ambient temperature**

General: If the ambient temperature is < 5 or > 35°C, do not lay tiles.

##### **Substrates without wet area membranes**

General: Ensure substrates are as follows:

- Clean and free of any deposit or finish which may impair adhesion or location of tiles.
- If framed or discontinuous, support members are in full lengths without splicing.
- If solid or continuous:
  - . Excessive projections are removed.
  - . Voids and hollows > 10 mm with abrupt edges are filled with a cement:sand mix not stronger than the substrate or weaker than the bedding.
  - . Depressions < 10 mm are filled with a latex modified cementitious product with feathering eliminated by scabbling the edges.

Absorbent substrates: If suction is excessive, control it by dampening but avoid over-wetting and do not apply mortar bedding to substrates showing surface moisture.

Dense concrete: If not sufficiently rough to provide a mechanical key, roughen by scabbling or the like to remove 3 mm of the surface and expose the aggregate; then apply a bonding treatment.

##### **Substrates with wet area membranes**

General: Ensure substrates are as follows:

- Clean and free of any deposit or finish which may impair adhesion or location of tiles.
- Compatible with all components of the floor system.

### **Trial set-out**

General: Prepare a trial tile set-out of each area as follows to:

- Maximise the size of equal margins of cut tiles.
- Locate control joints.
- Note minor variations in joint widths to eliminate cut tiles at margins.
- Mark location of fittings on walls.

### **E36.3.3 TILING GENERALLY**

#### **Sequence**

General: Fix wall tiles before floor tiles.

#### **Cutting and laying**

Cutting: Cut tiles neatly to fit around fixtures and fittings and at margins where necessary. Drill holes without damaging tile faces. Cut recesses for fittings such as soap holders. Rub edges smooth without chipping.

Laying: Return tiles into sills, reveals and openings. Butt up to returns, frames, fittings, and other finishes. Strike and point up beds where exposed. Remove tile spacers before grouting.

#### **Variations**

General: Distribute variations in hue, colour, or pattern uniformly, by mixing tiles or tile batches before laying.

#### **Protection**

Floor tiles: Keep traffic off floor tiles until the bedding has set and attained its working strength.

Cleaning: Keep the work clean as it proceeds and protect finished work from damage.

#### **Floor finish dividers**

General: Finish tiled floors at junctions with differing floor finishes with a corrosion-resistant metal dividing strip fixed to the substrate. If changes of floor finish occur at doorways, make the junction directly below the closed door.

### **E36.3.4 SETTING OUT**

#### **Tile joints**

Joint widths: Set out tiles to give uniform joint widths within the following limits:

- Floors:
  - . Dry pressed tiles: 3 mm.
  - . Extruded tiles: 6 mm.
  - . Vitrified: 3 to 5 mm.
  - . Quarry tiles: 6 to 12 mm.
  - . Chemical resistant epoxy jointed tiling: 5 to 6 mm.
- Large and/or irregular floor tiles: 6 to 12 mm.
- Mounted mosaics: To match mounting pattern.
- Walls:
  - . Dry pressed tile: 1.5 mm.
  - . Extruded tile: 6 mm.

Joint alignment: Set out tiling with joints accurately aligned in both directions and wall tiling joints level and plumb.

Joint position: Set out tiles from the centre of the floor or wall to be tiled.

#### **Margins**

General: Provide whole or purpose-made tiles at margins where practicable, otherwise set out to give equal margins of cut tiles. If margins less than half tile width are unavoidable, locate the cut tiles where they are least conspicuous.

#### **Fixtures**

General: If possible position tiles so that holes for fixtures and other penetrations occur at the intersection of horizontal and vertical joints or on the centre lines of tiles. Continue tiling fully behind fixtures which are not built in to the tiling surface. Before tiling ensure that fixtures interrupting the tile surfaces are accurately positioned in their designed or optimum locations relative to the tile layout.

### **E36.3.5 FALLS AND LEVELS**

#### **Grading**

General: Grade floor tiling to even and correct falls to floor wastes and elsewhere as required. Make level junctions with walls. Where falls are not required lay level.

Fall, general: 1:100 minimum.

Fall, in shower areas: 1:60 minimum.

Change of finish: Maintain finished floor level across changes of floor finish including carpet.

### **E36.3.6 BEDDING**

#### **Standard**

Cement mortar: To AS 3958.1 clause 5.5.

Adhesive: To AS 3958.1 clause 5.6.

#### **Preparation of tiles**

Adhesive bedding: Fix tiles dry; do not soak.

Mortar bedding: Soak porous tiles in water for half an hour and then drain until the surface water has disappeared.

#### **Bedding**

General: Use bedding methods and materials which are appropriate to the tile, the substrate, the conditions of service, and which leave the tile firmly and solidly bedded in the bedding material and adhered to the substrate. Form falls integral with the substrate.

#### **Thin adhesive beds**

General: Provide only if the substrate deviation is less than 3 mm when tested with a 3 m straight edge. Cover the entire tile back with adhesive when the tile is bedded.

Thickness: 1.5 – 3 mm.

#### **Thick adhesive beds**

General: Provide on substrates with deviations up to 6 mm when tested with a 3 m straight edge, and with tiles having deep keys or frogs.

Nominal thickness: 6 mm.

#### **Adhesive bedding application**

General: Apply adhesive by notched trowel to walls and floors and direct to tiles if required, to provide evenly distributed coverage after laying as follows:

- Domestic internal walls: > 65%.
- Domestic internal floors: > 80%.
- Other wall and floors: > 90%.
- Wet areas and bench tops: 100%.

Pattern of distribution of adhesive: As described in AS 3958.1 clause 5.6.4.3. Verify by examining one tile in ten as work proceeds.

Wall tile spacers: Do not use spacer types that inhibit the distribution of adhesive.

Curing: Allow the adhesive to cure for the period nominated by the manufacturer prior to grouting or allowing foot traffic.

#### **Mortar beds**

For floor tiles: Either lightly dust the screeded bed surface with dry cement and trowel level until the cement is damp, or spread a thin slurry of neat cement, or cement-based thin bed adhesive, on to the tile back. Do not provide mortar after initial set has occurred.

- Nominal thickness: 20 to 40 mm.

Thick reinforced beds: Place mortar bed in two layers, and incorporate the mesh reinforcement in the first layer.

#### **Mechanical fixing**

General: Provide a proprietary system of support and fixing appropriate to the type of tile and the substrate conditions.

### **E36.3.7 CONTROL OF MOVEMENT**

#### **General**

General: Provide control joints carried through the tile and the bedding to AS 3958.1 clause 5.4.5, the **Control joints schedule** and as follows:

- Floor location:
  - . Over structural control joints.
  - . To divide complex room plans into rectangles.
  - . Around the perimeter of the floor.
  - . At junctions between different substrates.
  - . To divide large tiled areas into bays.
  - . At abutments with the building structural frame and over supporting walls or beams where flexing of the substrate is anticipated.
- Depth of joint: Right through to the substrate.
- Sealant width: 6 – 25 mm.
- Depth of elastomeric sealant: One half the joint width, or 6 mm, whichever is the greater.

### **E36.3.8 GROUTED AND SEALANT JOINTS**

#### **Grouted joints**

General: Commence grouting as soon as practicable after bedding has set. Clean out joints as necessary before grouting.

Face grouting: Fill the joints solid and tool flush. Clean off surplus grout. Wash down when the grout has set. When grout is dry, polish the surface with a clean cloth.

Edges of tiles: Grout exposed edge joints.

Epoxy grouted joints: Ensure that tile edge surfaces are free of extraneous matter such as cement films or wax, before grouting.

#### **Sealant joints**

General: Provide joints filled with sealant and finished flush with the tile surface as follows:

- Where tiling is cut around sanitary fixtures.
- At corners of walls in showers.
- Around fixtures interrupting the tile surface, for example pipes, brackets, bolts and nibs.
- At junctions with elements such as window and door frames and built-in cupboards.

Material: Anti-fungal modified silicone.

Width: 5 mm.

Depth: Equal to the tile thickness.

### **E36.3.9 JOINT ACCESSORIES**

#### **Floor finish dividers**

General: Finish tiled floors at junctions with differing floor finishes with a corrosion resistant metal dividing strip suitably fixed to the substrate, with top edge flush with the finished floor. Where changes of floor finish occur at doorways make the junction directly below the closed door.

Stepping: Less than 5 mm.

#### **Adjustments**

If the floor finish divider was installed by the wet area waterproof membrane applicator check that the height is sufficient for the topping and tile thickness. Adjust as required with a matching flat bar adhesive fixed to the divider angle.

#### **Weather bars**

General: Provide a corrosion resistant metal weather bar under hinged external doors. Locate under the centres of closed doors.

**E36.3.10 COMPLETION****Spare tiles**

General: Supply spare matching tiles and accessories of each type for future replacement purposes. Store the spare materials on site.

Quantity: At least 1% of the quantity installed.

Storage location: As directed by the Principal's Representative.

**Cleaning**

General: Clean tiled surfaces using an appropriate tile cleaning agent, and polish.

**Operation and maintenance manuals**

General: Submit a manual describing care and maintenance of the tiling, including procedures for maintaining the slip-resistance grading stating the expected life of the slip-resistance grade.

**E36.4 SELECTIONS****E36.4.1 SCHEDULES****Floor tiling schedule**

<b>Location</b>	<b>New Platform Building</b> - Staff Toilet - Family Accessible Toilet - Cleaners Room
<b>Tiles</b>	
- Type	Better Tiles BFA700
- Colour	As noted in the Finishes Schedule
- Size	600 x 300mm
- Bedding	Thick cement based bedding laid to falls
- Grout	Proprietary, cement based, natural colour
- Slip resistance classification	To comply with all relevant Australian Standards

**Wall tiling schedule**

<b>Location</b>	<b>New Platform Building</b> - Staff Toilet - Family Accessible Toilet - Splashback to Kitchenette - Wall behind to Cleaners sink
<b>Tiles</b>	
- Type & colour	Better Tiles, BGY-107 (White) BGY-Red (Red)
- Extent of each colour	As noted in the Finishes Schedule
- Size	162 x 495mm
- Bedding	Thin adhesive bed
- Grout	Proprietary, cement based, to match colour of tiles

**Skirting**

<b>Location</b>	Staff Toilet, Family Access Toilet and Cleaners Room
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Tiles	
- Type	Better Tiles BSP 105C coved skirting
- Colour	As noted in the Finishes Schedule
- Size	100 x 200mm
- Bedding	Thin adhesive bed
- Grout	Proprietary, cement based, to match colour of tiles

## E37 RESILIENT FINISHES

### E37.1 GENERAL

#### E37.1.1 RESPONSIBILITIES

##### General

General: Install resilient floor coverings to substrates as follows and/or to **Selections**:

- To remain secured for the warranty life of the covering.
- To remain consistently smooth for the warranty life of the covering.
- To form the pattern required.

#### E37.1.2 CROSS REFERENCES

##### General

Requirement: Conform to the following:

- *General requirements.*

#### E37.1.3 INTERPRETATION

##### Definitions

General: For the purposes of this worksection the following definitions apply:

- Resilient floor coverings classification: To BS EN 685.
- Substrate: The surface to which a material or product is applied.
- Underlay: A layer of sheet material or in situ filling on the substrate that modifies the behaviour of the subsequent finish.

#### E37.1.4 INSPECTION

##### Notice

Inspection: Give notice so that inspection may be made of the following:

- Completion of laying underlay, if any.
- Substrate immediately before fixing resilient finishes.
- Finished surface before applying sealers or polishes (if any).
- Completed installation.

#### E37.1.5 TESTS

##### Slip resistance

Submit tests as follows:

- Type test slip resistance of flooring product to AS/NZS 4586.
- Site test completed surfaces to AS/NZS 4663.

#### E37.1.6 SUBMISSIONS

##### Samples

Range: Submit labelled samples of resilient finishes illustrating the range of colour, pattern or texture as seen in the finished work.

Minimum size per sample:

- Sheet: 450 x 450 mm.
- Tiles: A whole tile or 0.09 m<sup>2</sup>, whichever is the greater.
- Linear accessories (coving, skirting, stair nosing, protection strips, and the like): A piece 300 mm long.

Welded joints: Submit a sample joint 300 mm long.

##### Identification

Labelling: Label each sample, giving brand, product name, and manufacturer's code reference (including the code for each coat of multi-coat work).

Trial set-out: Prepare a trial set-out before fixing.

**Subcontractors**

General: Submit names and contact details of proposed suppliers and installers.

**Tests**

Manufacturer's test data: Submit independent testing authorities' reports of factory or type tests showing that materials comply with cited standards.

**Materials and components**

Manufacturer's data: Submit the manufacturer's published product data for each type of finish, and recommendations for its application in the project including, where relevant, the following:

- Thickness and width of sheet or size of tile.
- Adhesive and jointing method.
- Resistance to wear, indentation, chemicals, light and fire.
- Flexibility and bending strength.

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**E37.2 PRODUCTS**

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**E37.2.1 GENERAL**

**Critical radiant flux**

Standard: To AS ISO 9239.1.

Floor finishes: Conform to the values of critical radiant flux nominated in **Selections**.

**Smoke development rate**

Standard: To AS ISO 9239.1.

Floor finishes in non-sprinklered buildings: 750 percent-minutes.

**E37.2.2 MARKING**

**Identification**

General: Deliver materials to the site in the manufacturer's original sealed containers legibly marked to show the following:

- Manufacturer's identification.
- Product brand name.
- Product type.
- Dimensions and quantity.
- Product reference code and batch number.
- Date of manufacture.
- Material composition and characteristics such as volatility, flash point, light fastness, colour and pattern.
- Handling and installation instructions.

**E37.2.3 UNDERLAYS**

**Cementitious**

General: Polymer modified cementitious self smoothing and levelling compound.

- Thickness: 3 mm minimum.

**Fibre cement underlay**

Standard: To AS/NZS 2908.2, Type B, category 2 minimum.

Thickness: 5 mm minimum.

**Wet processed fibreboard (hardboard) underlay**

Standard: To AS/NZS 1859.4.

Classification: General purpose medium board, manufactured specifically as flooring underlay.

Thickness: 5.5 mm.

**E37.2.4 SHEETS AND TILES****Edges of sheets and tiles**

General: Ensure edges are firm, unchipped, machine-cut accurately to size and square to the face, and that tile edges are square to each other.

**Cork tiles**

Standard: To BS EN 12104.

**Linoleum**

Standard: To BS EN 548.

**Corklinoleum**

Standard: To BS EN 688.

**Rubber**

Standard: To BS EN 12199.

**Polyvinyl chloride (PVC)**

Resilient floor covering, jute or polyester felt backing: To BS EN 650.

Resilient floor covering, with foam layer: To BS EN 651.

**Adhesives**

General: As recommended by the resilient finishes manufacturer.

**Acoustic sheet vinyl**

General: Unbacked flexible sheet vinyl laid over separate closed cell foam underlayment.

Underlayment thickness: 2 mm.

**Slip resistant sheet vinyl**

Verification: A product type tested to confirm the stated slip resistance classification.

**Inlaid vinyl sheet**

General: A layer of vinyl chips inlaid in a translucent vinyl matrix, bonded to a moisture resistant backing.

**E37.3 EXECUTION****E37.3.1 SUBCONTRACTORS****General**

General: Use specialist installers recommended by the materials manufacturers.

**E37.3.2 PREPARATION****Substrates**

General: To AS/NZS 2455.1 Section 2.

Tolerance: Conform to the **Substrate tolerance table**.

**Substrate tolerance table**

Property	Length of straight edge laid in any direction	Max. deviation under the straight edge
Flatness Class A	3 m	3 mm
Smoothness	150 mm	1 mm
Projections	50 mm	0.5 mm

Cleaning concrete surfaces: Mechanically remove the following surface treatments:

- Sealers and hardeners.
- Curing compounds.

Cleaning timber surfaces: Remove oil, grease and traces of applied finishes.

Concrete substrate correction: Remove projections and fill voids and hollows with a levelling compound compatible with the adhesive.

Timber substrate correction: Remove projections. If conformance to the **Substrate tolerance table** can not be achieved fix an underlay in brick pattern with joints avoiding substrate joints.

Moisture content: Do not commence installation unless:

- Concrete: The moisture content of the concrete has been tested to AS/NZS 2455.1 Appendix B and the values in clause 2.4.2 (c) have been obtained.
- Plywood and timber: The moisture content of battens/joists or plywood background has been tested to AS/NZS 1080.1 and values obtained as follows:
  - . Air conditioned buildings: 8 to 10%.
  - . Intermittently heated buildings: 10 to 12.5%.
  - . Unheated buildings: 12 to 15%.

#### **Working environment**

General: Do not start work before the building is enclosed, wet work is complete and dry, and good lighting is available. Protect adjoining surfaces.

#### **Conditioning**

General: Stabilise the room temperature for seven days before, and two days after, installation of resilient finishes, as follows:

- Areas with air conditioning installed: Run air conditioning at operational temperature.
- Air conditioned areas not operational: Maintain a room temperature range of  $< 30^{\circ} > 18^{\circ}\text{C}$ .
- Underfloor heating: Turn off heating and allow background to stabilise at the temperature recommended by the carpet manufacturer.
- Non-air conditioned areas: Install at  $< 30^{\circ} > 18^{\circ}\text{C}$ .

Underlay: Expose both faces of each sheet for  $> 24$  hours before fixing.

Resilient sheet and tile floor covering: Stack for  $> 48$  hours before installation.

### **E37.3.3 SHEET AND TILE INSTALLATION**

#### **Sheet set out**

General: Set out sheets to give the minimum number of joints. Run sheet joints parallel with the long sides of floor areas, vertically on walls.

#### **Tile set out**

General: Wherever possible cut tiles at margins only, to give a cut dimension of at least 100 mm x full tile width. Match edges and align patterns. Arrange the material so that variation in appearance is minimised.

#### **Joints**

Non-welded: Butt edges together to form tight neat joints showing no visible open seam.

#### **Junctions**

General: Scribe neatly up to returns, edges, fixtures and fittings. Finish flush with adjoining surfaces.

#### **Rolling**

General: Where rolling is required, roll the finish in 2 directions before the adhesive sets, using a 70 kg multi-wheeled roller.

#### **Change of finish**

General: Maintain finished floor level across changes of floor finish including carpet.

#### **Cleaning**

General: Keep the surface clean as the work proceeds.

### **E37.3.4 VINYL SHEETING**

#### **Welded joints**

Heat welding: After fixing, groove the seams using a grooving tool and weld the joints with matching filler rod and using a hot air welding gun. When the weld rod has cooled, trim off flush.

Cold welding: Apply seaming compound 100 mm wide to the substrate centrally under the seam. Roll the seam until the compound is forced up into the joint. Clean off flush using a damp cloth.

Epoxy jointing: Join seams with epoxy adhesive.

#### **Static control flooring**

General: Install conductive vinyl sheet on a copper grid comprising copper tape 80  $\mu\text{m}$  thick x 10 mm wide adhered to the floor with conductive adhesive. Lay copper tape along each length of sheet vinyl and connect it at right angles to a 1 M $\Omega$  resistor. Connect to earth with copper tape at 20 – 30 m<sup>2</sup> intervals.

### E37.3.5 JOINTS AND ACCESSORIES

#### Junctions

General: Finish junctions tapered to with adjoining surfaces. Where changes of floor finish occur at doorways locate the joint on the centreline of the closed door leaf.

#### Accessories

General: Provide purpose-made matching moulded accessories for nosings, coves, skirtings, edge cover strips and finishes at junctions, margins, and angles, if available. Otherwise form accessories from the sheet material. Provide solid backing for radiused coves and nosings.

#### Edge strips

General: Provide edge cover strips at junctions with different floor finishes and to exposed edges.

Metal cover strip: Extruded tapered strip 25 mm wide, of the same thickness as the sheet or tile. Fix with matching screws to timber bases or to masonry anchors in concrete bases, at 200 mm maximum centres.

UPVC cover strip: Feather-edge strip matching the floor finish, fixed with contact adhesive.

#### Control joints

Location: Provide control joints as follows:

- Over structural control joints.
- At junctions between different substrates.

Depth of joint: Right through to the substrate.

Sealant width: 6 – 25 mm.

Depth of elastomeric sealant: One half the joint width, or 6 mm, whichever is the greater.

#### Control joint materials – sheet flooring

Proprietary slide plate divider strip: An arrangement of interlocking metal plates grouted into pockets formed in the concrete joint edges to finish flush with the flooring surface.

#### Vinyl skirting

Feather edge: Moulded PVC skirting section.

Flat skirting: Flat PVC skirting section.

Fixing: Scribe as necessary. Mitre corners. Fix to walls with contact adhesive.

Minimum height: 100 mm.

#### Rubber coved skirtings and margins

General: Form from smooth flat sheet matching the colour and total thickness of the rubber flooring. Scribe and mitre at internal corners.

External corners and stop ends: Provide purpose-made matching moulded pieces.

### E37.3.6 COMPLETION

#### Protection of sheet materials

General: Keep traffic off floors until bonding has set or for 24 hours after laying, whichever period is the longer. Do not allow water in contact with the finish for 7 days.

#### Reinstatement

Extent: Repair or replace faulty or damaged work. If the work cannot be repaired satisfactorily, replace the whole area affected.

#### Warranties

General: For each type of resilient finish specified, submit the installer's warranty of the workmanship and application.

#### Certificate of compliance

General: Provide a certificate of compliance for antistatic and conductive floor installations.

#### Maintenance manual

General: Submit manufacturer's published use, care and maintenance requirements for each type of finish.

#### Spare materials

General: Supply spare matching covering materials and accessories of each type for future replacement purposes. Store the spare materials on site where directed.

Quantity: At least 1% of the quantity installed.

**Cleaning**

General: Clean the finished surface. Buff and polish. Before the date for practical completion, mop and leave the finished surface clean and undamaged on completion.

**Cleaning antistatic and conductive flooring**

General: Do not use sealers, wax or floor polish. Clean using a mild neutral detergent and lukewarm water. A clean floor may be dry buffed using a normal scrubbing machine and a white nylon pad.

**E37.4 SELECTIONS**

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**E37.4.1 SCHEDULES**

**Sheet and tile schedule**

Location: Lobby, Kitchenette and Ticket Office in the new Platform Building

Type: Sheet vinyl

Manufacturer: Forbo

Product: Safestep R11

Thickness: 2mm

Colour: 82962

Skirting: Timber as specified in Lining

**E37.5 SELECTIONS**

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**E37.5.1 SCHEDULES**

**Sheet schedule**

As detailed in the Finishes Schedule.

**E38 PAINTING****E38.1 GENERAL****E38.1.1 RESPONSIBILITIES****General**

General: Provide coating systems to new or previously painted substrates as follows:

- Consistent in colour, gloss level, texture and dry film thickness.
- Free of runs, sags, blisters, or other discontinuities.
- Paint systems fully opaque.
- Clear finishes at the level of transparency consistent with the product.
- Fully adhered.
- Resistant to environmental degradation within the manufacturer's stated life span.

Selections: Conform to the **Selections**.

**E38.1.2 CROSS REFERENCES****General**

Requirement: Conform to the following:

- *General requirements*.
- *Texture coatings*

**E38.1.3 STANDARDS****Painting**

General: Comply with the recommendations of those parts of AS/NZS 2311 which are referenced in this worksection.

**E38.1.4 INTERPRETATION****Definitions**

General: For the purposes of this worksection the following definitions apply:

- Adhesion: The sum total of forces of attachment between a dry film and its substrate.
- Finish coat: The final coat of a coating system.
- Gloss: The optical property of a surface, characterised by its ability to reflect light specularly.
- Gloss unit: Numerical value for the amount of specular reflection relative to that of a standard surface under the same geometric conditions.
- Levels of gloss finish: When the specular direction is 60 degrees, a surface with the following specular gloss reading are defined as follows:
  - . Full gloss finish between 50 and 85 gloss units.
  - . Semi gloss between 20 and 50 gloss units.
  - . Low gloss between 5 and 20 gloss units ( also known as low sheen).
  - . Flat finish < 5 gloss units (also known as matt).
- Opacity: The ability of a paint to obliterate the colour difference of a substrate.
- Paint: A product in liquid form, which when applied to a surface, forms a dry film having protective, decorative or other specific technical properties.
- Primer, prime coat: The first coat of a painting system that helps bind subsequent coats to the substrate and which may inhibit its deterioration.
- Sealer: A product used to seal substrates to prevent:
  - . Materials from bleeding through to the surface.
  - . Reaction of the substrate with incompatible top coats.
  - . Undue absorption of the following coat into the substrate.
- Sheen: Gloss which is observed on an apparently matt surface at glancing angles of incidence.

- Substrate: The surface to which a material or product is applied.
- Undercoat: An intermediate coat formulated to prepare a primed surface or other prepared surface for the finishing coat.

### **E38.1.5 INSPECTION**

#### **Notice**

Inspection: Give notice so that inspection may be made of the following:

- Painting stages:
  - . Completion of surface preparation.
  - . After application of prime or seal coats.
  - . After application of undercoat.
  - . After application of each subsequent coat.
- Clear finishing stages:
  - . Before surface preparation of timber.
  - . Completion of surface preparation.
  - . After staining.
  - . After sanding of sealer.
  - . After application of each clear finishing coat.

### **E38.1.6 SUBMISSIONS**

#### **Clear finish coated samples**

General: Submit pieces of timber or timber veneer matching the timber to be used in the works, prepared, puttied, stained, sealed and coated in accordance with the specified system, of sufficient size so that, each piece can be cut into 4 segments, marked for identification, and distributed as directed.

#### **Opaque coated samples**

General: Submit, on representative substrates, samples of each coating system showing surface preparation, colour, gloss level, texture, and physical properties.

#### **Wet samples**

General: Submit two 500 mL samples, clearly labelled, of each type of paint to be tested.

#### **Paint**

General: Submit the selected manufacturer's details at least 3 weeks before the paint is required, as follows:

- Paint brand name and paint line quality statement.
- Material safety data sheets (MSDS) showing the health and safety precautions to be taken during application.
- The published recommendations for maintenance.

#### **Specialist applicators**

General: Submit name and contact details of proposed specialist applicators.

## **E38.2 PRODUCTS**

### **E38.2.1 PAINTS**

#### **Paint brand**

Quality: If the product is offered in a number of levels of quality, provide premium quality lines.

#### **Combinations**

General: Do not combine paints from different manufacturers in a paint system.

Clear timber finish systems: Provide only the combinations of putty, stain and sealer recommended by the manufacturer of the top coats.

#### **Delivery**

General: Deliver paints to the site in the manufacturer's labelled and unopened containers.

**Putty and fillers**

Material: To the recommendation of the paint system manufacturer, as suitable for the substrate and compatible with the primer.

**Tinting**

General: Provide only products which are colour tinted by the manufacturer or supplier.

**Toxic ingredients**

General: Comply with the requirements of Appendix I Uniform Paint Standard to the Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP).

**Standards**

Paint types: Conform to the Australian Standard as referenced in the **Paint type table**.

**Paint type table**

Paint type	AS/NZS 2311 Paint reference no. (Table 4.2)	Australian Standard
Semi gloss solvent-borne: interior	B3	AS 3730.5
Full gloss solvent-borne: exterior	B5	AS 3730.6, AS/NZS 3750.22
Full gloss solvent-borne: interior	B5	AS 3730.6
Flat latex: exterior	B6	AS 3730.7
Flat latex: interior	B6	AS 3730.1
Low gloss latex: exterior	B7	AS 3730.8
Low gloss latex: interior	B7	AS 3730.3
Semi gloss latex: exterior	B8	AS 3730.9
Semi gloss latex: interior	B8	AS 3730.2
Gloss latex: exterior	B9	AS 3730.10
Gloss latex: interior	B9	AS 3730.12
Wood primer, solvent-borne	B10	AS 3730.13
Wood primer, latex	B10A	AS 3730.17
Metal primer for steel, lead and chromate free	B11	AS 3730.21, AS/NZS 3750.19
Metal primer, latex	B11A	AS 3730.15
Metal primer for metallic-coated surfaces solvent-borne	B12	AS 3730.21
Metal primer for metallic-coated surfaces, latex	B12A	AS 3730.15
Two-pack etch primer for metals, chromate free	B13	AS/NZS 3750.17
Zinc-rich organic binder/primer for steel	B14	AS/NZS 3750.9
Concrete and masonry sealer	B15	AS 3730.22
Undercoat, solvent-borne	B17	AS 3730.14
Undercoat, latex: exterior	B17A	AS 3730.18
Undercoat, latex: interior	B17A	AS 3730.18
Furniture varnish, one-pack	B19	AS 3730.25
Two-pack clear gloss floor finish	B20	AS 3730.27
Exterior latex stain, opaque	B22	AS 3730.16
Exterior stain, lightly pigmented	B23	AS 3730.28
One-pack paving paint for concrete	B24	AS 3730.29
Two-pack epoxy enamel	B29	AS/NZS 3750.1
Two-pack high build epoxy	B29	AS/NZS 3750.4
Texture finish latex coating for masonry and concrete: exterior	B38	AS/NZS 4548.1 AS/NZS 4548.2 AS/NZS 4548.3 AS/NZS 4548.4
Texture finish latex coating for masonry and concrete: interior	B38	AS/NZS 4548.1 AS/NZS 4548.2

Paint type	AS/NZS 2311 Paint reference no. (Table 4.2)	Australian Standard
		AS/NZS 4548.3 AS/NZS 4548.4
Full gloss polyurethane (2-pack) for steel	B44	AS/NZS 3750.6

### E38.3 EXECUTION

#### E38.3.1 PREPARATION

##### Order of work

Other trades: Before painting, complete the work of other trades as far as practicable within the area to be painted, except for installation of fittings, floor sanding and laying flooring materials.

Clear finishes: Complete clear timber finishes before commencing opaque paint finishes in the same area.

##### Protection

General: Before painting, clean the area and protect it against dust entry. Use drop sheets and masking to protect finished surfaces or other surfaces at risk of damage during painting.

Internal and external fixtures and furniture: Remove door furniture, switch plates, light fittings and other fixtures before starting to paint, and refix in position undamaged on completion of the painting.

Adjacent surfaces: Protect adjacent finished surfaces liable to damage from painting operations.

##### 'Wet paint' warning

General: Place notices conspicuously and do not remove them until the paint is dry.

##### Repair

General: Clean off marks, paint spots and stains progressively and restore damaged surfaces to their original condition. Touch up new damaged decorative paintwork or misses only with the paint batch used in the original application.

##### Substrates

General: Prepare substrates to receive the painting systems.

Cleaning: Clean down the substrate surface. Do not cause undue damage to the substrate or damage to, or contamination of, the surroundings.

Filling: Fill cracks and holes with fillers, sealants, putties or grouting cements as appropriate for the finishing system and substrate, and sand smooth.

Clear finish: Provide filler tinted to match the substrate.

Clear timber finish systems: Prepare the surface so that its attributes will show through the clear finish without blemishes, by methods which may involve the following:

- Removal of bruises.
- Removal of discolourations, including staining by oil, grease and nailheads.
- Bleaching where necessary to match the timber colour sample.
- Puttying.
- Fine sanding (last abrasive no coarser than 220 grit) to show no scratches across the grain.

##### Unpainted surfaces

Standard: To AS/NZS 2311 Section 3.

##### Previously painted surfaces

Preparation of a substrate in good condition: To AS/NZS 2311 clause 7.4.

Preparation of a substrate in poor condition: To AS/NZS 2311 clause 7.5.

Preparation of steel substrates with protective coatings: To AS/NZS 2312 Section 10 and AS 1627.1.

Additional preparation:

- Seal stained ceilings before the application of latex paints.
- Clean PVC with methylated spirit and a nylon scouring pad.
- Remove wall paper and glue size with clean water and seal before painting.
- Remove water based kalsomine or lime wash paints by brushing with warm water.

### **Cleaning external surfaces**

Sound external surfaces other than timber: Remove dirt, grease, loose and foreign matter, efflorescence and mould by water blasting or steam cleaning without damaging the surface. Remove remaining loose material with appropriate hand tools. Use sanding blocks to preserve the arrises of masonry and stone details.

### **E38.3.2 PAINTING**

#### **Light levels**

General:  $\geq 400$  lux.

#### **Drying**

General: Use a moisture meter to demonstrate that the moisture content of the substrate is at or below the recommended maximum level for the type of paint and the substrate material.

#### **Paint application**

Standard: To AS/NZS 2311 Section 6.

Timing: Apply the first coat immediately after substrate preparation and before contamination of the substrate can occur. Apply subsequent coats after the manufacturer's recommended drying period has elapsed.

#### **Painting conditions**

General: Do not paint in dusty conditions, or otherwise unsuitable weather as follows unless the paint is suitable and recommended for such conditions:

- Relative humidity:  $\geq 85\%$ .
- Surface temperature  $\leq 10^{\circ}\text{C}$  or  $\geq 35^{\circ}\text{C}$ .

#### **Priming before fixing**

General: Apply one coat of wood primer (2 coats to end grain) to the back of the following before fixing in position:

- External fascia boards.
- Timber door and window frames.
- Bottoms of external doors.
- Associated trims and glazing beads.
- Timber board cladding.

#### **Spraying**

General: If the paint application is by spraying, use conventional or airless equipment which does the following:

- Satisfactorily atomises the paint being applied.
- Does not require the paint to be thinned beyond the maximum amount recommended by the manufacturer.
- Does not introduce oil, water or other contaminants into the applied paint.

Paint with known health hazards: Provide masking, ventilating and screening facilities generally to the standards set out for spray painting booths, AS/NZS 4114.1 and AS/NZS 4114.2.

#### **Sanding**

Clear finishes: Sand the sealer using the finest possible abrasive (no coarser than 320 grit) and avoid cutting through the colour. Take special care with round surfaces and edges.

#### **Repair of galvanizing**

General: For galvanized surfaces which have been subsequently welded, power tool grind to remove all rust and weld splatter. Remove all surface contaminants then immediately prime the affected area.

Primer: Organic zinc rich coating for the protection of steel to AS/NZS 3750.9 Type 2.

#### **Tinting**

General: Tint each coat of an opaque coating system so that each has a noticeably different tint from the preceding coat, except for top coats in systems with more than one top coat.

#### **Services**

General: If not embedded, paint new services and equipment including in plant rooms, except chromium, anodised aluminium, GRP, UPVC, stainless steel, non-metallic flexible materials and normally lubricated machined surfaces. Repaint proprietary items only if damaged.

**Door leafs**

Drying: Leave doors fixed open to allow drying. Do not allow door hardware, accessories or the like to damage the door finish during the drying process.

**E38.4 SELECTIONS****E38.4.1 PAINTING SYSTEMS****New unpainted interior surfaces**

Standard: To AS/NZS 2311 Table 5.1.

**New unpainted exterior surfaces**

Standard: To AS/NZS 2311 Table 5.2.

**Specialised painting systems**

Standard: To AS/NZS 2311 clause 5.2 for the following final coats:

- High build textured or membrane finishes (B38 to AS/NZS 2311).
- 2 pack gloss pigmented polyurethane (B44 to AS/NZS 2311).
- 2 pack epoxy (B29 to AS/NZS 2311).
- 2 pack water based epoxy (B29A to AS/NZS 2311).

**Previously painted surfaces**

Standard: To AS/NZS 2311 Section 8.

**E38.4.2 PAINTING SCHEDULES****General**

Number of coats: Unless specified as one or two coat systems, each paint system consists of at least 3 coats.

Final coat selection: To the **Interior painting schedule** and the **Exterior painting schedule**.

**Low VOC emitting paints**

Where available, use paints with low VOC emission.

**Paint colours**

Refer to the Finishes Schedule for paint colours.

**Interior painting schedule**

Location	Substrate	Paint type and finish	Colour
New Platform Building			
- Walls generally	Plasterboard	Semi-gloss latex	Refer to Finishes Schedule
- Walls to external cupboard	Compressed fibre cement	Semi-gloss latex	Refer to Finishes Schedule
- Ceilings	Plasterboard	Low-gloss latex	Refer to Finishes Schedule
- Doors	Plywood	Full gloss enamel	Refer to Finishes Schedule
- Door frames	Steel	Full gloss enamel	Refer to Finishes Schedule
- Skirting	Timber	Full gloss enamel	Refer to Finishes Schedule

**Exterior painting schedule**

Location	Substrate	Paint type and finish	Colour
Exposed concrete surfaces, including columns, walls,	Concrete	Texture coating	Refer to Finishes Schedule

balustrades, soffits and hobs			
Walls to TVM recess in new Platform building	Compressed fibre cement	Semi-gloss latex	Refer to Finishes Schedule
Doors	Steel	Full gloss enamel	Refer to Finishes Schedule
Door frames	Steel	Full gloss enamel	Refer to Finishes Schedule
Steel roof framing to canopy outside new platform building	Steel	Epoxy paint	Refer to Finishes Schedule
Stair balustrades	Galvanised steel	Epoxy paint	Refer to Finishes Schedule
Balustrade to footbridge and Lift landings	Galvanised steel	Epoxy paint	Refer to Finishes Schedule
Framing to anti-throw screens	Galvanised steel	Epoxy paint	Refer to Finishes Schedule

**E38.4.3 ADDITIONAL DATA**

**Anti graffiti treatment**

Apply Clear Anti-graffiti treatment to walls and other elements noted on the drawings and/or Finishes Schedule, including:

- Texture coating on various concrete walls as noted on the drawings and/on the Finishes Schedule, including Lift shafts, balustrades and miscellaneous concrete walls.
- Other areas indicated on drawings and/or Finishes Schedule.

Proprietary Item: Durobond water-based non-sacrificial Anti-graffiti sealer or approved equal.

**Epoxy paint**

Epoxy paint to structural steelwork, balustrades and other areas as scheduled shall be equivalent to Vitrethane 580/590 and Vitreflon 700/744 as supplied by A&I Coatings.

Prepare steelwork in accordance with the instructions of the manufacturer, including blast clean to AS 1627.1 – whip blast.

Apply the following coating in accordance with the manufacturer's printed instructions.

- Vitrethane Two Pack Epoxy Primer in two coats to a minimum dry film thickness of 200 microns. Allow to dry overnight.
- Vitreflon 700/744 Anti Graffiti Two Pack Fluoropolymer in two coats wet on wet, to a minimum dry film thickness of 50 microns. Finish must be smooth, consistent and free of dry spray.

**Textured finish**

Refer to Textured Coatings

## E39 TEXTURED COATINGS

### E39.1 GENERAL

#### E39.1.1 RESPONSIBILITIES

##### General

General: Provide coating systems to substrates as follows:

- Consistent in colour, gloss level, texture and dry film thickness.
- Free of runs, sags, blisters, or other discontinuities.
- Textured coating systems fully opaque.
- Clear finishes at the level of transparency consistent with the product.
- Fully bonded.
- Resistant to environmental degradation within the manufacturer's stated life span.
- Will accommodate movement in the substrate between control joints.

Selections: Conform to the **Selections**.

#### E39.1.2 CROSS REFERENCES

##### General

Requirement: Conform to the following:

- *General requirements*.
- Painting

#### E39.1.3 STANDARDS

##### Textured and membrane coatings

General: Comply with the recommendations of those parts of AS/NZS 2311 which are referenced in this worksection.

#### E39.1.4 INTERPRETATION

##### Definitions

General: For the purposes of this worksection the definitions given below apply.

- Substrate: The surface to which a material or product is applied.
- Latex extensible wall coating (or 'membrane' coating): A non-aggregate flexible watertight finish.
- High-build low profile latex coating: A water based coating designed to be used over textured coatings to elevate the exposure performance of the paint system.
- Non-aggregate textured latex coating: A latex coating selected for aesthetic purposes to provide decorative profiles according to the application technique used.
- Aggregate filled textured latex coating: An aggregate filled medium to high profile textured coating selected for aesthetic purposes to provide maximum relief from underlying surface irregularities according to the application technique used.
- Paint or coating system: A product in liquid form, which when applied to a surface, forms a dry film having protective, decorative or other specific technical properties.
- Sealer: A product used to seal substrates to prevent:
  - . Materials from bleeding through to the surface.
  - . Reaction of the substrate with incompatible top coats.
  - . Undue absorption of the following coat into the substrate.
- Primer, prime coat: The first coat of a coating system that helps bind subsequent coats to the substrate and which may inhibit its deterioration.
- Undercoat: An intermediate coat formulated to prepare a primed surface or other prepared surface for the finishing coat.
- Finish coat: The final coat of a coating system.

- Gloss: The optical property of a surface, characterised by its ability to reflect light specularly.
- Sheen: Gloss which is observed on an apparently matt surface at glancing angles of incidence.
- Levels of gloss finish: When the specular direction is 60 degrees, a surface with the following specular gloss reading are defined as follows:
  - . Full gloss finish between 50 and 85 gloss units.
  - . Semi gloss between 20 and 50 gloss units.
  - . Low gloss between 5 and 20 gloss units ( also known as low sheen).
  - . Flat finish < 5 gloss units (also known as matt).
- Opacity: The ability of a paint to obliterate the colour difference of a substrate.
- Adhesion: The sum total of forces of attachment between a dry film and its substrate.
- Gloss unit: Numerical value for the amount of specular reflection relative to that of a standard surface under the same geometric conditions.

### **E39.1.5 INSPECTION**

#### **Notice**

Inspection: Give notice so that inspection may be made of the following:

- Application stages:
  - . Completion of substrate preparation.
  - . After application of prime or seal coats.
  - . After application of undercoat.
  - . After application of each subsequent coat.

### **E39.1.6 SUBMISSIONS**

#### **Textured or membrane coated samples**

General: Submit, on representative substrates, samples of each coating system showing surface preparation, colour, gloss level, texture, and physical properties; to the **Coated samples schedule**.

#### **Coating system**

General: Submit the selected manufacturer's details at least 3 weeks before the paint is required, as follows:

- Coating brand name.
- Technical data sheets.
- Material safety data sheets (MSDS) showing the health and safety precautions to be taken during application.
- The published recommendations for maintenance.

#### **Specialist applicators**

General: Submit name and contact details of proposed specialist applicators.

#### **Tests**

Fire retardant systems: Submit type test results to confirm minimum indices, when tested to AS/NZS 1530.3, on a substrate representative of the intended use, for paint systems specified as Low flame spread or Fire retardant:

- Spread of flame index: 3.
- Sum of Ignitability index and Heat evolved index: 7.
- Smoke developed index: 3.

#### **Substrate acceptance**

Applicator: Submit the applicator's certification of the acceptability of the paint finish substrate.

Timing: Before commencing installation.

#### **Samples**

Prepare a sample area of a concrete wall, including recesses, painted in the selected colours, and complete with anti graffiti barrier.

Size of sample area: 2m x 2m approximately

#### **Warranty**

Material Warranty: Submit the manufacturer's material warranty as follows:

- Extent: Paintwork generally.
- Terms: Paint systems are suitable for their intended use.
- Warranty period: As defined by the manufacturer.

Material performance warranty: Submit an alternative performance warranty to include materials and application as follows:

- Terms: Submit the performance criteria as defined by the manufacturer.
- Measure: As defined by the manufacturer.
- Warranty period: As defined by the manufacturer.

Timing: Before the application of the paint system.

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## E39.2 PRODUCTS

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### E39.2.1 COATINGS

#### Combinations

General: Do not combine coatings from different manufacturers in a coating system.

#### Delivery

General: Deliver coatings to the site in the manufacturer's labelled and unopened containers.

#### Tinting

General: Provide only products which are colour tinted by the manufacturer .

#### Toxic ingredients

General: Comply with the requirements of Appendix I Uniform Paint Standard to the Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP).

#### Standards

Coating types:

- Wall coatings - latex extensible: To AS/NZS 4548.1
- Latex finish coatings – high-build, low profile: To AS/NZS 4548.2.
- Latex – textured coatings – non aggregate: To AS/NZS 4548.3.
- Latex – textured coatings – aggregate filled: To AS/NZS 4548.4.

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## E39.3 EXECUTION

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### E39.3.1 PREPARATION

#### Standards

General: To AS/NZS 2311 Sections 3.

#### Order of work

Other trades: Before painting, complete the work of other trades as far as practicable within the area to be painted, except for installation of fittings, floor sanding and laying flooring materials.

#### Protection

Fixtures: Remove door furniture, switch plates, light fittings and other fixtures before starting to paint, and refix in position undamaged on completion of the painting.

Adjacent surfaces: Protect adjacent finished surfaces liable to damage from painting operations.

#### 'Wet paint' warning

General: Place notices conspicuously and do not remove them until the paint is dry.

#### Restoration

General: Clean off marks, paint spots and stains progressively and restore damaged surfaces to their original condition.

Touch up: Apply seamless repairs to damaged decorative coatings or misses with the coating batch used in the original application.

#### Substrate preparation

General: Prepare substrates to receive the coating systems.

**Cleaning:** Clean down the substrate surface. Do not cause undue damage to the substrate or damage to, or contamination of, the surroundings.

**Filling:** Fill cracks and holes with fillers, sealants or grouting cements as recommended by the coating system manufacturer and as appropriate for the substrate.

**Moisture content:** Do not commence application unless:

- Concrete: The moisture content of the concrete has been tested to AS/NZS 2455.1 Appendix B and the values in clause 2.4.2 (c) have been obtained.

### **E39.3.2 APPLICATION**

#### **Proprietary coating systems**

Generally: Apply the complete coating system to the manufacturer's technical data sheets.

#### **Standard**

Methods of application: To AS/NZS 2311 clause 6.7.

#### **Light levels**

General:  $\geq 400$  lux.

#### **Drying**

General: Use a moisture meter to demonstrate that the moisture content of the substrate is at or below the recommended maximum level for the type of coating and the substrate material.

#### **Paint application**

General: Apply the first coat immediately after substrate preparation and before contamination of the substrate can occur. Apply subsequent coats after the manufacturer's recommended drying period has elapsed.

#### **Spraying**

Coatings with known health hazards: Not permitted on site.

### **E39.4 SELECTIONS**

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#### **E39.4.1 COATING SYSTEMS**

##### **Textured coating**

**Location:** Apply textured paint coating to all exposed concrete walls, balustrades, soffits, hobs of Lift shafts and Platform Building and other areas as detailed in the Finishes Schedule. Allow for painting recesses in concrete walls in a different colour from the main face of the walls.

**Material:** Dulux Acratex texture coating, with Dulux AcraShield protective top coat

**Colours:** As detailed in the Finishes Schedule.

**Application:** Apply the coating in accordance with the manufacturer's printed recommendations.

**Anti graffiti barrier:** In addition to the texture and protective coating, apply an approved anti graffiti barrier as specified in Painting.

## E40 SIGNS AND DISPLAY

### E40.1 GENERAL

#### E40.1.1 RESPONSIBILITIES

##### General

General: Provide signage systems to the **Selections**.

#### E40.1.2 CROSS REFERENCES

##### General

Requirement: Conform to the following:

- *General requirements*.
- Metals and prefinishes

#### E40.1.3 STANDARDS

##### Signs

Safety signs - design and use: To AS 1319.

Signs and graphics for disabled access: AS 1428.1 and AS 1428.2.

##### TfNSW standards

Refer to TfNSW's Station, Interchange & Carpark Signage Types Guide April 2009 for manufacturing specifications and details.

#### E40.1.4 INTERPRETATION

##### Definitions

General: For the purposes of this worksection the definitions given below apply.

- Changeable plate systems: Sign systems consisting of fixed plate holders to which may be attached or inserted removable interchangeable sign plates.
- Variable room identification systems: Changeable plate systems incorporating fixed room numbers and removable name strips.
- Changeable letter systems: Sign systems consisting of display boards or holders into which can be inserted removable individual letters, numbers, etc.
- Illuminated signs: Signs consisting of cabinets enclosing an illuminated source, lighting translucent face panels bearing the specified signage.
- House signage: Internal and external project specific signs.
- Statutory signage: Signs prescribed by the BCA and statutory authorities.

#### E40.1.5 INSPECTION

##### Notice

Inspection: Give notice so that inspection may be made of the following:

- Custom-built graphics items fabricated and ready to be delivered to the site.
- Graphics items delivered to site before installation.
- Building locations or substrates prepared to receive graphics items before they are installed.

#### E40.1.6 SAMPLES

##### General

Materials: Submit samples showing each colour and finish of exposed graphics materials and accessories. If there is a range of colours and/or textures for a particular item, submit samples showing the extremes and mean of the range.

#### E40.1.7 SUBMISSIONS

##### Shop drawings

General: Submit shop drawings showing the following information where relevant:

- Layout, construction and fixing details for custom designed (non standard) sign systems.
- Large scale (full size if practicable) lettering layouts for individual letter signs.
- Computer generated graphic images.
- Full size spacing templates for individually mounted characters.
- Location template drawings for anchorages to permanent construction. Show type of anchorage.
- Wiring diagrams for illuminated signs.

## **E40.2 PRODUCTS**

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### **E40.2.1 MATERIALS**

#### **Materials standards**

##### **Aluminium:**

- Plate for engraving: Alloy and temper designation 6063-0.
- For casting: To AS 1874.

Stainless steel: Surface finish designation 4 (general purpose polished).

##### **Plastics:**

- PVC-U sheet: Semi-rigid sheet.
- Rigid cellular polystyrene: To AS 1366.3, class VH for cut-out shapes.

## **E40.3 EXECUTION**

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### **E40.3.1 WORKMANSHIP**

#### **Production**

General: Form graphics items accurately with clean, well defined edges or arises, free from blemishes.

Engraving to two layer plastic laminate: Lettering excavated to expose the lower laminate.

Engraved and filled: Lettering precision excavated and filled colouring material. Clean faces of all filling material.

Casting: Produce shapes free of pits, scale, blow holes or other defects, hand or machine finished if necessary.

Laser cut: Individual vinyl letters with self adhesive backing.

Printed lettering: Lettering and graphic images screen / digitally printed on:

- Film with self adhesive backing.
- Acrylic sheet.
- Aluminium plate.
- Stainless steel plate.

Large format digital printing: Lettering and graphic images screen printed film with self adhesive backing.

Signwriting: Lettering and graphic images hand painted direct to the background by a tradesman with recognised qualifications and demonstrated experience.

Fabricated: Three dimensional, formed as follows:

- Laser cutting from solid material and hand finished as necessary.
- Moulding: Individual plastic hollow three dimensional characters and shapes formed by:
  - . Injection moulding.
  - . Vacuum forming.
- Built-up individual shapes by fabricating the faces and edges from separate pieces neatly and securely joined.

#### **Installation**

General: Install signage level and plumb, securely mounted, with concealed theft-resistant fixings. Fix self adhesive signs free of bubbles and creases.

**E40.4 SELECTIONS****E40.4.1 GENERAL SIGNS****Sign type schedule**

Provide general directional, passenger information, notices and other signage.

Refer to the drawings and TfNSW Standards for the design and specification of the various signs.

**E40.4.2 STATUTORY SIGNS****Lifts – warning**

Position	Near every call button for passenger lift(s)
Message	DO NOT USE LIFTS IF THERE IS A FIRE (or) Do not use lifts if there is a fire
Letter size	10 mm (upper case) 8 mm (lower case)
Sign type	Incised, inlaid or embossed on metal, wood, plastic or similar plate securely and permanently attached to the wall; or letters incised or inlaid directly into the surface of the material forming the wall
Compliance	BCA E3.3

**Fire hose reels and fire hydrants**

Position	Cupboard door or adjacent the FHR
Message	FIRE HOSE REEL (and/or) FIRE HYDRANT
Letter size	External cabinets: 75 mm Internal cabinets: 50 mm
Sign type	White adhesive backed vinyl
Compliance	AS 2441 AS 2419.1 BCA E1.3 and BCA E1.4

**Fire hose reel location sign**

Position	Above or adjacent the FHR if located in a recess or obscure location
Message	To AS 2441 Figure 10.1
Letter size	16 mm
Sign type	Adhesive backed vinyl
Compliance	AS 2441

**Fire brigade booster assembly cabinet**

Position	Cabinet doors
Message	FIRE HYDRANT BOOSTER, or FIRE HYDRANT AND SPRINKLER BOOSTER, or COMBINED FIRE HYDRANT AND SPRINKLER BOOSTER, as appropriate. If a feed fire hydrant is enclosed in the cabinet, add the symbol FH within a 100 mm circle of thickness and colour to match lettering.
Letter size	≥ 50 mm
Sign type	Adhesive backed vinyl
Compliance	AS 2419.1 clause 7.9

**Hose reel system valve**

Position	At any system valve that can isolate flow in the hose reel water supply main
Message	FIRE SERVICE VALVE – CLOSE ONLY TO SERVICE FIRE HOSE REELS
Letter size	8 mm

Sign type	Label with engraved non-ferrous metal tag
Compliance	BCA E1.4 (b)(v)(d)

**Portable fire extinguishers**

Position	Cabinet
Message	FIRE EXTINGUISHER
Letter size	32 mm min
Sign type	Adhesive backed vinyl
Compliance	BCA E1.6 AS 2444 clause 3.6 Fire Brigade

**Portable fire extinguishers – location signs**

Position	As nominated in AS 2444 clause 3.2 at every installed extinguisher nominated BCA Table E1.6
Message	Prescribed graphic
Letter size	
Sign type	Computer generated adhesive backed vinyl graphic
Compliance	BCA E1.6 AS 2444 clause 3.3 Fire Brigade

**Fire blankets**

Position	As nominated in AS 2444 clause 6.4 at every blanket location
Message	Prescribed graphic
Letter size	
Sign type	Computer generated adhesive backed vinyl graphic
Compliance	BCA E1.6 AS 2444 clause 5.1, 5.3 and Fig 5.1 Fire Brigade

**Signage for disabled access**

Position	As nominated BCA D3.3, and AS 1428.1 clause 8 To each: Sanitary facility Accessible entrance Accessible lift(s) Path of travel to accessible facilities
Message	International symbols to AS 1428.1 clause 8
Letter size	AS 1428.2 clause 16, Table 1
Sign type	Printed acrylic sheet adhesive fixed
Compliance	BCA Spec A1.3, BCA D3.3(c), BCA D3.6 AS 1428.1

**Braille and tactile signs**

Position	To each: Sanitary facility Accessible entrance Accessible lift(s) Path of travel to accessible facilities
Message	International symbols to AS 1428.1 clause 8 for access or deafness

Letter size	BCA Spec D3.6
Sign type	Adhesive fixed polyvinyl membrane with raised message
Compliance	BCA D3.6 AS 1428.1

**Deafness**

Position	Where hearing augmentation is installed BCA D3.7
Message	International symbols to AS 1428.1 clause 8
Letter size	BCA Spec D3.6, clause 16, Table 1 AS 1428.2
Sign type	Printed acrylic sheet adhesive fixed
Compliance	BCA D3.7 AS 1428.1

**Main switchboard - main entry, excluding Class 1 dwellings**

Position	Main entry or fire indicator panel
Message	Indicate location of main switchboard. Incorporate the term 'Main Switchboard'.
Letter size	
Sign type	Printed acrylic sheet adhesive fixed
Compliance	AS/NZS 3000 clause 2.9.2.4

**Main switchboard - room or enclosure, excluding Class 1 dwellings**

Position	The room or enclosure containing the main switchboard.
Message	MAIN SWITCHBOARD
Letter size	
Sign type	Printed acrylic sheet adhesive fixed
Compliance	AS/NZS 3000 clause 2.9.2.4

**E40.4.3 TRAFFIC CONTROL SIGNS****General**

The Contractor is responsible for the supply, delivery and installation of signs including all necessary accessories for signs shown on the Contract drawings.

The Contract drawings show the general arrangement and layout for all signs. The actual position of all signs shall be governed by details of the site.

The drawings shall be regarded as indicative and all details, dimensions and locations shown thereon are subject to confirmation before commencement of the works.

The layout shown is subject to reasonable alteration as may be found necessary on setting out the work on the site and prior to commencement without additional charge by the Contractor.

All work and materials shall comply with the latest editions of all relevant Australian codes or standards, including but not necessarily limited to:

- AS1742.1 (Manual of Uniform Traffic Control Devices – General introduction and index of signs);  
and
- AS1742.2 (Manual of Uniform Traffic Control Devices – Traffic control devices for general use)

Sign support structures are to be provided in accordance with RTA specification R143. The Contract Drawings shall take the place of Annexure R143/A (details of work) and Annexure R143/B shall not apply.

<b>E41 FINISHES SCHEDULE</b>
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Item	Supplier/ Product	Code	Finish/Colour
<b>E41.1 NEW LIFTS</b>			
External Wall cladding panels  CD-01	1.6mm thick steel sheet Vitreous Enamelled Panels with 12mm calcium silicate board backing bonded to panel.  Concealed panel fixing with silicone joints  HH Robertson – Phil O' Loan 0411 237 210 or equivalent approved		RAL 7037 Dusty Grey (grey) – COL5  RAL 7038 Agate Grey (light grey) – COL2  RAL 7043 Traffic Grey B (dark grey)–COL4  RAL 3001 Signal Red (red) – COL1  70% gloss level  Refer to architectural wall cladding setout drawings for cladding colour locations
Concrete Skirting Base of External Wall  PNT-01	Dulux Acratex paint system with anti-graffiti paint top coat		Colour: PG2.C2 Malay Grey (dark grey)
Exposed External structural steel roof members  PNT-02	Hot dipped Galvanised with Vitrathane 580/590 epoxy primer and Vitreflon 700/744 Fluoropolymer.  Architectural and Industrial Coatings P/L		Colour: K168 (dark grey)
Roofing  RS-01	Ritek roof panel system 75mm		Colorbond : Shale Grey
External Window Framing  GS-01	Commercial Aluminium Glazing Suite. Nominal 100mm profile  Equivalent to 'G James 475 series frames'.  35mm min rebates required by TfNSW.		Natural Anodised Aluminium
Louvres Ventilation  LVR-01	Aluminium Double Bank Louvre.  50% open area required in accordance with mechanical drawings  Alps louvres	Type 2UL/SH	Natural Anodised Aluminium
Glass	Viridian – New World Glass	VFloat SuperGree	SuperGreen. 10.38mm Laminated annealed Safety Glass with Anti-blast film on inside and anti graffiti

Item	Supplier/ Product	Code	Finish/Colour
GLZ-01	3M Film	n	film on outside
<b>E41.2 NEW STAIRCASE AND LANDINGS, FOOTBRIDGE EXTENSION, RAMPS, NEW REGRADED PATH FROM MAIN ROAD.</b>			
Concrete Floor Finish FL-01	Concrete / Sealer Class 2 finish		Broom finish. Natural / Clear. Slip resistance to R12min
Stair Nosing Strip – to new staircase  SNS-01	Safety Stride Pty Ltd.	SN-CL4- MBN-TP5	Crystalline with luminous sparkling black inserts. Recessed in treads and risers for flush finish with concrete. Slip resistance rating min of Ramp R11 and Pendulum 'W' required in accordance with Australian Standards AS3661, AS4586 and HB197, AS1428 all parts. Evidence of compliance with these standards will be required prior to product ordering and installation.
Stair Nosing Strip – to existing staircase  SNS-02	Safety Stride Pty Ltd.	SN-CL4	Crystalline with luminous sparkling black inserts. Recessed in treads and risers for flush finish with concrete. Slip resistance rating min of Ramp R11 and Pendulum 'W' required in accordance with Australian Standards AS3661, AS4586 and HB197, AS1428 all parts.. Evidence of compliance with these standards will be required prior to product ordering and installation.
Tactile Ground Surface Indicators  TGSI-01	Individual pin fixed & 600mm wide x full width of stair or ramp  Pathfinder Systems Australia		Contrasting black. Minimum 30% luminance contrast against the surrounding surface, Slip resistance rating accordance with Australian Standards AS4586:1999 and HB197:1999. Evidence of compliance with these standards will be required prior to product ordering and installation.
Anti-throw screen frames, Stair balustrade, posts and handrails.  PNT-02	Hot dipped Galvanised with Vitrathane 580/590 epoxy primer and Vitreflon 700/744 Fluoropolymer.  Architectural and Industrial Coatings P/L		Colour: H168 (light grey)
Anti-throw screen Security mesh	Woven Wire 25 x 25 mm max Apt size.  Locker Group		Galvanised Mild Steel

Item	Supplier/ Product	Code	Finish/Colour
Concrete upturn Balustrade to New footbridge PNT-01	Dulux Acratex paint system with anti-graffiti paint top coat		Colour: PG2.C1 Dieskau
External Concrete Walls (including recesses) and hobs and all exposed concrete including soffits PNT-01	Dulux Acratex paint system with anti-graffiti paint top coat		Colour: PG2.C1 Dieskau Colour of recesses: PG2.C2 Malay Grey (dark grey)
Weather protection Screens at Lift landings SCN-01	Horizontal and Vertical 'Z' shaped Waterproof Type louvers with Perimeter frames fixed to top rail of balustrade.  CS Group  Refer to Architectural Plans and Elevations for sizes		Natural Anodised Aluminium

#### **E41.3 NEW CANOPIES**

Exposed external structure steel including beams and columns  PNT-02	Hot dipped Galvanised with Vitrathane 580/590 epoxy primer and Vitreflon 700/744 Fluoropolymer.  Architectural and Industrial Coatings P/L		Colour: K168 (dark grey)
Roofing RS-02	Ritek roof panel system 100mm thick		Colorbond : Shale Grey
Capping	Colorbond		Colorbond : Shale Grey
Eaves gutter and downpipes	Colorbond Half round gutter		Colorbond : Shale Grey

#### **E41.4 PLATFORM**

Raised concrete floor finish  To existing platform FL-01	To gradients as documented on drawings		Broom finish. Light grey coloured concrete.  Scabble back existing surface.  R13 Slip resistance rating to TfNSW requirements and in accordance with Australian Standards AS3661, AS4586 and HB197, AS1428 all parts.
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Item	Supplier/ Product	Code	Finish/Colour
			Pendulum test, and not ramp test is to be used. Evidence of compliance with these standards will be required prior to product ordering and installation.
Platform Extension FL-02	To gradients as documented on drawings		Broom finish. Light grey coloured concrete. Scabble back existing surface.  R13 Slip resistance rating to TfNSW requirements and in accordance with Australian Standards AS3661, AS4586 and HB197, AS1428 all parts. Pendulum test, and not ramp test is to be used. Evidence of compliance with these standards will be required prior to product ordering and installation.
Coping tiles  FL-03	Exposed aggregate concrete paver  Urbanstone		Light short blast finish, colour Western Cream 832 L/B  R13 & W Slip resistance rating to TfNSW requirements and in accordance with Australian Standards AS3661, AS4586 and HB197, AS1428 all parts. Pendulum test, and not ramp test is to be used. Evidence of compliance with these standards will be required prior to product ordering and installation.  400 x 300 x 40mm Nominal  Paving sealer: Sure Seal – Stone sealer 24/7 stone impregnator - clear
Tactile Ground Surface Indicators  TGSI-01	Exposed aggregate concrete paver  Stone Directions		Shotblast or off-form Colour: sunmetal  Minimum 30% luminance contrast against the surrounding surface, compliant with DDA Public transport Standards sections 18.2(1) and 18.4 and AS1428.4.  R13 & W Slip resistance rating in accordance with Australian Standards AS3661, AS4586 and HB197, AS1428 all parts. Evidence of compliance with these standards will be required prior to product ordering and installation.  Type 'B' 300x300x40mm

Item	Supplier/ Product	Code	Finish/Colour
			Paving sealer: Sure Seal – Stone sealer 24/7 stone impregnator - clear
Yellow Warning	Pigmented concrete paver		Contrasting yellow
TGSI-02	Urbanstone		Minimum 30% luminance contrast against the surrounding surface, compliant with DDA Public transport Standards sections 18.2(1) and 18.4 and AS1428.4.  R13 & W Slip resistance rating in accordance with Australian Standards AS3661, AS4586 and HB197, AS1428 all parts. Evidence of compliance with these standards will be required prior to product ordering and installation.  Paving sealer: Sure Seal – Stone sealer 24/7 stone impregnator - clear

#### **E41.5 NEW PLATFORM BUILDING**

##### **STRUCTURAL STEEL FRAMING**

Exposed external structure steel including beams and columns	Hot dipped Galvanised with Vitrathane 580/590 epoxy primer and Vitreflon 700/744 Fluoropolymer.		Colour: K168 (dark grey)
PNT-02	Architectural and Industrial Coatings P/L		

##### **ROOFING**

Roofing RS-03	Ritek roof panel system 140mm thick  Insulation to R3.2 rating min.		Colorbond : Shale Grey
Capping	Colorbond		Colorbond : Shale Grey
Eaves gutter and downpipes	Colorbond Half round gutter		Colorbond : Shale Grey Bluescope Steel. Dp's to stop 50mm short of rain water outlets
Roof anchor points and ladder bracket Safety System	To Workcover requirements.  To be provided to existing canopies also		

Item	Supplier/ Product	Code	Finish/Colour
	to provide access to platform building roof.		
<b>EXTERNAL WALLS</b>			
External Wall cladding panels	1.6mm thick steel sheet Vitreous Enamelled Panels with 12mm calcium silicate board backing bonded to panel.		RAL 7037 Dusty Grey (grey) – COL3 RAL 7038 Agate Grey (light grey)- COL2 RAL 7043 Traffic Grey B (dark grey)-COL4 RAL 5010 Gentian Blue (blue)- COL5
CD-01	Concealed panel fixing with silicone joints HH Robertson – Phil O' Loan 0411 Or equivalent approved		70% gloss level Refer to architectural wall cladding setout drawings for cladding colour locations
Concrete Skirting Base of External Wall PNT-01	Dulux Acratex paint system with anti-graffiti paint top coat		Colour: PG2.C2 Malay Grey (dark grey)
External Window Framing GS-01	Commercial Aluminium Glazing Suite. Nominal 100mm profile Equivalent to 'G James 475 series frames'. 35mm min rebates required by TfNSW.		Natural Anodised Aluminium Frames
Glass GLZ-02	Viridian – New World Glass 3M Film	VFloat SuperGreen	SuperGreen. Laminated annealed Safety Glass with Anti-blast film on inside and anti graffiti film on outside
Louvres LVR-01	Aluminium Double Bank Louvre. 50% open area required in accordance with mechanical drawings Alps louvres	Type 2UL/SH	Natural Anodised in Commercial Window Aluminium Frames
<b>EXTERNAL DOORS</b>			
External Steel door frames PNT-03	Dulux Paint/full gloss		Colour: PG2.C3 Flooded gum (mid grey)
External Solid core doors PNT-03	Dulux Paint/full gloss		Colour: PG2.C3 Flooded gum (mid grey)
<b>FLOORING</b>			
Tiles to New Staff toilet,	Better Tiles	BFA700	300 x 600mm Dark Grey.

Item	Supplier/ Product	Code	Finish/Colour
New F.A.T Room and Cleaners Room			Slip resistance rated to comply with Australian Standards AS3661, AS4586 and HB197, AS1428 all parts.. Evidence of compliance with these standards will be required prior to product ordering and installation.
CT			
Vinyl - to all other rooms/areas	Forbo Commercial grade		Dark grey. Slip resistance rated to comply with Australian Standards AS3661, AS4586 and HB197, AS1428 all parts.. Evidence of compliance with these standards will be required prior to product ordering and installation.
VYL			
<b>INTERNAL WALLS</b>			
Wall Tiles to New Staff toilet and New F.A.T Room and entire wall behind Cleaners sink	Better Tiles	BGY-107(White) BGY-Red (Red)	Full height. White to 3 walls. Red on Feature Wall only (Wall behind toilet suite) 162 x 495mm
WA-01			
Paint to plasterboard - to all other rooms	Dulux paint/semi gloss		Colour: PW2.D4 White Watsonia
PNT-04			
Skirting - Coved Tiles to New Staff toilet, New F.A.T Room and Cleaners room	Better Tiles	BSP 105C	100 x 200mm Dark grey to match floor tiles
SK-02			
Skirting - to all other rooms	15mm thick x 150mm high (from floor finish) timber(not MDF) & Painted. Square edge.To Finish flush with plasterboard wall lining. Provide Rondo P50 Shadowline Stopping bead at skirting/wall lining junction		Colour: PW2.D4 White Watsonia - Super Enamel High Gloss
SK-01	Dulux Paint/full gloss		
Splashback to Kitchenette	Better Tiles		White
WA-02			150 x 150mm
<b>CEILING</b>			
13mm plasterboard Flush set suspended (wet area)	Dulux paint/matt		Colour: PW2.D4 White Watsonia

Item	Supplier/ Product	Code	Finish/Colour
plasterboard to New Staff toilet and New F.A.T room) PNT-05			
Cornice	Rondo P50 shadowline stopping angle		
<b>INTERNAL DOORS</b>			
Internal Steel door frames PNT-03	Dulux Paint/full gloss		Colour: PG2.C3 Flooded gum (mid grey)
Internal Solid core doors PNT-03	Dulux Paint/full gloss		Colour: PG2.C3 Flooded gum (mid grey)
<b>JOINERY</b>			
Carcasses	Melamine		
Above and below bench cupboards LAM-02	Laminex Laminate	Laminex 205	Polar White natural finish
Office bench tops LAM-01	32mm thick Laminex Laminate	Laminex 442	Evening Shale natural finish
Kitchen bench tops LAM-01	32mm thick Laminex Laminate	Laminex 442	Evening Shale natural finish
<b>FIXTURES</b>			
Kitchen sink SNK-01	Clark 1 bowl Benchmark 930mm single end bowl	1003.1(1 TH LHB)	Stainless steel
Kitchen sink tapware TAP-01	Enware Single Lever sink mixer with extended lever 5 star WELS rating model	SLM607D	Chrome
Accessible WC WC-01	Caroma Care 800 Wall Faced Invisi™ Series II Suite with buttons and panels	718100W	White
Accessible basin BSN-01	Caroma Care Integra 500 with one tap hole	648210W	White
Accessible taps TAP-03	Caroma Nordic Care Basin Mixer 5 star WELS rating model	90965C5A	Chrome
Toilet roll holders			

Item	Supplier/ Product	Code	Finish/Colour
TRH-01	Kimberly Clark	Jumbo –	Stainless steel
TRH-02	Bradley	Code 4972 Code 5084	Stainless steel
Soap dispensers SD-01	Kimberly Clark	Code 6340	White
Hand dryers HD-01	Dyson Airblades	A01 Model	Silver
Clothes Hook CH-01	Single robe hook JD Mcdonald	7340	Stainless steel
Baby Change Unit BCU-01	RBA. Builder to construct frame.		<ol style="list-style-type: none"> <li>1. 32mm thick MDF top and sides (2 x 16mm MDF sheets laminated together)</li> <li>2. Laminex bench top and sides – Polar White, 10mm</li> <li>3. Laminex material glued to MDF substrate backing using manufacturers specifications</li> <li>4. MDF substrate to be screw fixed to mild steel frame as required</li> <li>5. 40 x 40 SHS Mild steel frame construction fully welded</li> <li>6. Steel to be powdercoated colour risotto</li> <li>7. Bench height 900mm</li> <li>8. Baby change table “Koala Care” Countertop recessed mounted Model “KB112-01RE”</li> </ol>
Cleaner's sink SNK-02	Caroma With 1521 wall mounted bracket	811592W 811594	White White
Cleaner's sink tapware TAP-02	Caroma G Series Standard wall sink set 150mm	G91842C4 A	
Mop and Broom Holder Rack MBH-01	JD Mcdonald	8215-3	Stainless steel
Lockers LK-EXST	Relocate existing to as shown on architectural drawings		

Item	Supplier/ Product	Code	Finish/Colour
<b>E41.6 OTHER</b>			
Fencing – SF1 Security Fence (Palisade)  SF-01	Design and install Security Fence (palisade) to define the boundary of the commuter car park and road areas in the immediate vicinity of the Station. Tamper resistant, security-type fasteners shall be used.  As indicated on architectural drawing CV0420727.  Leda Security or Blue dog Fences Australia		2400mm powdercoated high palisade 'W' profile palings with triple-point spear top fence. To be designed and installed by manufacturer in accordance with TfNSW Standards SPC 511 BOUNDARY FENCES Version 1.1 Issued December 2009. and ESC 510 - BOUNDARY FENCES; Version 2.1, Issued December 2009 and TMC 511.  Colour: Powdercoat black
Fencing – SF2 Enhanced Urban Fence (Tubular)  SF-02	Design and install Enhanced Urban Fence (tubular steel) type fencing to define the operational rail corridor and Station platform. Tamper resistant, security-type fasteners shall be used. This is to include fencing for 50 metres past each end of the platforms.  As indicated on architectural drawing CV0420727.  Leda Security or Blue dog Fences Australia		2400mm powdercoated high tubular steel fence. 2.5mm wall thickness, square section, crimped spear pointed. Provide lockable gates to match existing size and locations(including vehicle gate) and any new gates required by TfNSW. To be designed and installed by manufacturer in accordance with TfNSW Standards SPC 511 BOUNDARY FENCES Version 1.1 Issued December 2009 and ESC 510 - BOUNDARY FENCES; Version 2.1, Issued December 2009 and TMC 511.  Colour: Powdercoat black
Fencing – SF3 Enhanced Urban Fence (Tubular)  SF-03	To both ends of platform.  Leda Security or Blue dog Fences Australia		As per SF2 but 2100mm high. Provide 1 x lockable gate at steps.  Colour: Powdercoat black
Fencing – Garbage Bin storage area  SF-02	As per Fence type SF2		As per Fence type SF2
Seating – New  SE-01	3 person seat with integrated armrests.		Supplied by TfNSW. Wall Mounted to TfNSW standards.

Item	Supplier/ Product	Code	Finish/Colour
Seating – New SE-02	To match existing seats on platform		Supplied by TfNSW. Floor mounted to TfNSW standards
Seating – Existing SE-EXST	Relocate existing platform seats to new locations as shown on architectural drawing		
Bin – New BN-01	To match existing bins on platform		As per TfNSW requirements
Bollards Vehicle protection - Fixed  BL-01	AEGIS 150NB Fixed Aluminium Bollard with Heavy duty Galvanised pipe.  To shared area of proposed accessible parking spaces at lower ground level.  Leda Security	AAE 150NB FIXED ALUM	Finish and Colour: Powdercoat precious silver pearl
Ticket Vending Machine (TVM)			Existing Relocated as directed. Services provision only
Telstra Public Telephone	Relocate existing as shown on architectural drawings, and install in accordance with reach height criteria as set out for disability standards in AS1428.2(1992)		Installation and Supply by Telstra
Light Poles	Galvanised Steel / Painted		
Commercial Vending Machines (CVM)			Supply & Install by others, Electrical supply provision only
Kerbs	Concrete	Natural	150mm high with accessible compliant kerb ramps at crossings. Broom Finish
Bicycle Parking Racks  BK-01	Bicycle hitch rail fixed insitu  Leda Security	BR85F	Proprietary 5 Secure Racks allowing storage for 10 bicycles.  Stainless Steel

**GHD**

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**Document Status**

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A – 90%	J. Saliba	A. Miller	<i>A. Miller*</i>	N.Nicotra	<i>N.Nicotra*</i>	25 Nov 2011
B-Tender	J. Saliba	V. Lugovoy		N.Nicotra		29 Feb 2012



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**Cover Letter**

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**Project Name:** CARDIFF STATION - EASY ACCESS UPGRADE  
**Project Address:** MAIN ROAD CARDIFF NSW 2285  
**Schedule No:** 11NSWCA034A (24 Feb 2012)  
**Keying System:** Existing  
**Architect Company:** GHD GROUP PTY LTD  
**Architect Name:** Joe Saliba

**Sales Rep:** Chris Theyers

---

This schedule is based upon the following documentation:

**Drawing Nos:****Spec/Doc Nos:**

Door hardware schedule to be checked against final floor plans and specification prior to the ordering of hardware by hardware supplier / builder.

This schedule is to be read in conjunction with any Electronic & Security documentation to avoid duplications.

**Project Comments**

An existing master key system has been allowed for. Key quantities and subsequent costs will need to be determined in conjunction with the relevant supplier.

Temporary construction keyed cylinders have been allowed for on all lockable doors for the duration of the project. The Hardware Distributor should allow for 4 construction keys.

The builder will need to make arrangements and allow for the cost of the change over from construction cylinders to the final master keyed cylinders.

Where door closers have been scheduled they should generally be mounted to the less visible side of the door.

All Lockwood stainless steel hinges specified in this schedule are manufactured from 304 Grade stainless steel.

Where equal pairs of doors are specified it has been assumed that, when viewed from the outside, the right hand leaf is active.

Please coordinate the supply of the specified electronic products with electrical and security contractors to ensure adequate power and cabling has been allowed for. Also please confirm who is to supply to ensure the products are not supplied to site twice.

All electronic security products are to have the voltage, power and security mode requirements are to be verified on site prior to ordering. The electronic security products specified in this door hardware schedule should be checked and coordinated with the information shown on the electrical drawings.

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**Door Hardware Schedule**

Total Pages: 3

**Project Name:** CARDIFF STATION - EASY ACCESS UPGRADE

**Project Address:** MAIN ROAD CARDIFF NSW 2285

**Schedule No:** 11NSWCA034A (24 Feb 2012)

**Segments:** ALL,-STATION BUILDING,-EQUIPMENT ROOM

**Locations:** ALL

**Trade:** ALL

Code	Description	Brand	Qty
<b>STATION BUILDING : D.01 OFFICE LOBBY</b>			
<i>Height:</i> 2040	<i>Width:</i> 920	<i>Door Type:</i> SOLID CORE	
<i>Thick:</i> 40	<i>Handing:</i> LH OIL	<i>Frame Type:</i> STEEL 1/2" REBATED	<i>Rev:</i>
570/101SC	570 OVAL CYLINDER ASSEMBLY WITH "U" CAM	Lockwood	1
CK 570	TEMPORARY OVAL CONSTRUCTION CYLINDER	Not Branded	1
CUTKEY-6PIN	CUT KEY 6 PIN	Lockwood	1
GMK6P	KEYING CHARGE - 6 PIN GRAND MASTER KEYING	Lockwood	1
3P72SS-E23E	60MM B-SET MORTICE ESCAPE, STOREROOM LOCK	Lockwood	1
WS9-CH	DOOR VIEWER 170 DEG 30MM TO SUIT 40-95MM DOORS	Chubb	1
109001-000	ES9000 PRE - LOAD MULTI FUNCTION STRIKE	Padde	1
184SC	BRASS DOUBLE BEND PULL HANDLE	Lockwood	1
1900SC	SQUARE END VIS FIX PLATE, CYLINDER HOLE ONLY	Lockwood	1
1905/70SC	SQUARE END VIS FIX PLATE, LEVER ONLY	Lockwood	1
7714SSS	STD ARM CLOSER SIZE 1-4, D-ACTION, B-CHECK	Lockwood	1
LW10075BBSSS	100X75X2.5MM BROAD BUTT BEARING HINGE, BUTTON TIP, FIXED PIN	Lockwood	3
A250SC	FLOOR MOUNTED DOORSTOP	Lockwood	1
NB: CARD READER	BY SECURITY CONTRACTOR	Not Branded	1
NB: REED SWITCH	BY SECURITY CONTRACTOR	Not Branded	1

<b>STATION BUILDING : D.02 TICKET OFFICE</b>			
<i>Height:</i> 2040	<i>Width:</i> 920	<i>Door Type:</i> SOLID CORE	
<i>Thick:</i> 40	<i>Handing:</i> LH OIL	<i>Frame Type:</i> STEEL 1/2" REBATED	<i>Rev:</i>
570/101SC	570 OVAL CYLINDER ASSEMBLY WITH "U" CAM	Lockwood	1
CK 570	TEMPORARY OVAL CONSTRUCTION CYLINDER	Not Branded	1
CUTKEY-6PIN	CUT KEY 6 PIN	Lockwood	1
GMK6P	KEYING CHARGE - 6 PIN GRAND MASTER KEYING	Lockwood	1
3P72SS-E23E	60MM B-SET MORTICE ESCAPE, STOREROOM LOCK	Lockwood	1
WS9-CH	DOOR VIEWER 170 DEG 30MM TO SUIT 40-95MM DOORS	Chubb	1
109001-000	ES9000 PRE - LOAD MULTI FUNCTION STRIKE	Padde	1
184SC	BRASS DOUBLE BEND PULL HANDLE	Lockwood	1
1900SC	SQUARE END VIS FIX PLATE, CYLINDER HOLE ONLY	Lockwood	1
1905/70SC	SQUARE END VIS FIX PLATE, LEVER ONLY	Lockwood	1
7714SSS	STD ARM CLOSER SIZE 1-4, D-ACTION, B-CHECK	Lockwood	1
LW10075BBSSS	100X75X2.5MM BROAD BUTT BEARING HINGE, BUTTON TIP, FIXED PIN	Lockwood	3
A250SC	FLOOR MOUNTED DOORSTOP	Lockwood	1
NB: CARD READER	BY SECURITY CONTRACTOR	Not Branded	1
NB: REED SWITCH	BY SECURITY CONTRACTOR	Not Branded	1

**Door Hardware Schedule**

Total Pages: 3

Code	Description	Brand	Qty
<b>STATION BUILDING : D.03 CLEANERS ROOM</b>			
Height: 2040	Width: 920	Door Type: SOLID CORE	
Thick: 40	Handing: LH O/I	Frame Type: STEEL 1/2" REBATED	Rev:
570/101SC	570 OVAL CYLINDER ASSEMBLY WITH "U" CAM	Lockwood	1
CK 570	TEMPORARY OVAL CONSTRUCTION CYLINDER	Not Branded	1
CUTKEY-6PIN	CUT KEY 6 PIN	Lockwood	1
GMK6P	KEYING CHARGE - 6 PIN GRAND MASTER KEYING	Lockwood	1
3P72SS-E23E	60MM B-SET MORTICE ESCAPE, STOREROOM LOCK	Lockwood	1
1801/70SC	SQUARE END CON FIX PLATE, CYLINDER HOLE, LEVER	Lockwood	1
1905/70SC	SQUARE END VIS FIX PLATE, LEVER ONLY	Lockwood	1
LW10075FPSSS	100X75X2.5MM BROAD BUTT HINGE, BUTTON TIP, FIXED PIN	Lockwood	3
A250SC	FLOOR MOUNTED DOORSTOP	Lockwood	1
KP0920X0150UDSS	STAINLESS STEEL KICKPLATE UNDRILLED 920MM X 150MM	Lockwood	2
<b>STATION BUILDING : D.04 STAFF ACCESSIBLE</b>			
Height: 2040	Width: 920	Door Type: SOLID CORE	
Thick: 40	Handing: RH O/O	Frame Type: STEEL 1/2" REBATED	Rev:
3P72ESS-A11N	60MM B-SET MORTICE ESCAPE, ANTI LOCKOUT, PRIVACY LATCH	Lockwood	1
1814/70SC	SQUARE END CON FIX PLATE, INDICATING EMERGENCY TURN, LEVER	Lockwood	1
1939P/70LSC	SQUARE END VIS FIX PLATE, L-HAND DISABLED TURN, LEVER (SUIT 3P72)	Lockwood	1
2516-104SIL	2516 SERIES SLIDE RAIL MOUNTING BRACKET (PUSH SIDE)	Lockwood	1
2516DASSS	SLIDE RAIL CAM ACTION CLOSER SIZE 1-6, D-ACTION, B-CHECK	Lockwood	1
LW10075BBSSS	100X75X2.5MM BROAD BUTT BEARING HINGE, BUTTON TIP, FIXED PIN	Lockwood	3
KP0920X0150UDSS	STAINLESS STEEL KICKPLATE UNDRILLED 920MM X 150MM	Lockwood	2
297 SSS	297 BUMPER & HOOK	Lockwood	1
<b>STATION BUILDING : D.05 FAMILY ACCESS TOILET</b>			
Height: 2040	Width: 920	Door Type: SOLID CORE	
Thick: 40	Handing: LH O/O	Frame Type: STEEL 1/2" REBATED	Rev:
CK 570	TEMPORARY OVAL CONSTRUCTION CYLINDER	Not Branded	1
570/101SC Mlak	FINAL KEYED OVAL CYLINDER KEYED TO Mlak	Not Branded	1
CUTKEY-6PIN	CUT KEY 6 PIN	Lockwood	1
GMK6P	KEYING CHARGE - 6 PIN GRAND MASTER KEYING	Lockwood	1
3571PTSC	60MM B-SET MORTICE PRIVACY DEADBOLT (THROUGH FIX TURN FIXINGS)	Lockwood	1
3P72SS-E23E	60MM B-SET MORTICE ESCAPE, STOREROOM LOCK	Lockwood	1
109001-000	ES9000 PRE - LOAD MULTI FUNCTION STRIKE	Padde	1
1227DPRSC	DISABLED TURNSNIB (46.5MM DIA CON FIX ROSE) (SUIT 3P72)	Lockwood	1
1228PSC	INDICATING EMERGENCY SNIB (46.5MM DIA CON FIX ROSE)	Lockwood	1
184SC	BRASS DOUBLE BEND PULL HANDLE	Lockwood	1
1900SC	SQUARE END VIS FIX PLATE, CYLINDER HOLE ONLY	Lockwood	1
1905/70SC	SQUARE END VIS FIX PLATE, LEVER ONLY	Lockwood	1
2516-104SIL	2516 SERIES SLIDE RAIL MOUNTING BRACKET (PUSH SIDE)	Lockwood	1
2516-153	OPENING DAMPER	Lockwood	1
2516DASSS	SLIDE RAIL CAM ACTION CLOSER SIZE 1-6, D-ACTION, B-CHECK	Lockwood	1
LW10075BBSSS	100X75X2.5MM BROAD BUTT BEARING HINGE, BUTTON TIP, FIXED PIN	Lockwood	3
KP0920X0150UDSS	STAINLESS STEEL KICKPLATE UNDRILLED 920MM X 150MM	Lockwood	2
297 SSS	297 BUMPER & HOOK	Lockwood	1

**Door Hardware Schedule**

Total Pages: 3

Code	Description	Brand	Qty
<b>EQUIPMENT ROOM : D.06 STORAGE</b>			
Height: 2100	Width: 550+550	Door Type: SOLID CORE	
Thick: 45	Handing: PAIR OJO	Frame Type: STEEL 1/2" REBATED	Rev:
570/101SC	570 OVAL CYLINDER ASSEMBLY WITH "U" CAM	Lockwood	1
570-2SC	570X CYLINDER	Lockwood	1
CK 570	TEMPORARY OVAL CONSTRUCTION CYLINDER	Not Branded	1
CUTKEY-6PIN	CUT KEY 6 PIN	Lockwood	1
GMK6P	KEYING CHARGE - 6 PIN GRAND MASTER KEYING	Lockwood	1
3P72SS-E23E	60MM B-SET MORTICE ESCAPE, STOREROOM LOCK	Lockwood	1
3P72-RK32SS	REBATE KIT SUIT 3P70 SERIES DEADLATCH 32MM LIP	Lockwood	1
184SC	BRASS DOUBLE BEND PULL HANDLE	Lockwood	1
1900SC	SQUARE END VIS FIX PLATE, CYLINDER HOLE ONLY	Lockwood	1
1905/70SC	SQUARE END VIS FIX PLATE, LEVER ONLY	Lockwood	1
791O/SX450SC	VIS FIX PANIC BOLT 450M OFFSET	Lockwood	1
791X230SC	VISIBLE FIX PANIC BOLT 230MM	Lockwood	1
LW10075FPSSS	100X75X2.5MM BROAD BUTT HINGE, BUTTON TIP, FIXED PIN	Lockwood	6



CLIENTS | PEOPLE | PERFORMANCE

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**Transport for NSW**  
**Cardiff Station Easy Access**  
**Upgrade**  
**Mechanical Specification**

March 2012



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# 1. Project Information

## 1.1 Definitions

Client	-	TfNSW
Consulting Engineer	-	GHD
Works	-	Mechanical Services as described in Section 2
Mechanical Contractor	-	The company contracted to undertake the works

## 1.2 The Project

This project involves the Easy Access upgrade to the existing Railway Station at Cardiff, NSW. This specification covers the Design and Construction of Mechanical Services for the new extension and refurbishment at Cardiff Station.

## 1.3 Specification Objectives

The intent of this specification and the associated documents is:

- ▶ To provide a clear statement of contractual requirements against which compliance can be assessed.
- ▶ To provide documentation for the Client to demonstrate what is being bought.
- ▶ To define the expectations upon the Contractor by the Consulting Engineer.
- ▶ To define the roles of the parties involved with the works.
- ▶ To enable other interested parties to assess their obligations and to understand expectations of them.
- ▶ To define the requirements of the installer with respect to Quality Assurance.

## 1.4 Obligations of Installer

In writing this specification the Consulting Engineer expects and relies upon the tenderers' possessing specialist trade expertise necessary to complete the works in accordance with the documentation.

In addition, the installer has the following obligations:

- ▶ To raise in good time, issues requiring design intent or clarification from the Consulting Engineer, particularly in respect to:
  1. Interpretation of the design intent specification or drawings.
  2. Problems in complying with the specification.
  3. Omissions from the tender documents.
  4. Suggested alternatives/substitutions.
- ▶ To certify compliance with contract documents, including all variation instructions, at Practical Completion.
- ▶ To certify compliance with Authority requirements, as far as he/she can ascertain.

- ▶ To implement procedures to ensure that only competent tradesmen are used for the works.
- ▶ To be cognisant of the role of all relevant parties during the construction phase of the project and to assist them in the conduct of their duties wherever possible.
- ▶ To contribute, in the spirit of partnering, towards the successful execution of the contract.
- ▶ To provide manufacturer's and construction drawings.
- ▶ To make final equipment selections to meet the requirements listed.

### **1.5 Required Submissions**

- ▶ The Main Contractor shall provide a program, in good time to allow review without impediment.
- ▶ Certified schedule of compliance for all equipment, prior to placing orders.
- ▶ Certified schedule of competency for all tradesmen intended to work on the project.
- ▶ Factory test results where applicable.
- ▶ All product data, performance test and commissioning results required by this specification.
- ▶ Shop drawings for fabrication and installation of all equipment and items supplied.
- ▶ Inspection and test plans for every section of the works. Detail the procedure of how to complete the task, the skill or competency of the person undertaking the works, the review or testing procedure to assure satisfactory completion of the task, the person within the installer's organisation authorised to sign-off the task as accepted.
- ▶ Client handover/training proposals.
- ▶ Record and installation drawings: Record all changes to equipment and services layouts, wiring and any other items during the construction period, which may have been incorporated into these works.
- ▶ Operating and Maintenance manuals.
- ▶ Certifications for compliance with project specific Code/Design requirements of the completed works.
- ▶ Maintenance and servicing during the defects liability period.
- ▶ Fully developed functional descriptions, written in simple sentences, of each system including but not limited to start up, normal running, shut down, fire mode operation, operation in fault conditions, alarms, safety controls and manual over-ride provisions.
- ▶ Control schematics or diagrams illustrating control logic, valve and damper sequences, external interlocks, and interfaces.
- ▶ Details of connections to external interfaces and components outside the automatic control system.
- ▶ When requested, provide manuals, data sheets and other explanatory information needed to interpret the material submitted.
- ▶ Test reports: Submit a report showing the test results. Carry out necessary modifications and re-test.
- ▶ Samples of ceiling grilles and all exposed elements and as required by the lead architect
- ▶ Data sheets for each item of mechanical plant, type of controller, actuator, sensor and other hardware component.

## 1.6 Quality Assurance

A Quality Assurance plan shall be provided in order to propose, establish, maintain, monitor and document a quality assurance system covering all aspects of the design, purchase, fabrication, installation and completion of the works. The plan shall be in accordance with ISO 9001:2008 (as appropriate).

## 2. General

### 2.1 Responsibilities

#### General

General: Provide air conditioning and mechanical ventilation.

Selections: As documented.

#### 2.1.1 Extent of works

The extent of work comprises the supply, installation, testing, commissioning, maintenance and defects liability service, of materials, labour and equipment for the complete Mechanical Services installation.

The work shall include all necessary minor and incidental work required to implement the intent and meaning of this specification.

Whether or not the words "supply and install" appear in this specification, unless clearly excluded, all items of equipment for the complete installation are required and shall be supplied and installed.

#### Scope of works

Provide mechanical service systems as documented in drawings CV0420791 - CV0420793 and as follows:

- ▶ Supply and install new split systems to serve the ticketing office and kitchen of the new building as scheduled and as shown on the drawings CV0420791.
- ▶ Supply and Install new weather proof louvers to each of the lift shafts to provide cross ventilation.
- ▶ Supply and install supply air fans and filters at low level of the lift shafts behind the louvers.
- ▶ Supply and Install mechanical exhaust system to the toilets.

### 2.2 System Description

#### 2.2.1 Air Conditioning

The Ticketing office and the Kitchen areas are to include the following

- ▶ Ceiling mounted reverse cycle cassette type indoor units in the ticketing office and kitchen area including outdoor condenser units, complete with matching hard-wired wall mounted touch pads.

#### 2.2.2 Lift Shaft Ventilation

Lift shaft ventilation to include the following

- ▶ Filtered outside air supply via speed controllable supply air fans to each of the lift shafts installed approximately 2.2 m above the platform level to provide positively pressurised ventilation within the shaft.

- ▶ Removable weatherproof proof louvers where exposed to rain for easy access and maintenance of filters and fans at the platform level complete with protective steel wire mesh and magnetic gauge indicating filter change.
- ▶ Fixed weatherproof louvers at high level of the shaft to maintain positively pressurised cross flow ventilation.
- ▶ Thermostat to monitor the temperature in the lift shaft and to activate the supply air fan high speed when temperature exceeds 27 °C (temperature set point adjustable).

### **2.2.3 Exhaust**

The Toilet Exhaust system to include the following:

- ▶ Supply and Install new exhaust system including grilles ductwork, and roof mounted exhaust fans.
- ▶ The toilets shall also be provided with a 100% redundancy system, which will operate on a lead-lag arrangement.

## **2.3 Associated Works**

### **2.3.1 Works by Builder**

Builder is to provide penetrations and any structural support, concrete plinths and the like.

The mechanical contractor is to liaise with the builder and provide all pertinent information in good time and in a professional manner.

### **2.3.2 Works by Electrical Trade**

Mains power for the proposed air conditioning systems is to be supplied from the new electrical distribution boards.

The electrical contractor shall provide isolators within 1.5m of all condensing units for connection by the mechanical contractor.

### **2.3.3 Works by Civil Trade**

Stormwater pits to drain the condensate lines to local authority requirements & approval.

The mechanical contractor is to liaise with the civil contractor and provide all pertinent information and requirements in good time and in a professional manner.

## **2.4 Standards**

The complete installation shall comply with the latest standards and requirements, referenced herein as well as and including all amendments, of the following:

- ▶ The Building Code of Australia, including section J.
- ▶ The Department of Environment and Planning.
- ▶ RailCorp Stations & Buildings Standards ESB-001 to 004

- ▶ The Insurance Council of Australia.
- ▶ NSW Fire Brigade.
- ▶ Current Australia Standards:
  - AS1345 The Identification of Pipes, Conduits and Ducts
  - AS1530.4 Methods for Fire Tests on Building Materials, Components & Structures Part 4 Fire Resistance Tests on Elements of Construction
  - AS/NZS1668.1-1998 The Use Of Ventilation and Air Conditioning in Buildings Part 1: Fire and Smoke Control in Multi-Compartment Buildings
  - AS1668.2-1991 The Use Of Ventilation and Air Conditioning in Buildings Part 2 Mechanical Ventilation for Acceptable Indoor-Air Quality
  - AS/NZS2053 Conduits & Fittings for Electrical Installations
  - AS/NZS2107 Acoustics – Recommended Design Sound Levels & Reverberation Times for Building Interiors
  - AS2625.1 Mechanical Vibration – Evaluation of Machine Vibration by Measurements on Non-Rotating Parts – General Guidelines
  - AS2625.4 Mechanical Vibration – Evaluation of Machine Vibration by Measurements on Non-Rotating Parts – Industrial Machines with Nominal Power Above 15kW & Nominal Speeds Between 120r/min & 15000r/min When Measured In Situ
  - AS/NZS3000:2007 Electrical Installations
  - AS/NZS3947 Low Voltage Switchgear & Controlgear
  - AS4254 Ductwork for Air-Handling Systems in Buildings
  - AS4426 Thermal Installation of Pipework, Ductwork and Equipment – Selection, Installation and Finish
  - AS60529 Degrees of Protection Provided by Enclosures (IP Code)
  - HB40.1 The Australian Refrigeration and Air Conditioning Code of Good Practice – Reduction of Emissions of Fluorocarbon Refrigerants in Commercial and Industrial Refrigeration and Air-Conditioning Applications

## **2.5 Design**

Provide all design work necessary to complete the mechanical services documentation to work shop fabrication level.

Use only appropriately experienced and qualified persons to undertake mechanical design work. If requested, provide documents verifying the qualification and experience.

### **2.5.1 Electrical**

General: Supply system to be 240V, 50Hz with single phase for indoor and 3 phase for outdoor units.

Fault level protection: To withstand the fault level of the incoming supply at the equipment location.

### **2.5.2 Uniformity**

General: All products of the same type to be of the same manufacture.

## **2.6 Submissions**

### **2.6.1 Drawings**

Minimum drawing size shall be at least A1.

Standard: To AS 1100 Parts 101, 201, 301, 401 and 501 as applicable.

The following drawings shall be submitted:

- ▶ Building work drawings showing all building work required to complete the mechanical services.
- ▶ Detailed drawings, at 1:50 scale or larger, showing:
  - Pipe work and equipment layouts and sections.
  - For refrigerant piping include slope of horizontal runs, oil traps, double risers and valving;
  - Relevant performance data for each item of equipment including make, model, speed, capacity etc., as appropriate.
- ▶ Submission drawings required by authorities;
- ▶ Wiring diagrams.

Services coordination: Coordinate with other building and service elements. Show adjusted positions on the shop and record drawings.

Space requirements: Check space requirements of equipment and services indicated diagrammatically in the contract documents.

### **2.6.2 Execution details**

Before starting the respective portions of the installation the following shall be submitted:

- ▶ Typical details of locations, types and methods of fixing of services to structure.
- ▶ If services will be enclosed and not accessible after completion, submit proposals for location of service runs and fittings.
- ▶ Proposals for location of exposed piping.
- ▶ Proposals for location and mounting of outdoor condensing units.

### **2.6.3 Technical data**

Certification shall be submitted that the plants and equipment submitted meets the requirements and capacities of the contract documents except for departures that are identified in the submission.

Technical data shall be submitted for all items of plant and equipment.

### **2.6.4 Standards**

#### **General**

Mechanical ventilation: To AS/NZS 1668.1 and AS 1668.2, as required by the Building Code of Australia.

Refrigeration systems: To AS/NZS 1677.2 and the recommendations of SAA HB 40.1 and SAA HB 40.2.

Microbial control: To AS/NZS 3666.1, AS/NZS 3666.2 and the recommendations of SAA/SNZ HB 32.

## **2.6.5 Submissions**

### **General**

Before starting work, submit the following:

- ▶ Outside design conditions, corresponding geographic location and source of data.
- ▶ Calculated total and sensible cooling capacities and heating capacity.
- ▶ Name of calculation method used.
- ▶ Makes and model numbers of proposed equipment.
- ▶ Total and sensible cooling capacities and heating capacity of the proposed equipment, adjusted for the documented outdoor and indoor conditions and any effects of the proposed plant configuration.
- ▶ Any assumptions on which the calculations are based.
- ▶ Details of any departures from this specification.
- ▶ Details of fire provisions.
- ▶ A drawing of the proposed duct, pipe and equipment layout. Show proposed zoning and methods of heating.
- ▶ Mechanical contractor provision for attendance to breakdowns.
- ▶ AREMA certification of equipment.
- ▶ Proposed ventilation systems.
- ▶ Licence numbers and type of licences held by persons responsible for the installation.

## **2.7 Products**

### **2.7.1 Air-conditioning equipment**

#### **Standards**

Ducted air conditioners: To AS/NZS 3823.1.2.

Non-ducted air conditioners: To AS/NZS 3823.1.1.

#### **Equipment**

Performance: Provide equipment in conformance with the following:

- ▶ Made by a manufacturer with a demonstrated ability to provide spare parts and service promptly to the site.
- ▶ Operational within the documented range of outdoor design conditions under the calculated loads without excessive head pressure or icing.
- ▶ Labelled to AS/NZS 3823.2.

Reverse cycle units: Provide an effective outdoor coil defrost facility that prevents room temperature dropping more than 2°C during defrost.

Head pressure control: Provide manufacturer's standard head pressure control kit on units that operate in cooling mode at low ambient temperatures.

Cabinet: Aluminium, powder coated steel or moulded ABS plastic with metallic-coated steel or stainless steel fasteners. Insulate and vapour seal cabinet and drain trays to prevent external condensation under all operating conditions.

Drain trays: Aluminium, stainless steel or plastic to collect all moisture inside indoor and outdoor units.

Filters:

1) Air conditioning: Disposable panel type

Performance when tested to AS 1324.2:

- ▶ Test Dust No. 1:  $\geq 20\%$  efficiency.
- ▶ Test Dust No. 4:  $\geq 85\%$  arrestance.
- ▶ Dust holding capacity:  $\geq 130$  g at 125 Pa against Test Dust No 4 for a nominal 600 mm x 600 mm cell.

2) Lift shaft ventilation: Disposable panel type

Performance when tested to AS 1324.2:

- ▶ Test Dust No. 4:  $\geq 85\%$  arrestance.

## Controls

General: Provide the following functions:

- ▶ Temperature control for each zone located to accurately sense zone temperature.
- ▶ Fan speed selection for multi and variable speed fans.
- ▶ Time switch for each system with  $\geq 6$  temperature programs per day, separate programs for each day of the week, manual set point override and Vacation temperature set back.

### 2.7.2 Grilles and diffusers

#### General

Size and locate diffusers to provide even air distribution and temperatures without draughts.

Ceiling diffusers: Provide at least one per air-conditioned room and at least one per 12 m<sup>2</sup>.

Construction:

- ▶ Variable volume diffusers: Powder coated pressed steel.
- ▶ All others: Powder coated aluminium.

Dampers: Provide a damper to each diffuser and grille. If connected by flexible duct, locate the damper at the duct spigot unless a damper in this position is inaccessible.

#### Return or exhaust grilles – indoor

Ceiling and wall louvre type: Half chevron louvres at 25 mm maximum centres.

Egg crate type (ceiling use only): Elements at 90° to each other, and at 15 mm maximum centres.

Door grilles: Full chevron, 50% minimum free area. Frame to suit door thickness.

### **2.7.3 Fans**

#### **General**

Guards: Provide galvanized steel or bronze mesh guards.

Steel components: Provide corrosion protection by zinc plating or better.

Motors in air stream: Direct mount to impellers with minimum thermal class of 155 (F) insulation to IEC 60085. Provide terminal boxes external to fan casings and wired to fan motors.

Motor minimum degree of protection: IP55.

Bearings: Provide sealed for life or grease packed bearings.

Balancing: Dynamically balance impellers.

Connections: Provide flexible duct connections at fan.

#### **Roof mounted fans**

Type: Centrifugal, mixed flow, axial flow aerofoil or propeller. Comply with the respective clauses above.

Housing: House fans in compact bases fitted with weathering skirts and manufactured from zinc-coated steel or UV stabilised plastic or composite.

Finish:

- ▶ Metallic-coated steel: UV stabilised powder coat to match roof colour.
- ▶ Other materials: Manufacturer's standard colour.

Vertical discharge fans: Provide weatherproof galvanized steel, plastic or aluminium backdraft dampers where the weather may enter when units are stopped.

Bird mesh: Where backdraft dampers are not fitted, provide bird mesh guards.

## **2.8 Execution**

### **2.8.1 Ductwork**

#### **Standard**

Ductwork: To AS 4254.

#### **Rigid duct**

Material: Metallic-coated sheet steel to AS 1397, coating class G2/Z275.

Provide approved vermin screens over all duct penetrations to outside.

#### **Flexible duct**

Material: Aluminized fabric clamped on formed metal helix with insulation blanket wrapped around duct and covered with an outer vapour barrier.

Installation: Install flexible duct as straight as possible with minimum number of bends. Maximise bend radius. Check for and rectify any crushed flexible duct.

Support: To AS 4254. Limit sag to < 40 mm/m.

#### **Duct insulation**

General: Insulate ducts to reduce heat gain and prevent condensation. Provide continuous vapour barrier around ducts carrying conditioned air. Insulate flexible connections on ducts carrying air below ambient temperature.

#### **Cleaning**

Clean interior of ductwork progressively during installation.

Insulation and sealing: Notwithstanding the class of building, conform to BCA Spec J5.2.

### **2.8.2 Refrigeration pipework**

#### **General**

Conform to equipment manufacturer's recommendations for the refrigerant used.

Pipes: To AS/NZS 1571.

Deemed to comply: Split system manufacturer's standard pre-charged piping kit

Provide all refrigerant pipe work and ancillaries for the proper operation of each system including any additional refrigerant charge if required.

#### **Pipe insulation**

General: Insulate all refrigerant and drain piping that may sweat with chemically blown closed cell nitrile rubber in tubular form to ASTM C534. Apply to manufacturer's recommendations. Protect insulation from sunlight and mechanical damage.

Insulation thickness: 13 mm for pipes < DN 20, 19 mm otherwise.

#### **Condensate drains**

Requirements: Provide trapped  $\geq$  DN 20 condensate drains to AS/NZS 3666.1 from each indoor coil and safety tray. Provide drains from each reverse cycle outdoor condenser coil unless casing freely drains to a roof or other location where condensate will not cause damage or pond.

### **2.8.3 Unit installation**

#### **General**

Supply all components and install to manufacturer's recommendations.

Outdoor equipment: Provide clearance around units for condenser air flow and maintenance access. Ensure discharge air does not short-circuit to condenser intake.

Equipment at ground level: Mount on 100 mm high concrete plinth or equivalent impervious material.

Duct connections: Provide internal or external flexible duct connections at indoor unit.

All electrical connections and wiring for the proper operation of the entire system.

All internal wall mounted units shall have power supplied to them from their associated outdoor units.

All model numbers for units scheduled on the drawings shall be used as a base only.

Contractor is to provide product of equivalent or better performance, if the installation of the scheduled unit is not possible.

Site deliveries, off-loading and hoisting of equipment and materials to the positions where they are.

Cost of wiring for temporary power, which may be required for temporary portable lighting.

All electrical control equipment and services for the operation of the heating, ventilation and air conditioning systems.

Cutting, patching, framing up, furring in, chasing and making good associated with the building construction for the passage of ductwork, pipes, conduits and grilles etc. Details are to be provided in the mechanical shop drawings.

#### **Vibration isolation**

Suspended units: Provide  $\geq 4$  metal spring or rubber-in-shear isolation mountings with  $\geq 25$  mm static deflection and 98% isolation efficiency.

Floor mounted units: Provide neoprene waffle pads. Bolt in place.

#### **Safety trays**

General: If leaks or condensation from equipment could cause nuisance or damage to the building or its contents, provide a galvanized steel safety tray under the equipment.

## 3. Completion

### 3.1 Commissioning

General: Commission the systems to manufacturer' recommendations using instruments calibrated within the past 12 months. Check ductwork for leaks. Test all safety controls by simulating fault.

Air quantities: Balance systems to accord with design air quantities.

Tolerance on air quantities: Between +10% and -0% of the design air quantities.

Check list: Submit signed commissioning check list before the date for practical completion.

Painting and labelling of equipment as specified. Painting of all ducting, duct supports and equipment located externally of the building and on roofs of all buildings. No untreated items of plant, equipment or associated materials are to be used on this project.

Testing, commissioning and balancing of all systems and equipment supplied and installed under this specification.

### 3.2 Cleaning

General: Clean filters, outdoor coils, grilles and diffusers immediately before the dates for practical completion.

### 3.3 Operating and maintenance instructions

Requirements: Provide written operating and maintenance instructions containing:

- ▶ Contractor's contact details for service calls.
- ▶ Manufacturer's maintenance and operation literature.
- ▶ Manufacturer's warranty certificates if the manufacturer's warranty period is greater than the defects liability period.
- ▶ Description of day to day operation.
- ▶ Setting of time switches.
- ▶ Schedule of recommended maintenance.
- ▶ Provide workshop drawings for review and as-built documentation at project completion
- ▶ Provide operation and maintenance manuals and training of relevant to staff
- ▶ Provide 12 months defects liability period on the installation and manufacturers warranty on the equipment.

Record drawing: Provide a drawing of the system as installed.

#### 3.3.1 Maintenance

##### General

Provide corrective and preventative maintenance on the installation.

Maintenance period: The greater of 12 months from the date of completion of commissioning of the systems and the duration of the Defects Liability Period.

The plant should have at least 12 months warranty and maintenance period to ensure it operates through the full range of cooling and heating seasons.

Corrective maintenance: Attend site and undertake corrective maintenance within 24 hours of receipt of verbal or written advice.

Preventative maintenance: Provide preventative maintenance recommended by the equipment manufacturer. Provide all materials including consumable items and refrigerant.

Summer preventative maintenance visit: Provide at least one preventative maintenance visit during the months of December, January or February. Carry out preventative maintenance and provide electronic data logger or thermo-hydrograph to record temperatures at one location in each zone a period of 7 days. Submit results. If the temperature recorded is outside the specified tolerance identify and correct the cause and repeat the test.

Maintenance reports: Provide a signed maintenance report setting out the work done and any measured values after each visit.

### **3.4 Warranties**

#### **General**

The contractor shall provide a guarantee that:

- ▶ All equipment is of such capacity and is installed in such a manner that it shall satisfactorily perform the work specified
- ▶ The performance data for all equipment shall be as specified in the contract documents, or as detailed by the contractor in the tender form
- ▶ All equipment, unless otherwise specified or directed, shall be installed in accordance with the manufacturer's instructions and recommendations
- ▶ The contractor shall rectify, make good, and pay all associated costs arising from poor workmanship, incorrect installation of equipment and services, or if the performance data for all equipment is not met.

### **3.5 Training**

Explain and demonstrate to the principal's staff the purpose, function and operation of the installations.

## 4. Selections

For Schedules – refer to CV0420791

Item No.	Description	Quantity	Unit	Material	Manufacturer	Notes
1	...	...	...	...	...	...
2	...	...	...	...	...	...
3	...	...	...	...	...	...
4	...	...	...	...	...	...

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**Document Status**

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## TfNSW Specification for Cardiff Station Electrical Services

March 2012

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# 1. Project Information

## 1.1 Definitions

Client	-	TfNSW
Consulting Engineer	-	GHD
Works	-	Electrical Services as described in Section 2
Electrical Contractor	-	The company contracted to undertake the Electrical works

## 1.2 The Project

This project involves the Easy access upgrade to the existing Railway Station at Cardiff, NSW.

This involves:

- station building,
- platform extension,
- pedestrian foot bridge
- Extension of the foot bridge to the carpark,

This specification covers the electrical works required for the new Cardiff Station.

## 1.3 Extent of works

This specification, together with the drawings are based upon the information available at the time of publication. The drawings are coordinated, where obvious, however this should not be relied upon as the basis of tender. Tenders must view the site and exercise their own initiative based on experience in respect to the commercial implications of installing conduits and pits and possible structural impediments. The contractor must allow in the tender return costs coordination of all services and systems with all other trades. Coordination must take place prior to any works on site. Any part of the installation which is not coordinated and requires relocation / repair will be at the cost of the contractor.

The extent of work comprises the completion of detailed design, supply, installation, testing, commissioning, maintenance and defects liability for the entire electrical services package.

The work shall include all necessary minor and incidental work required to implement the intent and meaning of this specification.

Whether or not the words "supply and install" appear in this specification, unless clearly excluded, all items of equipment for the complete installation are required and shall be supplied and installed.

### 1.3.1 Constraints

The following site constraints apply to the electrical services for this project:

- Existing rail way tracks and overhead wiring are adjacent the new railway station. All works will need to be coordinated with the existing track and overhead wiring during the construction.

## 2. Scope of Works

### 2.1 General

This specification, together with the drawings is based upon the information available at the time of publication. The drawings are coordinated, where obvious, however this should not be relied upon as the basis of tender. Tenders must view the site and exercise their own initiative based on experience in respect to the commercial implications of installing conduits and pits and possible structural impediments. The contractor must allow in the tender return costs coordination of all services and systems with all other trades. Coordination must take place prior to any works on site. Any part of the installation which is not coordinated and requires relocation / repair will be at the cost of the contractor.

The extent of work comprises the completion of detailed design, supply, installation, testing, commissioning, maintenance and defects liability for the entire electrical services package.

The work shall include all necessary minor and incidental work required to implement the intent and meaning of this specification.

Whether or not the words "supply and install" appear in this specification, unless clearly excluded, all items of equipment for the complete installation are required and shall be supplied and installed.

### 2.2 Specification Objectives

The intent of this Specification and the associated documents is:

- To provide a clear statement of contractual requirements against which compliance can be assessed.
- To provide documentation for the Client to demonstrate what is being bought.
- To define the expectations upon the Contractor by the Consulting Engineer.
- To define the roles of the parties involved with the works.
- To enable other interested parties to assess their obligations and to understand expectations of them.
- To define the requirements of the installer with respect to Quality Assurance.

### 2.3 Obligations of Installer

In writing this specification the Consulting Engineer expects and relies upon the tenderers' possessing specialist trade expertise necessary to complete the works in accordance with the documentation.

In addition, the installer has the following obligations:

- To raise in good time, issues requiring design intent or clarification from the Consulting Engineer, particularly in respect to:

1. Interpretation of the design intent specification or drawings.
  2. Problems in complying with the specification.
  3. Omissions from the tender documents.
  4. Suggested alternatives/substitutions.
- To certify compliance with contract documents, including all variation instructions, at Practical Completion.
  - To certify compliance with Authority requirements, as far as he/she can ascertain.
  - To implement procedures to ensure that only competent tradesmen are used for the works.
  - To be cognisant of the role of all relevant parties during the construction phase of the project and to assist them in the conduct of their duties wherever possible.
  - To contribute, in the spirit of partnering, towards the successful execution of the contract.
  - To provide manufacturer's and construction drawings.
  - To make final equipment selections to meet the requirements listed.

## 2.4 Extent of Works

This section of the specifications details the requirements of the work included in the Electrical Services, but is not limited to, the following:

- Obtain supply authority approval prior to construction, obtain easement as required and pay all costs associated with the supply authority.
- Supply and install new submain cabling from Installation Main Switchboard (IMSB) to new station building distribution board (DB-1) located in store room.
- Supply and install new site distribution boards as indicated on the drawings.
- Supply and install new submains to all equipment as indicated on the drawings. Provide fire rated submains to the lifts ~~and the IMSB.~~
- Supply and install a new 16kW Uninterruptible Power Supply (UPS), with an external maintenance by pass switch, and 30 minute battery autonomy at end of life confirm with TfNSW before installation.
- Supply and install underground conduits for all electrical and communications cable reticulation.
- Supply and install cable duct systems with clip on lids for power and data cable reticulation beneath the platform awnings.
- Provide draw wire for all conduits to allow for future cable reticulation.
- Supply and install electrical and communications pits for all underground cable reticulation. Provide drainage to all cable pits via rubble drains.

- Allow for all trenching and backfilling for underground cable reticulation.
- Provide power and communications cable paths via the overbridge for cable reticulation across the tracks, coordinate with structural.
- Provide a complete earthing system for the electrical distribution system in accordance with AS 3000. Provide equipotential bonding to all metallic pipe work.
- Provide new lighting throughout. Provide all luminaires complete with lamp and accessories. Supply and install all brackets and light poles.
- Provide underground cable reticulation paths for all external pole mounted light fittings.
- Supply and install a complete lighting control system for external lighting, with override controls.
- Provide local lighting controls for the individual rooms in the station building.
- Supply and install all required electrical subcircuits.
- Supply and install all electrical outlets and accessories. Final location of all outlets and accessories to be confirmed on site.
- Provide a CAT 6 structured cabling system for all data/telephone points.
- Provide power circuits to mechanical and hydraulic services.
- Supply and install a complete Public Address (PA) system on the platforms and the over bridge.
- Supply and install an array hearing induction loops on the platforms.
- ~~Supply and install a smoke detection system in the station building. Provide a fire panel in the equipment room to automate call outs in the event of fire.~~
- ~~Supply and install an access controls and intruder detection system. Provide electronic access via proximity cards to all rooms.~~
- Supply and install a complete CCTV system. Locate cameras as positioned on the drawings, and as documented in the security report to achieve the desired coverage.
- Coordinate the location of services with all other service trades to avoid clashes.
- Provide shop drawings for approval prior to commencing any works on site.
- Test and commission all equipment.
- Provide as-built drawings.
- Provide a operation and maintenance manual for all installed equipment
- Submit test reports, provide client with all test results, bound for review. The certificate for practical completion will only be signed after the complete test reports have been reviewed including hard and soft copy of the full test reports in the operation and maintenance manuals.

The contractor shall:

- Coordinate the electrical services with all other trades.
- Liaise with local authorities for all inspections.
- Review all works for compliance with the specifications prior to calling for inspections.
- Review all submissions prior to submitting the items to the superintendent.

## **2.5 Contract Drawings**

The electrical services drawings that accompany this Specification shall be referred to herein as 'the drawings' or 'the Contract drawings'.

The electrical drawings shall be read in conjunction with this specification.

## **2.6 Pre Tender requirements**

- It is the Electrical Contractor's responsibility to inspect the site to establish the extent, nature and constraints.
- The Electrical Contractor shall be responsible for becoming familiar with all staging of the works.
- The Electrical Contractor shall become familiar with all temporary works required during the construction period.
- The information shown on the drawings will not necessarily be complete and the Tenderer shall obtain any other available drawings referenced to satisfy himself the full extent of work.

## **2.7 Setting out of works**

- The position of all equipment shown on the drawings is to be taken as approximate only and the exact positions shall be ascertained prior to installation on site.
- It is the Electrical Contractor's responsibility to ensure that the setout of the electrical installation presents an ordered appearance and coordinates with the structure and other services. In heavily serviced areas the Electrical Contractor shall prepare layout drawings showing dimensioned setout and RL's of electrical equipment and submit these for approval.

## **2.8 Site Supply**

The site supply will be managed and installed by TfNSW.

## **2.9 Uniformity**

All electrical equipment shall as follows:

- Power: All products of the same type are to be of the same manufacturer.
- Lighting: All products as per luminaire schedule.

## 2.10 Associated Works

### 2.10.1 General

“Associated work” is defined as work required to be provided by other trades in order to ensure completion of the electrical services works.

Trade	Works provided <u>for</u> others	Works provided <u>by</u> others
Mechanical Services	Provide submains for mechanical services switchboard. Coordination with mechanical Contractor of all ceiling services and in ceiling services.	Sub main cable shall be terminated by the Mechanical contractor who shall provide all lugs, cable glands and gland plates as required. Mechanical contractor to confirm selected equipment loadings to ensure correct sub main cable and breaker sizing to mechanical services switchboards and equipment.
Hydraulic Services	Supply and install power cabling and isolators / outlets for connection of hydraulic services equipment including pumps, filters, hot water units, chilled/boiling water units etc.	Hydraulic contractor shall coordinate with the Electrical contractor to confirm selected equipment loadings to ensure correct outlet ratings and cable sizes.
Equipment Racks	Provide captive socket outlets in equipment room	Equipment/system vendors shall supply racks and rack mounted equipment

### 3. General Requirements

#### 3.1 Design

##### 3.1.1 General

Provide all design work necessary to complete the electrical services documentation to work shop fabrication level.

Use only appropriately experienced and qualified persons to undertake electrical design work. If requested, provide documents verifying the qualification and experience.

##### 3.1.2 Design Criteria

Item	Standards	Design Criteria
Supply conditions	AS 3000	415/240 V
		50 Hz
		125% of initial maximum demand
Reticulation Design		Volt Drop (max)
		Consumer mains < 1.0%
		Submains approx < 2.0%
		Final sub-circuits, < 2.0%
		All cabling shall utilise copper conductors
IMSB	AS 3439.1	IMSB TO BE INSTALLED BY TFNSW

<b>Item</b>	<b>Standards</b>	<b>Design Criteria</b>
Distribution Boards	AS 3439.1	Final subcircuit protection -Miniature cb's, < 100 A
		Rating 25% above initial load
		Local Main Switch Isolator Form 1 Construction
		Minimum 160A main switch and busbar chassis rating (final sizing to be confirmed during detailed design)
		25% spare pole capacity after initial loads
Consumer Mains	AS/NZS 3000 and AS/NZS 3008.1.1	Fire rated to WS52 classification
		Max. Demand + 25% spare capacity
Submains	AS/NZS 3000 and AS/NZS 3008.1.1	Capacity maximum demand + 25% spare capacity
		Lift submains will be WS52 classification.
		Reduced neutral shall not be utilised
		4 core less than 35mm <sup>2</sup> cabling, single core cabling to be used for 50mm <sup>2</sup> and larger.
Earthing	AS/NZS 3000 and EP 12 10 00 21 SP - Low voltage Installations Earthing	Earth cabling to meet the requirements of the relevant standards
Final subcircuits	AS/NZS 3000 and AS/NZS 3008.1.1	Power 2.5mm <sup>2</sup> minimum
		Lighting 2.5mm <sup>2</sup> minimum
		Max 80% utilisation
		Initial spare outlet capacity of 25%.
		Final lighting and general power circuits will be supplied using 30mA RCD circuit breakers.

Item	Standards	Design Criteria
Uninterruptible Power Supply Systems		Circuit breaker protecting UPS to be selected to handle inrush current and battery recharging
		UPS equipment to be sized for initial load + 25% spare.
		Autonomy time 30 minutes at end of life

### Lighting Levels

All lighting levels are to comply with TfNSW Requirements as set out below.

The following lighting design criteria have been extracted from Part E technical requirements provided by TfNSW for Cardiff Station.

Location	Lighting Level (Lux)
Car Parks:	
Covered areas	50
Open Areas	20
Bus-Rail Stations:	
Covered Areas	50
Open Areas	20
Pathways	50
External approaches	85
Covered areas, entrance halls & verandas	150 – 200
Awnings on platforms	100
Platforms	
- underground	150
- open	50

Location	Lighting Level (Lux)
Waiting rooms	150 – 200
Overbridges	150
Stairs (covered)	150
Stairs (uncovered)	150
Subways	100

The above levels are minimum average service illuminance after lamp and dirt depreciation factors (maintenance factor of 0.75) are allowed for.

The minimum illumination on open platforms shall not be less than 30 lux and the uniformity shall not be less than 0.5 (ratio of the minimum illumination level to the average illumination level).

## 3.2 Standards

### 3.2.1 Australian Standards

The Australian Standards listed below, including latest amendments, shall apply to the design:

Standard Number	Standard Name
BCA 2010	Building Code of Australia
AS/NZS 1125:2001	Conductors in insulated electric cables and flexible cords
AS 2184	Low voltage switchgear and controlgear - Moulded-case circuit-breakers for rated voltages up to and including 600 V a.c. and 250 V d.c.
AS 3000	Electrical Installations - (SAA Wiring Rules)
AS/NZS 3008.1.1	Electrical Installations - Selection of Cables
AS/NZS 3013	Electrical installations - Wiring systems for specific applications
AS/NZS 3017	Electrical installations – Testing guidelines
AS 3439.1	Low voltage switchgear and control gear assemblies
AS 3851	The calculation of short-circuit currents in three-phase a.c. systems
AS 3947.2	Low voltage switchgear and control gear – General Rules
AS 3947.1	Low voltage switchgear and control gear – Circuit breakers

<b>Standard Number</b>	<b>Standard Name</b>
AS 3947.5.1	Low voltage switchgear and control gear – Control circuit devices and switching elements – Electromechanical control circuit devices
AS 3947.6.1	Low Voltage Switchgear and Control gear
AS 60529	Degrees of protection provided by enclosures for electrical equipment (IP Code)
AS 5000.1	Approval and Test Specification - Electric Cables
AS/NZS 61000	Electromagnetic Compatibility (EMC) series of standards
AS/NZS 1680	Interior and Workplace Lighting
AS/NZS 1158	Lighting for Roads and Public Spaces

### 3.2.2 TfNSW Engineering Standards

The TfNSW Engineering Standards listed below shall apply to the design:

<b>Standard Number</b>	<b>Standard Name</b>	<b>Rev</b>	<b>Date</b>
ESB 004	Station Services and Systems	1.1	May 2010
EP 17 00 00 11 SP	Low Voltage Isolation Transformer	3	May 2010
EP 12 10 00 11 SP	Distribution Substation Earthing	3	May 2010
EP 00 00 00 13 SP	Electrical Power Equipment – Design Ranges of Ambient Conditions	2	May 2010
EP 00 00 00 15 SP	Common Requirements for Electrical Power Equipment	3	May 2010
EP 12 10 00 20 SP	Low Voltage Distribution Earthing	3	May 2010
EP 12 10 00 21 SP	Low Voltage Installations Earthing	3	May 2010
EP 20 00 00 03 SP	Above Ground Cable Installation Systems – Selection Guide	1.1	May 2010
EP 00 00 00 16 SP	Electrical Power Systems Signage	2	May 2010
EP 20 00 03 01 SP	Requirements for Cable Polymeric Terminations and Joints	2	May 2010
EP 20 00 04 01 SP	Cable Route Selection Guide	2	May 2010

EP 20 00 04 04 SP	Ground Entry Arrangements	2	May 2010
EP 20 00 04 05 SP	Cable Pits	2	May 2010
EP 20 00 04 06 SP	Underground Cable - Location Recording	2	May 2010
EP 21 00 00 01 SP	Insulation Co-ordination & Surge Arrester Selection	3	May 2010
F2010/22647 D2010/52646	Enhanced Public Address System Design and Installation Guideline	1.1	Oct 2010

### 3.2.3 TfNSW Drawings – Standard

The TfNSW Drawings listed below shall apply to the design:

Drawing Number	Drawing Name	Rev	Date
EL 0474151	Distribution Padmount Substation Low Voltage Switchboard (DSMSB) General Arrangement	A	-
EL 0494646	415V/415V Padmount Isolating transformer Schematic Diagram	A	-
EL 0480479	415V/415V Padmount Isolating transformer General Arrangement		
EL 0474149	Distribution Padmount Substation Double Insulated Metering Panel General Arrangement	A	-
EL 0474159	Distribution Padmount Substation type R Kiosk Assembly General Arrangement		
EL 0455387	TfNSW 415V/415V Padmount Assembly Minimum Requirements information Footprint Arrangement.		

### 3.3 Submissions

#### General

Default timing: Make submissions with notice before ordering products for, or starting installation of, the respective portion of the works.

Program: Allow in the construction program for at least the following times for response to submissions:

- Shop drawings: 2 weeks.

- Samples and prototypes: 2 weeks
- Manufacturers' or suppliers' recommendations: 2 weeks
- Product data: 2 weeks
- Product/design substitution or modification: 2 weeks.

Proposed products schedules: If major products are not specified as proprietary items, submit a schedule of those proposed for use within 3 weeks of site possession.

### **3.4 Submissions**

- Shop drawings prior to any works onsite.
- Certified schedule of compliance for all equipment, prior to placing orders.
- Certified schedule of competency for all tradesmen intended to work on the project.
- Factory test results where applicable.
- All product data, performance test and commissioning results required by this specification.
- Inspection and test plans for every section of the works. Detail the procedure of how to complete the task, the skill or competency of the person undertaking the works, the review or testing procedure to assure satisfactory completion of the task, the person within the installer's organisation authorised to sign-off the task as accepted.
- Client handover/training proposals.
- Record and installation drawings: Record all changes to equipment and services layouts, wiring and any other items during the construction period, which may have been incorporated into these works.
- Operating and Maintenance manuals.
- Certifications for compliance with project specific Code/Design requirements of the completed works.
- Maintenance and servicing during the defects liability period.
- Details of connections to external interfaces and components.
- Certification of the entire installation.

#### **3.4.1 Shop & As-built Drawings**

- Minimum drawing size shall be at least A1.
- Standard: To AS 1100 Parts 101, 201, 301, 401 and 501 as applicable.
- Submissions: The following drawings shall be submitted:
- Workshop drawings for review prior to construction
- As-Built drawings prior to project completion

Prior to commencement of any works on site, submit three (3) hard copies of the following workshop drawings to the Project Manager.

Shop drawings are required to detail all elements of the electrical installation works, which include, but are not limited to the following:

- Distribution boards including main switchboard (shop drawing level)
- Cable schedules
- Site plan reticulation layouts and support systems details
- Lighting layouts and support system details
- Lighting control details.

Data to be submitted: Include at least the following information in technical submissions:

- Assumptions.
- Calculations.
- Certification of compliance with the applicable code or standard.
- Design basis and performance parameters.
- Drawings.
- Installation and maintenance requirements.
- Manufacturers' technical literature.
- Risk assessment.
- Samples where relevant.
- Sketch, single line diagram, flowchart.
- Technical data schedules corresponding to the equipment schedules in the contract documents. If there is a discrepancy between the two, substantiate the change.

All as-built drawings shall be provided as hard copies, PDF's and in AutoCAD dwg format.

### **3.4.2 Authorities**

**Authorities' approvals:** Submit documents showing approval by the authorities whose requirements apply to the work.

**Correspondence:** Submit copies of correspondence and notes of meetings with authorities whose requirements apply to the work.

### **3.4.3 Hard copy submissions**

Standard contract drawing size: A1

#### **3.4.4 Errors**

General: If a submission contains errors, make a new or amended submission as appropriate, indicating changes made since the previous submission.

#### **3.4.5 Inspection and testing plan**

General: Submit an inspection and testing plan which is consistent with the construction program. Include particulars of test stages and procedures.

Test reports: Submit written reports on nominated tests.

#### **3.4.6 Materials and components**

Product certification: If products must conform to product certification schemes, submit evidence of conformance.

Product data: For proprietary equipment, submit the manufacturer's product data as follows:

- Technical specifications and drawings.
- Type-test reports.
- Performance and rating tables.
- Recommendations for installation and maintenance.
- Additional product data for services equipment:
  - Model name, designation and number.
  - Country of origin and manufacture.
  - Capacity of all system elements.
  - Size, including required clearances for installation.
  - Materials used in the construction.

#### **3.4.7 Substitution**

Identified proprietary items: Identification of a proprietary item does not necessarily imply exclusive preference for the item so identified, but indicates the necessary properties of the item.

Alternatives: If alternatives to the documented products, methods or systems are proposed, submit sufficient information to permit evaluation of the proposed alternatives, including the following:

- *Evidence that the performance is equal to or greater than that specified.*
- *Evidence of conformity to a cited standard.*
- *Samples.*
- *Essential technical information, in English.*

- *Reasons for the proposed substitutions.*
- *Statement of the extent of revisions to the contract documents.*
- *Statement of the extent of revisions to the construction program.*
- *Statement of cost implications including costs outside the contract.*
- *Statement of consequent alterations to other parts of the works.*

Availability: If the documented products or systems are unavailable within the time constraints of the construction program, submit evidence.

Criteria: If the substitution is for any reason other than unavailability, submit evidence that the substitution:

- *Is of net enhanced value TfNSW.*
- Is consistent with the contract documents and is as effectual as the identified item, detail or method.

### **3.4.8 Samples**

Submission: Submit nominated samples.

Incorporation of samples: If it is intended to incorporate samples into the works, submit proposals. Incorporate samples in the works which have been endorsed for incorporation. Do not incorporate other samples.

Retention of samples: Keep endorsed samples in good condition on site, until practical completion.

### **3.4.9 Certification**

Submit certification that the plant and equipment submitted meets all requirements and capacities of the contract documents except for departures that are identified in the submission.

## **3.5 Quality Assurance**

A Quality Assurance plan shall be provided in order to propose, establish, maintain, monitor and document a quality assurance system covering all aspects of the design, purchase, fabrication, installation and completion of the works. The plan shall be in accordance with ISO 9001

A designated Project Quality Inspector shall be appointed to execute the quality plan, which must include the following minimum:

- Check all shop drawings for conformance to requirements prior to submission.
- Check equipment compliance schedule against the particular specification requirements and equipment schedules prior to submission.
  - Check all samples for conformance to requirements prior to submission.
  - Check all tests required for proper manufacturing of the equipment.

- Check all manufactured items for compliance prior to dispatch to site.
- Check installation of all items fixed under this specification.
- Check all materials, welding, joining, terminations, fixing and finishes.
- Check all on-site tests required to commission the works.
- Check operating and maintenance manuals to ensure they contain adequate information to permit systems to be operated by the Client at the end of defects liability period. (Including adequate training and tuition of the client's representative.)
- Submit the following documentation:
  - Quality System third party certification, if any, to the Standards specified by the Joint Accreditation System of Australia and New Zealand.
  - Quality manual detailing, corporate QA. policy statement, system element description and register of procedures.

## 4. Cable Support and Duct Systems

### 4.1 General

Arrangement: Arrange services so that services running together are parallel with each other and with adjacent building elements.

Fixing: If non-structural building elements are not suitable for fixing equipment and services to, fix directly to structure and trim around holes or penetrations in non-structural elements.

Installation: Install equipment and services plumb, fix securely and organise reticulated services neatly. Allow for movement in both structure and services.

Lifting: Provide heavy items of equipment with permanent fixtures for lifting as recommended by the manufacturer.

#### 4.1.1 Aims

##### Responsibilities

General: Provide cable support, trunking and duct systems as documented.

#### 4.1.2 Cross references

##### General

General: Conform to the *General requirements* worksection.

##### Associated worksections

Associated worksections: Conform to the following:

- *Electrical general requirements*.

#### 4.1.3 Submissions

##### Shop drawings

General: Submit shop drawings showing the following:

- Cable tray and trunking routes.
- Layout of cable supports and enclosures on the current architectural background coordinated with the structure and other services.
- Layout of underground conduits, pits and drainage trenches.
- Invert levels for underground conduits.
- Depth of burial for cables and conduits.
- In situ pits.

- Provision for expansion and ground movement.
- Fabricated columns.
- Footing for columns.

#### **Technical data**

General: Submit technical data for the following:

- Ducted wiring enclosure systems.
- Cable support systems.
- Proprietary pits.
- Proprietary columns.

## **4.2 External Reticulation**

### **4.2.1 Site Reticulation**

- Provide new underground conduits for cable reticulation throughout the site for power and comms. Allow sufficient space capacities within the conduits to allow for future reticulation.
- Provide draw wire for all conduits.
- Routes shown on the drawings are indicative only. The electrical contractor shall be responsible for determining routes which do not clash with other services and structural elements.

### **4.2.2 Trenches**

- Backfilling: Place backfill in layers not exceeding 200 mm loose thickness and compact to the required density.
- Backfill soil thermal resistivity: Where the thermal resistivity of the excavated soil exceeds 1.2 K.m/W backfill trench with either cement-bound sand or gravel in accordance with AS 3008.1.

### **4.2.3 Under roadways**

- Under roadways and areas subject to traffic movement, install cables in a duct or conduit extending to not less than 1 m on either side of the sealed surface or trafficable area.
- Minimum depth: 500mm

### **4.2.4 Sealing ducts, pipes and conduits**

Seal the buried entries to ducts, pipes and conduits with a pliable non-setting waterproof compound. Seal spare ducts, pipes or conduits immediately after installation, and seal the others after the cable installation.

#### **4.2.5 Survey**

Prior to backfilling accurately record the routes of underground cables.

#### **4.2.6 Location marking**

Accurately mark the location of underground cables by route markers consisting of a marker plate set flush in a concrete base not less than 200 mm diameter x 200 mm deep, placed at each joint, route junction, change of direction, termination and building entry point and in straight runs at intervals of not more than 100 m.

#### **4.2.7 Cable Pits**

- Provide covers to meet the requirements of the surrounding environment in accordance with AS 3996. Minimum C class pits and lids.
- Provide drainage from the bottom of all cable pit to an absorption trench filled with rubble or to the storm water drainage system.
- Absorption trench: Minimum size 300 x 300 x 2000 mm.
- Suitably label pits "ELECTRICITY" or "COMMUNICATIONS"
- Pit lids on platforms are to be the infill type.

### **4.3 Products**

#### **4.3.1 Conduits**

##### **General**

Standards: AS/NZS 2053 Parts 1, 2, 3, 4, 5, 6, 7 and 8.

##### **Type**

General: Rigid.

##### **Fixings**

Saddles: Double sided fixed.

##### **Colour**

Conduits for telecommunications systems: White.

Conduits for Electrical systems: Electric orange.

##### **Galvanized water pipe**

Medium or heavy: To AS 1074.

### **4.3.2 Metallic conduits and fittings**

#### **General**

Standards: AS/NZS 2053.7 or AS/NZS 2053.8.

#### **Type**

General: Screwed steel.

#### **Fixings**

Saddles:

- Internal: Zinc plated.
- External: Hot-dipped galvanized.

#### **Corrosion protection**

Steel conduits: Paint ends and joint threads with zinc rich organic primer to AS/NZS 3750.9.

### **4.3.3 Non-metallic conduits and fittings**

#### **General**

Standards: Non-metallic conduits and fittings: AS/NZS 2053 Parts 2, 3, 4, 5 or 6.

Solar radiation protection: Required for conduits and fittings exposed to sunlight.

#### **Flexible conduit**

General: Provide flexible conduit to connect with equipment and plant subjected to vibration. If necessary, provide for adjustment or ease of maintenance. Provide the minimum possible length.

#### **Associated fittings**

Type: The same type and material as the conduit.

Wall boxes on UPVC conduits: For special size wall boxes not available in UPVC, provide prefabricated earthed metal boxes.

#### **Inspection fittings**

General: Provide inspection-type fittings only in accessible locations and where exposed to view.

#### **Joints**

Type: Cemented or snap on joints.

#### **4.3.4 Cable duct/trunking**

##### **General**

Standards:

- Cable duct/trunking systems: To AS/NZS 4296.

##### **Cable duct**

Material: Metal.

Material finish: Metallic-coated to AS 1397 Grade G2, Coating Class Z275.

Construction: Solid.

Covers:

- Accessible locations: clip-on type removable only with the use of tools.

Accessories: Purpose-made to match the duct system.

Cable support: Except for horizontal runs where the covers are on top, support wiring with retaining clips at intervals of not more than 1000 mm.

##### **Proprietary trunking systems**

General: Provide proprietary, skirting duct, wall duct, floor duct and service column systems, incorporating segregation where used for multiple services. Provide rigid supports. Round off sharp edges and provide bushed or proprietary cable entries into metallic trunking.

Accessories: Provide proprietary fixings and mountings facilities for accessories and outlets.

Covers: Screw-fixed or clip-on type removable only with the use of tools.

#### **4.3.5 Cable tray/ladder support systems**

##### **General**

System: Provide a complete cable support system consisting of trays or ladders and including brackets, fixings and accessories.

Selection: Run cables < 13 mm diameter on cable trays or in ducts.

Standard: NEMA VE-1.

Type tests: To NEMA VE-1.

Manufacture: Provide proprietary trays, ladders, fittings and accessories from a single manufacturer for the same support system.

Selection: Select cable tray/ladder in conjunction with support system installation to achieve the documented loading and deflection requirements.

Spare capacity: ≥ 25%.

Support:

- Power cables: Trapeze or centre rail structure.
- Communications cables: Single sided.

Dimensions: To the preferred dimensions nominated in NEMA VE-1.

Material: Corrosion-resistant finished steel.

Material finish: Metallic-coated to AS 1397, Grade G2, Coating Class Z275.

Covers: Provide ventilated flat covers to cable trays/ladders installed in accessible locations.

#### **4.3.6 Catenary systems**

##### **General**

Catenary systems: May be used within suspended ceiling spaces in lieu of cable tray and ladder systems.

Wire: Provide stainless steel or coated galvanized cable and couplings for catenary systems.

#### **4.3.7 Cable pits**

##### **General**

Cable draw-in pits: Provide. Sizes given are internal dimensions.

##### **Proprietary cable pits**

Pits  $\leq$  1200 x 1200 mm: Provide proprietary concrete or polymer moulded pits.

##### **Pit covers**

General: Provide pit covers to suit external loads. Fit flush with the top of the pit.

Standard: To AS 3996.

Weight: < 40 kg for any section of the cover.

Lifting handles: Provide a lifting handle for each size of cover section.

##### **Drainage**

General: Provide drainage from the bottom of cable pits, either to absorption trenches filled with rubble or to the stormwater drainage system.

Absorption trenches: Minimum size 300 x 300 x 2000 mm.

#### **4.3.8 Columns**

##### **General**

Columns: Conform to the following for fabricated columns more than 2400 mm high which are designed to support accessories outdoors.

Standards: Comply with the following standards as appropriate:

- AS 1798 for public lighting poles.
- AS 3600 for concrete structures.
- AS 4100 for steel structures.
- AS/NZS 4676 for structural design of columns.
- AS 4680 for hot-dipped galvanized (zinc) coatings on ferrous articles.

## **4.4 Execution**

### **4.4.1 Conduit systems – installation**

#### **Set out**

General: If exposed to view, install conduits in parallel runs with right angle changes of direction.

#### **Bends**

General: Install conduits with the equivalent of  $\leq 2$  right angled bends per cable draw-in run.

#### **Conduits in roof spaces:**

General: Locate below roof insulation and sarking. In accessible roof spaces, provide mechanical protection for light-duty conduits.

#### **Inspection fittings**

General: Locate in accessible positions.

#### **Draw cords**

General: Provide 5 mm<sup>2</sup> polypropylene draw cords for all conduits with spare capacity.

#### **Expansion**

General: Allow for thermal expansion/contraction of conduits and fittings due to changes in ambient temperature conditions. Provide expansion couplings as required.

#### **Rigid conduits**

General: Provide straight long runs, smooth and free from rags, burrs and sharp edges.

#### **Routes**

General: Run conduits concealed in wall chases, embedded in floor slabs or installed in inaccessible locations directly between points of termination.

#### **Conduits in concrete slabs**

Route: Do not run in concrete toppings. Do not run within pretensioning cable zones. Cross pretensioning cable zones at right angles. Route to avoid crossovers and minimise the number of conduits in any location. Space parallel conduits  $\geq 50$  mm apart.

Minimum cover: The greater of the conduit diameter and 20 mm.

Fixing: Fix directly to top of the bottom layer of reinforcing.

#### **Hollow-block floors**

Locate conduits in the core-filled sections of precast hollow-block type floors.

#### **Columns**

Confirm with structural all conduits in columns, conduits in columns:

- $\leq 4$  per column.
- $\leq 80$  mm diameter.
- Locate conduits centrally in each column.

Bends: Enter columns via  $\geq 150$  mm radius sweep bends. Do not use elbows.

Chasing: Do not chase columns.

### **4.4.2 Cable tray/duct/ladder support systems – installation**

#### **General**

Standard: To NEMA VE-2.

Design: Support cable trays/ladders to achieve the in accordance with the manufacturers specification and the below:

- Concealed trays/ladders: Support spacing  $\leq$  length of tray/ladder section.
- Visible trays/ladders: Loaded deflection  $\leq$  span/350.

#### **Fixing to building structure**

General: Fix supports to the building structure or fabric by means of  $\geq 8$  mm threaded rod hangers attached to hot-dipped galvanized U-brackets, or by means of proprietary brackets.

#### **Cable fixing**

General: Provide strapping or saddles suitable for fixing cable ties.

#### **Bend radius**

General: Provide bends with an inside radius  $\geq 12$  times the outside diameter of the largest diameter cable carried.

#### **Cable protection**

General: Provide rounded support surfaces under cables where they leave trays or ladders.

#### **Access**

General: Locate trays and ladders to provide  $\geq 150$  mm free space above and  $\geq 600$  mm free space on at least one side.

## Clearances

From hot water pipes: > 200 mm.

EMI: Locate support systems for electrical power cabling and communication cabling to minimise electromagnetic interference.

### 4.4.3 Cables in trenches – installation

#### Sand bed and surround

General: Provide clean sharp sand  $\geq$  150 mm around cables and conduits installed underground.

#### Sealing ducts and conduits

General: Seal buried entries to ducts and conduits with waterproof seals. Seal spare ducts and conduits immediately after installation. Seal other ducts and conduits after cable installation.

### 4.4.4 Columns – installation

#### General

General: Install columns as documented including the provision of in situ reinforced concrete footings to the Wiring enclosures and cable support systems schedule.

## 4.5 Selections

### 4.5.1 Wiring enclosures and cable support systems schedule

#### Cable trays/ladders

Type	Ezystrut or approved equivalent
Material	Galvanized steel
Finish	Galvanized steel
Dimensions	As shown on drawings
Usable width	As shown on drawings
Usable depth	50 mm minimum

#### Cable duct

Type	Esco Industries, Cableway or approved equivalent
Material	Galvanized steel
Finish	Galvanized steel
Dimensions	As shown on drawings
Usable width	mm minimum
Usable depth	100 mm minimum

## 5. Earthing

### 5.1 General

Provide a complete earthing system for the installation, in accordance with TfNSW Standards. Provide a separate earthing conductor with each sub-main.

The main earth conductor will be installed by TfNSW at the Distribution Supply Main Switchboard (DSMSB). A Multiple Earthed Neutral (MEN) link will be provided between the main earth bar and the main neutral bar at the DSMSB.

Full sized earth cable will be reticulated from the DSMSB to the Installation Main Switchboards (IMSB) will be installed by TfNSW.

Copper earth conductors will be used to link the earth bars of all distribution boards back to the ISMSB. The minimum earth conductor for submains cables will be 16mm<sup>2</sup>.

Each rack within the equipment room shall be individually connected to earth link bar by a 6.0mm<sup>2</sup> copper conductor.

Earthing of LV subcircuits will be provided as per the requirements of AS/NZS3000 and the minimum fault loop impedance.

### 5.2 Execution

#### 5.2.1 Tests

- Testing: Submit an earth resistance test report detailing the testing of the earth resistance and the results of that test. If the measured earth resistance is outside specification provide proposals for additional earthing to reduce the resistance.
- Test Point: Measure earth resistance for the earth pits before all bonding connections are connected.

#### 5.2.2 Earthing Terminal Bars

- Terminations shall comprise cable lugs bolted to terminal bar with stainless steel nuts bolts and locknuts.
- Provide a tinned copper earthing terminal bar mounted on standoff insulators and predrilled for 25% additional terminations.
- Label each cable terminating on the terminal bar and numbers stamp each termination.

#### 5.2.3 Switchboards

- Effectively earth all metal work in the vicinity of the switchboards. Do not earth equipment via the neutral bus or the neutral earth connection.
- Where items of equipment (push buttons, instruments or switches) are mounted on doors:

- Bond the doors to the main body of the cubicle via a tinned copper braided flexible cable sufficient in length to allow the door to open 180 degrees.
- Attach the braided cable at each end by studs at least 5mm in diameter and 12mm in length.
- Securely weld the studs to each anchoring point prior to painting.
- Use flat brass washers and lock washers beneath a brass nut for securing ends of the cable.

#### **5.2.4 Cabling Accessories & Appliances**

- Earth lighting fittings, socket outlets and fixed wiring to appliances by means of the earth conductor which forms part of the respective circuit cabling.
- Use a separate earthing conductor for each circuit.
- Run earthing conductors back to the earth bar within the switchboard from where the supply originated.
- Number each earth bar terminal and record on Circuit Schedules.
- Earth all exposed metal fittings, e.g. cable trays, ducts, etc. associated with the Electrical Services.
- Earth all metal door frames fitted with a switch, electric lock etc.
- Where cable trays, troughs, ladders etc. support cables that penetrate a fire wall or separation, maintain earthing continuity of the support system through the penetration.

#### **5.2.5 Earthing of Accessible equipment**

- Provide earthing in accordance with AS/NZS 3000 Section 5 and AS/NZS 3003.

## 6. Low Voltage Power Systems

### 6.1 General

#### 6.1.1 Aims

##### Responsibilities

General: Provide low voltage power systems as documented.

#### 6.1.2 System description

##### Network supply

General: Liaise with the Network Distributor and provide network connection as documented.

Programme: Schedule the works and statutory inspections to suit the construction programme.

##### Distribution system

General: Provide power distribution system elements as documented.

##### Isolating Padmount Substation

Supply and install a complete Isolating padmount substation to TfNSW Standard EP 17 00 00 11 SP. Provide supply authority metering, 415V/415V isolation transformer and DSMSB in the padmount enclosure. Refer to TfNSW drawings EL 0282072, EL 0494646, EL 0480479 for further details.

Retail: Provide metering to the requirements TfNSW, the selected electricity retailer and the network distributor.

Private: Provide private metering as documented.

##### Design

Design responsibilities: Refer to the definition of 'provide' in the *General requirements* worksection.

Design parameters: As documented.

Fault protection: Automatic disconnection to AS/NZS 3000 clause 2.4.

Maximum demand: Calculation method to AS/NZS 3000 Appendix C.

#### 6.1.3 Cross references

##### General

General: Conform to the *General requirements* worksection.

### **Associated worksections**

Associated worksections: Conform to the following:

- *Electrical general requirements.*
- *Cable support and duct systems.*

### **6.1.4 Standards**

#### **General**

General: To SAA HB 301.

Electrical equipment: To AS/NZS 3100.

Fire and mechanical performance classification: To AS/NZS 3013.

Selection of cables: To AS/NZS 3008.1.1.

Distribution cables: To AS/NZS 4961.

#### **Testing**

Standard: To AS/NZS 3017.

### **6.1.5 Interpretations**

#### **Definitions**

Extra-low voltage: Not exceeding 50 V a.c. or 120 V ripple-free d.c.

Low-voltage: Exceeding extra-low voltage, but not exceeding 1000 V a.c. or 1500 V d.c.

High voltage: Exceeding low-voltage.

### **6.1.6 Submissions**

#### **Samples**

General: Submit samples of all visible accessories and equipment.

#### **Technical data**

General: Submit the following information for each main, submain and final subcircuit for which calculation is the responsibility of the contractor.

- Single line diagram.
- Fault Levels at switchboards.
- Maximum demand calculations.
- Cable and conductor cross sectional area and insulation type.
- Cable operating temperature at design load conditions.

- Voltage drop calculations at design load conditions.
- Protective device characteristics, e.g. curves,  $I^2t$ .
- Discrimination and grading of protective devices.
- Prospective short circuit current automatic disconnection times.
- Earth fault loop impedance calculations for testing and verification.
- Certify compliance with AS/NZS 3000, for electrical services.

Final subcircuits: May be treated as typical for common route lengths, loads and cable sizes.

### **Shop drawings**

General: Submit shop drawings of the following:

- Layout drawings showing the extent of the low voltage power system

## **6.2 Products**

### **6.2.1 Wiring systems**

#### **General**

Selection: Provide wiring systems appropriate to the installation conditions and the function of the load.

### **6.2.2 Power cables**

#### **Standard**

Polymeric insulated cables: To AS/NZS 5000.1.

Aerial cables: To AS 1746.

#### **Cable**

General: Select multi-stranded copper cable generally,

Default insulation: V-90HT.

Minimum size:

- Lighting sub-circuits: 2.5 mm<sup>2</sup>.
- Power sub-circuits: 2.5 mm<sup>2</sup>.

Voltage drop: Select final subcircuit cables within the voltage drop parameters dictated by the route length and load.

Fault loop impedance: Select final subcircuit cables selected to satisfy the requirements for automatic disconnection under short circuit and earth fault/touch voltage conditions.

Underground residential distribution systems: Select cables according to AS/NZS 4026.

Distribution cables: To AS/NZS 4961.

### **Colours**

Cables: For fixed wiring, provide coloured conductor insulation. If this is not practicable, slide at least 150 mm of close fitting coloured sleeving on to each conductor at the termination points.

Active conductors in single phase circuits: Red.

Active conductors in polyphase circuits:

- A phase: Red.
- B phase: White.
- C phase: Blue.

Sheath: White.

### **6.2.3 Accessories**

#### **General purpose socket outlets**

Standard:

- General: To AS/NZS 3112.
- Industrial: To AS/NZS 3123.

Socket outlet switches: Required.

Pin arrangement: Mount outlets with the earth pins at the 6 o'clock position.

#### **Plugs – 240/415 volt**

General: Provide plugs with integral pins of the insulated type to AS/NZS 3112.

#### **Installation couplers**

Standard: to AS/NZS 61535.

#### **Permanently connected equipment**

General: Provide final subcircuit to permanently connected equipment, as documented.

Isolation: Provide isolating switch adjacent to equipment.

Coordination: Coordinate with equipment supplier.

Wall/ceiling mounted equipment: Conceal final cable connection to equipment.

#### **Isolating switches**

Standard: To AS/NZS 3133.

#### **Emergency stop switches**

Standard: To IEC 60947-5-5.

### **3-phase outlets**

Construction: Surface mounted type of high-impact resistant plastic, with flap lid on the outlet.

Minimum: 20 A, 415 V a.c.

Pin arrangement: Five round pins mounted with earth pins at the 6 o'clock position, neutral pins in the centre and the red, white and blue phases in a clockwise sequence when viewed from the front of the outlet.

Plug: Provide a matching plug top for each outlet.

### **Appliances**

General: Provide appliances, as documented.

Connection: Shorten lead to minimum length for plug connections.

## **6.3 Execution**

### **6.3.1 Power cables**

#### **General**

Standard: Classifications to AS/NZS 3013.

Handling cables: Report damage to cable insulation, serving or sheathing.

Stress: Ensure that installation methods do not exceed the cable's pulling tension. Use cable rollers for cable installed on tray/ladders or in underground enclosures.

Straight-through joints: Unless unavoidable due to length or difficult installation conditions, run cables without intermediate straight-through joints.

Cable joints: Locate in accessible positions in junction boxes and/or in pits.

Extra-low voltage circuits: Individual wiring of extra-low voltage circuits: Tie together at regular intervals.

#### **Tagging**

General: Identify multi core cables and trefoil groups at each end with stamped non-ferrous tags clipped around each cable or trefoil group.

#### **Marking**

General: Identify the origin of all wiring by means of legible indelible marking.

### **6.3.2 Fire-rated (other than mims)**

#### **Protection**

General: If exposed to mechanical damage, provide protection to AS/NZS 3013.

### **6.3.3 Copper conductor terminations**

#### **General**

General: Other than for small accessory and luminaire terminals, terminate copper conductors to equipment, with compression-type lugs of the correct size for the conductor. Compress using the correct tool or solder.

#### **Within assemblies and equipment**

General: Loom and tie together conductors from within the same cable or conduit from the terminal block to the point of cable sheath or conduit termination. Neatly bend each conductor to enter directly into the terminal tunnel or terminal stud section, allowing sufficient slack for easy disconnection and reconnection.

Alternative: Run cables in UPVC cable duct with fitted cover.

Identification: Provide durable numbered ferrules fitted to each core, and permanently marked with numbers, letters or both to suit the connection diagrams.

Spare cores: Identify spare cores and terminate into spare terminals, if available. Otherwise, neatly insulate and neatly bind the spare cores to the terminated cores.

### **6.3.4 Accessories**

#### **Installation couplers**

Standard: To AS/NZS 3000 and AS/NZS 61535.

Location: Accessible.

### **6.3.5 Completion tests**

#### **Site tests**

Inspection: Visually inspect the installation to AS/NZS 3000 before testing. Submit record on a checklist.

Test and verify the installation to AS/NZS 3000 Section 8 using the methods outlined in AS/NZS 3017. Record and submit the results of all tests.

#### **Dummy load tests**

General: Where electrical tests are required and the actual load is not available, provide a dummy load equal to at least 75% of the design load.

## 6.4 Selections

### 6.4.1 Network supply

#### Network supply connection schedule

Nominal supply voltage	240/415 V
Number of phases	3
Frequency	50 Hz
Number of wires – system	4
Earthing system	MEN

### 6.4.2 Design

#### Design schedule

Voltage drop in final subcircuits	2%
Spare capacity for future use	25%
Export metering	N/A
Neutral sizing	100%
Harmonic loads	5%

### 6.4.3 Accessories

#### Accessory selections schedule

Component	Manufacture	Catalogue or reference	Description/ rating	Other/IP rating	Special
3 phase outlets	Clipsal	Industrial	10A or greater	IP66	
Isolating switches	Clipsal	C2000i Seris / WHB series		External and plant areas IP66	
Socket outlets	Clipsal	C2000i series	10A, 15A, 20A		
Outdoor socket outlets	Clipsal	WSCF228	10A Flush mounting	IP54	
Wall boxes	Clipsal	To suit outlets			
Captive Outlets	Clipsal	Clipsal 56 series	15A/20A	IP66	

## 7. Switchboards - Custom

### 7.1 General

#### 7.1.1 Aims

##### Responsibilities

General: Provide switchboards as follows and as documented.

#### 7.1.2 Cross references

##### General

General: Conform to the *General requirements* worksection.

##### Associated worksections

Associated worksections: Conform to the following:

- *Electrical general requirements.*
- *Low voltage power systems.*
- *Switchboard components.*

#### 7.1.3 Standard

##### General

Standards: To AS/NZS 3439.1.

#### 7.1.4 Interpretations

##### Abbreviations

General: For the purposes of this worksection the abbreviations given below apply.

- TTA: Type tested assemblies.
- NTTA: Non-type tested assemblies.
- PTTA: Partially type tested assemblies.

##### Definitions

General: For the purposes of this worksection the definitions given below apply.

- Custom-built assemblies: Low voltage switchgear and controlgear assemblies manufactured to order.

- There are a number of proprietary modular systems which can be configured to suit individual projects. For the purposes of this worksection, these assemblies can be regarded as custom-built assemblies.
- Rated currents: Rated currents are continuous uninterrupted current ratings within the assembly environment under in-service operating conditions.
- Rated short-circuit currents: Maximum prospective symmetrical root mean square (r.m.s.) current values at rated operational voltage, at each assembly incoming supply terminal, excluding effects of current limiting devices.

#### **7.1.5 Tests**

##### **Routine tests**

Standard: To AS 3439.1.

Assemblies: Electrical and mechanical routine function tests at the factory using externally connected simulated circuits and equipment.

Dielectric testing: NTTAs and PTTAs: 2.5 kV r.m.s. for 15 s.

#### **7.1.6 Inspection**

##### **Notice**

Inspection: Give sufficient notice so inspection may be made of the following:

- Assembly ready for routine testing.
- Assembly installed prior to connection.
- Assembly installed and connected.

#### **7.1.7 Submissions**

##### **Calculations**

General: Submit detailed certified calculations verifying design characteristics.

Standard: To AS 3865 and AS 4388.

##### **Type test data**

General: Submit type test certificates for components, functional units and assemblies. Verify that type tests and internal arcing-fault tests, if any, were carried out at not less than the designated fault currents at rated operational voltage.

Alterations to TTAs: Submit records of alterations made to assemblies since the tests.

##### **Routine tests**

General: Submit reports.

### **Technical data**

Calculations: Submit design calculations of non-type tested and non-proprietary busbar assemblies.

### **Shop drawings**

General: Submit shop drawings showing:

- Types, model numbers and ratings of assemblies.
- Component details, functional units and transient protection.
- Detailed dimensions.
- Shipping sections, general arrangement, plan view, front elevations and cross-section of each compartment.
- Projections from the assembly that may affect clearances or inadvertent operation, such as handles, knobs, arcing-fault venting flaps and withdrawable components.
- Fault level and rated short circuit capacity characteristics.
- IP rating.
- Fixing details for floor or wall mounting.
- Front and back equipment connections and top and bottom cable entries.
- Door swings.
- External and internal paint colours and paint systems.
- Quantity, brand name, type and rating of control and protection equipment.
- Construction and plinth details, ventilation openings, internal arcing-fault venting and gland plate details.
- Terminal block layouts and control circuit identification.
- Single line power and circuit diagrams.
- Details of mains and submain routes within assemblies.
- Busbar arrangements, links and supports, spacing between busbar phases and spacing between assemblies, the enclosure and other equipment and clearances to earthed metals.
- Dimensions of busbars and interconnecting cables in sufficient detail for calculations to be performed.
- Form of separation and details of shrouding of terminals.
- Labels and engraving schedules.

## **7.2 Products**

### **7.2.1 General**

### **7.2.2 Custom-built switchboard construction**

#### **General**

General: Provide custom-built switchboards as documented.

#### **Separation**

IMSB: Form 2b.

Standard DB's: Form 1.

#### **Metering**

Refer Low voltage power systems.

#### **Spare capacity**

Default spare poles:  $\geq 25\%$ .

#### **Surge diversion**

General: Required.

#### **Earthing**

General: Make provision for connection of communications systems CET at switchboard earth bar to AS/ACIF S009.

#### **IP rating**

Default rating: IP42 minimum.

Weatherproof: IP56 minimum.

#### **Supporting structure**

Assemblies:

- Wall mounted:  $\leq 2 \text{ m}^2$ .
- Floor mounted:  $> 2 \text{ m}^2$ .

#### **Ventilation**

General: Required to maintain design operating temperatures at full load.

#### **Layout**

General: Position equipment to provide safe and easy access for operation and maintenance. Group devices according to function.

Connexion: Front connected.

Equipment on doors: Set out in a logical manner in functional unit groups, so it is accessible without the use of tools or keys.

### **Segregation**

General: Segregate BCA emergency equipment from non-emergency equipment by means of metal partitions designed to prevent the spread of a fault from non-emergency equipment to emergency equipment.

### **Enclosure materials**

General: Fabricate from sheet metal of rigid folded and welded construction. Obtain approval for non-welded forms of construction.

Material: Metallic-coated sheet steel to AS 1397.

Material thickness:

- Diagonal dimension:
  - < 900 mm:  $\geq 1.6$  mm.
  - $\geq 900$  mm:  $\geq 2.0$  mm.

Coating class:

- Indoor assemblies: Z200.
- Outdoor assemblies: Z450.

### **Insect proofing**

General: Cover ventilation openings with non-combustible and corrosion resistant 1 mm mesh.

### **Equipment mounting panels**

General: To support the weight of mounted equipment.

Metallic panels: Construct from  $\geq 3$  mm thick metal with heavy metal angle supports or plates bolted or welded to enclosure sides.

Non-metallic panels: Provide non-metallic panels selected to suit the weight of the mounted equipment and design the mounting structure for stability and stiffness.

Non-metallic boards: To IEC 60893-1.

### **Equipment fixing**

Spacing: Provide 50 mm minimum clearance between the following:

- Busbars for lifts, fire services and building emergency services.
- General installation services, busbars and equipment.

Mounting: Bolts, set screws fitted into tapped holes in metal mounting panels, studs or proprietary attachment clips. Provide accessible equipment fixings which allow equipment changes after assembly commissioning.

Installation: For lightweight equipment, provide combination rails and proprietary clips.

### **Earth continuity**

General: Strip painted surfaces and coat with corrosion resistant material immediately before bolting to the earth bar. Provide serrated washers under bolt heads and nuts at painted, structural metal-to-metal joints.

### **Construction**

Lifting provisions: For assemblies with shipping dimensions exceeding 1800 mm high x 600 mm wide, provide fixings in the supporting structure and removable attachments for lifting.

Supporting structure: Provide concealed fixings or brackets to allow assemblies to be mounted and fixed in position without removing equipment.

Floor-mounting: Provide mild steel channel plinth, galvanized to class Z600, with toe-out profile, nominal 75 mm high x 40 mm wide x 6 mm thick, for mounting complete assemblies on site. Drill M12 clearance holes in assembly and channel and bolt assemblies to channel. Prime drilled holes with zinc rich organic primer to AS/NZS 3750.9.

Ventilation: Provide ventilation to maintain design operating temperatures at full load.

## **7.2.3 Cable entries**

### **General**

General: Provide cable entry facilities within assembly cable zones for incoming and outgoing power and control cabling. Provide sufficient clear space within each enclosure next to cable entries to allow incoming and outgoing cables and wiring to be neatly run and terminated, without undue bunching and sharp bends.

### **Cover and gland plates**

Cover plates: Provide 150 mm maximum width cover plates butted together and covering the continuous cable entry slot.

Gland plates: Provide removable gland plates fitted with gaskets to maintain the degree of protection.

Materials: 1.5 mm thick steel, 5 mm thick composite material or laminated phenolic. 6 mm thick brass for MIMS cables and cable glands.

## **7.2.4 Doors and covers**

### **General**

Provide lockable doors with a circuit card holder unless enclosed in cupboards.

### **Door layout**

Maximum width: 900 mm.

Minimum swing: At least 90°.

Door stays: Provide stays to outdoor assembly doors.

Adjacent doors: Space adjacent doors to allow both to open to 90° at the same time.

### **Door construction**

Protection: Provide single right angle return on all sides and fit suitable resilient sealing rubber to provide the documented IP rating and prevent damage to paintwork.

Hinges: Provide corrosion-resistant pintle hinges or integrally constructed hinges to support doors. For removable doors, provide staggered pin lengths to achieve progressive engagement as doors are fitted. Provide 3 hinges for doors higher than 1000 mm. Provide restraining devices and opposed hinges for non lift-off doors.

Door hardware: Provide the following:

- Corrosion resistant lever-type handles, operating a latching system with latching bar and guides strong enough to withstand explosive force resulting from fault conditions within the assembly.
- Dual, edge mounted, corrosion resistant T handles with provision for key locking cylinder.
- Captive, corrosion resistant knurled thumb screws.

Locking: Incorporate cylinder locks in the latching system. Key alike, 2 keys per assembly.

Door mounted equipment: Protect or shroud door mounted equipment and terminals to prevent inadvertent contact with live terminals, wiring, or both.

Earthing: Maintain earth continuity to door mounted indicating or control equipment with multi-stranded, flexible earth wire, or braid of equal cross-sectional area, bonded to the door.

### **Covers**

Maximum dimensions: 900 mm wide and 1.2 m<sup>2</sup> surface area.

Fixing: Fix to frames with at least 4 fixings. Provide corrosion-resistant acorn nuts if the cover exceeds 600 mm in width. Rest cover edges on the cubicle body or on mullions. Do not provide interlocked covers.

Handles: Provide corrosion resistant D type handles.

### **Escutcheons**

General: For doors enclosing circuit breakers, provide escutcheon plates as barriers between operating mechanisms and live parts.

### **Escutcheon plates**

General: Provide plates or removable covers with neat circuit breaker toggle cut-outs allowing interchangeability of 1, 2 and 3 pole circuit breakers. Provide corrosion-resistant lifting handles or knobs. Provide unused circuit breaker toggle cut-outs with blanking in-fill pole covers.

Maximum dimensions: 900 mm wide and 1.2 m<sup>2</sup> surface area.

### 7.2.5 Factory finishes

#### General

Standard: To AS 2700.

Extent: Apply protective coatings to internal and external metal surfaces of assembly cabinets including covers, except to stainless steel, galvanized, electroplated, or anodised surfaces and to ventilation mesh covers.

Finish coats: Thermoset powder coating to AS 4506 or two-pack liquid coating of AS/NZS 3750.13 primer and proprietary or epoxy acrylic full gloss spray finish to Factory finishes schedule.

#### Factory finishes schedule

Mounting structure (brackets)	To match enclosure
Enclosure	Indoor assemblies: Orange X15 Outdoor assemblies: Avocado green G34 Assembly interior: White
Escutcheons	Removable equipment panels: Off white Y35
Doors	To match enclosure
Plinths	Black

### 7.2.6 Busbars

#### General

General: Provide main circuit supply busbars within assemblies, extending from incoming supply terminals to the line side of protective equipment for outgoing functional units and for future functional units.

Standards: To AS 3768, AS 3865 and AS 4388.

#### Definitions

Incoming busbars: Busbars connecting incoming terminals to line side terminals of main switches.

Main circuit supply busbars: Busbars connecting incoming functional unit terminals, or incoming busbars where no main switches are included, to outgoing functional unit terminals or outgoing functional unit tee-offs.

Tee-off busbars: Busbars connecting main busbars to incoming terminals of outgoing functional units.

### **Custom-built busbar construction**

Material: Hard-drawn high-conductivity electrolytic tough pitched copper alloy bars, designation 110.

Temperature rise limits - active and neutral conductors:

- Maximum rated current temperature rise limits:  $65 \pm 1.5^{\circ}\text{C}$  by type test or calculation to AS 3768 or AS 4388.

Maximum short-circuit withstand current temperature rise limits:  $160^{\circ}\text{C}$  by calculation to AS 3865.

Cross section: Rectangular with radiused edges.

Supports: Sufficient to withstand thermal and magnetic stresses due to maximum prospective fault currents.

Support material: Non-hygroscopic insulation capable of holding busbars at  $105^{\circ}\text{C}$ .

### **Proprietary busbars**

Type: Multi-pole proprietary insulated busbar assemblies or busbar systems, verified for short circuit capacity and temperature rise-limits by type tests.

### **Phase sequence**

General: For main busbars and connections to switching devices, set-out phase sequence for phases A, B and C, from left-to-right, top-to-bottom and front-to-back when viewed from the front of the assembly.

### **Colour coding**

General: Provide 25 mm minimum width colour bands permanently applied to busbars at 500 mm maximum intervals with at least one colour band for each busbar section within each compartment.

Active busbars: Red, white and blue respectively for the A, B and C phase.

Neutral busbar: Black.

MEN link: Green-yellow and black.

Protective earth busbar: Green-yellow.

Restrictions: Do not provide adhesive type colour bands.

### **Current carrying capacity**

Active conductors: Take into account thermal stresses due to short circuit current, assuming magnetic material enclosures located indoors in well-ventilated rooms and  $90^{\circ}\text{C}$  final temperature.

Neutral conductors: Size to match incoming neutral conductor current carrying capacity.

Protective earth conductors: Size for at least 50% of the rated short circuit withstand current for 100% of the time duration.

#### **Tee-off busbars current rating**

For individual outgoing functional units: Equal to maximum frame size rating of the functional unit.

For multiple functional units: Equal to the diversity factors of AS 3439.1, based on frame size rating.

#### **MEN links**

MEN links > 10 mm<sup>2</sup> in cross-section: Bolted removable busbar links stamped MEN LINK, located in the incoming compartment, between neutral and earth busbars.

#### **Busbar links**

General: For current transformers, provide removable busbar links ≤ 450 mm long.

#### **Cable connection flags**

General: Provide and support busbar flags for equipment with main terminals too small for cable lugs. Provide flags sized to suit cable lug termination, with current rating of at least the maximum equipment frame size.

Phase isolation: Provide phase isolation between flags where the minimum clearance distances phase-to-phase and phase-to-earth are below the component terminal spacing.

#### **Custom-built busbar insulation**

Active and neutral busbars and joints: Select from the following:

- Polyethylene: At least 0.4 mm thick with dielectric strength of 2.5 kV r.m.s for 1 minute, applied by a fluidised bed process in which the material is phase coloured and directly cured onto the bars.
- Close fitting busbar insulation mouldings at least 1 mm thick.
- Heat shrink material: Only on rounded edge busbars.

Taped joints: Apply non-adhesive stop-off type tape, coloured to match adjacent insulation and half lapped to achieve a thickness at least that of the solid insulation.

Damaged insulation: Repair damaged insulation before energising.

### **7.2.7 Neutral links and earth bars**

#### **Terminals**

General: Provide terminals for future circuits.

## Links

Assembly capacity > 36 poles: Provide neutral links and earth bars at the top and bottom of the circuit breaker section.

Assembly capacity ≤ 36 poles: Provide links and bars at the point of entry of incoming supply cables.

Mounting: Mount neutral links on an insulated base.

Control circuits: Provide separate neutral links and earth bars.

Labels: Provide labels for neutral and earth terminals.

Cables > 10 mm<sup>2</sup>: Provide bolts or studs.

Communications earth: Make provision for connection of communications systems earth at switchboard earth bar to AS/ACIF S009.

### 7.2.8 Internal wiring

#### Wiring

General: Cable type: 0.6/1 kV copper cables. Provide V-90HT insulation where directly connected to active and neutral busbars.

#### Cable interconnections

General: For the main circuit supply, provide cable interconnections as follows:

- ≥ 1.5 mm<sup>2</sup> internal cables, with minimum V90 insulation rating with stranded copper conductors rated to AS/NZS 3008.1.1. Provide cables with current ratings suitable for the internal assembly ambient air temperature and for temperature rise limits of equipment within the assembly.
- Run cables clear of busbars and metal edges.
- Provide cables capable of withstanding maximum thermal and magnetic stresses associated with relevant fault level and duration.
- Run cables neatly. Provide slotted trunking sized for future cables or tie at 150 mm maximum intervals with ties strong enough to withstand magnetic stresses created at the specified fault current. Do not provide adhesive supports.
- Ensure wiring for future equipment can be installed without removal of existing equipment.
- Identify power and control cables at both ends with neat fitting ring type ferrules agreeing with record circuit diagrams. Mark to AS/NZS 4383.
- Terminate control cables and motor control circuits in tunnel terminals or, if necessary, provide suitable palm type lugs and correct crimp tool.
- For equipment mounted on hinged doors run cables on the hinge side to avoid restricting the door opening. Bundle cables with spiral wrap PVC and secure to door.

- If recommended by device manufacturers, provide shielded wiring.

Adjacent circuit breakers: If suitable proprietary multi-pole busbar assemblies are available to link adjacent circuit breakers, do not provide cable interconnections.

### **Cables > 6 mm<sup>2</sup>**

Terminations:

- Tunnel terminals: Single cables.
- Other connection points or terminals: ≤ 2 cables.

Doors: Do not run cables to hinged doors or removable panels.

Supports:

- Spacing at enclosure: ≤ 200 mm from a termination.
- Spacing generally: ≤ 400 mm.
- Strength: Capable of withstanding forces exerted during fault conditions.

Single core cables rated ≥ 300 A: Do not provide ferrous type metal cable saddles.

Terminals marked: Terminate marked cables for connection to external controls in correspondingly marked terminals within the assembly.

### **Control and indication circuits**

General: Provide conductors sized to suit the current carrying capacity of the particular circuit.

Minimum size: 1 mm<sup>2</sup> with 32/0.2 stranding.

### **Cable colours**

General: Colour code wiring as follows:

- A phase: Red.
- B phase: White.
- C phase: Blue.
- Neutral: Black.
- Earthing: Green-yellow.

### **7.2.9 Terminations**

#### **Submains, light and power circuits**

General: Connect direct to the control equipment terminals.

Shipping breaks: Provide terminal blocks for interconnecting wiring on each side of shipping breaks.

## **7.3 Execution**

### **7.3.1 Assembly installation**

#### **Fixing**

General: Before making inter-panel connections, fix assemblies and metering equipment enclosures into position, level and plumb.

### **7.3.2 Assembly entries**

#### **Cable entries**

General: Neatly adapt one or more cable entry plates, if fitted, to accept incoming cable enclosure. Provide the minimum number of entry plates to leave spare capacity for future cable entries. Do not run cables into the top of weatherproof assemblies.

Single core cables rated > 300 A: Pass separately through non-ferrous gland plates. Do not use metal saddles.

#### **Cable enclosures**

General: Continue cable enclosures to or into assemblies and fit cable entry plates so that the IP rating of the assembly and the fire rating of the cable are maintained.

#### **Cable supports**

General: Support or tie mains and submains cables within 200 mm of terminations. Provide cable supports suitable for stresses resulting from short circuit conditions.

#### **Bus trunking system entry**

General: Provide entry plates with close tolerance cut-out to accommodate busbars, fitted with a flange bolted and sealed to assembly enclosure to maintain assembly IP rating. Earth busway enclosure to assembly protective earth conductor. Fit busway flanges at assembly manufacturer's premises and retain for transportation.

### **7.3.3 Marking and labelling**

#### **General**

General: Label the switchboard assembly in conformance with AS/NZS 3439.1 including the following:

- Size and type of all incoming and outgoing mains and submains.
- Emergency operating procedures.

### **7.3.4 Completion**

#### **Maintenance**

Standard: To AS 2467.

General: Carry out the following:

- Rectify faults, make adjustments and replace consumable and faulty materials and equipment within 24 hours of notification.
- Monthly inspections and maintenance work to maintain the assembly, including battery systems.

## 7.4 Selections

### 7.4.1 Custom Switchboards

Assembly designation	IMSB
Location	Switch Room
Fault level	20kA
Special service conditions	-
Form of separation	2b
Future bus bar extension required	No
Future circuits required	Yes
Surge diversion required	Yes
Supporting structure	Floor Standing
Protection (IP rating)	IP42
Bus bar rated current (minimum)	300A
Main isolator rated current (minimum)	300A
Surge diversion required	Yes
Metering	-
Provision for control equipment	As required

## 8. Switchboards – Proprietary

### 8.1 General

#### 8.1.1 Aims

##### Responsibilities

General: Provide switchboards as follows and as documented.

#### 8.1.2 Cross references

##### General

General: Conform to the *General requirements* worksection.

##### Associated worksections

Associated worksections: Conform to the following:

- *Electrical general requirements.*
- *Switchboard components.*

#### 8.1.3 Standards

##### General

Standards: To AS/NZS 3439.3.

#### 8.1.4 Interpretations

##### Definitions

General: For the purposes of this worksection the definitions given below apply.

- **Proprietary assemblies:** Low voltage switchgear and controlgear assemblies available as a catalogue item, consisting of manufacturer's standard layouts and equipment.
- **Rated currents:** Rated currents are continuous uninterrupted current ratings within the assembly environment under in-service operating conditions.
- **Rated short-circuit currents:** Maximum prospective symmetrical root mean square (r.m.s.) current values at rated operational voltage, at each assembly incoming supply terminal, excluding effects of current limiting devices.

#### 8.1.5 Submissions

##### Product data for proprietary assemblies

General: Submit the following:

- Makes, types and model numbers of items of equipment.
- Type test certificates for components, functional units and assemblies including internal arcing-fault tests and factory test data
- Overall dimensions.
- Fault level.
- IP rating.
- Rated current of components.
- Number of poles and spare capacity.
- Mounting details.
- Door swings.
- Paint colours and finishes.
- Access details.
- Schedule of labels.

## **8.2 Products**

### **8.2.1 General**

#### **Enclosure**

Default material: Metallic coated sheet steel.

#### **Separation**

Default: Form 1.

#### **Metering**

Refer Low voltage power systems.

#### **Busbars**

General: Incorporate proprietary insulated busbar systems for the interconnection of isolators, circuit breakers and other circuit protective devices.

#### **Spare capacity**

Default spare poles:  $\geq 25\%$ .

#### **Surge diversion**

General: Required.

## **Earthing**

General: Make provision for connection of communications systems CET at switchboard earth bar to AS/ACIF S009.

## **Doors**

General: Provide lockable doors with a circuit card holder unless enclosed in cupboards or in an area which is not readily accessible to the public.

## **IP rating**

Default rating: IP42 minimum.  
Weatherproof: IP56 minimum.

## **Finishes**

Interior: White.

Exterior: Installed in cupboards, switchrooms and plant rooms: Manufacturers standard powder coated finish.

Exterior: Installed elsewhere: To non-standard selected powder coated colour.

## **Supporting structure**

Assemblies:

- Wall mounted:  $\leq 2 \text{ m}^2$ .
- Floor mounted:  $> 2 \text{ m}^2$ .

## **Ventilation**

General: Required to maintain design operating temperatures at full load.

## **8.3 Execution**

### **8.3.1 General**

#### **Fixing**

General: Before making inter-panel connections, fix assemblies and metering equipment enclosures into position, level and plumb.

#### **Cable entries**

General: Neatly adapt one or more cable entry plates, if fitted, to accept incoming cable enclosure. Provide the minimum number of entry plates to leave spare capacity for future cable entries. Do not run cables into the top of weatherproof assemblies.

Single core cables: Pass separately through non-ferrous gland plates. Do not provide metal saddles. Provide glands for all single core cables.

### **Cable enclosures**

Cable enclosures: Continue cable enclosures to or into assemblies and fit cable entry plates so that the IP rating of the assembly and the fire rating of the cable are maintained.

### **Cable supports**

Cable supports: Support or tie mains and submains cables within 200 mm of terminations. Provide cable supports suitable for stresses resulting from short circuit conditions.

## **8.3.2 Maintenance**

### **General**

Standard: To AS 2467.

## **8.4 Selections**

### **8.4.1 Proprietary switchboards**

<b>Assembly designation</b>	
Location	As show on the drawings
Special service condition	-
Enclosure material	Metallic-coated sheet steel
Bus bar rated current (minimum)	160A
Rated short-circuit current (minimum)	10kA
Form of separation (minimum)	Form 1
Main isolator rated current (minimum)	As shown on drawings
Future circuits required	≥ 20% spare poles
Minimum number of poles (excluding main isolator)	As shown on drawings
Surge diversion required	Yes
Metering	N/A
Provision for control equipment	As required

## 9. Switchboard Components

### 9.1 General

#### 9.1.1 Aims

##### Responsibilities

General: Provide switchboard components as follows and as documented.

#### 9.1.2 Cross references

##### General

General: Conform to the *General requirements* worksection.

##### Associated worksections

Associated worksections: Conform to the following:

- *Electrical general requirements.*
- *Switchboards – proprietary.*
- *Switchboards – custom-built.*

#### 9.1.3 Design

##### Statutory authority's equipment

General: Liaise with the supply authority with regard to the installation and coordinate with their protective and control equipment.

#### 9.1.4 Submissions

##### Technical data

General: Submit technical data for all components.

### 9.2 Products

#### 9.2.1 General

##### General

Selection: To comply with the requirements of AS/NZS 3000 clause 1.7 and Section 2.

Rated duty: Uninterrupted.

Rated making capacity (peak):  $\geq 2.1 \times$  fault level (RMS) at assembly incoming terminals.

Utilisation category: To AS 60947.1 clause 4.4.

- Circuits consisting of motors or other highly inductive loads: At least AC-23.
- Other circuits: At least AC-22.

Coordination: Select and adjust protective devices to discriminate under over-current, and earth faults.

Enclosure: IP4X minimum.

### **9.2.2 Switch-isolator and combination fuse-switch units**

#### **General**

Standard: To AS 60947.1 and AS/NZS 3947.3.

Poles: 3.

Operation: Independent manual operation including positive ON/OFF indicator.

Shrouding: Effective over range of switch positions.

Rated breaking capacity:  $\geq$  rated full load current.

#### **Fuse-switch units**

Operation: Provide an extendable operating handle.

Fuse links: To be isolated when switch contacts are open. Provide 3 phase sets of high rupturing capacity (HRC) fuse links.

### **9.2.3 Moulded case and miniature circuit breakers**

#### **General**

Moulded case breakers: To AS 60947.1, AS 2184 and AS 60947.2.

Miniature circuit breakers: To AS/NZS 60898.1 or AS 3111.

Operation: Independent manual operation including positive ON/OFF indicator.

Trip type:

- Moulded case breakers: Adjustable thermal, fixed magnetic.
- Miniature circuit breakers: Fixed thermal, fixed magnetic.

Current limiting:

- Moulded case breakers: Required.

Isolation facility: Required.

Mounting: Mount circuit breakers so that the ON/OFF and current rating indications are clearly visible with covers or escutcheons in position. Align operating toggles of each circuit breaker in the same plane.

Utilisation category: Moulded case breakers:

- Final subcircuits category: Category A.
- Mains and submains: Category B.

Trip settings: Set as documented, seal, and label.

Trip units: Connect interchangeable and integrally fused trip units so that trip units are not live when circuit breaker contacts are open.

#### **9.2.4 Residual current operated circuit breakers (RCBO)**

Standard: To AS/NZS 3190.

Integral non-overload protection type: To AS/NZS 61008.1.

Integral overload protection type: To AS/NZS 61009.1.

Modular type: To AS 60947.2.

Default tripping current: 30 mA.

#### **9.2.5 Circuit breaker integral protective relays**

General: Provide integral protective relays which provide for tripping in the event of relay operation, and for manually resetting. Provide operation indicators with a set of change over voltage free alarm contacts, for connection to an alarm circuit.

Mounting: Integral type: Readily accessible for viewing and adjustment with doors and covers in position.

Mounting: External type: Flush.

#### **9.2.6 Transient protection**

##### **Standards**

Assemblies connected to the MEN earthing system: To AS 4070 Category II.

##### **Primary protection**

General: Provide shunt connected metal oxide varistors at assembly incoming supply terminals, on the line side of incoming functional units.

Visual indicator: Provide visual indication of status of transient detection.

Alarm contacts: Provide one set of normally closed 'dry' contacts indicating occurrence of a surge transient.

### **Secondary protection**

General: Provide metal oxide varistors or zener diode surge protection to assembly in-built equipment and to semi-conductor components which are not able to withstand transient overvoltages exceeding primary protection let-through residual levels.

### **9.2.7 Current transformers (metering)**

#### **Standard**

Measurement current transformers: To AS 60044.1.

#### **Test links**

General: Provide test links for connection of calibration instruments and meters and for shorting of current transformer secondaries.

Energy meters, maximum demand meters, ammeters and protection relays: Provide with rail-mounted links consisting of screw-clamped slide links and an earth link.

#### **Test studs**

General: For energy and demand meters provide rail-mounted potential test studs or plug connections next to associated current transformer links. Provide at least one set of test studs for each compartment.

#### **Accuracy classification**

Energy measurements: Class 0.5.

Indicating instruments: Class 3.

#### **Ratings**

Rated short time current: At least the short time withstand current equivalent of the circuit in which the transformer is installed.

Rated primary current: At least equal to the current rating of the functional unit.

Secondary windings: Rated at 5 A, burden of 0.4  $\Omega$  (10 VA) with star point earthed.

#### **Type**

General: If practicable, cast resin encapsulated window-type with busbar clamping devices. Otherwise wound-primary type with mounting feet.

#### **Installation**

General: Install transformers to permit easy removal.

Removable links: Provide removable links of minimum length for transformers fitted on busbar systems.

## **Labels**

General: If associated exclusively with one phase, label meters *RED*, *WHITE*, or *BLUE* as applicable.

## **Protection devices**

Meter potential protection devices: Group together behind associated meter cover or hinged door, preferably next to current transformer test links.

## **Accessories**

General: Mount next to associated instruments, inside cabinets.

### **9.2.8 Contactors**

Standard: To AS 60947.4.1.

Type: Enclosed, block type, air break, electro-magnetic.

Poles: 3.

Rated operational current: The greater of:

- Full load current of the load controlled.
- $\geq 16$  A.

Mechanical durability: 10 million cycles to AS 60947.4.1.

Electric durability:  $\geq 1$  million operations at AC-22 to AS 60947.4.1.

Mounting: Mount with sufficient clearance to allow full access for maintenance, removal and replacement of coils and contacts, without the need to disconnect wiring or remove other equipment.

Auxiliary contacts: Provide auxiliary contacts with at least one normally-open and one normally-closed separate contacts with rating of 6 A at 240 V a.c., utilisation category: AC-1.

Slave relay: If the number of auxiliary contacts exceeds the number which can be accommodated, provide separate slave relays.

### **9.2.9 Control devices and switching elements**

#### **Standards**

General: To AS 60947.1 and AS 60947.5.1.

Switching elements:

- Electrical emergency stop device with mechanical latching function: To AS 60947.5.4.
- Electromechanical control circuit devices: To AS 60947.5.1.
- Proximity switches: To AS 60947.5.2.

### Rotary switches

General: Cam operated type with switch positions arranged with displacement of 60°.

Off position: Locate at the 12 o'clock position. Test positions must spring return to off position.

Rated operational current: At least 6 A at 240 V a.c.

Escutcheon plates: Provide rectangular plates securely fixed to the assembly panel. Identify switch position and function.

### Time switches

Operation: 365 day operation.

Mains failure operation: 100 hour minimum operating capacity.

Contact rating:  $\geq 16$  A at 240 V a.c.

Construction: Provide readily accessible means of adjustment. Provide operational settings which are clearly visible when switch cover is fitted.

Dial: Digital with hour and minute display.

Override switch (manual): Required.

### Control relays

Standards: To AS 60947.5.1.

Operation: Suitable for continuous operation. Provide relays selected in conformance with the Control relay selection table.

Construction: Plug-in types. Receptacle bases with captive clips which can be operated without using tools.

Contact elements: Electrically separate, double break with silver alloy, non-welding contacts.

Configuration: For standard relays, provide assemblies with  $\geq 2$  sets of contacts and expandable to 8 sets of contacts in the same assembly. Provide at least one normally-open and one normally-closed contact.

On site conversion: Provide contact blocks readily convertible to either normally-open or normally-closed contacts.

### Control relay selection table

Relay type	Minimum mechanical life (million operations)	Base	Minimum contact rating	Inter-changeable	Minimum number of contact elements
1	5	Plug-in	1.25I <sub>L</sub>	Yes	2
2	10	Plug-in	5 A at 240 V	Yes	2
3	10	Fixed mounting	5 A at 240 V	Yes	4

### **Time delay relays**

Adjustable range: Adjustable over the full timing range with timing repeatability within  $\pm 12.5\%$  of nominal setting.

Electronic relays: Incorporate light emitting diodes indicating energisation states of relays.

### **Phase failure relays**

General: Provide separate solid-state phase failure relays which release at the following:

- < 85% of normal voltage.
- Single phase failure.
- Reverse phase sequence after an appropriate time delay.

Sensing circuit: To reject induced voltage spikes and disturbances with frequencies other than 50 Hz.

Back-up protection: Provide high rupturing capacity fuses to each phase.

### **Push-buttons**

Type: Oil-tight, minimum 22 mm diameter, or 22 x 22 mm.

Rated operational current: At least 4 A at 240 V a.c.

Emergency stop devices with mechanical latching: To AS/NZS 3947.5.5.

Marking: Identify functions of each push-button. For latched STOP or EMERGENCY STOP push-buttons, provide label with instructions for releasing latches.

## **9.2.10 Control and protective switching devices or equipment**

### **General**

Standard: AS 60947.6.2.

## **9.2.11 Indicator lights**

### **Standard**

General: To AS 60947.5.1.

### **Incandescent indicators**

Type: Incandescent oil tight type minimum 22 mm diameter or 22 x 22 mm.

Lamps: Changeable from front of panel without removing the holder.

Lamp rating: 1.2 to 5 W.

### **Neon indicators**

General: 240 V, 12 mm diameter with in-built resistor.

### **LED indicators**

General: 12 or 24 V as necessary, in corrosion-resistant bezel, nominal 5 mm diameter.

### **Press-to-test**

Compartments/subsections with < 5 indicating lights: Provide each indicating light with a fitted integral press-to-test lamp actuator.

Compartments/subsections with  $\geq 5$  indicating lights: Provide a common press-to-test lamp push-button.

## **9.2.12 Indicating counters**

### **General**

General: Provide the following:

- At least 6 digits.
- Digits at least 3.5 mm high.
- Continuous duty rated.
- Non-reset type.
- 500 V surge diverters.

## **9.3 Execution**

### **9.3.1 Marking and labelling**

#### **General**

General: Provide labels including control and circuit equipment ratings, functional units, notices for operational and maintenance personnel, incoming and outgoing circuit rating, sizes and origin of supply and kW ratings of motor starters.

Lettering heights: Include the following requirements:

- Isolating switches:  $\geq 5$  mm.
- Switchboards, main assembly designation:  $\geq 25$  mm.
- Switchboards, outgoing functional units:  $\geq 8$  mm.
- Switchboards, sub assembly designations:  $\geq 15$  mm.

#### **Labels on assembly exteriors**

Manufacturer's name: Required.

**Assemblies:** Label with essential markings.

**Designation labels:** For other than main assemblies, provide designation label stating source of electrical supply. Identify separate sections of enclosures.

**Assembly controls:** Label controls and fault current limiters, including the following:

- Circuit designation for main switches, main controls and submains controls.
- Details of consumers mains and submains.
- Incoming busbar or cable rating to first tee-off.
- Fuse link size.

### **Labels on assembly interiors**

**General:** Provide labels for equipment within assemblies. Locate so that it is clear which equipment is referred to, and so that lettering is not obscured by equipment or wiring.

**Moulded case circuit breakers:** If circuit breaker manufacturer's markings are obscured by operating handle mechanisms or motor operators, provide additional markings open to view on, or next to, the circuit breaker.

**Arrestors:** Label each group of primary arrestors, stating their purpose and the necessary characteristics.

### **Danger, warning and caution notices**

**Busbars:** If polymer membrane coating is used without further insulation, provide warning notices on the front cover near the main switch or local main switch and on rear covers, indicating that busbars are not insulated.

**Fault current limiters:** In assembly sections containing fault current limiter fuses provide caution notices fixed next to the fault current limiters, stating that replacement fuse links are to match the installed fuse link ratings, make and characteristics. Provide separate label stating make and fault current limiting fuse ratings.

**Externally controlled equipment:** To prevent accidental contact with live parts, provide warning notices for equipment on assemblies not isolated by main switch or local main switch.

**Stand-by power:** Provide warning notices stating that assemblies may be energised from the stand-by supply at any time.

**Anti-condensation heaters:** To prevent accidental switching off, provide caution notices for anti-condensation heaters.

**Insulation and shrouding:** For insulation or shrouding requiring removal during normal assembly maintenance, provide danger notices with appropriate wording for replacement of insulation shrouding before re-energising assemblies.

**Positioning:** Locate notices so that they can be readily seen, next to or, if impracticable, on busbar chamber covers of functional units and behind the front cover of functional units. Provide

circuit identification labels in the cabling chamber of each functional unit, located next to external terminations.

### **Schedule cards**

General: For general light and power distribution assemblies, provide schedule cards of minimum size 200 x 150 mm, with typewritten text showing the following as-installed information:

- Submain designation, rating and short-circuit protective device.
- Light and power circuit numbers and current ratings, cable sizes and type and areas supplied.
- Mounting: Mount schedule cards in a holder fixed to the inside of the assembly or cupboard door, next to the distribution circuit switches. Protect with hard plastic transparent covers.

### **Single-line diagrams**

Main and submain assemblies: Provide single-line diagrams.

Format: Non-fading print, at least A3 size, showing the situation as installed.

Mounting: Enclose in a non-reflective PVC frame and wall mount close to assembly.

### **Marking cables**

General: Identify the origin of all wiring by means of legible indelible marking.

Identification labels: Provide durable labels fitted to each core and sheath, permanently marked with numbers, letters or both to suit the connection diagrams.

Multicore cables and trefoil groups: Identify multicore cables and trefoil groups at each end with durable non-ferrous tags clipped around each cable or trefoil group.

## 10. UPS System

The Contractor shall supply and install:

An Uninterruptible Power System (hereinafter referred to as UPS system) rated to support the load.

- The UPS shall be rated to a minimum 20kVA and shall be positioned within the main switch room.
- The contractor shall be responsible for all associated works to be carried out for the system to be fully operational.

Any deviations or exceptions to, the minimum requirements must appear in the offer.

Where no exceptions are shown, the requirements of the present specifications will be considered as accepted.

All associated equipment shall be sourced from the same manufacturer, including batteries, wrap-around bypass etc.

### 10.1 Standards

The choices, engineering developments, choice of materials and components and the construction of the equipment must comply with current legislation, directives and standards.

Some of the laws, regulations, directives and standards are listed below to provide a minimum frame of reference. The list is intended as a guideline only and is not exhaustive.

In the event of conflict of laws, it is agreed that the most restrictive law, regulation or standard will apply.

#### 10.1.1 Legislation, directives and standards

AS/NZS 3000:2007

Electrical installations (known as the Australian/New Zealand Wiring Rules)

##### UPS Standards

AS 62040.1

Uninterruptible Power Systems (UPS)

"General and safety requirements for UPS used in restricted access locations"

AS62040.2

Uninterruptible Power Systems (UPS)

"Electromagnetic compatibility (EMC) requirements"

AS62040.3

Uninterruptible Power Systems (UPS)

"Performance requirements and test methods"

### **10.1.2 Battery Standards**

AS 2676.1

Guide to the installation, maintenance, testing and replacement of secondary batteries in buildings - Vented cells

AS 2676.2

Guide to the installation, maintenance, testing and replacement of secondary batteries in buildings - Sealed cells

AS 3011.1

Electrical installations - Secondary batteries installed in buildings - Vented cells

AS 3011.2

Electrical installations - Secondary batteries installed in buildings - Sealed cells

Quality Standards

ISO 9001

Quality systems

Model for quality assurance in Design, Development, Production, Installation and Servicing.

ISO 14001

Environmental Systems

Environmental management system for sales, distribution, configuration, installation, commissioning and service of Uninterruptible Power Supply units.

## **10.2 UNINTERRUPTIBLE POWER SYSTEM TECHNICAL DATA / SCHEDULES**

- Rating 20kVA – 16kW
- Runtime – 30 minutes based on a constant load of 16kW at end of life.
- Battery life – 10 years minimum
- Input wiring – 3 phase + N + PE (415V)
- Frequency – In/out 50Hz
- Output wiring – 3 phase + N + PE
- Nominal Voltage rating – 240/415V
- Connectivity – Modbus, Web/SNMP
- By Pass - Rotary Switch Type (Wrap Around or Change Over)

### 10.3 AS 62040.3 UPS FACTORY AND SITE TESTING SCHEDULE

TEST DESCRIPTION (AS 62040.3)	AS62040 sub- clause #	ROUTINE (AS62040) TEST	OPTIONAL (AS62040) TEST	TEST Required Factory, Site
Interconnection cable check	6.6.1	X		Factory & Site
Test specifications (conditions)	6.6.2	X		Factory & Site
Light load test	6.6.3	X		Factory & Site
UPS auxiliary device(s) test	6.6.4	X		Site
AC input failure test	6.6.6	X		Factory & Site
AC input return test	6.6.7	X		Factory & Site
Transfer test	6.6.9	X		Factory & Site
Full load test	6.6.10	X		Site
UPS efficiency test	6.6.11		X	Site
Balanced load test	6.6.13		X	Site
Rated stored energy time test	6.6.15		X	Site

# 11. Lighting

## 11.1 General

### 11.1.1 Aims

#### Responsibilities

General: Provide a complete operational lighting system, tested and commissioned.

### 11.1.2 Project requirements

#### Proprietary equipment

General: The requirements of this specification for lamps, ballasts and luminaire control equipment over-ride the specifications inherent in the selection of a particular make and model of luminaire.

#### Minimum energy performance standards (MEPS)

General: To AS/NZS 4783.2 and AS/NZS 4782.2.

Self ballasted lamps: To AS/NZS 4847.2 (Int).

### 11.1.3 Cross references

#### General

General: Conform to the *General requirements* worksection.

#### Associated worksections

Associated worksections: Conform to the following:

- *Electrical general requirements.*
- *Low voltage power systems.*

### 11.1.4 Standards

#### Standards

EMC compliance: To AS/NZS CISPR 15.

Energy efficiency for ballasts and lamps: To AS/NZS 4783.2.

Fixed general purpose luminaires: To AS/NZS 60598.2.1.

Floodlights: To AS/NZS 60598.2.5.

Harmonic limits: AS/NZS 61000.3.2.

Luminaires, general requirements and tests: To AS/NZS 60598.1.

Luminaires: To AS/NZS 60598.1.

Luminaires with built-in transformers for filament lamps: To AS/NZS 60598.2.6.

Recessed luminaires: To AS/NZS 60598.2.2.

Road lighting luminaires: To AS/NZS 1158.6.

Radio interference limits: To AS/NZS CISPR 15.

#### **11.1.5 Minimum energy performance standards**

General: To AS/NZS 4783.2 and AS/NZS 4782.2.

#### **11.1.6 Lamps**

Lamps: Provide all luminaires complete with lamps and accessories.

Verify operation: Install lamps in all luminaries and verify correct operation

Standards:

- Fluorescent: To AS 4782.1.

### **11.2 Emergency Lighting**

#### **11.2.1 Standards**

##### **General**

System design, installation and operation: AS 2293.1.

Inspection and maintenance: To AS/NZS 2293.2.

Provide a complete operational, emergency evacuation lighting system, tested and commissioned in accordance with AS/NZS 2293.1 and as documented.

#### **11.2.2 Single-point system luminaires**

Visual indicator lights: Provide a red indicator, readily visible when the luminaire is in its operating location, which indicates that the battery is being charged.

Inverter system: Provide protection of the inverter system against damage in the event of failure, removal or replacement of the lamp, while in normal operation.

Local test switches: Provide a momentary action test switch, accessible from below the ceiling, on each luminaire to temporarily disconnect the mains supply and connect the battery to the lamp.

Common test switches: Provide a common test switch on the kitchen distribution board which disconnects main supply to the luminaries and tests for discharge performance, after testing, this switch must automatically revert to normal operating mode.

### **11.2.3 Batteries**

Type: Lead-acid or nickel-cadmium batteries capable of operating each lamp at its rated output continuously at least 2 hours during final commissioning, pre-practical completion tests and 1.5 hours during subsequent tests.

Battery life: At least 3 years when operating under normal conditions at an ambient temperature of 25°C and subjected to charging and discharging at 6 monthly intervals.

Marking: Indelibly mark each battery with its date of manufacture.

### **11.2.4 Power supply to single-point systems**

General: Provide an unswitched active supply to each luminaire and exit sign, originating from the test switch control panel.

## **11.3 Accessories**

### **Lighting outlets**

Pin arrangement: Standard: 3 flat pin with looping terminal.

### **Lighting switches**

General: Provide light switches as documented.

Standard: To AS/NZS 3133.

Minimum: 10 A, 240 V a.c.

### **Dimmer switches**

General: Provide integral dimmer/switch units as documented.

### **Daylight switches**

General: Provide integral photo electric switch units as documented.

Performance: Adjustable between 50 and 1000 lux.

Time delay: > 2 minutes.

Illumination differential: > 50 lux.

### **Motion detector switches**

General: Provide movement detectors which cover designated areas as documented.

Timer: variable 'on' timer adjustable between 1 minute up to 2 hours maximum (generally set to 20 minutes).

Standard: To AS 2201.3.

Type: Passive infra-red.

## **11.4 Execution**

### **11.4.1 Supports**

#### **General**

General: Install luminaires on proprietary supports by means of battens, trims, noggings, roses and packing material.

#### **Installation**

Supports: Mount luminaires on proprietary supports by means of battens, trims, noggings, roses or packing material to suit location.

#### **Lighting poles**

Provide proprietary light poles for pole mounted light fittings. Allow to mount to concrete footings.

#### **Surface mounted luminaires**

General: Fit packing pieces to level luminaires and prevent distortion of luminaire bodies. Provide packing strips to align end to end luminaires.

Fixing: Provide 2 fixings at each end of fluorescent luminaires. A single fixing at each end in conjunction with 1.6 mm backing plates may be used for narrow luminaires.

### **11.4.2 Completion**

#### **General**

Prior to practical completion carry out the following:

- Verify the operation of all luminaires.
- Adjust aiming and controls for all luminaires under night time conditions.
- Replace lamps which have been in service for a period greater than 50% of the lamp life as published by the lamp manufacturer.

## 11.5 Selections

### 11.5.1 Schedules

#### Luminaire schedule

Refer to legend of symbols

Lamps shall be 4000k unless noted otherwise.

## 12. Communications

### 12.1 General

#### 12.1.1 Aims

##### **Responsibilities**

Provide a complete operational telecommunications cabling system, tested and commissioned in accordance with AS/NZS 3080, AS/ACIF S009, SAA HB 29 and as appropriate SAA HB 252.

Provide accommodation for telecommunications cabling infrastructure complying with AS/NZS 3084 including the detailed requirements of Appendix ZA, ZB and ZC. Include the following as documented:

- Building distributors (MDF).
- Horizontal cabling.
- Telecommunications outlets.
- Fly leads.

#### 12.1.2 System description

##### **Network connection**

General: Notify the authority of the new connection and provide a network connection path as documented.

##### **Building distributor**

General: Provide building distributor as documented.

##### **Telecommunications outlets**

General: Provide telecommunications outlets as documented.

##### **Patching**

General: Provide patching of telecommunications outlets and equipment as documented.

##### **System performance**

Application class to AS/NZS 3080 clause 6.3: E.

Balanced system to AS/NZS 3080 clause 7 (data): Category 6.

Balanced system to AS/NZS 3080 clause 7 (voice): Category 6.

Warranty (years): 20/20 years minimum.

### 12.1.3 Cross references

#### General

General: Conform to the *General requirements* worksection.

#### Associated worksections

Associated worksections: Conform to the following:

- *Electrical general requirements.*
- *Cable support and duct systems.*

## 12.2 Products

### 12.2.1 Equipment racks

Equipment racks in the equipment room shall be provided as part of this contract.

- ▶ Equipment Racks shall be 19" 45RU Floor standing 1000mm deep.
- ▶ 2 x 20A switched, captive power socket on dedicated UPS circuit installed adjacent the racks.
- ▶ Provide horizontal patch panels and patch cord managers (cable management, 1 per patch panel, and an additional 2 for switches.
- ▶ Provide 2 x 15A 15 way 10A power distribution units to each rack.

### 12.2.2 Modular connector patch panels

Terminations: Terminate directly to the modular connector.

Patch cords: Terminate cord ends with appropriate registered jacks.

### 12.2.3 Patch cords

General: Provide terminated patch cords for 100% of the total incoming and outgoing ports used.

### 12.2.4 Telecommunications outlets

Outlets: Provide RJ45 8 way modular jacks except where documented otherwise.

Pinouts: The pinouts vary with the application. Determine required pinouts before making cable terminations.

### 12.2.5 Fly leads

General: Provide fly leads to 100% of the outlets installed.

## 12.3 Execution

### 12.3.1 Installation

Crossover: Install cables neatly and without crossovers between cables.

Loom size: Loom cables into groups not exceeding 50 cables, and hold looms in place using reusable cable ties at least 20 mm wide. Do not exert compressive force on the cables when installing cable straps.

### 12.3.2 Cable separation

Low voltage cables: Separate telecommunications cables not enclosed in conduits or ducts from low voltage services by at least 150 mm.

Electromagnetic interference (EMI): Provide clearance to minimise the effect of EMI where communications cables are installed parallel and adjacent to power cables carrying loads in excess of 200 A.

### 12.3.3 Records

Record book: Provide a record book at each cross connect.

Records in pencil: Complete the records in pencil for each termination and jumper, providing origin and destination and type of service.

Location: Secure log books in each distribution frame records holder.

Identification and labelling, and record documentation: To AS/NZS 3085.1.

### 12.3.4 Earthing system

Communication earth system (CES): Provide a communications earth terminal (CET) associated with the local protective earth (PE) system adjacent to the communication racks.

### 12.3.5 Labels

#### Labelling

Telecommunications cables: Label cross-connects and outlets in accordance with the requirements of AS/NZS 3080 and SAA HB 29 Figures 5 – 18.

Cables: Label to indicate the origin and destination of the cable.

Outlets: Label to show the origin of the cross-connect, the workstation or outlet number and the port designation.

#### Label type table

Component	Label scheme	Type
Cables	Origin and destination	Self adhesive – wrap on

Component	Label scheme	Type
Cross-connects	Port Number	Proprietary
Outlets	SAA HB 29 Fig 5-18	Engraved plate
Wall boxes	SAA HB 29 Fig 5-18	Engraved adhesive label
Patch cords	Type of service	Colour code

### 12.3.6 Testing

#### Standards

Testing of balanced cabling systems: To AS/NZS IEC 61935.1.

Testing of patch cords: To AS/NZS IEC 61935.2.

See AS/NZS 3080 Annexes B and C for testing, both of which are Normative i.e. integral parts of the standards. AS/ACIF S009 has little to say on tests, except regarding telecommunications reference conductors. For field tester measurement procedures, see AS/NZS 3087.

General: Carry out 100% permanent link tests.

If active network equipment is included in the works specify the network tests required.

Tests: To AS/NZS 3080 in conformance with SAA HB 29. Include the following:

- Basic Link and Channel transmission tests including the following:
- Wire map.
- Length.
- Attenuation.
- NEXT.
- ACR.
- Propagation delay.
- Delay skew.
- Power sum NEXT.
- Power sum ACR.
- ELFEXT.
- Power sum ELFEXT.
- Return loss.
-

## 13. Access Control

### 13.1 Access Control

#### 13.1.1 General

General: Provide a complete operational access control system, tested and commissioned in accordance with AS/NZS 2053 and AS/NZS 2201.1, AS 2201.3 and AS/NZS 2201.5, as applicable.

The system shall be compatible with the standard TfNSW system and interface remotely.

#### 13.1.2 Processors or panels

Capacity: Provide separate entry/exit control modules for each designated door.

Users: Program the system to match the number of authorised users with unique access codes.

Time zones: At least 4 per day, with provision for weekends and public holidays.

#### 13.1.3 Door control devices

General: Provide electric strikes, electric locks, drop bolts, or similar devices to suit door construction and hardware.

Fail-safe: Connect door control devices in a fail-safe mode to permit egress in the event of power failure.

Authorised products: Provide equipment listed in the ActivFire Register of Fire Protection Equipment.

Glass doors: Provide tumbler, drop bolts or magnetic holders.

Double leaf doors (solid frame): Provide an electric strike or lock on the fixed leaf, connected to the door frame by concealed flexible wiring.

#### 13.1.4 Activation

General: Provide keypads, card readers or other activation devices, and locate next to entry points.

External: Provide weatherproof (IP56) hoods or housings for external units.

Default mounting height: 1100 mm from floor level.

#### 13.1.5 Interconnection to other services

General: Provide card readers or other devices to allow the interconnection to other systems as required. Provide and connect wiring to the designated services.

10. Access Control

10.1. Introduction

10.1.1. Purpose

The purpose of this document is to define the access control requirements for the system. It describes the roles and permissions of users and the methods used to enforce these controls.

This document is intended for system administrators and users who require access to the system.

10.1.2. Scope

This document applies to all users of the system. It covers the authentication, authorization, and accounting (AAA) processes. It does not cover physical access control or network security.

10.1.3. Definitions

Access Control: The process of restricting access to resources based on user identity and permissions.

Authentication: The process of verifying the identity of a user.

Authorization: The process of determining what a user is allowed to do.

Accounting: The process of tracking user activity and resource usage.

This document is based on the system requirements and security policies. It is subject to change as the system evolves.

10.2. Access Control

The access control system is implemented using a role-based access control (RBAC) model. Roles are assigned to users, and permissions are assigned to roles.

Users are authenticated using a secure protocol. The system enforces access control based on the user's role and the permissions of that role.

The system logs all access attempts and successful logins. These logs are used for auditing and troubleshooting.

The access control system is integrated with the system's security framework.

The system administrator is responsible for managing roles and permissions. The system administrator must ensure that access control is properly configured and maintained.

## 14. Public Address and Hearing Augmentation

### 14.1 General

#### 14.1.1 Public Address

Provide a complete public address system in accordance with TfNSW standard "Enhanced Public Address System Design and Installation Guideline" F2010/22647 D2010/52646.

- Provide all ancillary items required for the complete and functioning system in accordance with F2010/22647 D2010/52646.

## 15. Completion

### 15.1 Operation and maintenance manuals

- Provide maintenance manuals including the following:
  - a) Installation description: General description of the installation.
  - b) Systems descriptions: Technical description of the systems installed, written to ensure that TfNSW staff fully understand the scope and facilities provided. Identify function, normal operating characteristics, and limiting conditions.
  - c) Systems performance: Technical description of the mode of operation of the systems installed.
  - d) Equipment descriptions:
    - Manufacturers' technical literature for equipment installed, assembled specifically for the project, excluding irrelevant matter. Mark each product data sheet to clearly identify specific products and component parts used in the installation, and data applicable to the installation.
    - Supplements to product data to illustrate relations of component parts. Include typed text as necessary.
  - e) Operation procedures:
    - Safe starting up, running in, operating and shutting down procedures for systems installed. Include logical step-by-step sequence of instructions for each procedure.
    - Control sequences and flow diagrams for systems installed.
    - Legend for colour-coded services.
    - Schedules of fixed and variable equipment settings established during commissioning and maintenance.
  - f) Maintenance procedures:
    - Schedule of normal consumable items, local sources of supply, and expected replacement intervals up to a running time of 40 000 hours. Include lubricant and lubrication schedules for equipment.
    - Instructions for use of tools and testing equipment.
    - Emergency procedures, including telephone numbers for emergency services, and procedures for fault finding.
    - Material safety data sheets (MSDS).
  - g) Certificates:
    - Copies of test certificates for the installation and equipment used in the installation.
    - Test reports.
  - h) Drawings:
    - Single line diagrams.

- Service route layouts.
- Switchgear and controlgear assembly circuit schedules including electrical service characteristics, controls and communications.

## **15.2 Record drawings**

- a) Show dimensions, types and location of the services in relation to permanent site features and other underground services. Show the spatial relationship to building structure and other services. Include all changes made during commissioning and the maintenance period.
- b) Drawings: Include all documented shop drawings.
- c) Extensions and/or changes to existing: If a drawing shows extensions and/or alterations to existing installations, include sufficient of the existing installation to make the drawing comprehensible without reference to drawings of the original installation.

## **15.3 Commissioning**

### **15.3.1 Circuit protection**

- Confirm that circuit protective devices are sized and adjusted to protect installed circuits.

### **15.3.2 Controls**

- Calibrate, set and adjust control instruments, control systems and safety controls.

### **15.3.3 Notice**

- Give sufficient notice for inspection to be made of the commissioning of the installation.

### **15.3.4 Reports**

- Submit reports indicating observations and results of tests and compliance or non-compliance with requirements.

## **15.4 Cleaning**

- At practical completion hand over the following in a clean state:
  - a) Insides of switchgear and controlgear assemblies.
  - b) Luminaires.
  - c) Switchgear and contactors, and other electrical contacts.

## **15.5 Completion tests**

### **15.5.1 General**

- Test the works under the contract to demonstrate compliance with the documented performance requirements.

### **15.5.2 Functional checks**

- Carry out functional and operational checks on energised equipment and circuits and make final adjustments for the correct operation of safety devices and control functions.

### **15.5.3 Proprietary equipment**

- Submit type test reports confirming compliance of proprietary equipment.

### **15.5.4 Sound pressure level measurements**

- a) Correction for background noise: To AS/NZS 2107 Table B1.
- b) External: To AS 1055.1.
- c) Internal: To AS/NZS 2107.
- d) Measurement positions: If a test position is designated only by reference to a room or space, do not take measurements less than 1 m from the floor, ground or walls.
- e) Sound pressure level analysis: Measure the sound pressure level and the background sound pressure level over the full range of octave band centre frequencies from 31.5 Hz to 8 kHz at the designated positions.
- f) Sound pressure levels: Measure the A-weighted sound pressure levels and the A-weighted background sound pressure levels at the designated positions.

### **15.5.5 Test instruments**

- Use instruments calibrated by a registered testing authority.

## **15.6 Training**

### **15.6.1 General**

- a) Duration: Instruction to be available for the whole of the commissioning and running-in periods.
- b) Format: Conduct training at agreed times, at system or equipment location. Also provide seminar instruction to cover all major components.

- c) Operation and maintenance manuals: Use items and procedures listed in the final draft operation and maintenance manuals as the basis for instruction. Review contents in detail with TfNSW staff.
- d) Certification: Provide written certification of attendance and participation in training for each attendee. Provide register of certificates issued.

#### **15.6.2 Demonstrators**

- Use only qualified manufacturer's representatives who are knowledgeable about the installations.

#### **15.6.3 Maintenance**

- Explain and demonstrate TfNSW staff the purpose, function and maintenance of the installations.

#### **15.6.4 Operation**

- Explain and demonstrate to TfNSW staff the purpose, function and operation of the installations.

### **15.7 Maintenance**

#### **15.7.1 General**

• Warrant the whole of the Contract Works, for the Defects Liability Period, against defective workmanship and materials and against non-compliance of equipment and/or complete system with specified performance and operation. The Defects Liability Period shall continue for a period of 12 months after the date of issue of Practical Completion. During this period, the electrical contractor shall be responsible for making good with all possible speed, defects arising from the defective materials or workmanship, including the replacement of any failed items of equipment. Maintenance shall be provided during the warranty period to maintain warranty conditions. Maintenance shall comply with the current regulatory requirements.

- a) General: During the maintenance and defects liability periods, carry out periodic inspections and maintenance work as recommended by manufacturers of supplied equipment, and promptly rectify faults.
- b) Emergencies: Attend emergency calls promptly.

#### **15.7.2 Maintenance program**

• Submit details of maintenance procedures and program, relating to installed plant and equipment, 6 weeks before the date for practical completion. Indicate dates of service visits. State contact telephone numbers of service operators and describe arrangements for emergency calls.

### **15.7.3 Maintenance records**

- a) Submit, in binders which match the manuals, loose leaf log book pages designed for recording completion activities including operational and maintenance procedures, materials used, test results, comments for future maintenance actions and notes covering the condition of the installation. Include completed log book pages recording the operational and maintenance activities performed up to the time of practical completion.
- b) Include test and approval certificates.
- c) Prior to the date of completion, submit certificates stating that each installation is operating correctly.
- d) The greater of 100 pages or enough pages for the maintenance period and a further 12 months.
- e) If referenced documents or technical worksections require that log books or records be submitted, include this material in the maintenance records.
- f) Record comments on the functioning of the systems, work carried out, items requiring corrective action, adjustments made and name of service operator. Obtain the signature of TfNSW designated representative.

### **15.7.4 Spares**

- a) Provide 10% spare fluorescent lamps for each lamp source used.
- b) Provide 10 off spare MCCB circuit breakers

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**Document Status**

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**Transport for NSW**  
**Specification for Easy Access**  
**Upgrade - Cardiff Station**  
**Hydraulic Services**

March 2012

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# 1. Project Information

## 1.1 Definitions

Client	-	TfNSW
Consulting Engineer	-	GHD
Works	-	Hydraulic Services as described in Section 2
Hydraulic Contractor	-	The company contracted to undertake the works

## 1.2 The Project

This project involves the Easy access upgrade to the existing Railway Station at Cardiff, NSW. This specification covers the hydraulic works and Construction of the Hydraulic Services for the new extension of the Cardiff Station Building.

## 1.3 Specification Objectives

The intent of this Specification and the associated documents is:

- To provide a clear statement of contractual requirements against which compliance can be assessed.
- To provide documentation for the Client to demonstrate what is being bought.
- To define the expectations upon the Contractor by the Consulting Engineer.
- To define the roles of the parties involved with the works.
- To enable other interested parties to assess their obligations and to understand expectations of them.
- To define the requirements of the installer with respect to Quality Assurance.

## 1.4 Obligations of Installer

In writing this specification the Consulting Engineer expects and relies upon the tenderers' possessing specialist trade expertise necessary to complete the works in accordance with the documentation.

In addition, the installer has the following obligations:

- To raise in good time, issues requiring design intent or clarification from the Consulting Engineer, particularly in respect to:
  1. Interpretation of the design intent specification or drawings.
  2. Problems in complying with the specification.
  3. Omissions from the tender documents.
  4. Suggested alternatives/substitutions.
- To certify compliance with contract documents, including all variation instructions, at Practical Completion.
- To certify compliance with Authority requirements, as far as he/she can ascertain.

- To implement procedures to ensure that only competent tradesmen are used for the works.
- To be cognisant of the role of all relevant parties during the construction phase of the project and to assist them in the conduct of their duties wherever possible.
- To contribute, in the spirit of partnering, towards the successful execution of the contract.
- To provide manufacturer's and construction drawings.
- To make final equipment selections to meet the requirements listed.

### **1.5 Required Submissions**

- The Main Contractor shall provide a program, in good time to allow review without impediment.
- Certified schedule of compliance for all equipment, prior to placing orders.
- Certified schedule of competency for all tradesmen intended to work on the project.
- Copies of all correspondence to local Utility Authority, which are required to finalise the works.
- Factory test results where applicable.
- All product data, performance test and commissioning results required by this specification.
- Shop drawings for fabrication and installation of all equipment and items supplied.
- Inspection and test plans for every section of the works. Detail the procedure of how to complete the task, the skill or competency of the person undertaking the works, the review or testing procedure to assure satisfactory completion of the task, the person within the installer's organisation authorised to sign-off the task as accepted.
- Client handover/training proposals.
- Record and installation drawings: Record all changes to equipment and services layouts, wiring and any other items during the construction period, which may have been incorporated into these works.
- Operating and Maintenance manuals.
- Certifications for compliance with project specific Code/Design requirements of the completed works.
- Maintenance and servicing during the defects liability period.
- Fully developed functional descriptions, written in simple sentences, of each system including but not limited to start up, normal running, shut down, fire mode operation, operation in fault conditions, alarms, safety controls and manual over-ride provisions.
- Control schematics or diagrams illustrating control logic, valve and damper sequences, external interlocks, and interfaces.
- Details of connections to external interfaces and components outside the automatic control system.
- When requested, provide manuals, data sheets and other explanatory information needed to interpret the material submitted.
- Test reports: Submit a report showing the test results. Carry out necessary modifications and re-test.
- Samples of fixtures and tapware and all exposed elements and as required by the lead architect
- Data sheets for each item of hydraulic plant, type of controller and other hardware component.

## **Technical data**

### **Submit:**

- Filters
- UV disinfection
- All pumps and types
- RPZD

## **1.6 Quality Assurance**

A Quality Assurance plan shall be provided in order to propose, establish, maintain, monitor and document a quality assurance system covering all aspects of the design, purchase, fabrication, installation and completion of the works. The plan shall be in accordance with ISO 9001:2008 (as appropriate).

## 2. General

### 2.1 Extent of Works

The extent of work comprises the supply, installation, testing, commissioning, maintenance and defects liability service, of materials, labour and equipment for the complete Hydraulic Services installation.

The work shall include all necessary minor and incidental work required to implement the intent and meaning of this specification.

Whether or not the words "supply and install" appear in this specification, unless clearly excluded, all items of equipment for the complete installation are required and shall be supplied and installed.

### 2.2 Scope of Works

#### 2.2.1 General Description

General: Provide hydraulic services systems subject to the site and other constraints below.

#### Sanitary plumbing and drainage

- Connect the new sanitary drainage system to existing site infrastructure.
- Provide a new sanitary installation to cater for all fixtures, fittings and equipment.

#### Cold water services

- Connect the existing cold water supply system and existing site infrastructure through a stop valve.
- Provide site containment to Authority requirements.
- Provide the cold water installation to the draw-off points or connections to other services, within the new station building.

#### Hot water services

- Provide hot water unit.
- Provide the hot water installation from the cold water connection points to the draw-off points or connections to other services.

#### Rainwater Collection

- Provide rainwater collection system to cater for all roof gutters to discharge into the new in-ground tank.
- Provide a new in-ground rainwater tank and overflow to discharge into the stormwater system on site.
- Provide first flush diverter for the collected rainwater before discharging into the new in-ground tank.

#### Recycled Water

- Provide a new recycled water system to cater for all fixtures requiring recycled water.

- Provide a pre-treatment facility required to supply safe recycled water throughout the site.

#### **Authority submissions**

- Make submissions (including notices) to authorities relating to the works. Liaise with all authorities required to confirm new flows and loads of the building. Pay all fees and charges, where applicable.

#### **Selections**

- As documented.

#### **2.2.2 Constraints**

The following site and other constraints apply to the hydraulic services on this project:

Existing services: Existing services located within the proposed building footprint to be traced and diverted, temporarily if necessary, prior to excavation.

Temporary services: Take all necessary measures to allow the station to remain operational throughout the construction programme.

Conform to all TfNSW construction standards during the project.

### **2.3 Associated Works**

#### **2.3.1 Works by Builder**

Builder is to provide penetrations and any structural support, concrete slabs and the like.

Builder is to provide all statutory signage on service doors, enclosures and the like.

The hydraulic contractor is to liaise with the builder and provide all pertinent information in good time and in a professional manner.

#### **2.3.2 Works by Electrical Trade**

The Electrical contractor is to supply power to hydraulic appliances where required. These appliances are though not being limited to:

- Pumps
- Back wash filters
- BHWU
- UV disinfection unit
- Solenoid valves
- Hot water units

All equipments (pumps, filters, hot water unit, etc) are to be powered from electrical distribution boards, either existing or new, depending on the site and location of equipment.

The Hydraulic contractor is to liaise with the Electrical contractor and provide all pertinent information in good time and in a professional manner.

Electrical contractor shall confirm available electrical capacity within distribution board for the hydraulic systems, and provide isolators within 1.5m of all equipment for connection by the Hydraulic contractor.

### **2.3.3 Works in connection with Mechanical Trade**

All tundishes, gullies and the like for mechanical services equipment are to be provided by the Hydraulic contractor.

The Mechanical contractor is to liaise with the Hydraulic contractor and provide all pertinent information and requirements in good time and in a professional manner.

### **2.3.4 Works in connection with Civil Trade**

The Civil contractor is to provide connection from the rainwater tank overflow and the first flush diverter to the civil stormwater system.

The Civil contractor is to liaise with the Hydraulic contractor and provide all pertinent information and requirements in good time and in a professional manner.

### **2.3.5 Design**

Extent: Provide all additional design work necessary to complete the documented hydraulic services.

Qualification: Use only appropriately experienced and qualified persons to undertake hydraulic design work. If requested, provide documents verifying the qualification and experience.

## **2.4 Cross references**

### **2.4.1 General**

General: Conform to the *General requirements* worksection.

### **2.4.2 Associated worksections**

Associated worksections: Conform to the following:

Service trenching.

Roofing for roof plumbing.

Hydraulic general requirements.

Mechanical Services.

Electrical Services.

Stormwater Drainage.

### **2.4.3 Standards**

Plumbing, drainage: To AS/NZS 3500.0, AS/NZS 3500.1, AS/NZS 3500.2, AS/NZS 3500.3 and AS/NZS 3500.4 and the Plumbing Code of Australia.

Authorised products: Listed in the WaterMark Product Database, unless otherwise required by the Network Utility Operator.

Copper pipe and fittings-installation and commissioning: To AS 4809.

Microbial control: To AS/NZS 3666.1 and AS/NZS 3666.2.

The Building Code of Australia.

TfNSW Standards.

#### **2.4.4 Labelling**

Water efficiency labelling: Provide only products conforming to and labelled to the Water Efficiency Labelling Scheme (WELS).

#### **2.4.5 Interpretation**

##### Abbreviations

General: For the purposes of this work section the abbreviations given below apply.

- NP: non potable

##### Definitions

General: For the purposes of this worksection the definitions given below apply.

- Network Utility Operator: A person who undertakes the piped distribution of drinking water or natural gas for supply or is the operator of a sewerage system or a stormwater system.
- Hot dip galvanized: Zinc coated after fabrication to AS/NZS 4680 with coating thickness and mass to AS/NZS 4680 Table 1.

### **2.5 Inspection**

#### Notice

Inspection: Give sufficient notice so that inspection may be made of the following:

Excavated surfaces.

Concealed or underground services.

### **2.6 Submissions**

#### **2.6.1 Drawings**

General: Minimum A1 drawing size.

Standard: To AS 1100 Parts 101, 201, 301, 401 and 501 as applicable.

Drawings: Submit the following:

Building work drawings showing all building work required to complete the hydraulic services.

Detailed drawings, at 1:100 scale or larger, showing:

Pipework and equipment layout and sections showing the work to be installed in strata, that is, shown at the level that the services are installed. Do not submit 'glass floor' drawings.

Location, type, grade and finish of piping, fittings, valves, meters, pipe supports, access openings, cover plates, valve boxes and access pits.

Location, type and other relevant details of sanitary ware, appliances and water heaters.

Long sections of below ground drainage.

Piping schematic drawings.

Copy of submission drawings required by authorities and copies of approvals.

Inclusions: Include the following on the drawings:

Relevant survey levels, site and floor set out points.

### **2.6.2 Execution details**

General: Before starting the respective portions of the installation, submit the following:

Embedded services: Proposed method for embedding services in concrete walls or floors or chasing into concrete or masonry walls.

Fixing of services: Typical details of locations, types and methods of fixing of services to structure.

Inaccessible services: If services will be enclosed and not accessible after completion, submit proposals for location of service runs and fittings.

Proposals for location of exposed piping.

Workshop drawings.

### **2.6.3 Samples**

General: Provide samples listed in the Samples schedule.

### **2.6.4 Technical data**

Certification: Submit certification that the plant and equipment submitted meets the requirements and capacities of the contract documents except for departures that are identified in the submission.

Submissions: Submit technical data for all items of plant and equipment.

## 3. Execution

### 3.1 Installation

#### 3.1.1 Accessories

General: Provide the accessories and fittings necessary for the proper functioning of the systems, including taps, valves, outlets, pressure and temperature control devices, strainers, gauges and pumps.

Isolating valves: In addition to valves required to meet statutory requirements, provide valves so that isolation of parts of the system for safe isolation of the system in the event of leaks or maintenance causes a minimum of inconvenience to building occupants.

#### 3.1.2 Arrangement

Locate and arrange so that:

- Failure of plant and equipment (including leaks) does not create a hazard for the building occupants and causes a minimum or no damage to the building, its finishes and contents.
- Inspection and maintenance operations can be carried out in a safe and efficient manner, with a minimum of inconvenience and disruption to building occupants and without damaging adjacent structures, fixtures or finishes.

#### 3.1.3 Embedded pipes

Do not embed pipes that operate under pressure in concrete or surfacing material.

#### 3.1.4 Penetrations and fixing

If non-structural building elements are not suitable for fixing equipment and services to, fix directly to structure and trim around holes or penetrations in non-structural elements.

If it is proposed to penetrate or fix to the following, submit details of the methods proposed to maintain the required structural, fire and other properties:

- Structural building elements including external walls, fire walls, fire doors and access panels, other tested and rated assemblies or elements, floor slabs and beams.
- Membrane elements including damp-proof courses, waterproofing membranes and roof coverings. If penetrating membranes, provide a waterproof seal between the membrane and the penetrating component.
- Pipe sleeves: If piping or conduit penetrates building elements, provide metal or PVC-U sleeves formed from oversize pipe sections.

Seal penetrations with a system shall conform to AS 4072.1 and tested to AS1530.4-1997.

The integrity of any penetrated building element shall be maintained at all time. If the building element is weatherproof, acoustic rated or subject to pressure, maintain the rating.

Seal penetrations around conduits and sleeves. Seal around cables within sleeves. If the building element is acoustically rated, maintain the rating.

If piping or conduit penetrates building elements, provide metal or PVC-U sleeves formed from oversize

pipe sections.

Do not penetrate, or chase the following without approval:

- Structural building elements including external walls, core walls, fire walls, floor slabs, beams or columns.
- Acoustic barriers
- Other building services
- Membrane elements, including damp-proof courses, waterproofing membranes and roof coverings

If approval is given to penetrate membranes, provide a waterproof seal between the membrane and the penetrating compound.

### **3.1.5 Piping**

Piping shall be installed in straight lines, plumb and to uniform grades. Arrange and support the piping so that it remains free from vibration and water hammer, while permitting movement in both structure and services. Keep the number of joints to a minimum. Prevent direct contact between incompatible metals.

If practicable, piping and fittings requiring maintenance or servicing shall be concealed so that they are accessible within non-habitable enclosed spaces such as roof spaces, subfloor spaces and ducts. Pipelines in subfloor spaces shall be kept at least 150 mm above ground and ensure access can be provided throughout for inspection. Provide at least 25 mm clearance between adjacent pipelines (measured from the piping insulation where applicable).

Where exposed piping emerges from wall, floor or ceiling finishes, cover plates of stainless steel or non-ferrous metal finished shall be provided to match the piping.

If the geotechnical site investigation report predicts differential movements between buildings and the ground in which pipes are buried, provide movement control joints in the pipes.

Pipe support materials shall be the same as the piping or galvanized or non-ferrous metals, with bonded PVC or glass fibre woven tape sleeves where needed to separate dissimilar metals.

### **3.1.6 Pits**

Internal dimensions of pits shall give 300 mm clear space all around the fittings in the pit.

Concrete shall be of grade N20 to AS 1379, 100 mm thick, reinforced with F82 fabric.

Pit covers shall be to AS 3996.

Pit floors shall be graded to a point on one side and drain to the stormwater drainage system. Pit walls shall be carried up to 50 mm above finished ground level and shall be cast in the pit cover frame flush with the top. Trowel the top smooth.

### **3.1.7 Valve boxes**

Underground isolating valves shall be installed in cast-iron valve boxes with removable covers. Cast-iron sluice valve covers shall be provided for access to sluice valves.

Box covers shall be marked with the name of the service and shall be appropriately rated to a loading class matching the surrounding surface.

## **3.2 Painting, finishes and marking**

### **3.2.1 Exceptions**

Do not paint chromium or nickel plating, anodised aluminium, glass reinforced plastic, stainless steel, non-metallic flexible materials and normally lubricated machined surfaces.

### **3.2.2 Finishes**

Exposed piping, including fittings and supports shall be finished as follows:

- In internal locations such as toilet and kitchen areas: Chrome plate copper piping to AS 1192 service condition 2, bright.
- Externally and steel piping and iron fittings internally: Paint.
- In concealed but accessible spaces (including cupboards and non-habitable enclosed spaces): Leave copper and plastic unpainted except for identification marking. Prime steel piping and iron fittings.

Valves shall receive finish to match connected piping.

### **3.2.3 Marking and labelling**

Mark services and equipment to provide a ready means of identification.

- Locations exposed to weather: Provide durable materials.
- Pipes, conduits and ducts: Identify and label to AS 1345.

Label and mark equipment using a consistent scheme across all services elements of the project.

### **3.2.4 Pipeline identification**

Lay detectable plastic warning tape printed with the name of the service, 300 mm above buried piping, for the full length of the piping.

If pipes have grade or class identification markings install so that the markings are visible for inspection.

## **3.3 Cold and Heated Domestic Water**

### **3.3.1 Fittings and accessories**

Provide the fittings necessary for the proper functioning of the water supply system, including taps, valves, backflow prevention devices, pressure and temperature control devices, strainers, gauges and automatic controls and alarms.

### **3.3.2 Heated water temperature**

To AS/NZS 3500.4.

### **3.3.3 Line strainers**

- Low resistance, Y-form bronze bodied type, with screen of dezincification resistant brass, stainless steel or monel.
- Screen perforations: 0.8 mm maximum.

### **3.3.4 Pressure control valves**

Provide reduction valves, pressure limiting valves or ratio valves, which produce the necessary reduction in pressure.

### **3.3.5 Piping insulation**

- To AS/NZS 3500.4 Section 8.
- Fit insulation tightly to piping surfaces without gaps. Minimise number of joints. Insulate fittings for the same thermal resistance as the piping insulation. Install the insulation on unions and other items requiring service so that it is readily removable. Provide supports formed to fit around the insulation so the insulation thickness is reduced by < 10%.
- Select from the following:
  - Polyester in moulded tubular sections faced with factory bonded aluminium foil laminate or integral polyester scrim.
  - Polyolefin foam: Cross linked closed cell polyolefin foam faced with factory bonded aluminium foil laminate.
  - Elastomeric foam insulation: Chemically blown closed cell nitrile rubber in tubular sections to ASTM C534. Use only solvent-based adhesive supplied by insulation manufacturer and designed specifically for the material being used.

### **3.3.6 Tapware**

- Provide the tapware as documented on drawings and as per architectural details.
- All hose taps shall be vandal proof
- Provide brass fittings or suitably bushed to prevent electrolysis and growth.
- Provide break-resistant fittings of a compact nature, to prevent fracture and exposure of jagged or rough edges.
- Locate hot tap to the left of or above, the cold tap. If there is sufficient space, install with valve spindles vertical.
- Vandalproof or anti-tampering devices shall be provided for the designated types.
- Provide water efficient tapware as follows:
  - Shower heads: To AS/NZS 3662 and suitable for the pressures and pressure differences of the supplied water.
  - Water efficient tapware: Tested and labelled with their water efficiency rating to AS/NZS 6400.

### **3.3.7 Thermostatic mixing valves**

Water temperature shall be regulated by a single hand control, capable of delivering water at the temperature of either of the supply systems and at any temperature in between and suitable for controlling single or multiple outlets, as appropriate and incorporating the following:

- A temperature sensitive automatic control, which maintains temperature at the pre-selected setting and rapidly shuts down the flow if either supply system fails or if the normal discharge water temperature is exceeded.
- A hot water flush facility

The control shall be installed in a ready accessible location within a stainless steel wall box.

### **3.3.8 Water heaters**

Water heaters shall be provided as documented and installed in accordance with AS 3500.4 Section 5 and Section 6.

Standard

- Electric water heaters to AS/NZS 4692.1
- Minimum energy performance: To AS/NZS 4692.2.

## **3.4 Sanitary plumbing and drainage**

Provide complete soil and waste drainage system to cater for all fixtures, fittings and equipment as required, throughout the entire development.

### **3.4.1 Location**

General: Verify location and invert of piping before commencing installation. Make sure that location of piping will not interfere with other services and building elements not yet installed or built. Subject to the preceding and documented layouts, follow the most direct route with the least number of changes in direction.

Ducts: If installed in ducts, locate and fix stacks, wastes and pipes independently of other services. Arrange so they are easily accessible and removable throughout their entire length.

Piping: Conform to the Piping Schedule.

### **3.4.2 Discharge from air handling systems**

Trays, sumps and plumbing: To AS/NZS 3666.1.

### **3.4.3 Thermal movement**

General: Arrange piping to accommodate thermal expansion. Provide proprietary expansion joints in copper and plastic pipes where pipe flexibility is not sufficient to absorb movement. Make sure that movement does not strain branch connections.

### **3.4.4 Vent pipes**

General: Staying to roof: If fixings for stays penetrate the roof covering, seal the penetrations and make watertight.

Terminations: Provide bird-proof vent cowls of the same material and colour as the vent pipe.

Coordinate final location with architect and paint to match surrounding roof.

### **3.4.5 Wet area floors**

General: Where drainage connections pass through wet area floors, terminate 4 mm below the substrate surface.

### **3.4.6 Sanitary fixtures**

Provide sanitary fixtures complete with all accessories necessary for correct installation and use.

### **3.5 Guttering and Downpipes**

#### **3.5.1 General**

Standard: To AS/NZS 3500.3.

General: Provide the flashings, gutters, rainwater heads, outlets and downpipes necessary to complete the roof system. Connect to on-site rainwater tank or civil stormwater system as indicated on drawings.

#### **3.5.2 Materials**

Metal rainwater goods: To AS/NZS 2179.1.

PVC rainwater goods and accessories: To AS/NZS 3500.3.

#### **3.5.3 Proprietary flashings and cappings**

Standard: To AS/NZS 2904.

Material and colour: Match roof sheeting.

Rib notching: Match roof sheeting.

#### **3.5.4 Eaves gutters**

Product: Colourbond

Type: 150mm Half Round

Material and colour: Match roof sheeting.

Matching fascia/arge: If the selected eaves gutter is a proprietary high front pattern forming part of a combined system of gutter, fascia and barge, provide the matching proprietary fascias and barge cappings to roof verges and edges.

#### **3.5.5 Downpipes**

Product: Colourbond

Material: Zinalume

Colour: Paint to match roof sheeting.

Profile: Round

Size: As indicated on drawings

### **3.6 Rainwater Collection and Storage Systems**

#### **3.6.1 Standards**

- Design and installation: To the recommendations of SAA HB 230.
- Tanks: To ATS 5200.026.
- Tank marking: Display the WaterMark symbol and other marking required by ATS 5200.026.
- Other marking: If rainwater is not treated to potable quality, label rainwater piping and outlets to AS/NZS 3500.1.
- Cleaning: Flush the rainwater system. Wash and flush tanks to remove manufacturing and other contaminants.

### **3.6.2 Rainwater tank**

- Tank shall to be watertight.
- Provide the accessories needed to complete the installation, including inlet and outlet connections, and overflow.
- Materials
  - Concrete
- Include the following:
  - Flap valves at every opening to the tank.
  - Calmed inlet to the tank to prevent stirring sediment.
- Structural support shall be provided to withstand the mass of the tank when full without deformation or excessive settling.
- Connecting piping shall be supported independently of the tank. Provide a 300 mm long section of reinforced flexible hose to prevent piping exerting a load on the tank.
- Restrain the tank to prevent movement,
- A level base with gaps shall be provided not exceeding 10 mm, free of sharp projections and projecting beyond the edge of the tank at all points.
- Connections shall be reinforced to the tank wall so that connected piping is rigid.
- Provide a manufacturer's warranty on the tank.

### **3.6.3 First flush diverter**

- Provide a first flush diverter. Arrange to drain completely.
- Corrosion resistant and compatible with the rainwater plumbing and tank.
- Design and installation: To the recommendations of SAA HB 230.
- Provide the accessories needed to complete the installation, including inlet and outlet connections, and overflow.
- Discharge waste water from the first flush diverter to the stormwater installation.
- Install first flush strictly to tank manufacturer's guidelines and requirements.
- Provide a manufacturer's warranty.

### **3.6.4 Overflow**

- Strictly install overflow to tank manufacturer's guidelines.
- Overflow shall discharge away from the tank to civil stormwater system.
- Overflow must allow the unrestricted flow of rainwater to the stormwater outlet.

### **3.6.5 Recycled water Pumps**

General: Provide pumps as documented.

### **3.6.6 Installation**

- During construction, use temporary covers to openings and keep the system free of debris.

- Lay pipelines with the spigot ends in the direction of flow.
- Turn up drain branch pipelines to finish 50 mm above finished ground or pavement level.

### **3.6.7 Commissioning**

Cleaning: Flush the rainwater system. Wash and flush tanks to remove manufacturing and other contaminants.

### **3.6.8 Maintenance**

- Annual maintenance: Provide the annual maintenance to SAA HB 230 Table 10.1 at the following times:
- If the defects liability period is less than 12 months: Within one month before the end of the end of the defects liability period.
- If the defects liability period is 12 months or longer: Annually.

## 4. Completion

### 4.1 Testing

- Do not install insulation until the piping has been tested. Pressure test cold and hot water services to AS/NZS 3500.1 Section 16. Include pipe joints, valve seats, tap washers and strainers. Repair as necessary, replace if damaged and retest.
- Carry out verification tests and measurements to demonstrate compliance with the documents.
- Submit reports indicating observations and results of tests and compliance or non-compliance with requirements.

### 4.2 Completion

- Hot warm and domestic cold water services shall be completely and thoroughly flushed using water and be left clean.
- Stormwater and wastewater services shall be completely and thoroughly flushed using water and be left clean.

### 4.3 Charging

On completion of installation, commissioning, testing and disinfection, fill the hot, warm and cold water systems with water, turn on control and isolating valves and the energy supply and leave the water supply system in full operational condition.

### 4.4 Operation and maintenance manuals

General: Provide written operating and maintenance instructions containing:

- Contractor's contact details for service calls.
- Manufacturer's maintenance and operation literature.
- Manufacturer's warranty certificates if the manufacturer's warranty period is greater than the defects liability period.
- Description of day-to-day operation.
- Schedule of recommended maintenance.
- Heated water systems: Maintenance instructions to AS/NZS 3666.2.
- Recommendations for the operation, care and maintenance of appliances, storage tanks, valves, and their associated fittings.
- Installation description: General description of the installation. Include definitions of terms used in the manuals.
- Systems descriptions: Technical description of the systems installed, written to ensure that the operating and maintenance personnel fully understand the scope and facilities provided. Identify function, normal operating characteristics and limiting conditions.

- **Systems performance:** Technical description of the mode of operation of the systems installed.
- **Equipment descriptions:**
  - Manufacturers' technical literature for equipment installed, assembled specifically for the project, excluding irrelevant matter. Mark each product data sheet to clearly identify specific products and component parts used in the installation, and data applicable to the installation.
  - Supplements to product data to illustrate relations of component parts. Include typed text as necessary.
- **Operation procedures:**
  - Safe starting up, running-in, operating and shutting down procedures for systems installed. Include logical step-by-step sequence of instructions for each procedure.
  - Legend for colour-coded services.
- **Schedules of fixed and variable equipment settings established during commissioning and maintenance.**
- **Maintenance procedures:**
  - Schedule of normal consumable items, local sources of supply, and expected replacement intervals up to a running time of 40 000 hours. Include lubricant and lubrication schedules for equipment.
  - Schedule of maintenance work including frequency and manufacturers' recommended tests.
  - Instructions for use of tools and testing equipment.
  - Emergency procedures, including telephone numbers for emergency services and procedures for fault finding.
  - Material safety data sheets (MSDS).
  - A list of special safety devices and their set points.
  - Instructions for complying with the periodic testing and maintenance requirements of AS 2896.
- **Certificates:**
  - Copies of signed test certificates to AS 2896.
  - All other testing and commissioning results.
- **Record drawings**
  - Provide a drawing of the system as installed. Include all shop drawings. Show dimensions, types and location of the services in relation to permanent site features and other underground services. Show the spatial relationship to building structure and other services. Include all changes made during commissioning and the maintenance period.
  - Domestic cold water or fire mains shall show the pressure available at the initial connection point and the pressure available at the most disadvantaged location on each major section of the works.
  - Diagrams shall be included of each system.
  - Where pipes and fittings are below ground show the depth and dimensioned references that

will allow the future location of the service for maintenance or expansion.

#### **4.5 Training**

General: Explain and demonstrate to the principal's staff the purpose, function and operation of the installations.

## 5. Schedules

### 5.1 Samples Schedule

The contractor shall provide samples in good time and prior to any installation as listed below:

Sample required	Physical Sample	Technical Details / Sheet
Sink	x	
Tundish	x	
Hot water unit		x
Boiling water unit and tundish		x
Recycled water pump		x
Back wash filters		x
UV - Disinfection		x
RPZD	x	
First flush diverter		x
In-ground rainwater tank		x
TMV		x

### 5.2 Schedule of Equipment

Item	Technical Data	Make / Model	Additional Comments
Boiling water unit	P = 1.7kW	Zip Hydroboil Hydro Tap BC60/85	With sleep mode.
RPZD		M.A. Griffith	Complete with in-wall tundish and wall box
Hot water unit	V = 50L P = 3 x 3.6kW	Rheem 613 050	Installed complete with controller
First flush diverter		Waterflow Control WFC 1000600 Volume Filter VF6	Install within inspection chambers.
In-ground rainwater tank	V = 10,000L		

Recycled water pump	Q = 1 L/s H = 40m Variable speed, pressure controlled.		Dual pump station to be sized to 2 x 50% capacity with automatic change over.
Back wash filter 1 <sup>st</sup> stage	90 microns	BWT infinity	With anti scale screen, electronic timer, connection module & pressure gauges.
Bag filter 2 <sup>nd</sup> stage	50 microns	WFC FSI X100	Polypropylene housing with internal bag filter and pressure gauges,
UV-disinfection	4.50m <sup>3</sup> /h	BWT 80W80/11 LC 316 S/S	Including isolation valves, bypass valves and controller
TMV		Enware Aquablend TMV 1500	Complete with stainless steel wall box.

### 5.3 Piping Schedule

System	Pipe material and nominal size	Grade or class
Cold water	PP-R or polyethylene pipe, DN15-20 (alternative material: Pe-X for in-wall installation or rough-ins)	PN12 below ground PN20 above ground
Hot water	PP-R or polyethylene pipe, DN15-25 fibre composite (alternative material: Pe-X for in-wall installation or rough-ins)	PN12 below ground PN20 above ground
Recycled water	PP-R lilac to Authorities requirements DN15-20 (alternative material: Pe-X for in-wall installation or rough-ins)	PN12 below ground PN20 above ground
Sanitary plumbing and drainage	PVC-U DN65-DN100	DWW
Down pipes (visible)	Refer to architectural details	
Rainwater collection	PVC-U DN100-DN200	U-PVC DWW

### 5.4 Sanitary Fixtures Schedule

Provide sanitary fixtures complete with all accessories necessary for correct installation and use. Refer to architectural drawings/specification for details.

Item	Technical Data	Make / Model	Additional Comments
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Item	Technical Data	Make / Model	Additional Comments
Wall tundish	Stainless steel	Stainless Metal Craft TU-RE-2	For indoor location. Final location to be coordinated with architect.
Floor waste	Stainless steel	SPS	

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**Document Status**

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A – 60% issue	R. Oechsle	I. Krakov	IK*			08.03.11
B – Tender issue	Y. Kwan	I. Krakov	IK*	R. Pilz		1.03.12
C – Revised Tender Issue	R.Oechsle	I. Krakov	IK*	K.Brennan	KB*	13.03.12

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**EXHIBIT D – PLANNING APPROVAL**

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The Planning Approval comprises the following documents:

Review of Environmental Factors, Cardiff Station Upgrade – Stages 2 & 3, Version 1.0 dated 28 April 2011 (including REF Determination and Conditions of Approvals)



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## Review of Environmental Factors

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# Cardiff Railway Station Accessibility Upgrade – Stages 2 & 3

## Document History

Title	Cardiff Accessibility Upgrade Review of Environmental Factors		
Version	Author	Issued	Description
0.1	Jarred Kramer	2010	Draft at concept stage
0.2	Lesley Corkill	March 2011	Draft at 30% design
0.3	Lesley Corkill	21 April 2011	Draft at 60% design
1.0	Lesley Corkill	28 April 2011	Final REF

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## 1 Project Description & Scope of Works

Project Name:	Cardiff Railway Station Accessibility Upgrade
Project Manager:	<del>Cindy Yoon</del> Joe Dundovic <i>R. [Signature]</i>

### Location:

Location Name:	Cardiff Railway Station
Location Details:	The station is situated on the eastern edge of the suburb of Cardiff, and is located within the local government area of Lake Macquarie City Council. Three streets bound the site namely Main Road to the north, which continues past the station and becomes an overpass crossing the train tracks, Mary Street to the west and Thomas Street to the south.

### Project Timeframe:

Commencement date:	June 2011	
Duration of construction activities:	1 to 2 years	
Timing of construction work:	Day:	Monday to Friday 7:00am to 6:00pm Saturday 8:00am to 1:00pm
	Weekends:	Works permitted on weekends only during possessions (and during normal business hours on Saturday 8:00am to 1:00pm)
	Nights/Evenings:	Works permitted at evenings/night only during weekend possessions
Duration and frequency of operational activities:	The easy access facilities will be permanent and continuous, and will operate within the working hours of the station.	

## 1.1 Project Description and Scope of Work:

The project involves the following works:

<b>Station accessibility and the platform</b>
1. New lift (3 stop), linking lower carpark, upper carpark level and the pedestrian footbridge, and the associated landings, awnings, weather protection enclosures, accessible paths, and services.
2. New lift (2 stop), linking the pedestrian footbridge and platform, and the associated landings, awnings, weather protection enclosures, accessible paths, and services.
3. New footbridge extension, including all balustrades and anti throw screens (Up side).
4. Regraded ramp entry from the Main Road to the footbridge (Dn side).
5. Regraded ramp/footpath access from the City side of the Main Road to the upper carpark level (Up side).
6. Shared Access on the upper carpark level (Up side)
7. New stair access between the lower carpark, upper carpark level and footbridge level (Up side).
8. New bike rack (upper carpark level)
9. Platform extension to achieve 200m length platform, at 'Level Access' and compliant cross fall.
10. Platform raising (of existing platform) to achieve 'Level Access' and compliant cross fall.
11. Compliant accessible paths on platform, (and removal of seat shelter).
12. New platform, stair, ramp, landing tactile indicators
13. Removal of existing seating shelter due to low height and narrow accessible path (up side)
14. New family accessible toilet.
15. New fire rated storage space beneath platform stairs.
16. Demolish and rebuild main station building
17. New wind screening within the new platform canopies.
18. Provide and/or modify all required services (PA, CCTV, lighting, power, provision for other services, etc), furniture (seats, bins, etc), fencing and signage to the platform.
19. Allowance to be made for pits and inspection openings.
20. Provide platform drainage to suit platform extension and platform raising.
21. Modify the existing station building awning to achieve the required height clearance.
22. General repairs and improvements to the platform as required.
23. Temporary booking office during construction works
24. Underground water tank to be provided and connected to services
<b>Footbridge and stair works</b>
1. New broom finish concrete landings to new lifts.
2. Removal of existing stairs between footbridge and upper carpark level.
3. Provision of new balustrades to accommodate removal of existing stairs.
4. Modification to existing balustrades to accommodate new lift landings.
5. Anti throw screens to full extent of footbridge.
6. Localised repairs, including any painting, to existing footbridge, stair structure, balustrades and handrails.
7. Tactiles to top and bottom of stairs, ramps and lift lobbies.
8. New pre-cast concrete stair treads to all stairs complete with AS1428 compliant nosing.
9. Make good existing structures as required
<b>Street level works</b>
1. New retaining wall at lower carpark level to accommodate lift, lift and stair landings, stairs and footpath.
2. New and/or altered footpath at lower carpark level to accommodate lift, lift and stair landings, and stairs.
3. New and/or altered drainage at lower and upper carpark levels.
4. Road and civil works to suit new and/or altered works.
5. Modifications, relocations, and/or demolition of existing structures (fencing, lighting, paths, roads, crossings, signs, landscaping etc to suit new and/or altered works.
6. Removal of redundant structures and services, and making good.
7. Provision of a bin enclosure.

8. Minor landscaping in open areas.
9. Three new disabled car spaces in lower carpark
10. Removal of two (2) trees in lower carpark
<b>Services</b>
1. Containment and cabling for electrical/lighting supply, new PA system, phones and lift stop alarm.
2. Upgrade electrical supply downstream of Distribution Supply Main Switchboard (DSMSB).
3. Power to the lifts.
4. Lighting to lift shaft/pit/car/entries/foyers, paths, stairs, walkways, bridge, and any connecting walkway.
5. Lighting to the platform.
6. Power and lighting to the station building modifications.
7. Containment and cabling for CCTV, extending from new CCTV cameras back to the CCTV rack (existing) located in the Station Building.
8. All/any subsoil, water, sewer, stormwater and drainage services, including all/any relocations, diversions and/or disconnections, in conjunction with the lift shaft/pit/awnings/foyers etc.
9. Tidy up and rationalisation of services/fixtures/boards in the station booking office and building.
10. Security system, alarm panel, remote locking to be provided in the station booking office and building.
11. RailCorp Infrastructure (OHW, Signals, Track) works (both design & construction) in conjunction with the platform extension.

The following works are outside the scope of the project:

- New platform canopies are under construction under a separate RailCorp project and REF. These new platform canopies have been designed/constructed to take into account future platform raising.
- Construction of temporary stairs connecting the upper and lower carpark, including the removal of two (2) trees and trimming of another tree in the lower carpark. This work will be carried out under Stage 1 of the project, which is subject to a separate REF due to earlier scheduling of the works.

## 1.2 Reason and justification for the project

RailCorp is committed to providing accessibility upgrades across the rail network. Cardiff Railway Station has been identified as requiring accessibility upgrading and is listed as a high priority project. The upgrade works will help integrate the station and associated facilities within the surrounding context and establish Cardiff Railway Station as an address and gateway for Cardiff.

Another aim of the project is to reduce the safety incidences of passenger risk resulting from a short platform and improve the accessibility of the station, which is currently listed as high for safety incidents. These improvements are expected to enhance public safety and provide better disability access, and provide comfortable, safe, complying and attractive environment for all users.

This REF is for Stages 2 & 3 of the Cardiff Railway Station Accessibility Upgrade Project. Stage 1 of the project involved enabling works including the installation of temporary stairs, removal of 2 native trees and trimming of another tree in the lower car-park. The environmental impact of Stage 1 was assessed under an earlier REF due to the construction schedule. Stages 2 and 3 of the project have been assessed separately in this REF to allow for further resolution of the design, thereby ensuring that environmental impacts are assessed to the fullest extent. Control measures have been nominated in this REF for Stages 2 & 3, and were also incorporated into the separate REF for Stage 1, to ensure that potential cumulative environmental impacts of the accessibility upgrade project are addressed.

### 1.3 Construction Methodology

The work will involve the following main construction activities:

- Site set-up including erection of hoarding around construction areas;
- Delivery of construction materials and equipment;
- Excavation and demolition/removal of existing structures where required;
- Temporary stockpiling and removal of construction waste;
- Installation and fit-out of new structures/items; and
- Site restoration and cleanup.

The work is to be undertaken in line with the following staging:

- Stage 2 – Easy Access Works (including lift, bridge extension, stairs, part platform extension for lift only, platform raising (of existing platform) and replacement of the existing platform building.
- Stage 3 – Platform Extension Works (excluding the part platform extension for the lift only).

It is expected that construction phase of the project will include intermittent bored piling for the lift and stair structures, delivery of concrete by concrete pump trucks, concrete saw-cutting, use of a 200 tonne crane, hammering, breaking and handling of materials and waste, use of backhoes, bobcats and excavators, waste collection and bin drop-off by waste trucks, delivery of construction materials by heavy and light vehicles and the operation of power tools.

Construction activity is not expected to significantly increase traffic movements in the vicinity of Cardiff Railway Station. The majority of heavy vehicles used during the construction period will primarily consist of delivery trucks, waste trucks, concrete trucks, a 200 tonne crane, backhoes, bobcats and excavators. The total number of truck deliveries expected during normal working hours would be 5 in and 5 out per day. The likely route for construction traffic will be via Main Road.

The volume of excavation for the platform extension and lift installation is estimated to be up to 1000 cubic metres. Waste from the demolition of the existing platform building is estimated to be about 80 cubic metres.

### 1.4 Current Environment

Cardiff Railway Station is located in the suburb of Cardiff, New South Wales on the Newcastle and Central Coast Line. The station has one island platform that serves the Up and Down mains. There is a footbridge at the City (northern) end. The station office consists of a single storey building of brick and fibro construction with metal roof. There are two commuter carparks located on the western side of the station, benched over two levels with a height difference of about 3.0m. A railway yard abuts to the upper carpark to the south.

The site is situated on undulating to rolling terrain. Surrounding ground surface slopes down to the south-west at an average angle of about 10 degrees. The railway station is situated about 6m below Main Road to the north east and about the same level as the upper carpark to the south west. The lower carpark further to the south west of the station is situated at Mary Street level.<sup>1</sup> Main Road passes over the railway station to the north and features reasonably high traffic flow.

The lower carpark, which is owned by Lake Macquarie Council, is in close proximity to low density residential housing on Mary Street. The side boundary of the car park directly adjoins a residential property. Traffic noise from Myall Road is also audible in the lower carpark.

<sup>1</sup> GeoEnviro Consultancy Pty Ltd (2009) Geotechnical Investigation Proposed Station Upgrade – New Canopies Cardiff Railway Station Main Road, Cardiff, NSW

On the eastern side of the station there is mixture of two storey commercial and residential buildings. Construction noise complaints about a previous RailCorp project at Cardiff Station were received from a resident on Main Road on this side of the station.

The railway line is used by freight trains, which emit higher noise levels than standard passenger trains.

The project site is located in the Hunter-Central River catchment area. There are a number of stormwater drainage inlets on site, particularly in the lower and upper carpark areas. It is likely that that project site drains eventually to Winding Creek, which is located about 300 metres away.

The project site is predominantly sealed or gravelled or ballasted areas. The acid sulphate soils risk maps for Cardiff indicate that no acid sulfate soils are likely to exist at the site (see Appendix F).

There are a number of native trees in the lower carpark area.

There are no state or local heritage listings affecting the project site. There are reportedly no Aboriginal sites recorded within 200 metres of the site according to Department of Environment Climate Change and Water's Aboriginal Heritage Information Management System (see Appendix C).

The project site is located in the Lake Macquarie Mine Subsidence District (see Appendix A). Mine subsidence districts indicate conflict between mine subsidence and new development. Subsidence is the lowering or settling of the land's surface after underground mining has taken place. It is unclear whether there is any chance of actual mine subsidence at the site and this needs to be clarified with the Mine Subsidence Board.

Access to the work areas exist from three points namely the end of Mary Street (to the lower carpark), driveway off Main Road leading to the upper carpark and western side of the station, and Main Road passing the eastern side of the station. There is a locked compound area at the southern end of the upper carpark.

The 1:250,000 Geological map of Newcastle indicates the site to be underlain by Newcastle Measures consisting of shale, sandstone, conglomerate, tuff, chert and coal seams. A geotechnical investigation by GeoEnviro Consultancy Pty Ltd (2009)<sup>2</sup> identified that bedrock at the site is expected to be deep, greater than 10 metres. The site investigation revealed the station platform to be underlain by a 25mm to 30mm thick layer of asphalt concrete overlying poorly compacted fill, overlying natural clay at depths of between 1.4 an 1.6 metres below the existing platform level. In the yard at the southern end of the upper carpark, natural soil was encountered beneath the fill at a depth of about 2.4m below existing ground surface. Neither groundwater nor rock were encountered during the investigation despite one bore depth of up to 10.6 metres. The investigation did not extend to the lower carpark area. A copy of the geotechnical report is provided as Appendix D.

The Hazardous Materials Register (see Appendix E) for Cardiff Station indicates that the main station building on platform 1 contains the following hazardous materials, all of which are recommended for removal prior to refurbishment/demolition:

- Hot water unit in the kitchen
- 200m<sup>2</sup> of SMF insulation in the ceiling space
- Hot water unit in ceiling space
- 200m<sup>2</sup> of sarking in ceiling space

<sup>2</sup> GeoEnviro Consultancy Pty Ltd (2009) Geotechnical Investigation Proposed Station Upgrade – New Canopies Cardiff Railway Station Main Road, Cardiff, NSW



**Figure 1:** Aerial photograph of Cardiff Railway Station (image source: Department of Lands, Spatial Information Exchange). Closest residential receivers circled blue.

**Site Photos (Taken 16 Feb 2011):**



**Figure 2:** View of the lower car park, standing on the upper car park level looking south west



**Figure 3:** View of the lower car park, looking west



**Figure 4:** View of the lower car park, looking north east towards the existing footbridge



**Figure 5:** Native trees at the edge of the lower carpark, looking east



**Figure 6:** View of the existing bike rake along the driveway into the upper car park, looking north towards Main Road



**Figure 7:** View of the upper car park, looking south east



**Figure 8:** View of the existing footbridge, standing in the upper car park, looking north towards Main Road



**Figure 9:** View of the northern end of the platform, looking north east



**Figure 10:** View of the station platform, looking south from the existing footbridge



**Figure 11:** View of the station platform from the upper car park, looking south east

## 2 Statutory Planning and Approval

### 2.1 Planning considerations

#### **State Environmental Planning Policy (Major Development) 2005**

This SEPP identifies certain developments which are deemed major projects under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and are determined by the Minister for Planning. The project does not meet the criteria listed in Schedule 1, Section 23 (Rail and related transport facilities). As such, it is not subject to Part 3A assessment under the EP&A Act.

#### **State Environmental Planning Policy (Infrastructure) 2007**

*State Environmental Planning Policy (Infrastructure) 2007* commenced on 1 January 2008. The Infrastructure SEPP aims to assist in the effective delivery of public infrastructure across the State by improving certainty and regulatory efficiency through consistent planning assessment and approvals regime for public infrastructure and services and through the clear definition of environmental assessment and approval process for public infrastructure and services facilities.

Under Division 15 Clause 79 (1) of the SEPP:

*“Development for the purpose of a railway or rail infrastructure facilities may be carried out by or on behalf of a public authority without consent on any land.”*

Hence, the activity is assessed under Part 5 of the EP&A Act.

#### **State Environmental Planning Policy No. 14 – Coastal Wetlands**

The proposed works do not impact on any SEPP 14 wetlands and as such, the SEPP is not relevant to the proposed works.

#### **State Environmental Planning Policy No. 26 – Littoral Rainforests**

The proposed works do not impact on littoral rainforest and as such, the SEPP is not relevant to the proposed works.

#### **State Environmental Planning Policy No. 55 – Remediation of Land**

SEPP 55 provides for a consistent State-wide planning approach to the remediation of contaminated land. The policy states that land must not be developed if it is unsuitable for a proposed use because it is contaminated. If the land is unsuitable, remediation must take place before the land is developed. As this project is being conducted within the existing rail corridor, does not involve a change of land use and does not involve remediation of land the SEPP is not relevant to the proposed works.

#### **Local Environment Plan**

The permissibility of the proposed work under the local council LEP is not relevant as SEPP (Infrastructure) 2007 overrides local controls.

#### **Environment Protection Licence**

RailCorp holds Environment Protection Licence 12208 for 'railway systems activities' in accordance with the *Protection of the Environment Operations Act 1997* (POEO Act). The project does not meet the definition of 'railway systems activities' nor does it trigger any other premises-based licensing requirements under the POEO Act.

### 2.2 Appropriate consent mechanism

This activity is "permitted with consent" under the SEPP (Infrastructure) 2007 and has been assessed and determined in accordance with Part 5 of the *EP&A Act*. RailCorp is both the Proponent and approval authority.

### 3 Community and Authority Consultation

Who have you consulted?	When did you consult them?	Summary of comments raised	Outline how comments have been addressed
Lake Macquarie City Council	To be carried out 21 days prior to works commencing on-site	Traffic and Pedestrian Management Plan for the entry/egress to the site during the construction phase	To be determined
		Plan for directing commuters to park at areas free of construction activities (staged construction)	To be determined
Jason McKenzie, Asset Inspector - Natural Areas, Lake Macquarie City Council	28 Feb 2011	Council recommended new planting in the lower car park and on top of the crib wall to off-set removal of 2 trees (plus removal of 2 additional trees and trimming of another tree under Stage 1, covered by a separate REF) in the lower car-park	Landscaping will be carried out by RailCorp as per the landscaping plan for the project with consideration of planting recommendations by Council. Council has been forwarded a copy of the landscaping plan for approval.
Peter Semple, Environmental Specialist Biodiversity, RailCorp	16 Mar 2011	Copy of the preliminary proposed landscape plan (Ref 21-20144-SK) and Council's comments about planting forwarded. Peter advised that the landscaping proposal was satisfactory.	Landscaping will be carried out as per the approved landscaping plan.
Commuters using the site	Via local newspaper advertisement and leaflets delivered prior to works commencing	Initial advice regarding the work commencement and expected completion timeframes	Notification only
	Via billboard / notice board at site prior to works commencing	Summary of the works and progress Staging and alternative arrangements	Notification only
Residents and other sensitive receivers near the site	5 days prior to noisy or out-of-hours works commencing	Notification only	Notification only
Paul Gray District Supervisor Mine Subsidence Board, Newcastle District Office	12 April 2011 the project	Cardiff Railway station is not undermined and unlikely to be mined in the future. Plans stamped.	No further action required
Hunter Water Corporation	3 March 2011	Various requirements relating to the relocation of the sewer main	Design plans will be submitted by RailCorp's Project Manager for a 'Major Works' assessment prior to construction commencing

## 4 Potential Environmental Impacts

The works will not be carried out in critical habitat of an endangered species, population or ecological community (identified under the *Threatened Species Conservation Act 1995* or the *Fisheries Management Act 1994*).

The works will not be carried out in a wilderness area (identified under the *Wilderness Act 1987*).

The works will not be carried out in a contaminated site as specified under the *Contaminated Land Management Act, 1997*.

### 4.1 Land contamination and disposal of excavated material

#### Existing environment and Potential Impacts

Previous investigations of other railway land in the Cardiff area indicate that there is a potential risk for soil contamination at the site. In order to carry out the an extension to the platform and the lift / stair installation/s, excavation to a depth of 2 to 3 metres covering an area of 475 square metres will be carried out resulting in approximately 1000 cubic metres of spoil for off-site disposal. The majority of this spoil will be generated from the installation of the lift and stairs connecting the upper and lower car-park areas, and is likely to comprise fill material potentially containing contaminants.

#### Mitigation measures

The potential impacts of land contamination and subsequent disposal of excavated material generated from the project works will be minimised by implementing a number of mitigation measures, which include:

- Preparation of a preliminary waste classification and contamination assessment to accurately define the nature and extent of contamination at the site, for the purpose of disposal and potential on-site reuse of excavated material. Where contaminated soils are identified, specific strategies and control measures must be formulated via an Environment Management Plan (EMP) in order to manage any risks posed by the identified contamination to site workers, the public and the environment during the site works.
- Work shall cease immediately if unknown area(s) of potentially contaminated materials are encountered during excavation works. It is likely that the following actions will then be carried out:
  - Storage of potentially contaminated materials separately on an impermeable surface, and covered to protect against wind and rain. The stockpiled material will not be placed near any stormwater inlets or waterways.
  - Testing of the stockpiled material for contaminants and advice sought from a suitably qualified environmental specialist on the management of the contaminated material.
  - All identified contaminated material to be disposed off-site will be classified in accordance with the *Waste Classification Guidelines* (DECCW, 2009) and transported to a licensed landfill site for disposal.
  - If the potentially contaminated materials include asbestos containing material (ACM), it is likely that the following additional actions will be carried out:
    - Advice sought from a qualified Occupational Hygienist as to whether the ACM is bonded or friable.
    - ACM removed by a WorkCover licensed asbestos removalist under the supervision of the Occupational Hygienist, following the preparation of an Asbestos Removal and Management Plan.
    - ACM removal carried out strictly in accordance with *Code of Practice for the Management and Control of Asbestos in the Workplace* [NOHSC: 2018 (2005)] published by the NOHS Commission, as in force from time to time.

- Temporary storage on site (if off-site disposal cannot take place immediately) in an environmentally safe manner, in quantities less than 5 tonnes at any time, and removed at the earliest opportunity.
- An asbestos clearance certificate for the site prepared by a suitably qualified Occupational Hygienist at the completion of the removal works.

## 4.2 Noise

The project does not involve extending the NSW rail network. The project does not involve track duplication in a residential area. The project does not involve construction of a cross-over, siding, turnout, yard, loop, refuge, relief line or reopening a disused line, where it will result in significant noise impacts on residents.

### 4.2.1 Operational Noise

#### Existing Environment and Potential Impacts

A new enhanced PA system will be installed at Cardiff Railway Station as part of this project in accordance with the RailCorp (2010) *Enhanced Public Address System Design and Installation Guideline*. No complaints have been recorded by RailCorp in the past 12 months about environmental noise from the existing older style PA system at Cardiff Station. However, over the past few months, only about 2 speakers have been in operation (one at each end of the platform) as a result of the canopy replacement project and subsequent removal of some of the speakers. Announcements generally start after 6am each day and conclude at about 7:15 weekdays and 7:40pm on weekends. Station staff trigger pre-recorded announcements during this period and can make individual announcements about train scheduling.

Acoustic studies carried out at other stations following installation of the new enhanced PA system have shown that it produces less environmental noise spill than the older systems. The new systems generally run live public address and automated DVA announcements from first to last train in accordance with the *Disability Discrimination Act*. This means that the first morning announcement at Cardiff Station will be at about 2:51am and the last at 1:55am at Cardiff Station according to the current timetable. Assuming correct installation and setup of the new enhanced PA system at Cardiff Station, there should result in no or minimal noise impact to residents nearby during the day-time. It is possible that noise from the system in the early morning and late evening/night could cause a noise nuisance.

#### Mitigation measures

The potential impacts of noise from the operation of the new enhanced PA system will be minimised by implementing a number of mitigation measures, which include:

- Post-installation testing and commissioning of the system will be carried out in accordance with section 18 of the RailCorp (2010) *Enhanced Public Address System Design and Installation Guideline*.
- An acoustic specialist will be engaged post commissioning of the new system to assess the environmental noise impact of the PA system announcements at the nearest residential receivers. The assessment will involve noise measurements ( $L_{Aeq15min}$  and short-term background noise monitoring) between 7:00pm and the latest train, plus the earliest train to 6:00am (as shown in the CityRail timetable). The specialist will make recommendations (if necessary) in order to meet the noise goal of less than or equal to background plus 5dB(A) at the nearest residential receivers.

#### 4.2.2 Construction Noise

The construction phase of the project may cause noise impacts to sensitive receivers as a result of demolition and construction works such as intermittent bored piling for lift and stair structures, delivery of concrete by concrete pump trucks, concrete saw-cutting, use of a 200 tonne crane, hammering, breaking and handling of materials and waste, use of backhoes, bobcats and excavators, waste collection and bin drop-off by waste trucks, delivery of construction materials by heavy and light vehicles and the operation of power tools.

It is likely that a temporary work compound will be established at the site in the upper carpark area to receive deliveries and store waste for collection. Any necessary permission will be sought from the Lake Macquarie Council to establish suitable times for vehicles to access the work sites.

**Construction Noise Assessment**

Distance to nearest sensitive receiver		Approx. construction noise level at 7m, dB(A)		Noise screening or barriers		Ambient noise environment at receiver		Timing of construction work		Duration of construction work	
Note 1		Note 2		Note 3		Note 4					
Distance (m)	Rating	Category (refer AS2436 and Note 2)	Rating	Description	Rating	Description	Rating	Category	Rating	Duration	Rating
<10	0	≥110dB(A) (e.g. sheet piling)	110	Receivers screened from effective noise source	-10	Quiet, rural or isolated	-35	Day (0700 to 1800 weekdays, 0800 to 1300 Saturdays)	0	<1hr	-20
10-25	-10	≥100dB(A) (e.g. bored piling)	100	Receivers not screened	0	suburban	-45	Evenings / weekends (1800 - 2200hrs weekdays, 1300 - 2200 Saturdays, 0800 - 2200 Sundays / public holidays)	10	<1day	-10
25-50	-16	≥90dB(A) (e.g. concreting)	90			Urban or near busy roads or industrial activity	-55	Night-time (2200 - 0700 weekdays, 2200 - 0800 weekends / public holidays)	20	<1 week	-5
50-100	-22	≥80dB(A) (e.g. small generators)	80							1 to 4 weeks	0
100-200	-28									4 to 26 weeks	10
200-500	-34									>26 weeks	20
500-1000	-40										
>1000	-46										
Ratings	-10		100		0		-55		10		20
Score	65	<b>Impact/Risk Level Ranges</b> <b>Low: &lt;25</b> (highly likely that noise mitigation will not be required, other than those identified above and if complaints "hot spots" have been considered) <b>Moderate: &gt;25 and 35</b> (consider mitigation other than those identified above, inform community) <b>High: &gt;35</b> (inform community, implement all practical means to mitigate, seek specialist advice if >50)				<div style="border: 1px solid black; padding: 5px;"> <p><b>NOTE: The above construction noise assessment is based on a worse case scenario of the noisiest works happening at night for longer than half a year, however not all works will be carried</b></p> </div>					

### Existing Environment and Potential Impacts

The locality is generally suburban to urban with an acoustic environment that is affected by continuous traffic flows along Main Road, which passes over the railway station to the north. The railway line is used by freight trains, which emit higher noise levels than standard passenger trains. Traffic noise from Myall Road is also audible in the lower car park area.

The timing of construction works for the project is:

Day:	Monday to Friday 7:00am to 6:00pm Saturday 8:00am to 1:00pm
Weekends:	Works permitted on weekends only during possessions (and during normal business hours on Saturday 8:00am to 1:00pm)
Nights/Evenings:	Works permitted at evenings/night only during weekend possessions

Nearby sensitive receivers to the project site include:

- On the western side of the station there are residences buildings located directly next to and opposite the lower car park on Mary Street (about 30 metres away).
- On the eastern side of the station, there is mixture of two storey commercial and residential buildings (about 30 metres away).

Typical equipment to be utilised to complete the work have the following range of A-weighted sound pressure levels at 30m:

Plant Description	A-weighted sound power levels $L_{WA}$ (mid-point) dB ref. $10^{-12} W^*$	Predicted A-weighted sound pressure levels $L_{PA}$ (mid-point) dB at 30m
Backhoe	104	66
Concrete saw	117	79
Concrete pump truck	108	70
Mobile crane	104	66
Excavator	107	69
Generator (diesel)	99	61
Piling (bored)	111	73
Truck (>20 tonne)	107	66
Truck (dump)	117	79
Vehicles (light commercial)	106	68

\* Table from Appendix A1 of AS 2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites

The rating background level (RBL) for Cardiff Railway Station is likely to be between 40-45 dBA during evening/night and 55-60dBA during the day. The results above indicate that goal of background noise level (RBL) + 5dB will be exceeded for the majority of day, evening and night works. It is therefore anticipated that noise from the proposed works will impact sensitive receivers around Cardiff Railway Station, with the closest residential receiver being within 30 metres of the site on Mary Street.

For night works, sleep disturbance should be considered. The DECCW (2010) *Noise Guide for Local Government* recommends that an  $L_{A1, 1min}$  should not exceed the background noise by more than 15dBA external to a bedroom window between 10:00pm and 7:00am. Furthermore the EPA (1999) *Environmental Criteria Road Traffic Noise* (ECTRAN), concludes:

- Maximum internal noise levels below 50-55dBA are unlikely to cause awakening reactions; and
- One or two noise events per night, with maximum internal noise levels of 65-70dBA, are not likely to affect health and wellbeing significantly.

Hence, given the likely sound pressure levels at 30 metres as calculated above, it is possible that the construction works may cause some sleep disturbance to nearby residential receivers if these works are undertaken between 10:00pm and 7:00am.

The DECCW (2010) *Interim Construction Noise Guideline* recommends that restrictions be applied to the hours of construction where activities will generate noise at residences above the 'highly noise affected' noise management level (ie 75dBA or greater). In addition, noisy works should only be carried out outside of normal business hours (ie Monday to Friday 7:00am to 6:00pm and Saturday 8:00am to 1:00pm) where there is strong justification, reasonable and feasible work practices are applied and community negotiation is potentially carried out.

It is possible that impulsive or intermittent vibration may originate from various construction activities at the project site such as occasion loading and unloading, passing heavy vehicles and occasional dropping of heavy equipment.

### Possible Mitigation Measures

The potential impacts of noise and vibration from the project works will be minimised by implementing a number of mitigation measures, which include:

- Preparation of a Construction and Vibration Noise Management Plan (CNVMP) as a sub-plan of the Construction Environment Management Plan (CEMP) for the project. The CNVMP must include, but need not be limited to:
  - identification of sensitive receivers identified within the impacted zone(s);
  - detailed summary of expected noise and vibration impacts at these receivers (where, when and for how long etc);
  - clear descriptions of the hours of work to balance noise and vibration impacts on receivers (including justifications);
  - detailed examination of what feasible and reasonable practices are available to minimise noise and vibration impacts including, but not limited to the noise control measures outlined in the table below, and an estimation of approximate noise reduction when possible;
  - commitment to what feasible and reasonable practices will be applied to manage noise and vibration (including reasoning and justifications);
  - how complaints will be handled (description of readily accessible contact point, complaints process, maintaining a complaints register etc);
  - monitoring and reporting procedures, including regular internal checks by project team; and
  - how often the plan will be reviewed and updated to continuously apply best practice noise and vibration management for the duration of the project.
  - commitment to what feasible and reasonable practices will be applied to manage noise and vibration (including reasoning and justifications);
  - how complaints will be handled (description of readily accessible contact point, complaints process, maintaining a complaints register etc);
  - monitoring and reporting procedures, including regular internal checks by project team; and
  - how often the plan will be reviewed and updated to continuously apply best practice noise and vibration management for the duration of the project.

Possible Construction Noise Control Measures		Construction Noise Control Measures to be implemented during construction
Maximising the offset distance between noisy plant items and nearby residential receivers	<input checked="" type="checkbox"/> Yes	Fixed site location. Position any noisy plant items as far as practical from residential receivers.
	<input type="checkbox"/> No	
Avoid the simultaneous operation of two or more noisy plant items in close vicinity and adjacent to residential receivers	<input checked="" type="checkbox"/> Yes	Stage the use of plant and equipment to avoid the simultaneous operation of two (2) or more noisy plant items in close vicinity and adjacent to residential receivers.
	<input type="checkbox"/> No	
Schedule the noisiest activities during normal business hours (7am and 6pm Monday to Friday and 8am and 1pm Saturday), or where this is not possible, to less sensitive times of day	<input checked="" type="checkbox"/> Yes	Where possible, conduct noisy activities during normal business hours.  Schedule noisiest works for early in the evenings or in the middle of the day during weekend possessions. Noisy works involving the use of concrete cutters, concrete pumps and piling rigs are to be completed before 10pm.  Notify any residents and other sensitive receivers of any works that are to be conducted outside normal business hours and/or are likely to be noisy at least 5 days prior to those works being carried out.
	<input type="checkbox"/> No	
Provide periods of quiet if activities occur for extended periods during the night	<input checked="" type="checkbox"/> Yes	Limit the use of noisy plant and equipment to 3 consecutive hours if carried out during the evening/night as part of a weekend possession, and provide minimum respite period of 1 hour between each block.  There is a possibility of night-works during weekend possessions. Local residents must be notified of such works 5 days in advance and periods of quiet that will be provided to reduce impacts.
	<input type="checkbox"/> No	
Minimise consecutive night time activities in the same locality	<input checked="" type="checkbox"/> Yes	Evening/night works are only permitted during weekend possessions, and are therefore limited to no more than 3 consecutive nights.
	<input type="checkbox"/> No	
Orient equipment away from residential receivers	<input checked="" type="checkbox"/> Yes	Fixed site location. Where possible, position equipment away from residential receivers.
	<input type="checkbox"/> No	
Carry out loading and unloading away from residential receivers	<input checked="" type="checkbox"/> Yes	Fixed site location. Carry out loading and unloading activities where practical during business hours and away from residential receivers.

Possible Construction Noise Control Measures		Construction Noise Control Measures to be implemented during construction
	<input type="checkbox"/> No	
Position site access points and roads as far as possible away from residential receivers	<input checked="" type="checkbox"/> Yes	Fixed site location. Position access points to the sites as far from residential receivers as possible.
	<input type="checkbox"/> No	
Use structures to shield residential receivers from noise	<input type="checkbox"/> Yes	
	<input checked="" type="checkbox"/> No	Not feasible due to large open project site.
Plan for and conducting night time activities in ways that eliminate or minimise the need for audible warning alarms	<input checked="" type="checkbox"/> Yes	Use broadband reversing alarms only and design worksites for direct access and exits to minimise the need for reversing.  No whistles to be used for crane operations, instead radios should be utilised to minimise the impact to the surrounding residents.
	<input type="checkbox"/> No	
Notify residents of any proposed activities which are to be conducted outside normal business hours and which are likely to create offensive noise	<input checked="" type="checkbox"/> Yes	Notify residents and other sensitive receivers of any works that are to be conducted outside normal business hours and/or are likely to be noisy at least 5 days prior to those works being carried out.
	<input type="checkbox"/> No	
Carry out works in a competent and considerate manner	<input checked="" type="checkbox"/> Yes	No yelling, slamming of car doors or portable radios on site. Avoid dropping materials from a height where practical. Schedule truck movements to avoid residential streets where possible.
	<input type="checkbox"/> No	

## 5 EPBC Matters of NES & EP&A Regulation Clause 228 Factors

### 5.1 EPBC Act and Matters of NES

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) aims to:

- provide for the protection of the environment, especially matters of national environmental significance
- conserve Australian biodiversity
- provide a streamlined national environmental assessment and approvals process
- enhance the protection and management of important natural and cultural places
- control the international movement of plants and animals (wildlife), wildlife specimens and products made or derived from wildlife
- promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources

Matters of national environmental significance (NES) are protected under the Act and these matters:

- World Heritage properties
- National Heritage places
- wetlands of international importance
- listed threatened species and ecological communities
- migratory species protected under international agreements
- Commonwealth marine areas
- nuclear actions (including uranium mines)

A search of the EPBC Act for a 0.2 km radius around the project site indicated the following matters of NES were within the area (See Appendix B for EPBC listing search results).

- 0 World Heritage Properties;
- 0 National Heritage Places;
- 1 Wetland of International Significance (RAMSAR Site);
- 0 Commonwealth Marine Areas;
- 0 Threatened Ecological Communities;
- 16 Threatened Species; and
- 14 Migratory Species

There are no matters of national environmental significance that would be affected as a result of this project.

A search of the NSW Government threatened species database identifies 125 threatened species in the Hunter Catchment Management Authority (CMA) sub-region, which includes the subject site. The database does not provide a more focused search function for this locality.

The likelihood of disturbing actual or potential habitats associated with the threatened species and matters of NES are considered to be low as the works will be confined to the project site and associated assess points. There are no threatened species known to occur on the site.

No commonwealth land would be affected, either directly or indirectly, as a result of this project.

## 5.2 EP&A Regulation Clause 228 Factors

CLAUSE 228 FACTORS		
a.	<p><b>Any Environmental Impact On A Community?</b></p> <p>During the construction phase, the residential community near the site may be impacted by increased noise levels. Control measures will be nominated as part of the project's risk assessment to minimise this impact on the community.</p> <p>The operational phase of the project is expected to positively influence the community as it will provide greater accessibility to the station and train services.</p>	<input checked="" type="checkbox"/> Yes
		<input type="checkbox"/> No
b.	<p><b>Any Transformation Of A Locality?</b></p> <p>Transformation of the locality will occur as the proposed works involve construction of new infrastructure facilities, which will significantly improve the station facilities and amenities. The development may alter the views of the station though is not anticipated to impact on the consistency of character of the railway corridor. It is not expected to cause additional light reflection or shadowing.</p> <p>During evening and night-time works carried out during weekend possessions, lighting towers will illuminate work areas which may cause temporary nuisance for adjoining residents. Sensitive areas for light spill from evening/night time works include all residential areas where property adjoins the work site. No or minimal operational light spill is expected. Control measures will be nominated as part of the project's risk assessment to ensure that these potential risks to the locality are controlled.</p>	<input checked="" type="checkbox"/> Yes
		<input type="checkbox"/> No
c.	<p><b>Any Environmental Impact On the Ecosystems of the Locality?</b></p>	<input type="checkbox"/> Yes
		<input checked="" type="checkbox"/> No
d.	<p><b>Any Reduction of the Aesthetic, Recreational, Scientific or Other Environmental Quality or Value of a Locality?</b></p>	<input type="checkbox"/> Yes
		<input checked="" type="checkbox"/> No
e.	<p><b>Any Effect on A Locality, Place Or Building Having Aesthetic, Anthropological, Archaeological, Architectural, Cultural, Historical, Scientific Or Social Significance Or Other Special Value For Present Or Future Generations?</b></p>	<input type="checkbox"/> Yes
		<input checked="" type="checkbox"/> No
f.	<p><b>Any Impact On The Habitat Of Protected Fauna (Within The Meaning Of The <i>National Parks And Wildlife Act 1974</i>)?</b></p>	<input type="checkbox"/> Yes
		<input checked="" type="checkbox"/> No
g.	<p><b>Any Endangering Of Any Species Of Animal, Plant Or Other Form Of Life Whether Living On Land, In Water Or In The Air?</b></p>	<input type="checkbox"/> Yes
		<input checked="" type="checkbox"/> No
h.	<p><b>Any Long Term Effects On The Environment?</b></p>	<input type="checkbox"/> Yes
		<input checked="" type="checkbox"/> No

CLAUSE 228 FACTORS		
i.	<b>Any Degradation Of The Quality Of The Environment?</b>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
j.	<b>Any Risk To The Safety Of The Environment?</b> There is a risk to the safety of the environment, particularly during the construction phase of the project. This could include injury from physical hazards, worker movements and the use of plant and machinery. The site is currently used by commuters. Temporary fencing will be constructed around active work areas to protect pedestrians and customers from the construction works, and works staged to minimise disturbance to station operations and commuters. Other matters that may affect the safety of the environment are discussed below under 'Any Pollution of the Environment?'. Control measures will be nominated as part of the project's risk assessment to ensure that these potential risks to the safety of the environment are controlled.	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
k.	<b>Any Reduction In The Range Of Beneficial Uses Of The Environment?</b>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
l.	<b>Any Pollution of the Environment?</b> There is a risk of pollution arising, particularly arising during the construction phase of the project. For instance, there is potential for pollution of waters from the use and wash out of concrete, inappropriate transport and disposal of waste, and dust and noise from demolition and construction activities. Control measures will be nominated as part of the project's risk assessment to ensure that these potential pollution risks are controlled.	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
m.	<b>Any Environmental Problems Associated with the Disposal of Waste?</b> Large quantities of demolition and construction waste will be generated from the site as part of the project. Control measures will be nominated as part of the project's risk assessment to ensure that potential waste transport and disposal issues are controlled.	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
n.	<b>Any Increased Demands on Resources (Natural or Otherwise) that are or are Likely to Become in Short Supply?</b>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
o.	<b>Any Cumulative Environmental Effect with Other Existing or Likely Future Activities?</b> This REF is for Stages 2 & 3 of the Cardiff Railway Station Accessibility Upgrade Project. Stage 1 of the project involved enabling works including the installation of temporary stairs, removal of 2 native trees and trimming of another tree in the lower car-park. The environmental impact of Stage 1 was assessed under an earlier REF due to the construction schedule. Stages 2 and 3 of the project have been assessed separately in this REF to allow for further resolution of the design, thereby ensuring that environmental impacts are assessed to the fullest extent. Control measures have been nominated in this REF for Stages 2 & 3, and were also incorporated into the separate REF for Stage 1, to ensure that potential cumulative environmental impacts of the accessibility upgrade project are addressed.	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

Cardiff Railway Station Accessibility Upgrade – Stages 2 & 3  
 Review of Environmental Factors

CLAUSE 228 FACTORS		
p.	<b>Any Impact on Coastal Processes and Coastal Hazards, including those under Projected Climate Change Conditions?</b>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

## 6 Risk Assessment of the Project's Environmental Impacts

<b>Consequence:</b>	<b>MINOR:</b>	<b>MODERATE:</b>	<b>MAJOR:</b>
<b>Likelihood:</b>	Minimal environmental impact / community concern, or Short term duration.	Moderate environmental impact, community concern or complaints, or duration of more than one month.	Major adverse environmental/ community impact, breach of legislation, or notable impacts to sensitive areas/receivers, extended duration.
<b>LIKELY: in most cases</b>	Medium	High	High
<b>POSSIBLE: at some time</b>	Low	Medium	High
<b>UNLIKELY to ever occur</b>	Low	Low	Medium

### Impacts, Cause, and Control Measures

Impact Category	Cause(s)	Risk H/M/L	Control Measure(s)	Risk after control H/M/L	Person Responsible for ensuring the implementation of Controls E.g. Site Supervisor
Air: <input checked="" type="checkbox"/> Dust <input checked="" type="checkbox"/> Odour & Fumes <input checked="" type="checkbox"/> Smoke <input checked="" type="checkbox"/> Greenhouse Gases	Dust generated from demolition and construction activities	M	<p>The project site must be maintained in a proper and efficient condition.</p> <p>The project site must be maintained in a condition which minimises or prevents the migration of dust off-site.</p> <p>Loads of waste transported from the project site by vehicles must be adequately covered.</p> <p>Stabilise all disturbed areas as soon as possible to prevent wind blown dust.</p> <p>If required, use a water spray cart to dampen exposed areas and stockpiles of excavated materials to suppress dust.</p> <p>Carry out all demolition work in accordance with the provisions of relevant Australian Standards, including AS2601-2001 <i>Demolition of structures</i>.</p> <p>Ensure that the demolition is carried out with due consideration of all hazardous materials identified in RailCorp's Hazardous Materials Register for Cardiff Railway Station.</p>	L	Principal Contractor/ Project Manager

Cardiff Railway Station Accessibility Upgrade – Stages 2 & 3

Review of Environmental Factors

Impact Category	Cause(s)	Risk H/M/L	Control Measure(s)	Risk after control H/M/L	Person Responsible for ensuring the implementation of Controls E.g. Site Supervisor
	Plant and equipment generated atmospheric pollutants/greenhouse gases	L	All plant and equipment installed at and for the project or used in connection with the project: (a) must be maintained in a proper and efficient condition; and (b) must be operated in a proper and efficient manner. Plant and equipment must be switched off when not in use. Plant and equipment must be maintained in good operating condition including regular servicing in accordance with manufacturers specifications.	L	Principal Contractor/ Project Manager
Water: <input checked="" type="checkbox"/> Pollution <input checked="" type="checkbox"/> Sedimentation <input checked="" type="checkbox"/> Oil Spills	General demolition and construction works causing pollution of waters	M	The Project must comply with section 120 of the <i>Protection of the Environment Operations Act 1997</i> .	L	Principal Contractor/ Project Manager
	Spills of fuel, oil or other chemical substances	M	All fuels, oil or other chemical substances must be stored in an area has a secondary containment system (eg bunding) that will minimise the risk of pollution from liquid spills and leaks. The secondary containment system must have sufficient capacity to hold 110% of volume of the largest container stored or, for facilities where where only small containers are stored, 35% of the total volume of stored product.  All fuels and other hazardous substances must be stored at least 40 metres from watercourses.  Hazardous materials must be used and stored in accordance with relevant Material Safety Data Sheets (MSDS).  Appropriate equipment and absorbent material must be provided and maintained in a prominent position in order to combat any spill at the project sites.	L	Principal Contractor/ Project Manager

Cardiff Railway Station Accessibility Upgrade – Stages 2 & 3

Review of Environmental Factors

Impact Category	Cause(s)	Risk H/M/L	Control Measure(s)	Risk after control H/M/L	Person Responsible for ensuring the implementation of Controls E.g. Site Supervisor
	Soil, mud or sediment entering and polluting waterways due to washing or cleaning equipment/tools	M	All wash-down of soil, mud or sediment from equipment/ tools must be carried out within designed wash-down areas located away from drainage lines and stormwater pits. Wash-down areas shall utilise geotextile fabric to catch sediments laid over a ditch/depression (or a water tight skip bin). The depression shall have sufficient capacity to contain all wash-down water for percolation through the fabric without overflowing the depression. Captured sediment must be transported off-site for disposal at a waste facility that can lawfully receive that type of waste.	L	Principal Contractor/ Project Manager
	Concrete residues and wastes entering waterways and causing pollution due to washing concrete-delivery trucks, on-site mixing, washing tools/equipment, hosing/cleaning surfaces and saw-cutting	M	Carry out concreting works in accordance with the Department of Environment and Conservation NSW (2004) <i>Environmental Best Practice Guideline for Concreting Contractors</i> . This should include as a minimum:  1. Establishing and using a concrete wash-down area on site; and  2. Managing concrete run-off waste in a manner that prevents stormwater pollution.	L	Principal Contractor/ Project Manager
	Polluted run-off from stockpiles of materials entering the stormwater drainage system	M	Locate stockpiles away from waterways, roads, slopes steeper than 10%, and areas of concentrated water flow.  Prevent runoff from washing through storage areas by locating stockpiles high on the site or diverting runoff around the site or the stockpile areas.  Place sediment controls or bunding down the slope from stockpiles and provide weatherproof covering where possible.	L	Principal Contractor/ Project Manager
	Discharge of sediment laden water from dewatering footings and excavations to the stormwater drainage system	M	Any dewatering of excavations or footings of sediment laden water resulting from the ingress of rainwater or groundwater shall be managed in accordance with <i>The Blue Book - Managing Urban Stormwater : Soils and Construction – Volume 1, 4th Edition (Landcom)</i> .	L	Principal Contractor/ Project Manager

Cardiff Railway Station Accessibility Upgrade – Stages 2 & 3

Review of Environmental Factors

Impact Category	Cause(s)	Risk H/M/L	Control Measure(s)	Risk after control H/M/L	Person Responsible for ensuring the implementation of Controls E.g. Site Supervisor
	Damage to sewer main during relocation works	M	Consult with Hunter Water Corporation and comply with any conditions that they impose resulting from their assessment of the design drawings for relocation of the sewer main.	L	Principal Contractor/ Project Manager
Land: <input checked="" type="checkbox"/> Soil Erosion / Stability <input type="checkbox"/> Site rehabilitation <input type="checkbox"/> Acid Sulfate soils <input checked="" type="checkbox"/> Soil Contamination	Demolition and construction work may result in sediment being washed into stormwater drains	M	Establish effective sediment control measures for any works resulting in land disturbance in accordance with <i>The Blue Book - Managing Urban Stormwater: Soils and Construction – Volume 1, 4th Edition (Landcom)</i> , so to prevent sediment and/or building materials being carried or washed onto the footpath, gutter, road or into the stormwater drainage system.  These should include as a minimum: 1. stabilising entry and exit points to the work areas where possible; 2. diverting surface runoff around the works areas where necessary; 3. placing sediment barriers downslope of works areas and waste stockpiles; 4. placing sediment barriers around any stormwater drains/pits; 5. undertaking regular inspections of all sediment control structures; and 6. immediately adjusting or reinstating any structure found to be ineffective.  Hard stand areas must be reinstating as soon as possible.	L	Principal Contractor/ Project Manager
	Vehicles tracking sediment onto roads	M	Ensure vehicles are clean prior to leaving the project site.  If sediment is tracked onto road, ensure it is swept up immediately and disposed of lawfully. Water is not to be used to wash any material into stormwater drains.	L	Principal Contractor/ Project Manager
	Spills causing contamination of soil	M	Immediately contain and clean up any spills, excavate any contaminated soil and ensure that no contamination is left insitu, and transport the waste to a place that can lawfully received it.	L	Principal Contractor/ Project Manager

Cardiff Railway Station Accessibility Upgrade – Stages 2 & 3

Review of Environmental Factors

Impact Category	Cause(s)	Risk H/M/L	Control Measure(s)	Risk after control H/M/L	Person Responsible for ensuring the implementation of Controls E.g. Site Supervisor
	Encountering contaminated material during excavation works	H	<p>Prepare a preliminary waste classification &amp; contamination assessment to accurately define the nature and extent of contamination at the site, for the purpose of disposal and potential on-site reuse of excavated material. Where contaminated soils are identified, specific strategies and control measures must be formulated via an EMP in order to manage any risks posed by the identified contamination to site workers, the public and the environment during the site works.</p> <p>Work must cease immediately should previously unknown area(s) of potentially contaminated materials are encountered during excavation works. It is likely that the following actions will then be required:</p> <ul style="list-style-type: none"> <li>• Store potentially contaminated materials separately on an impermeable surface, and cover to protect against wind and rain. The stockpiled material must not be placed near any stormwater inlets or waterways.</li> <li>• Test the stockpiled material for contaminants and seek advice from a suitably qualified environmental specialist on the management of the contaminated material.</li> <li>• All identified contaminated material to be disposed off-site must be classified in accordance with the <i>Waste Classification Guidelines</i> (DECCW, 2009) and transported to a licensed landfill site for disposal.</li> <li>• If the potentially contaminated materials include asbestos containing material (ACM), it is likely that the following additional actions will be required: <ul style="list-style-type: none"> <li>○ Seek advice from a qualified Occupational Hygienist as to whether the ACM is bonded or friable.</li> <li>○ Ensure that the ACM is removed by a WorkCover licensed asbestos removalist under the supervision of the Occupational Hygienist, following the preparation of an Asbestos Removal and Management Plan.</li> <li>○ ACM removal is to be carried out strictly in accordance with <i>Code of Practice for the Management and Control of Asbestos in the Workplace</i> [NOHSC: 2018 (2005)] published by the NOHS Commission, as in force from time to time.</li> <li>○ Temporary storage on site (if off-site disposal cannot take place immediately) must be in an environmentally safe manner, in quantities less than 5 tonnes at any time, and removed at the earliest opportunity.</li> <li>○ An asbestos clearance certificate for the site must be prepared by a suitably qualified Occupational Hygienist at the completion of the removal works.</li> </ul> </li> </ul>	M	Principal Contractor/ Project Manager

Cardiff Railway Station Accessibility Upgrade – Stages 2 & 3

Review of Environmental Factors

Impact Category	Cause(s)	Risk H/M/L	Control Measure(s)	Risk after control H/M/L	Person Responsible for ensuring the implementation of Controls E.g. Site Supervisor
Noise and Vibration: <input checked="" type="checkbox"/> Noise <input checked="" type="checkbox"/> Vibration	Vehicle movements and use of construction equipment (possibly including concrete saws, piling, jackhammers, hammers, drilling and cutting hand tools)	H	Work must only be conducted between the approved hours for the project.  Prepare and implement a Construction Noise and Vibration Management Plan in accordance with Section 4.2 of this REF.  Wherever practicable the following measures must be implemented: <ul style="list-style-type: none"> <li>• Position any noisy plant items and equipment as far as practical from residential receivers;</li> <li>• Stage the use of plant and equipment to avoid the simultaneous operation of 2 or more noisy plant items in close vicinity and adjacent to residential receivers;</li> <li>• Where possible, conduct noisy activities during normal business hours;</li> <li>• Schedule noisiest works for early in the evenings or in the middle of the day during weekend possessions. Noisy works involving the use of concrete cutters, concrete pumps and piling rigs are to be completed before 10pm;</li> <li>• Notify any residents and other sensitive receivers of any works that are to be conducted outside normal business hours and/or are likely to be noisy at least 5 days prior to those works being carried out. Periods of quiet that will be provided to reduce impacts should also form part of the notification;</li> <li>• Limit the use of noisy plant and equipment to 3 consecutive hours if carried out during the night as part of a weekend possession, and provide minimum respite period of 1 hour between each block;</li> <li>• Night works are only permitted during weekend possessions, and are therefore limited to no more than 3 consecutive nights;</li> <li>• Carry out loading and unloading activities where practical during business hours and away from residential receivers;</li> <li>• Position access points to the sites as far from residential receivers as possible;</li> <li>• Use broadband reversing alarms only and design worksites for direct access and exits to minimise the need for reversing;</li> <li>• No whistles to be used for crane operations, instead radios should be utilised to minimise the impact to the surrounding residents;</li> <li>• No yelling, slamming of car doors or portable radios on site;</li> <li>• Avoid dropping materials from a height where practical; and</li> <li>• Schedule truck movements to avoid residential streets where possible.</li> </ul>	M	Principal Contractor/ Project Manager

Cardiff Railway Station Accessibility Upgrade – Stages 2 & 3

Review of Environmental Factors

Impact Category	Cause(s)	Risk H/M/L	Control Measure(s)	Risk after control H/M/L	Person Responsible for ensuring the implementation of Controls E.g. Site Supervisor
	Testing, commissioning and operation of PA System	M	<p>Install, test and commission the PA System in accordance with the RailCorp (2010) <i>Enhanced Public Address System Design and Installation Guideline</i>.</p> <p>An acoustic specialist will be engaged post commissioning of the new system to assess the environmental noise impact of the PA system announcements at the nearest residential receivers. The assessment will involve noise measurements (<math>L_{Aeq15min}</math> and short-term background noise monitoring) between 7:00pm and the latest train, plus the earliest train to 6:00am (as shown in the CityRail timetable). The specialist will make recommendations (if necessary) in order to meet the noise goal of less than or equal to background plus 5dB(A) at the nearest residential receivers.</p>	L	Principal Contractor/ Project Manager
Flora and Fauna: <input checked="" type="checkbox"/> Native vegetation <input checked="" type="checkbox"/> Trimming/ removing established trees >3m <input type="checkbox"/> Habitat <input type="checkbox"/> Threatened Species <input type="checkbox"/> Sensitive areas: Wetlands, Bush regeneration areas etc <input type="checkbox"/> Noxious Weeds <input type="checkbox"/> Pesticides Use	Removal and pruning of trees and other vegetation	L	<p>Removal of two (2) native trees located in the lower car-park area, as indicated on the architectural drawings attached to this REF, is to be carried out by an Arborist.</p> <p>To off-set the removal of the trees, develop and implement a landscape plan in consultation with Lake Macquarie City Council, using locally indigenous plant species as per the RailCorp Revegetation Technical Specification EMS-09-TP-0066 (section 4.1).</p> <p>Restrict the trimming and/or removal of any other vegetation to the minimum necessary.</p> <p>Engage an Arborist if necessary to advise on suitable measures to protect trees to be retained from damage by construction activities.</p>	L	Principal Contractor/ Project Manager
	Excavation of material causing damage to tree roots	L	Where possible avoid cutting or damaging tree roots during excavation works.	L	Principal Contractor/ Project Manager

Cardiff Railway Station Accessibility Upgrade – Stages 2 & 3

Review of Environmental Factors

Impact Category	Cause(s)	Risk H/M/L	Control Measure(s)	Risk after control H/M/L	Person Responsible for ensuring the implementation of Controls E.g. Site Supervisor
Waste and Resource Use: <input checked="" type="checkbox"/> Spoil <input checked="" type="checkbox"/> Litter <input checked="" type="checkbox"/> Liquid Waste <input checked="" type="checkbox"/> Hazardous Waste <input checked="" type="checkbox"/> Solid Waste	Waste generated from demolition and construction works	M	Follow the resource management hierarchy principles embodied in the <i>Waste Avoidance and Resource Recovery Act 2001</i> , namely: <ol style="list-style-type: none"> <li>1. avoid unnecessary resource consumption;</li> <li>2. recover resources (including reuse, reprocessing, recycling and energy recovery); and</li> <li>3. dispose (as a last resort).</li> </ol> Dispose of concrete waste from concrete wash-down areas off-site to a waste facility that can lawfully receive that type of waste.  Classify all waste in accordance with the DECCW <i>Waste Classification Guidelines</i> as in force from time to time, and transport the waste to a waste facility that can lawfully receive it.  Maintain a waste register in accordance with RailCorp's <i>Environmental Management Specification for Contractors</i> . The register must also include copies of waste dockets/receipts from the waste facility where the waste transported (date and time of delivery, name and address of the facility, its ABN, contact person).	L	Principal Contractor/ Project Manager
	Poor quality fill material imported to the sites.	M	The only fill material that may be imported to the site is virgin excavated natural material (within the meaning of the <i>Protection of the Environment Operations (POEO) Act 1997</i> and/or any other waste-derived material the subject of a resource recovery exemption under clause 51A of the <i>POEO (Waste) Regulation 2005</i> that is permitted to be used as fill material.  Any VENM received at the site must be accompanied by waste classification documentation.  Any waste-derived material the subject of a resource recovery exemption received at the site must be accompanied by documentation as to the material's compliance with the exemption conditions.	L	Principal Contractor/ Project Manager
	Waste material tracked onto public roads	M	Ensure that any spoil or waste tracked onto roads is immediately swept up and disposed of lawfully. Water is not to be used to wash any material or waste into stormwater drains.	L	Principal Contractor/ Project Manager

Cardiff Railway Station Accessibility Upgrade – Stages 2 & 3

Review of Environmental Factors

Impact Category	Cause(s)	Risk H/M/L	Control Measure(s)	Risk after control H/M/L	Person Responsible for ensuring the implementation of Controls E.g. Site Supervisor
	Litter deposited from meals/materials	L	<p>Provide an adequate number of bins at the project site for workers, and place all litter in these bins.</p> <p>Ensure that work areas of the project site are kept clean and free of litter, including cigarette butts, at all times.</p> <p>Remove all waste from the project site on completion of the works, and ensure that it transported to a waste facility that can lawfully receive that type of waste.</p>	L	Principal Contractor/ Project Manager
Social: <input checked="" type="checkbox"/> Adjoining landholder <input type="checkbox"/> Electric and Magnetic Fields	Disruption and disturbance to local residents	M	Notify residents and other sensitive receivers of any works that are to be conducted outside normal business hours and/or are likely to be noisy at least 5 days prior to those works being carried out. Normal business hours are between 7am and 6pm Monday to Friday and 8am and 1pm Saturday.	L	Principal Contractor/ Project Manager
Heritage: <input type="checkbox"/> European Heritage <input type="checkbox"/> Aboriginal Heritage <input type="checkbox"/> Conservation Area <input type="checkbox"/> Archaeological Potential	No heritage items or areas exist at the site	-	N/A	-	-
Aesthetic: <input type="checkbox"/> Visual <input type="checkbox"/> Views and vistas <input type="checkbox"/> Overshadowing <input checked="" type="checkbox"/> Light spill	Use of temporary lighting during construction phase of project	M	To ensure minimisation of any disturbance to the local community, any activity requiring lighting must be arranged to ensure light is directed towards the work area and minimal nuisance light allowed into the surrounding neighbouring properties.	L	
	Light spill from new or relocated light poles for operational phase of project	L	Where possible any additional light spill must be kept to a minimum by ensuring any new or relocated light poles use light fittings with directional reflectors.	L	Principal Contractor/ Project Manager

Cardiff Railway Station Accessibility Upgrade – Stages 2 & 3

Review of Environmental Factors

Impact Category	Cause(s)	Risk H/M/L	Control Measure(s)	Risk after control H/M/L	Person Responsible for ensuring the implementation of Controls E.g. Site Supervisor
Transport <input checked="" type="checkbox"/> Traffic and access <input type="checkbox"/> Transport <input type="checkbox"/> Land use impacts	Disruption of public access	M	Construction vehicles, materials and equipment must be positioned to minimise impacts to public access. If disruption to access is caused, ensure alternative safe and accessible thoroughfare is provided.	L	Principal Contractor/ Project Manager
	Vehicles transporting equipment and materials to and from the site may impact on traffic, property access and parking availability	L	Position construction vehicles, materials and equipment to minimise impacts to public access and parking. Ensure a Traffic and Pedestrian Management Plan is completed and approved by Lake Macquarie City Council for staged construction works to minimise and manage the disruption caused by the project	L	Principal Contractor/ Project Manager

## 7 Project Justification

This REF has been prepared to assess the potential environmental impact of the Cardiff Railway Station Accessibility Upgrade.

The primary objectives of the project are as follows:

1. provide accessibility upgrade to Cardiff Railway Station; and
2. adopt best management and administrative practices and to comply with the Principles of Ecologically Sustainable Development in attaining the above objectives.

### The Principles of Ecologically Sustainable Development applied to the Project

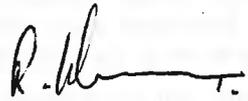
ESD Principle	Application to the Project
Precautionary principle	The results of this REF indicate that the project does not pose a risk of serious or irreversible environmental damage. Adverse impacts associated with the project would be minor. Measures to reduce adverse impacts as far as practicable have also been identified within this REF.
Intergenerational equity	This project is unlikely to adversely impact on the environment to the extent that future generations would be deprived of natural resources that presently exist.  The project is expected to contribute towards regional strategic benefits for future generations, including improved public transport, assuming the project encourages modal shift towards public transport. Upgrade to the station will make it more appealing transport option to a broader range of people in the community, including families and people with disabilities.
Conservation of biological diversity and ecological integrity	The project area is located in a highly developed urban area and would not result in any loss of biodiversity or ecological integrity.
Improved valuation and pricing of environmental resources	RailCorp recognises the value of environmental resources and aims to minimise the impacts of its activities by ensuring that appropriate mitigation measures are implemented for all aspects of the project.

## 8 REF Determination and Conditions

### ASSESSOR DECLARATION

Name: Mat Neeson Title: Environmental Facilitator, RailCorp Location: 36-46 George Street, Burwood NSW 2134	This REF provides a true and fair review of the activity in relation to its likely effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the project, and provides sufficient information to determine whether there is likely to be a significant impact on the environment as a result of the Project.  I have considered all environmental impacts and safeguards to the best of my knowledge, and have sought advice where required.
Phone: (02) 8575 0155 Fax: (02) 8575 0312 Mobile: 0459 819 197	
Signature:  Date: 28/04/11	

### DETERMINER DECLARATION & APPROVAL

Name: Richard Mumford Title: Program Manager Stations and Buildings, RailCorp Location: 36-46 George Street, Burwood NSW 2134	I have reviewed the document and consider that the project will not have a significant impact and can proceed subject to the controls outlined in this REF.
Phone: (02) 9536 2599 Mobile: 0417 494 371	
Signature:  Date: 29/04/11	

### The following actions must be undertaken as a condition of this approval.

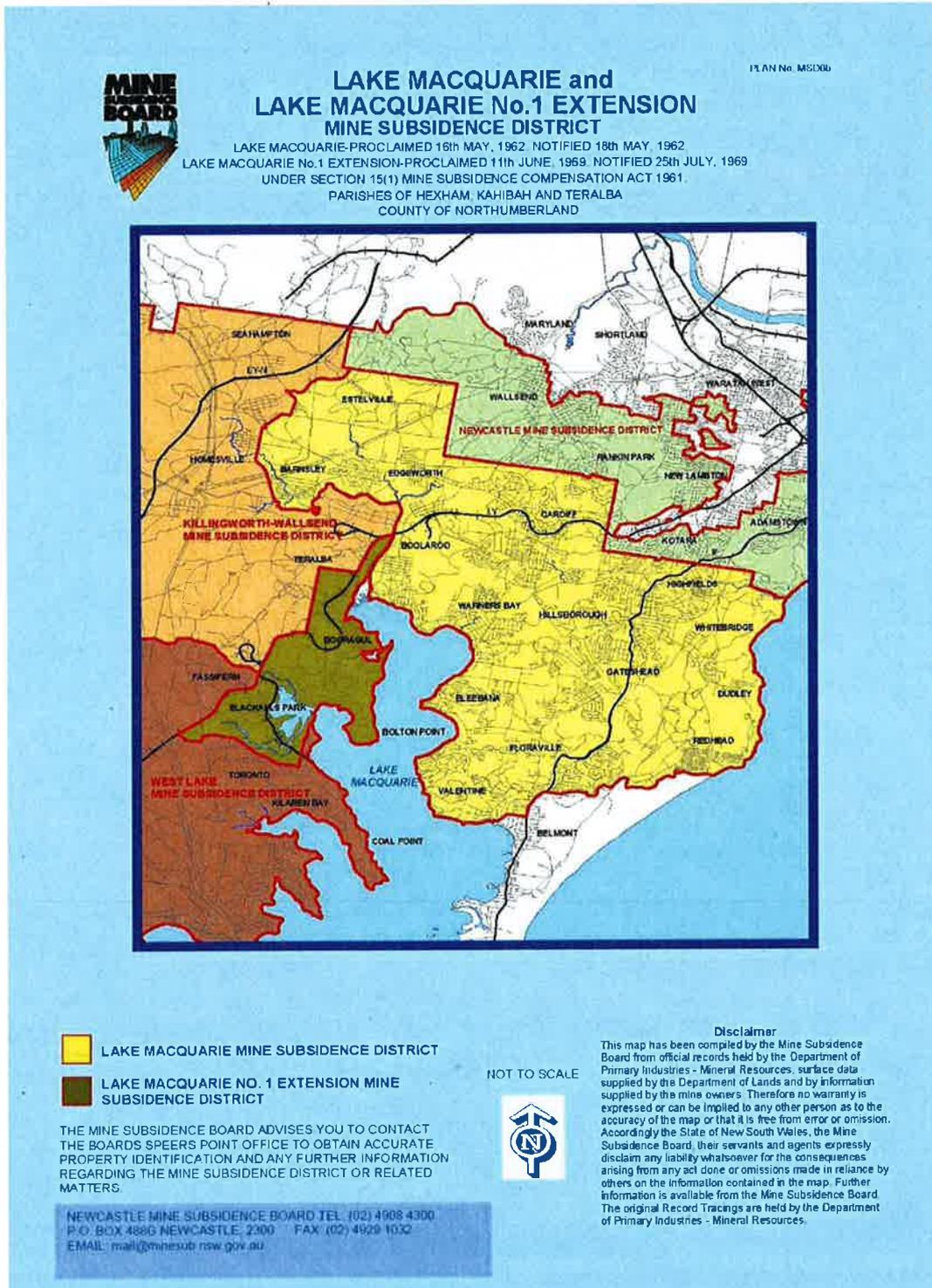
1. The project must be undertaken in accordance with the description of the activity and environmental control measures listed in this Review of Environmental Factors (REF).
2. Prior to the commencement of any works on-site, the RailCorp Project Manager must complete any outstanding consultation as described in Section 3 of this REF.
3. A Construction Environment Management Plan (CEMP) identifying the potential risks of the activity and how these will be managed must be prepared to the satisfaction of the RailCorp Projects Division Environmental Unit.
4. As a minimum the risks and mitigation/controls measures provided in Section 4 and Section 6 of the REF must be included the CEMP.
5. The CEMP must include the following sub-plans:
  - a. A Traffic and Pedestrian Management Plan.
  - b. A Sediment and Erosion Control Plan, which complies with *Managing Urban Stormwater: Soils and Construction* (Landcom 2004) and incorporates a site diagram showing the positioning of controls.
  - c. A Construction Noise and Vibration Management Plan as described in Section 4.1 of this REF.
  - d. A Waste Management Plan that includes:
    - i. details of, and the waste management action proposed for, each type of waste;
    - ii. procedures that ensure the waste is transported to a lawful place; and
    - iii. a description of the roles and responsibilities of everyone who manages the waste, including the site supervisor and sub-contractors.

6. Construction hours for this project are between 7am and 6pm Monday to Friday, and 8am and 1pm Saturday. Residents and other sensitive receivers must receive at least 5 days prior notification of any works that are:
  - a. to be conducted outside these hours, namely during weekend possessions; and/or
  - b. any works that are likely to be noisy.

Any works scheduled to be carried out outside of the above construction hours must be approved as an addendum to this REF.

7. A copy of this REF and the CEMP are to be retained on-site and produced upon request.
8. Ensure relevant control measures are in place before work commences and that they are regularly monitored.
9. Brief personnel during site inductions on the location of sensitive areas and control measures identified.
10. Stop work and immediately notify the relevant Railcorp Projects Division Program Manager and Environmental Unit if you encounter anything which was not identified adequately or was previously unknown.
11. Prepare a preliminary waste classification and contamination assessment to accurately define the nature and extent of contamination at the site, for the purpose of disposal and potential on-site reuse of excavated material. Where contaminated soils are identified, specific strategies and control measures must be formulated via an EMP in order to manage any risks posed by the identified contamination to site workers, the public and the environment during the site works.
12. An acoustic specialist will be engaged post commissioning of the new system to assess the environmental noise impact of the PA system announcements at the nearest residential receivers. The assessment will involve noise measurements ( $L_{Aeq15min}$  and short-term background noise monitoring) between 7:00pm and the latest train, plus the earliest train to 6:00am (as shown in the CityRail timetable). The specialist will make recommendations (if necessary) in order to meet the noise goal of less than or equal to background plus 5dB(A) at the nearest residential receivers.
13. This REF expires after five (5) years from the date of Determination unless works have physically commenced within that period.

## Appendix A: Mine Subsidence District Map



## Appendix B: EPBC Act Search





**Australian Government**  
 Department of the Environment, Water, Heritage and the Arts

**Protected Matters Search Tool**

You are here: [Environment Home](#) > [EPBC Act](#) > [Search](#)

12 October 2010 12:50

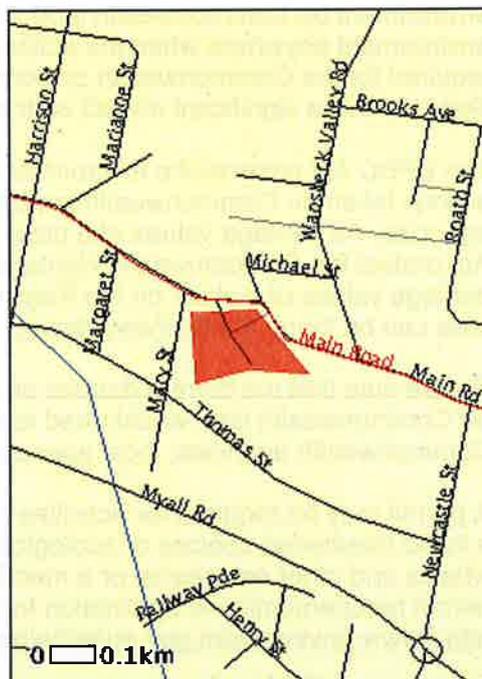
# EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

You may wish to print this report for reference before moving to other pages or websites.

The Australian Natural Resources Atlas at <http://www.environment.gov.au/atlas> may provide further environmental information relevant to your selected area. Information about the EPBC Act including significance guidelines, forms and application process details can be found at <http://www.environment.gov.au/epbc/assessmentsapprovals/index.html>

**Search Type:** Area  
**Buffer:** 0.2 km  
**Coordinates:** -32.9412058, 151.6627726, -  
 32.9412436, 151.6620204, -  
 32.9420630, 151.6620750, -  
 32.9418991, 151.6626801, -  
 32.9419538, 151.6633861



This map may contain data which are  
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 (Geoscience Australia)  
 © PSMA Australia Limited

- Report Contents:**
- [Summary](#)
  - [Details](#)
    - [Matters of NES](#)
    - [Other matters protected by the EPBC Act](#)
    - [Extra Information](#)
  - [Caveat](#)
  - [Acknowledgments](#)

## Summary

### Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see

<http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html>.

**World Heritage Properties:** None

**National Heritage Places:** None

**Wetlands of International Significance:**  
**(Ramsar Sites)** 1

**Commonwealth Marine Areas:** None

**Threatened Ecological Communities:** None

**Threatened Species:** 16

**Migratory Species:** 14

## Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage/index.html>.

Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at <http://www.environment.gov.au/epbc/permits/index.html>.

**Commonwealth Lands:** None

**Commonwealth Heritage Places:** None

**Places on the RNE:** None

**Listed Marine Species:** 12

**Whales and Other Cetaceans:** None

**Critical Habitats:** None

**Commonwealth Reserves:** None

## Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

<b>State and Territory Reserves:</b>	None
<b>Other Commonwealth Reserves:</b>	None
<b>Regional Forest Agreements:</b>	1

## Details

### Matters of National Environmental Significance

Wetlands of International Significance [ [Dataset Information](#) ]  
(Ramsar Sites)

#### HUNTER ESTUARY WETLANDS

Within 10 km of Ramsar site

Threatened Species [ [Dataset Information](#) ]

Status

Type of Presence

#### **Birds**

[\*Anthochaera phrygia\*](#)  
Regent Honeyeater

Endangered

Species or species habitat likely to occur within area

[\*Lathamus discolor\*](#)  
Swift Parrot

Endangered

Species or species habitat may occur within area

[\*Rostratula australis\*](#)  
Australian Painted Snipe

Vulnerable

Species or species habitat may occur within area

#### **Frogs**

[\*Litoria aurea\*](#)  
Green and Golden Bell Frog

Vulnerable

Species or species habitat may occur within area

[\*Litoria littlejohni\*](#)  
Littlejohn's Tree Frog, Heath Frog

Vulnerable

Species or species habitat may occur within area

#### **Mammals**

[\*Chalinolobus dwyeri\*](#)  
Large-eared Pied Bat, Large Pied Bat

Vulnerable

Species or species habitat may occur within area

[\*Dasyurus maculatus maculatus \(SE mainland population\)\*](#)  
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population)

Endangered

Species or species habitat may occur within area

[\*Potorous tridactylus tridactylus\*](#)  
Long-nosed Potoroo (SE mainland)

Vulnerable

Species or species habitat may occur within area

[\*Pseudomys novaehollandiae\*](#)  
New Holland Mouse

Vulnerable

Species or species habitat likely to occur within area

[\*Pteropus poliocephalus\*](#)  
Grey-headed Flying-fox

Vulnerable

Foraging, feeding or related behaviour known to occur within area

#### **Reptiles**

[\*Hoplocephalus bungaroides\*](#)

Vulnerable

Species or species habitat likely to

Broad-headed Snake

occur within area

**Plants***Cryptostylis hunteriana*  
Leafless Tongue-orchid

Vulnerable Species or species habitat may occur within area

*Eucalyptus camfieldii*  
Camfield's Stringybark

Vulnerable Species or species habitat likely to occur within area

*Melaleuca biconvexa*  
Biconvex Paperbark

Vulnerable Species or species habitat known to occur within area

*Pterostylis gibbosa*  
Illawarra Greenhood, Rufa Greenhood,  
Pouched Greenhood

Endangered Species or species habitat may occur within area

*Tetralathea juncea*  
Black-eyed Susan

Vulnerable Species or species habitat likely to occur within area

Migratory Species [ [Dataset Information](#) ]

Status Type of Presence

**Migratory Terrestrial Species****Birds***Haliaeetus leucogaster*  
White-bellied Sea-Eagle

Migratory Species or species habitat likely to occur within area

*Hirundapus caudacutus*  
White-throated Needletail

Migratory Species or species habitat may occur within area

*Merops ornatus*  
Rainbow Bee-eater

Migratory Species or species habitat may occur within area

*Monarcha melanopsis*  
Black-faced Monarch

Migratory Breeding may occur within area

*Myiagra cyanoleuca*  
Satin Flycatcher

Migratory Breeding likely to occur within area

*Rhipidura rufifrons*  
Rufous Fantail

Migratory Breeding may occur within area

*Xanthomyza phrygia*  
Regent Honeyeater

Migratory Species or species habitat likely to occur within area

**Migratory Wetland Species****Birds***Ardea alba*  
Great Egret, White Egret

Migratory Species or species habitat may occur within area

*Ardea ibis*  
Cattle Egret

Migratory Species or species habitat may occur within area

*Gallinago hardwickii*  
Latham's Snipe, Japanese Snipe

Migratory Species or species habitat may occur within area

*Rostratula benghalensis s. lat.*  
Painted Snipe

Migratory Species or species habitat may occur within area

**Migratory Marine Birds***Apus pacificus*  
Fork-tailed Swift

Migratory Species or species habitat may occur within area

*Ardea alba*  
Great Egret, White Egret

Migratory Species or species habitat may occur within area

*Ardea ibis*

Migratory Species or species habitat may

Cattle Egret

occur within area

**Other Matters Protected by the EPBC Act**Listed Marine Species [ [Dataset Information](#) ]

Status

Type of Presence

**Birds***Apus pacificus*  
Fork-tailed SwiftListed -  
overfly  
marine  
areaSpecies or species habitat may occur  
within area*Ardea alba*  
Great Egret, White EgretListed -  
overfly  
marine  
areaSpecies or species habitat may occur  
within area*Ardea ibis*  
Cattle EgretListed -  
overfly  
marine  
areaSpecies or species habitat may occur  
within area*Gallinago hardwickii*  
Latham's Snipe, Japanese SnipeListed -  
overfly  
marine  
areaSpecies or species habitat may occur  
within area*Haliaeetus leucogaster*  
White-bellied Sea-Eagle

Listed

Species or species habitat likely to  
occur within area*Hirundapus caudacutus*  
White-throated NeedletailListed -  
overfly  
marine  
areaSpecies or species habitat may occur  
within area*Lathamus discolor*  
Swift ParrotListed -  
overfly  
marine  
areaSpecies or species habitat may occur  
within area*Merops ornatus*  
Rainbow Bee-eaterListed -  
overfly  
marine  
areaSpecies or species habitat may occur  
within area*Monarcha melanopsis*  
Black-faced MonarchListed -  
overfly  
marine  
area

Breeding may occur within area

*Myiagra cyanoleuca*  
Satin FlycatcherListed -  
overfly  
marine  
area

Breeding likely to occur within area

*Rhipidura rufifrons*  
Rufous FantailListed -  
overfly  
marine  
area

Breeding may occur within area

*Rostratula benghalensis s. lat.*  
Painted SnipeListed -  
overfly  
marine  
areaSpecies or species habitat may occur  
within area**Extra Information**

## Regional Forest Agreements [ [Dataset Information](#) ]

Note that all RFA areas including those still under consideration have been included.

North East NSW RFA, New South Wales

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## Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the *Environment Protection and Biodiversity Conservation Act 1999*. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under "type of presence". For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the [migratory](#) and [marine](#) provisions of the Act have been mapped.

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as [extinct or considered as vagrants](#)
- some species and ecological communities that have only recently been listed
- [some terrestrial species](#) that overfly the Commonwealth marine area
- migratory species that are very [widespread, vagrant, or only occur in small numbers](#).

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites;
- seals which have only been mapped for breeding sites near the Australian continent.

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

## Acknowledgments

This database has been compiled from a range of data sources. The Department acknowledges the following custodians who have contributed valuable data and advice:

- [New South Wales National Parks and Wildlife Service](#)
- [Department of Sustainability and Environment, Victoria](#)
- [Department of Primary Industries, Water and Environment, Tasmania](#)
- [Department of Environment and Heritage, South Australia Planning SA](#)
- [Parks and Wildlife Commission of the Northern Territory](#)
- [Environmental Protection Agency, Queensland](#)
- [Birds Australia](#)
- [Australian Bird and Bat Banding Scheme](#)
- [Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [Queensland Herbarium](#)
- [National Herbarium of NSW](#)
- [Royal Botanic Gardens and National Herbarium of Victoria](#)
- [Tasmanian Herbarium](#)
- [State Herbarium of South Australia](#)
- [Northern Territory Herbarium](#)
- [Western Australian Herbarium](#)
- [Australian National Herbarium, Atherton and Canberra](#)
- [University of New England](#)
- Other groups and individuals

[ANUCliM Version 1.8, Centre for Resource and Environmental Studies, Australian National University](#) was used extensively for the production of draft maps of species distribution. Environment Australia is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Last updated: Thursday, 20-Nov-2008 14:17:56 EST

[Department of the Environment, Water,  
Heritage and the Arts](#)  
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Telephone: +61 (0)2 6274 1111

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## Appendix C: Aboriginal Sites Search



Railcorp - Burwood  
PO Box 515  
Burwood New South Wales 1805  
Attention: Lesley Corkill

Date: 10 March 2011

Dear Sir or Madam:

**AHIMS Web Service search for the following area at Datum :GDA, Zone : 56, Eastings : 374933 - 374968,  
Northings : 6354394 - 6354398 with a Buffer of 200 meters. Additional Info : conducted by Lesley Corkill on 10  
March 2011**

A search of the DECCW AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

<b>0</b>	<b>Aboriginal sites are recorded in or near the above location.</b>
<b>0</b>	<b>Aboriginal places have been declared in or near the above location. *</b>

**If your search shows Aboriginal sites or places what should you do?**

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (<http://www.nsw.gov.au/gazette>) website. Gazettal notices published prior to 2001 can be obtained from DECCW's Aboriginal Heritage Information Unit upon request

**Important information about your AHIMS search**

- AHIMS records information about Aboriginal sites that have been provided to DECCW and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

## Appendix D: Geotechnical report

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**GeoEnviro Consultancy Pty Ltd**

Unit 5/39-41 Fourth Avenue, Blacktown, NSW 2148, Australia  
PO Box 1543, Macquarie Centre, North Ryde, NSW 2113

ABN 62 084 294 762  
Tel : (02) 9679 8733  
Fax : (02) 9679 8744

## **Report**

### **Geotechnical Investigation Proposed Station Upgrade – New Canopies Cardiff Railway Station Main Road, Cardiff, NSW**

Prepared for

**Railcorp**

**C/- Caldis Cook Group**

**Level 2, 45 Chippen Street**

**CHIPPENDALE NSW 2008**

**Ref: JG09294D-r1**

**October 2009**



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28<sup>th</sup> October 2009

JG09294D-r1

Railcorp  
C/- Caldis Cook Group  
Level 2, 45 Chippen Street  
CHIPPENDALE NSW 2008

Attention: Mr Ken Ng

Dear Sir

**Re Geotechnical Report  
Proposed Station Upgrade – New Canopies  
Cardiff Railway Station, Main Road, Cardiff**

We are pleased to submit our geotechnical report for the proposed Station Upgrade project for Cardiff Railway Station at Main Road, Cardiff, NSW.

This report contains information on sub-surface conditions and our comments and recommendations on geotechnical issues for the proposed development.

Should you have any queries, please contact the undersigned.

Yours faithfully  
**GeoEnviro Consultancy Pty Ltd**

Solern Liew CPEng (NPER)  
Director

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## 1. INTRODUCTION

This report presents the results of a geotechnical investigation for the proposed station upgrade project for Cardiff Railway Station at Main Road, Cardiff, as shown on Drawing No 1. The investigation was commissioned by Mr Hisham Noori of Caldís Cook Group, acting on behalf of Railcorp. The scope of works were carried out in general accordance with our fee proposal Ref PG09936C dated 29<sup>th</sup> January 2009.

We understand that the project will include construction of new canopy structures on the station platform area. The new canopies will be about 40m long and cover an area of about 300m<sup>2</sup>. The project will also include some resurfacing of the station platform pavements.

The purpose of this investigation was to assess the subsurface ground conditions and based on the information obtained, to provide the following;

- Assessment on site classification to AS2870.
- Recommendations on platform subgrade preparation and resurfacing.
- Recommendation on suitable footing types for the proposed canopies including allowable bearing capacities and foundation depths.

## 2. SITE DESCRIPTION AND PROJECT APPRECIATION

Cardiff Railway Station is located between Main Road and Mary Street at Cardiff. The station consists of an island platform with railway tracks on both sides of the platform and an overhead pedestrian footbridge on the northern side. The station office consists of a single storey building of brick and fibro construction with metal roof. There is a car park located on the western side of the station which was benched at two levels with a height difference of about 3.0m. A railway yard abuts to the upper car park to the south.

The site is situated on undulating to rolling terrain. Surrounding ground surface slopes down to the south-west at an average angle of about 10 degrees.

The railway station is situated about 6m below Main Road to the north east and about the same level as the upper carpark to the south west. The lower carpark further to the south west of the station is situated at Mary Street level. Based on the drawing provided, the island platform is at about Reduced Level (RL) 30.1m Australian Height Datum (AHD).

The 1:250,000 Geological map of Newcastle indicates the site to be underlain by Newcastle Measures consisting of shale, sandstone, conglomerate, tuff, chert and coal seams.

We understand that the project will include construction of new canopy structures on the station platform area and these canopies will be about 40m long starting from the overhead footbridge to the station building. The project will also include some pavement resurfacing on the platform.

### **3. INVESTIGATION METHODOLOGY**

#### **3.1 Fieldwork**

Fieldwork for the investigation was carried out on the 6<sup>th</sup> October 2009 and involved drilling of three boreholes (BH 1 to BH 3). Boreholes No 1 was drilled in the railway yard area using a truck-mounted P160 drill rig equipped for site investigation purpose. This borehole was drilled to a depth of about 10.6m below existing ground surface. To assess the strength of the subsurface soil profile, Standard Penetration Tests (SPT) were carried out in the borehole. Hand penetrometer tests were carried out on the SPT split-tube clayey samples to augment the SPT test results.

Boreholes Nos 2 and 3 were drilled on the existing railway platform using a Dingo drill rig mounted on a rubber tracked machine. These boreholes were drilled using spiral augers to depths of about 2.7m and 2.8m respectively below existing ground surface. Immediate adjacent to these boreholes, Dynamic Cone Penetrometer tests (DCP 1 and DCP 2) were carried in order to aid assessment of the relative densities of subsurface profile.

Prior to boreholes drilling, underground services checks were carried out using available drawings provided by Dial-before-you-dig and Railsearch. An underground services locator equipped with a remote sensing device was engaged as an extra precautionary measure to reduce risk of damage to underground services caused by the borehole drilling.

Details of the subsurface profiles and field tests are summarised on the Borehole Reports in Appendix A. The DCP test results are summarised on the DCP Test Report in Appendix B. Explanatory notes defining the terms and symbols used on the preparation of the Borehole Report are attached in Appendix D.

The site investigation was supervised on a full-time basis by our geotechnical engineer and in the presence of a PO4 safety officer. The works were carried out on general accordance with out Safe Work Method Statement (Ref JG09294D-L1 dated 09<sup>th</sup> June 2009).

### **3.2 Laboratory Testing**

Two disturbed soil samples (BH 2 [0.8-1.0m] and BH 3 [1.8-2.0]) were taken from the site to our NATA accredited laboratory for Atterberg Limit tests to aid assessment of soil characteristics and reactivity to moisture variation.

The laboratory test results are summarised on Laboratory Test Reports in Appendix C.

## 4. RESULTS OF THE INVESTIGATION

### 4.1 Subsurface Conditions

Reference may be made to the Borehole Reports in Appendix A for details of the subsurface conditions encountered in each test location. The following is a generalised description of the subsurface profiles encountered;

#### Railway Yard – BH 1

- Rail Ballast was encountered on surface with thickness of about 200mm.
- Underlying the rail ballast, fill was encountered consisting predominantly of medium plasticity Gravelly Silty Clay with variable quantities of gravel and some rail ballast to a depth of about 2.0m below existing ground surface. At lower depth, Clayey/Gravel fill was encountered. The fill was generally found to be moist to wet. The SPT test results indicate the fill to be loose.
- Natural soil was encountered beneath the fill at a depth of about 2.4m below existing ground surface. The natural clay consists of medium to high plasticity Silty Clay with some conglomerate, gravel and shale. At a depth of about 6.8m below existing ground surface, medium plasticity Gravelly Silty Clay was encountered. Based on the SPT test results, the natural clay soil was generally assessed to be very stiff to hard. Moisture content of the natural clayey soil was found to be approximately equal to the plastic limit.
- The borehole was found to be dry during and shortly after completion of the site investigation.

#### Station Platform – BH 2 and 3

- A thin layer of Asphalt Concrete was encountered on the platform surface with thickness ranging of about 25mm to 30mm.
- Underlying the Asphalt Concrete, fill was encountered predominantly consisting of high plasticity Silty Clay mixture with variable quantities of gravel and rail ballast. Based on the DCP test results, the density of the fill was assessed to be poorly compacted. The fill was found to be moist.

- Natural medium to high plasticity Silty Clay was encountered at depths ranging of about 1.4m to 1.6m below existing platform level. Based on the DCP test results, the natural clay was assessed to be firm to very stiff at the upper 700mm and the natural clay becomes hard at lower depths. Moisture content of the natural clay was found to be approximately equal to the plastic limit.
- The boreholes were found to be dry during and shortly after completion of the site investigation.

#### 4.2 Laboratory Test Results

Based on the laboratory test results, the fill and natural clay soil was assessed to have a highly reactivity to moisture variation. The following is a summary of the Atterberg Limit test results for the samples taken from (BH 2 [0.8-1.0m] and BH 3 [1.8-2.0]);

<b>BH</b>	<b>Liquid Limit (%)</b>	<b>Plastic Index (%)</b>	<b>Plasticity Index (%)</b>	<b>Linear Shrinkage (%)</b>
BH 2 (0.8-1.0m)	46	19	27	11.5
BH 3 (1.8-2.0m)	48	19	29	12.0

## 5. COMMENTS AND RECOMMENDATIONS

### 5.1 Platform Resurfacing

The site investigation revealed the station platform to be underlain by a layer of asphalt concrete (i.e. 25mm to 30mm) overlying loosely compacted fill overlying firm to hard natural clay.

We anticipate that the platform resurfacing will require stripping of the existing asphalt concrete and excavation to a depth to suit the design thickness of the proposed new pavement. As the platform fill was assessed to be loose, we recommend the insitu fill be densified prior to construction of new pavement and this may include the following;

- Excavation of the top 0.5m of the fill and stockpiled for reuse as fill at a later stage.
- Rolling of the base of the excavation with a small vibration roller.
- Any soft areas identified during rolling should be further excavated and replaced with select granular fill such as ripped sandstone.
- The excavated clayey fill material may be reuse as fill beneath pavements subject to moisture conditioning. Alternatively, imported good quality fill such as ripped sandstone having a maximum particle size of 40mm may be used.
- The fill material should be compacted in layer not exceeding 250mm loose thickness compacted to a minimum 95% Standard Maximum Dry Density (SMDD) at close to Optimum Moisture Content.

Care should be taken to ensure rolling and compaction of the fill will not destabilise the platform retaining walls.

## 5.2 New Canopies

We understand that the proposed station upgrade project will include construction of new canopy structures on the platform area. The station platform is elevated about 1.2m above the track level and is retained by brick retaining wall.

The site investigation revealed the station platform to be underlain by a 25mm to 30mm thick layer of Asphalt Concrete overlying poorly compacted fill overlying natural clay. Bedrock was not encountered in the platform boreholes and judging from the borehole drilled on the railway yard, bedrock is expected to be deep, greater than 10m.

The DCP test results indicate the upper 0.7m of the natural clay to be firm to stiff and very stiff to hard clay was encountered at about 2.0m below existing platform level. Groundwater was not encountered in the boreholes during and upon completion of the site investigation.

For the proposed canopies, we are of the opinion that suitable footing should consist of pier taken through the fill and founded on natural very stiff to hard clay expected to be present at about 2.0m below platform level (ie below the existing track level).

For piers taken to a minimum depth of about 2.5m below existing platform surface (i.e. RL 28.0m AHD) and at least 0.5m into natural hard clay, an allowable end bearing of 150kPa may be adopted. Deeper piers taken to a minimum depth of 1.5m into natural very stiff to hard clay may be proportioned to an end allowable bearing capacity of 350kPa.

A shaft adhesion of 20kPa may be adopted for the section of piers within the natural clayey soil stratum. Uplift capacity of the piers should be half of the shaft adhesion. Shaft adhesion of the section of piers within the fill should be ignored.

As the site is underlain by a relatively thick layer (i.e. >10m) of clay assessed to be highly reactive, we recommend that the footings of the proposed structures be adequately designed to accommodate shrink-swell movements proportioned to a Class 'H' (Highly Reactive) site in accordance to AS2870 "Residential Slabs and Footings".

## 6. LIMITATIONS

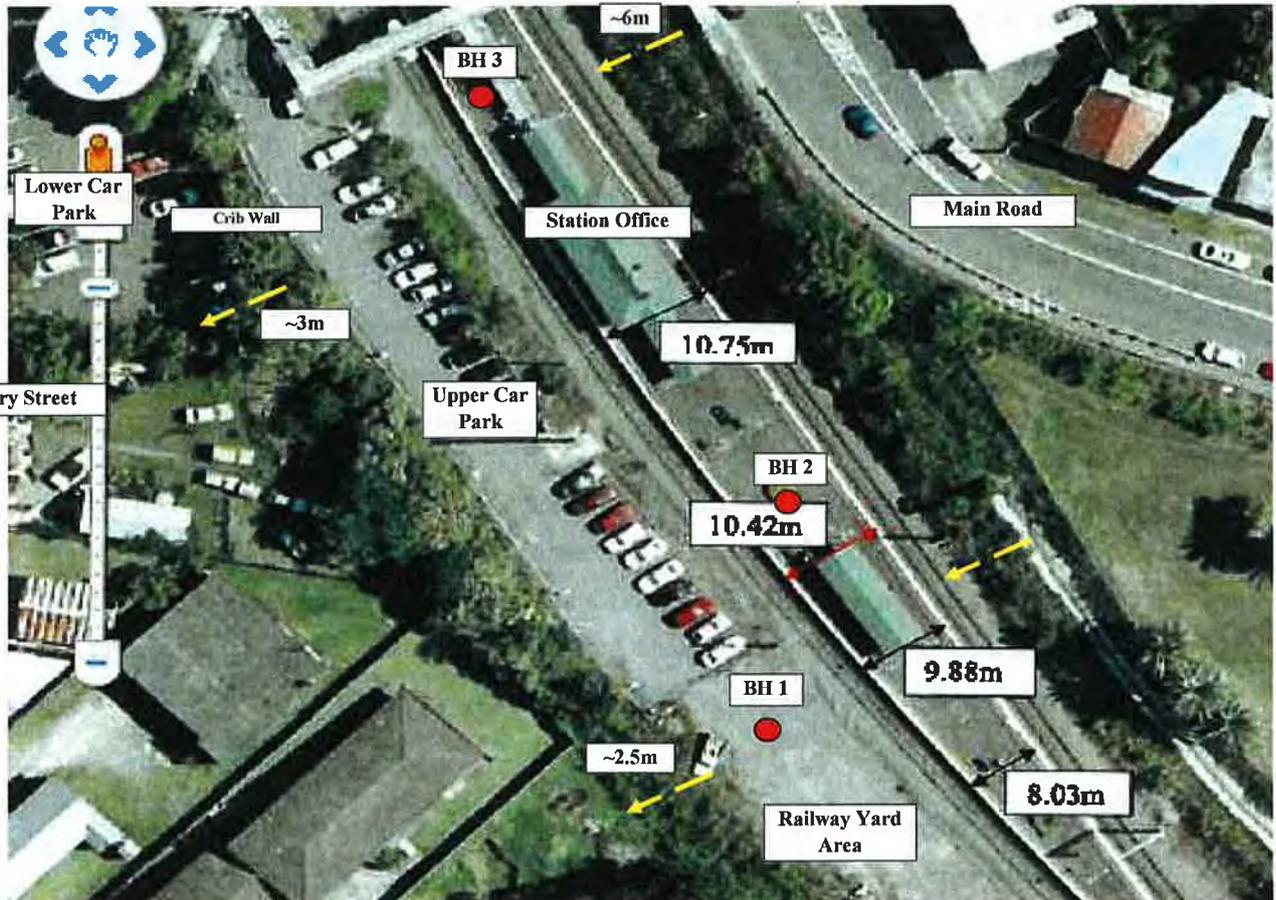
The interpretation and recommendations submitted in this report are based in part upon data obtained from a limited number of boreholes. There is no investigation which is thorough enough to determine all site conditions and anomalies, no matter how comprehensive the investigation program is as site data is derived from extrapolation of limited test locations. The nature and extent of variations between test locations may not become evident until construction.

Groundwater conditions are only briefly examined in this investigation. The groundwater conditions may vary seasonally or as a consequence of construction activities on or adjacent to the site.

In view of the above, the subsurface soil and rock conditions between the test locations may be found to be different or interpreted to be different from those expected. If such differences appear to exist, we recommend that this office be contacted without delay.

The statements presented in this document are intended to advise you of what should be your realistic expectations of this report and to present you with recommendations on how to minimise the risk associated with groundworks for this project. The document is not intended to reduce the level of responsibility accepted by GeoEnviro Consultancy Pty Ltd, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in to doing.

Your attention is drawn to the attached "Explanatory Notes" in Appendix D and this document should be read in conjunction with our report



**Legend**

- Borehole
- ~2.5m ↘ Ground surface drops 2.5m

 <b>GeoEnviro Consultancy Pty Ltd</b>	Drawn: JC	Date: 28-10-09	<b>Caldis Cook Group</b> Cardiff Railway Station, Main Road, Cardiff, NSW <b>Borehole Location Plan</b>	
	Checked By: SL	Date: 28-10-09		
	Revision			
	Scale: Proportional	A4	JG09494D-r1	Drawing No : 1

3

APPENDIX A  
Borehole Reports





Borehole no: 1 (Page 2 of 2)

Client: **Caldis Cook Group Pty Ltd**  
 Project: **Proposed Station Upgrade - New Canopy**  
 Location: **Cardiff Railway Station**

Job no: **JG09294D**  
 Date: **26/10/2009**  
 Logged by: **JC**  
 Checked By: **SL**

Drill Model and Mounting: **P160**      Slope: **90 degrees**  
 Hole Diameter: **100 mm**      Bearing: **-**

R.L. Surface: **-**  
 Datum: **-**

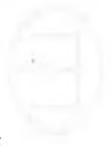
Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description	Moisture Content	Consistency/Density Index	Hand Penetrometer (kPa)	Structure and Additional Observations
TC - BIT	N I L	NO GROUNDWATER ENCOUNTERED		8.0 9.0 10.0	[Hatched Box]	CI	Gravelly Silty Clay: medium plasticity, grey with some conglomerate, gravel, chert and few cobble	MC= PL	Vst- H		
				11.0 12.0 13.0 14.0 15.0 16.0			End of BH 1 at 10.6m				



Borehole no: 2

Client: Caldis Cook Group Pty Ltd		Job no: JG09294D												
Project: Proposed Station Upgrade - New Canopy		Date: 26/10/2009												
Location: Cardiff Railway Station		Logged by: JC												
		Checked By: SL												
Drill Model and Mounting: P160		Slope: 90 degrees												
Hole Diameter: 100 mm		Bearing: -												
		R.L. Surface: ~30.1m												
		Datum: AHD												
Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description	Moisture Content	Consistency/Density Index	Dynamic Cone Penetrometer	Structure and Additional Observations			
T C - B I T	N I L	NO GROUNDWATER ENCOUNTERED		0.0			Asphalt Concrete: thickness=25mm	M			The fill appears loosely compacted			
				0.5		Fill: Silty Clay/Gravel mixture: brown with some rail ballast								
						Fill: Gravelly Silty Clay: medium to high plasticity, yellow brown with some gravel								
						Fill: Silty Clay: high plasticity, yellow brown with some fine gravel								
				1.0										
				1.5										
				2.0		CH Silty Clay: high plasticity, yellow brown with a trace of gravel	MC=					Vst	5	
							PL					6		
												8		
												8		
				10	H									
				11										
				12										
				12										
				10										
				10										
				11										
				13										
				14										
				16										
				16		End of DCP at 3.1m								
				3.0		End of BH 2 at 2.7m								
				3.5										
				4.0										





APPENDIX B  
DCP Test Report



APPENDIX C  
Laboratory Test Report

Sample No.	Location	Depth (m)	Soil Type	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Shrinkage (%)
1	...	...	...	...	...	...	...
2	...	...	...	...	...	...	...
3	...	...	...	...	...	...	...
4	...	...	...	...	...	...	...
5	...	...	...	...	...	...	...
6	...	...	...	...	...	...	...
7	...	...	...	...	...	...	...
8	...	...	...	...	...	...	...
9	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...
11	...	...	...	...	...	...	...
12	...	...	...	...	...	...	...
13	...	...	...	...	...	...	...
14	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...
16	...	...	...	...	...	...	...
17	...	...	...	...	...	...	...
18	...	...	...	...	...	...	...
19	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...
21	...	...	...	...	...	...	...
22	...	...	...	...	...	...	...
23	...	...	...	...	...	...	...
24	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...
26	...	...	...	...	...	...	...
27	...	...	...	...	...	...	...
28	...	...	...	...	...	...	...
29	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...
31	...	...	...	...	...	...	...
32	...	...	...	...	...	...	...
33	...	...	...	...	...	...	...
34	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...
36	...	...	...	...	...	...	...
37	...	...	...	...	...	...	...
38	...	...	...	...	...	...	...
39	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...
41	...	...	...	...	...	...	...
42	...	...	...	...	...	...	...
43	...	...	...	...	...	...	...
44	...	...	...	...	...	...	...
45	...	...	...	...	...	...	...
46	...	...	...	...	...	...	...
47	...	...	...	...	...	...	...
48	...	...	...	...	...	...	...
49	...	...	...	...	...	...	...
50	...	...	...	...	...	...	...







**EXPLANATORY NOTES**

**Introduction**

These notes have been provided to amplify the geotechnical report with regard to investigation procedures, classification methods and certain matters relating to the Discussion and Comments sections. Not all notes are necessarily relevant to all reports.

Geotechnical reports are based on information gained from finite sub-surface probing, excavation, boring, sampling or other means of investigation, supplemented by experience and knowledge of local geology. For this reason they must be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

**Description and Classification Methods**

The methods the description and classification of soils and rocks used in this report are based on Australian standard 1726, the SSA Site investigation Code, in general descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions. Identification and classification of soil and rock involves to a large extent, judgement within the acceptable level commonly adopted by current geotechnical practices.

Soil types are described according to the predominating particle size, qualified by the grading or other particles present (eg sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	Less than 0.002mm
Silt	0.002 to 0.6mm
Sand	0.6 to 2.00mm
Gravel	2.00m to 60.00mm

Soil Classification	Particle size
Clay	less than 0.002mm
Silt	0.002 to 0.06mm
Sand	0.06 to 2.00mm
Gravel	2.00mm to 60.00mm

Cohesive soils are classified on the basis of strength, either by laboratory testing or engineering examination. The strength terms are as follows:

Classification	Undrained Shear Strength kPa
Very Soft	Less than 12
Soft	12 - 25
Firm	25 - 50
Stiff	50 - 100
Very Stiff	100 - 200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer test (CPT), as below:

Relative Dense	SPT 'N' Value (blows/300mm)	CPT Cone Value (q <sub>c</sub> -Mpa)
Very Loose	Less than 5	Less than 2
Loose	5 - 10	2 - 5
Medium Dense	10 - 30	5 - 15
Dense	30 - 50	15 - 25
Very Dense	> 50	> 25

Rock types are classified by their geological names, together with descriptive terms on degrees of weathering strength, defects and other minor components. Where relevant, further information

regarding rock classification, is given on the following sheet.

**Sampling**

Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provided information on plasticity, grained size, colour, type, moisture content, inclusions and depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin walled sample tube (normally know as U<sub>50</sub>) into the soil and withdrawing a sample of the soil in a relatively undisturbed state. Such Samples yield information on structure and strength and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils. Details of the type and method of sampling are given in the report.

**Field Investigation Methods**

The following is a brief summary of investigation methods currently carried out by this company and comments on their use and application.

**Hand Auger Drilling**

The borehole is advanced by manually operated equipment. The diameter of the borehole ranges from 50mm to 100mm. Penetration depth of hand augered boreholes may be limited by premature refusal on a variety of materials, such as hard clay, gravels or ironstone.

**Test Pits**

These are excavated with a tractor-mounted backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descend into the pit. The depth of penetration is limited to about 3.0m for a backhoe and up to 6.0m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Care must be taken if construction is to be carried out near, or within the test pit locations, to either adequately recompact the backfill during construction, or to design the structure or accommodate the poorly compacted backfill.

**Large Diameter Auger (eg Pengo)**

The hole is advanced by a rotating plate or short spiral auger generally 300mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 05m) and are disturbed, but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers and is usually supplemented by occasional undisturbed tube sampling.

**Continuous Spiral Flight Augers**

The hole is advanced by using 90mm - 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling or insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the augers flights, but they are very disturbed and may be highly mixed with soil of other stratum.

Information from the drilling (as distinct from specific sampling by SPT or undisturbed samples) is of relatively low reliability due to remoulding, mixing or softening of samples by ground water, resulting in uncertainties of the original sample depth.



#### Continuous Spiral Flight Augers (continued)

The spiral augers are usually advanced by using a V - bit through the soil profile refusal, followed by Tungsten Carbide (TC) bit, to penetrate into bedrock. The quality and continuity of the bedrock may be assessed by examination of the recovered rock fragments and through observation of the drilling penetration resistance.

#### Non - core Rotary Drilling (Wash Boring)

The hole is advanced by a rotary bit, with water being pumped down the drill rod and returned up the annulus, carrying the cuttings, together with some information from the "feel" and rate of penetration.

#### Rotary Mud Stabilised Drilling

This is similar to rotary drilling, but uses drilling mud as a circulating fluid, which may consist of a range of products, from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg SPT and  $U_{50}$  samples).

#### Continuous Core Drilling

A continuous core sample is obtained using a diamond tipped core barrel. Providing full core recovery is achieved (which is not always possible in very weak rock and granular soils) this technique provides a very reliable (but relatively expensive) method of investigation. In rocks an NMLC triple tube core barrel which gives a core of about 50mm diameter, is usually used with water flush.

#### Portable Proline Drilling

This is manually operated equipment and is only used in sites which require bedrock core sampling and there is restricted site access to truck mounted drill rigs. The boreholes are usually advanced initially using a tricone roller bit and water circulation to penetrate the upper soil profile. In some instances a hand auger may be used to penetrate the soil profile. Subsequent drilling into bedrock involves the use of NMLC triple tube equipment, using water as a lubricant.

#### Standard Penetration Tests

Standard penetration tests are used mainly in non-cohesive soils, but occasionally also in cohesive soils, as a means of determining density or strength and of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289 "Methods of testing Soils for Engineering Purpose"- Test F31.

The test is carried out in a borehole by driving a 50mm diameter split sample tube under the impact of a 63Kg hammer with a free fall of 769mm. It is normal for the tube to be driven in three successive 150mm increments and the "N" value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rocks, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In a case where full penetration is obtained with successive blows counts for each 150mm of, say 4, 6, and 7 blows.

$$\begin{array}{l} \text{as } 4, 6, 7 \\ N = 13 \end{array}$$

- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm.

$$\text{as } 15,30/40\text{mm}$$

The results of the tests can be related empirically to the engineering properties of the soil. Occasionally the test

methods is used to obtain samples in 50mm diameter thin walled samples tubes in clays. In these circumstances, the best results are shown on the bore logs in brackets.

#### Dynamic Cone Penetration Test

A modification to the SPT test is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The cone can be continuously driven into the borehole and is normally used in areas with thick layers of soft clays or loose sand. The results of this test are shown as 'N<sub>c</sub>' on the bore logs, together with the number of blows per 150mm penetration.

#### Cone Penetrometer Testing and Interpretation

Cone penetrometer testing (sometimes referred to as Dutch Cone-CPT) described in this report, has been carried out using an electrical friction cone penetrometer and the test is described in Australian Standard 1289 test F5.1.

In the test, a 35mm diameter rod with cone tipped end is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig, which is fitted with a hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separate 130mm long sleeve, immediately behind the cone. Transducer in the tip of the assembly are connected by electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) the information is output on continuous chart recorders. The plotted results in this report have been traced from the original records. The information provided on the charts comprises:

- Cone resistance - the actual end bearing force divided by the cross sectional area of the cone, expressed in Mpa.
- Sleeve friction - the frictional force on the sleeve divided by the surface area, expressed in kPa.
- Friction ratio - the ratio of sleeve friction to cone resistance, expressed in percentage.

There are two scales available for measurement of cone resistance. The lower "A" scale (0-5Mpa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main "B" scale (0-50Mpa) is less sensitive and is shown as a full line.

The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative frictions in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and very soft clays, rising to 4% to 10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range:

$$q_c \text{ (Mpa)} = (0.4 \text{ to } 0.6) N \text{ (blows per 300mm)}$$

In clays the relationship between undrained shear strength and cone resistance is commonly in the range:

$$q_c = (12 \text{ to } 18) C_u$$

Interpretation of CPT values can also be made to allow estimate of modulus or compressibility values to allow calculation of foundation settlements. Inferred stratification, as shown on the attached report, is assessed from the cone and friction traces, from experience and information from nearby boreholes etc.



### **Cone Penetrometer Testing and Interpretation continued**

This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties and where precise information or soil classification is required, direct drilling and sampling may be preferable.

#### **Portable Dynamic Cone Penetrometer (AS1289)**

Portable dynamic cone penetrometer tests are carried out by driving a rod in to the ground with a falling weight hammer and measuring the blows per successive 100mm increments of penetration.

There are two similar tests, Cone Penetrometer (commonly known as Scala Penetrometer) and the Perth Sand Penetrometer. Scala Penetrometer is commonly adopted by this company and consists of a 16mm rod with a 20mm diameter cone end, driven with a 9kg hammer, dropping 510mm (AS 1289 Test F3.2).

#### **Laboratory Testing**

Laboratory testing is carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedures are given on the individual report forms.

#### **Engineering Logs**

The engineering logs presented herein are an engineering and/or geological interpretation of the sub-surface conditions and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, however, this is not always practicable or possible to justify economically. As it is, the boreholes represent only a small sample of the total sub-surface profile. Interpretation of the information and its application to design and construction should take into account the spacing of boreholes, frequency of sampling and the possibility of other than "straight line" variations between the boreholes.

#### **Ground water**

Where ground water levels are measured in boreholes, there are several potential problems:

- In low permeability soils, ground water although present, may enter the hole slowly, or perhaps not at all, during the investigation period.
- A localised perched water table may lead to a erroneous indication of the true water table.
- Water table levels will vary from time to time, due to the seasons or recent weather changes. They may not be the same at the time of construction as indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must be washed out of the hole if any water observations are to be made.

More reliable measurements can be made by installing stand pipes, which are read at intervals over several days, or weeks for low permeability soils. Piezometers sealed in a particular stratum may be interference from a perched water table or surface water.

#### **Engineering Reports**

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal is changed, say to a twenty storey building. If this occurs, the company will be pleased to review the report and sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of sub-surface conditions, discussions of geotechnical aspects and recommendations or suggestions for design and construction. However, the company cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on bore spacing and sampling frequency.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of contractors responding to commercial pressures.

If these occur, the company will be pleased to assist with investigation or advice to resolve the matter.

#### **Site Anomalies**

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the company request immediate notification. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

#### **Reproduction of Information for Contractual Purposes**

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information trader Documents", published by the Institute of Engineers Australia. Where information obtained for this investigation is provided for tender purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or make additional copies of the report available for contract purpose, at a nominal charge.



The Company will always be pleased to provide engineering inspection services for geotechnical aspect of work to which this report is related. This could range from a site visit to confirm that the conditions exposed are as expected, to full time engineering presence on site

#### **Review of Design**

Where major civil or structural developments are proposed, or where only a limited investigation has been completed, or where the geotechnical conditions are complex, it is prudent to have the design reviewed by a Senior Geotechnical Engineer.



## Graphic Symbols For Soil and Rock

SOIL		ROCK	
	Fill		Shale
	Topsoil		Sandstone
	Gravel (GW, GP)		Siltstone, Mudstone, Claystone
	Sand (SP, SW)		Granite, Gabbro
	Silt (ML, MH)		Dolerite, Diorite
	Clay (CL, CH)		Basalt, Andesite
	Clayey Gravel (GC)		<b>Other Materials</b>
	Silty Sand (SM)		Concrete
	Clayey Sand (SC)		Bitumen, Asphaltic Concrete, Coal
	Sandy Silt (ML)		Ironstone Gravel
	Gravelly Clay (CL, CH)		Organic Material
	Silty Clay (CL, CH)		
	Sandy Clay (CL, CH)		
	Peat or Organic Soil		

## Appendix E: Hazardous Materials Register for Cardiff Railway Station (at 9 March 2011)

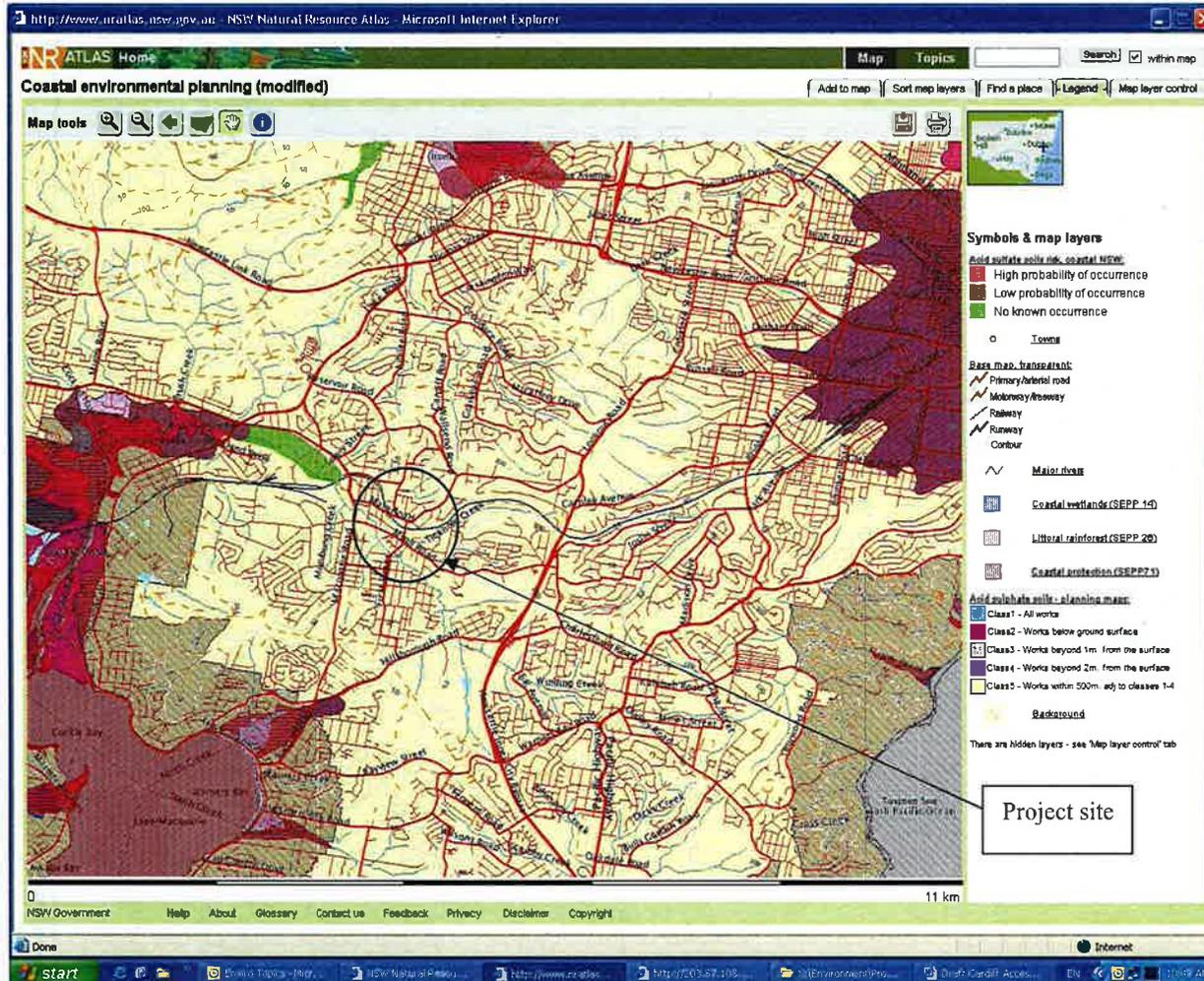
Date	Event	LOCATION					MATERIAL DESCRIPTION									RISK MANAGEMENT			
		Station	Platform	Building	Room	Surface	Material Application	Quantity	Units	Sample Type	Sample ID No.	Photo No.	Analytical Result	Material Condition as Surveyed	Risk Status	Control Recommendations / Comments	Review interval (Months after Date)	Review date	
13/07/2006	1	Cardiff	1	Main Building	Kitchen	N/A	Hot water unit	1	count	Fabric	N/A	1	Positive	Good	Low	Maintain material in current condition. Remove prior to refurbishment/demolition. Inspected on 7/06/07 by BMM North, Condition unchanged. Inspected 17/06/10, condition unchanged - DMM North.	36	17-Jun-13	
13/07/2006	2	Cardiff	1	Main Building	Ceiling	Ceiling Space	SMF insulation	200	sq. m	Fabric	N/A	2	N/A	Good	Low	Maintain material in current condition. Remove prior to refurbishment/demolition. Inspected on 7/06/07 by BMM North, Condition unchanged. Inspected 17/06/10, condition unchanged - DMM North.	36	17-Jun-13	
13/07/2006	3	Cardiff	1	Main Building	Ceiling	Ceiling Space	Hot water unit	1	sq. m	Fabric	N/A	3	N/A	Good	Low	Maintain material in current condition. Remove prior to refurbishment/demolition. Inspected on 7/06/07 by BMM North, Condition unchanged. Inspected 17/06/10, condition unchanged - DMM North.	36	17-Jun-13	

Cardiff Railway Station Accessibility Upgrade – Stages 2 & 3

Review of Environmental Factors

13/07/2006	4	Cardiff	1	Main Building	Ceiling	Ceiling Space	Sarking	200	sq. m	Fabric	N/A	4	N/A	Good	Low	Maintain material in current condition. Remove prior to refurbishment/demolition. Inspected on 7/06/07 by BMM North, Condition unchanged. Inspected 17/06/10, condition unchanged - DMM North.	36	17-Jun-13
13/07/2006	5	Cardiff	1	Main Building	External Panels	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No hazardous materials identified - no further action required		
13/07/2006	6	Cardiff	1	Main Building	Station Manager's Office	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No hazardous materials identified - no further action required		
13/07/2006	7	Cardiff	1	Main Building	Booking Office	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No hazardous materials identified - no further action required		
13/07/2006	8	Cardiff	1	Commuter Shelter	Shelter	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No hazardous materials identified - no further action required		
13/07/2006	9	Cardiff	1	External areas and fenceline	Exterior	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No hazardous materials identified - no further action required		

## Appendix F: NSW Natural Resource Atlas (at 16 March 2011)



Author: Lesley Corkill – Projects Division, Environment Unit

Determiner: Richard Mumford – Projects Division, Stations and Buildings

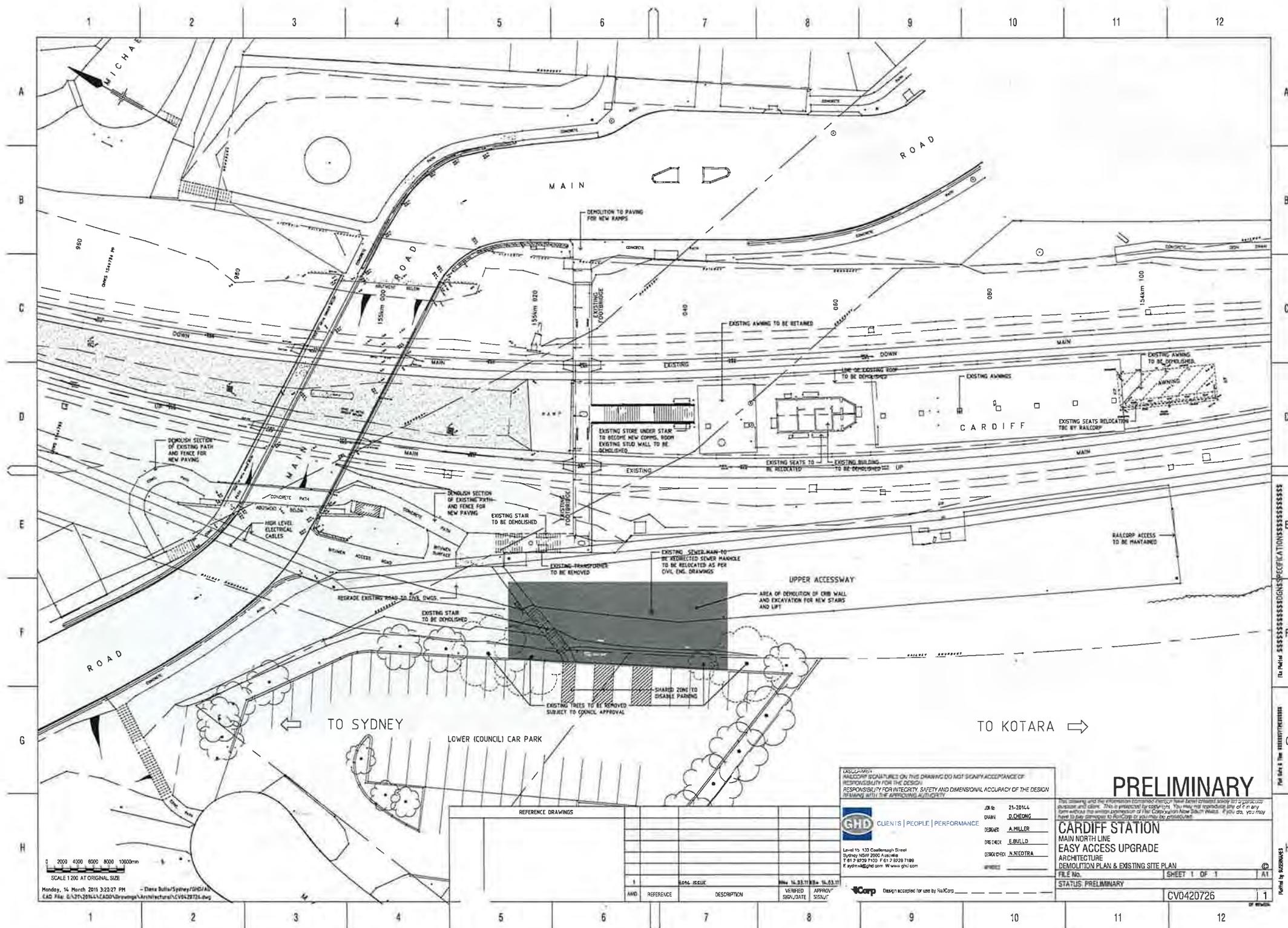
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## Appendix G: Architectural drawings







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NO.	DATE	ISSUE	DESCRIPTION	VENUE	APPROVED
1					
2					
3					
4					
5					
6					
7					
8					

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**CARDIFF STATION  
 MAIN NORTH LINE  
 EASY ACCESS UPGRADE  
 ARCHITECTURE  
 DEMOLITION PLAN & EXISTING SITE PLAN**

FILE NO.	SHEET 1 OF 1	A1
STATUS: PRELIMINARY		
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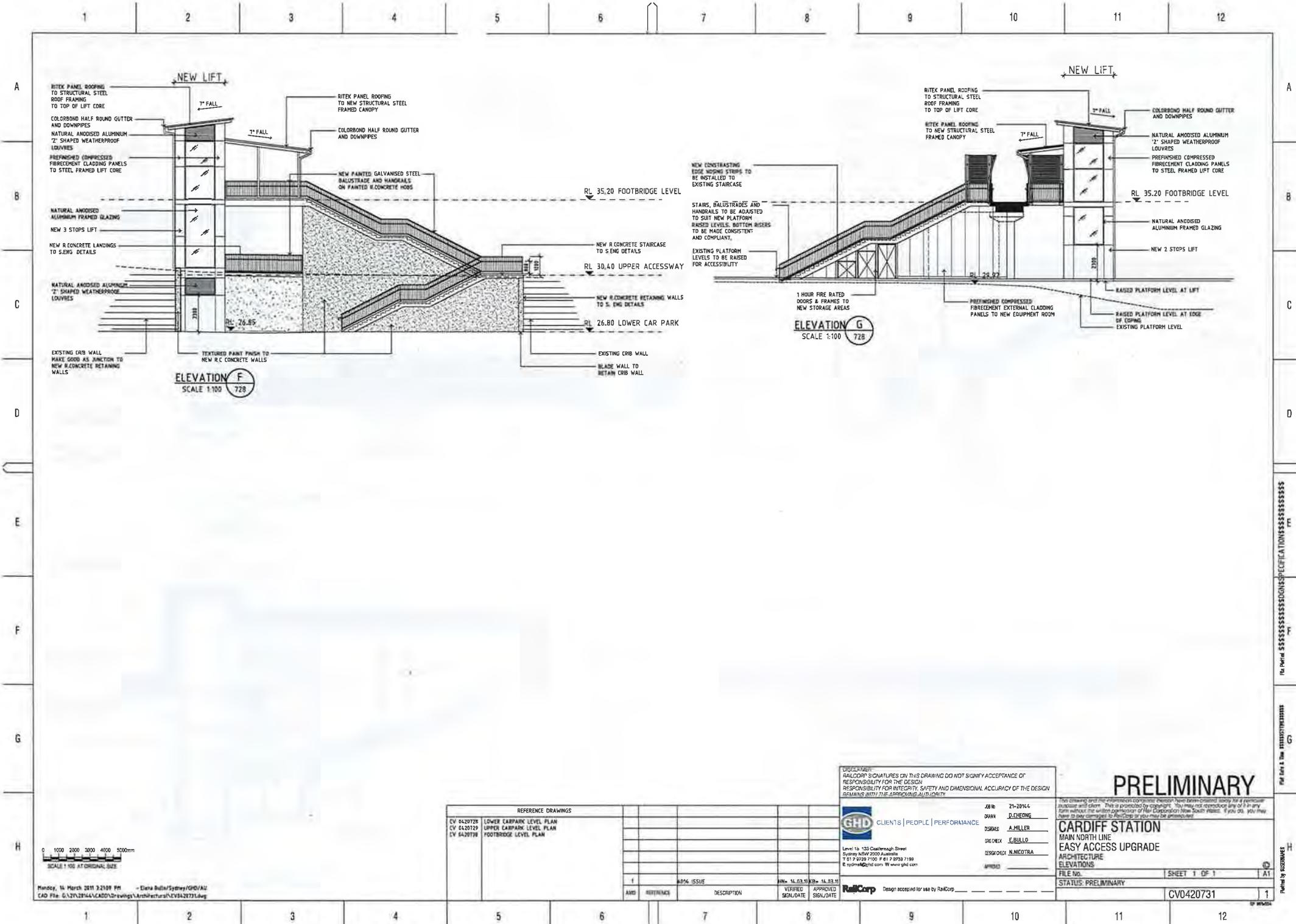
The number of sheets in this specification is indicated by the number of sheets in this specification.











**ELEVATION F**  
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**ELEVATION G**  
SCALE 1:100 728



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REFERENCE DRAWINGS	
CV 6420728	LOWER CARPARK LEVEL PLAN
CV 6420729	UPPER CARPARK LEVEL PLAN
CV 6420730	FOOTBRIDGE LEVEL PLAN

NO	REV	DATE	DESCRIPTION
1			ISSUE

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DESIGNED: A. MILLER  
CHECKED: E. BULLO  
DESIGNED BY: N. NICOTRA  
APPROVED: \_\_\_\_\_

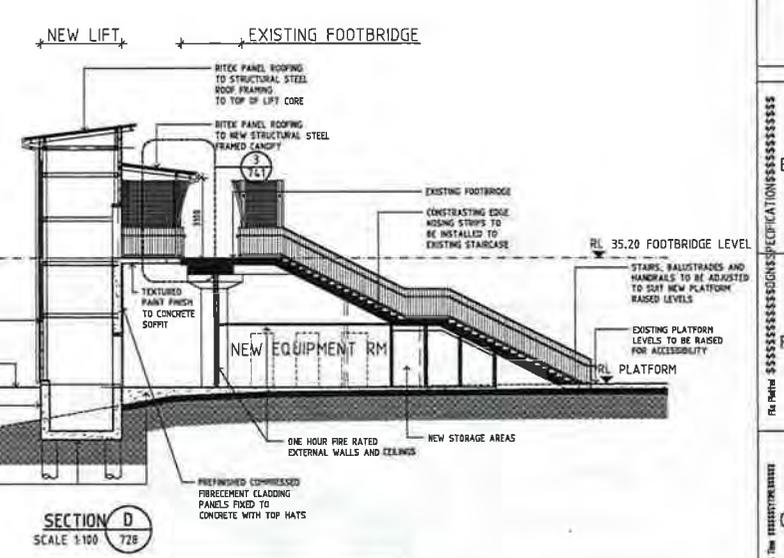
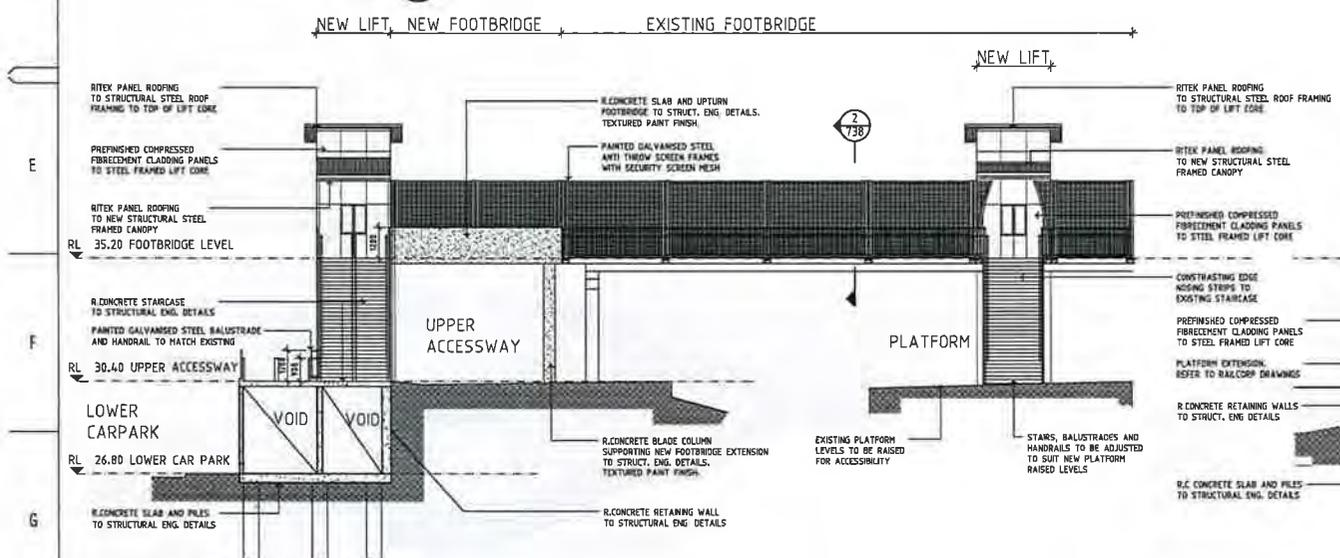
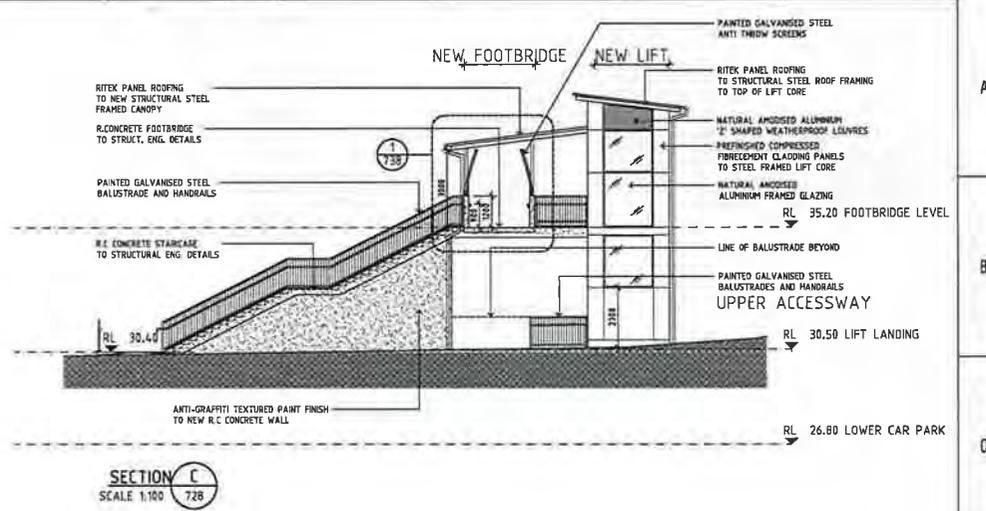
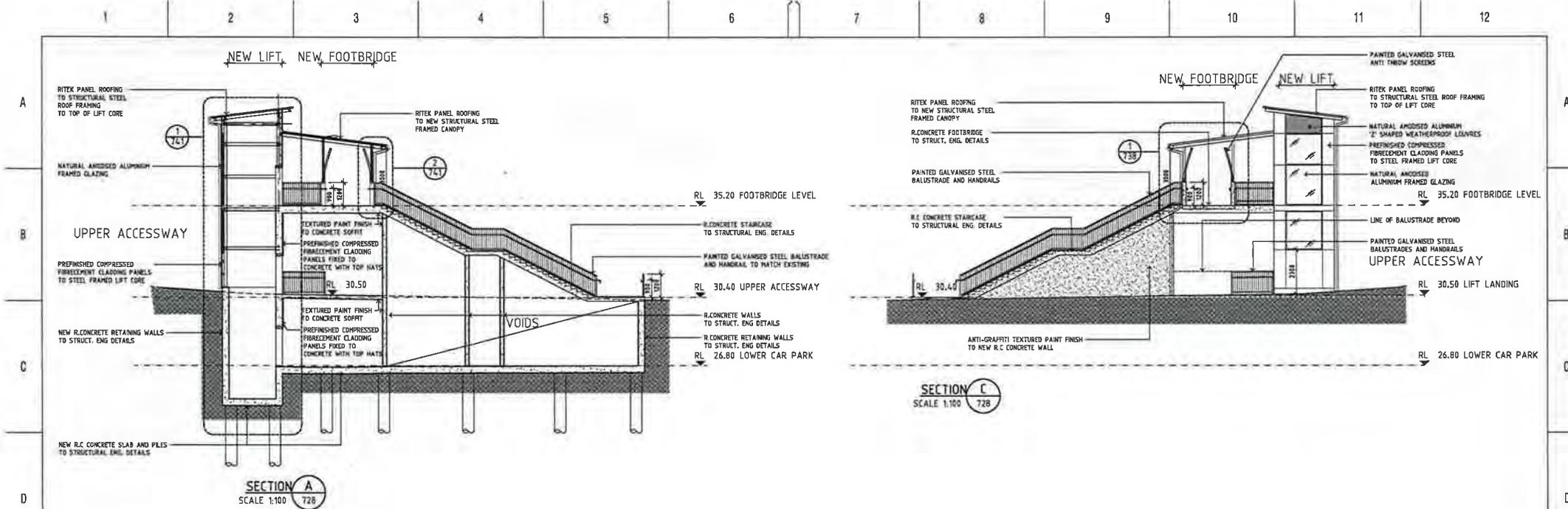
RAILCORP Design accepted for use by RailCorp

**PRELIMINARY**

**CARDIFF STATION**  
MAIN NORTH LINE  
EASY ACCESS UPGRADE  
ARCHITECTURE  
ELEVATIONS

FILE NO: \_\_\_\_\_ SHEET 1 OF 1 A1  
STATUS: PRELIMINARY  
CV0420731 1

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 Dena Bull



SECTION B  
SCALE 1:100 728

SECTION D  
SCALE 1:100 728

REFERENCE DRAWINGS	
CV 0420728	LOWER CARPARK LEVEL PLAN
CV 0420729	UPPER CARPARK LEVEL PLAN
CV 0420730	FOOTBRIDGE LEVEL PLAN
CV 0420738	FOOTBRIDGE WITH ANTI-THROW SCREEN DETAILS
CV 0420741	LIFT DETAILS
CV 0420745	NEW EQUIPMENT ROOM DETAILS

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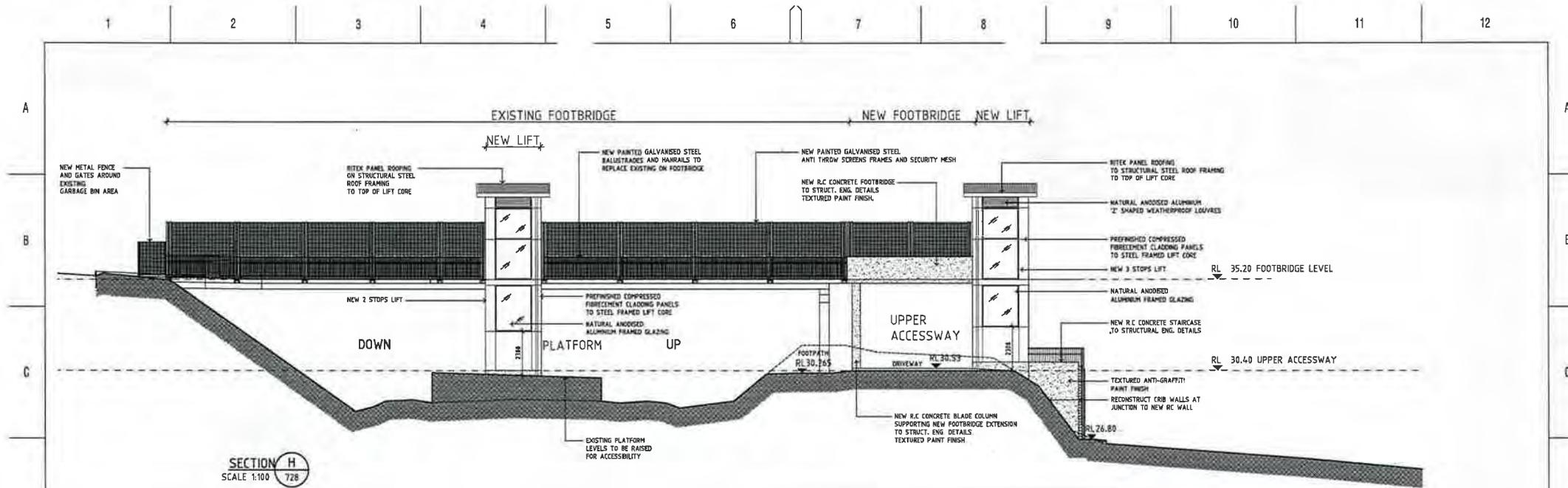
JOB NO	21-20144
DRAWN	P. CHENG
ISSUED	A. MILLER
DESIGNED	E. BULLO
DESIGNED	MANICOTRA
PROJECT	

**PRELIMINARY**

**CARDIFF STATION**  
MAIN NORTH LINE  
EASY ACCESS ROOF  
ARCHITECTURE  
SECTIONS SHEET 1 OF 2

FILE NO.	SHEET 1 OF 2	A1
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	CVD420732	1

FILE NO. 21-20144  
 SHEET 1 OF 2  
 A1  
 CVD420732



SECTION H  
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CV 0420729	UPPER CARPARK LEVEL PLAN					
CV 0420730	FOOTBRIDGE LEVEL PLAN					
1	10% ISSUE	14.03.11	14.03.11			
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**PRELIMINARY**

Cardiff Station  
Main North Line  
Easy Access Upgrade  
Architecture  
SECTIONS SHEET 2 OF 2

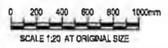
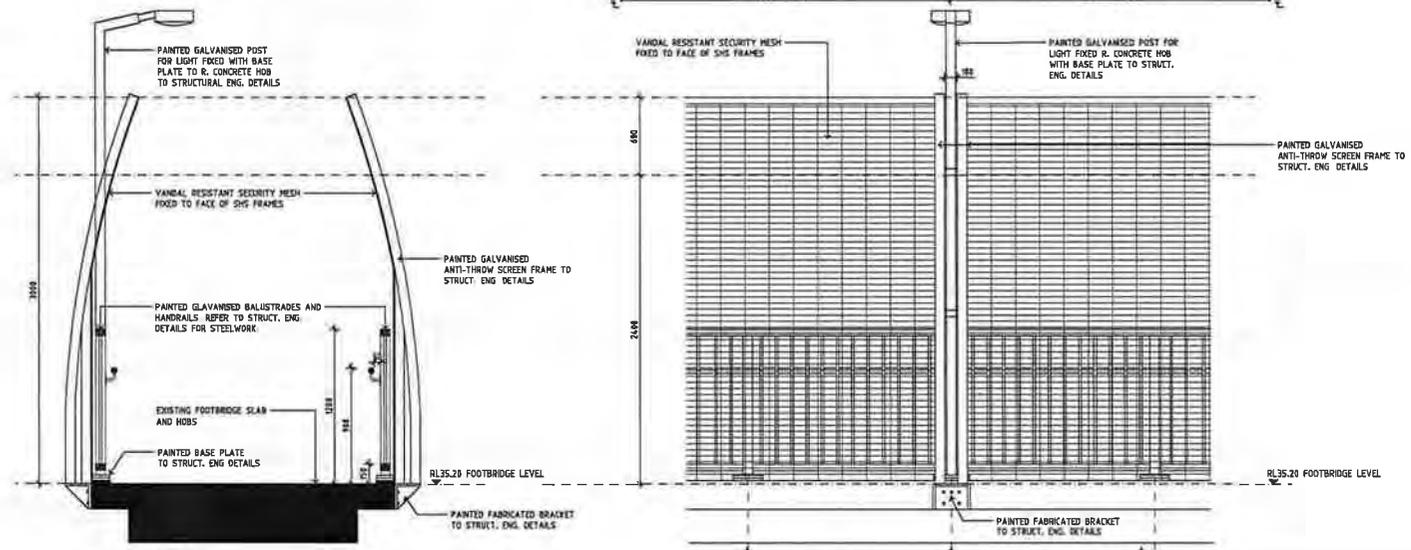
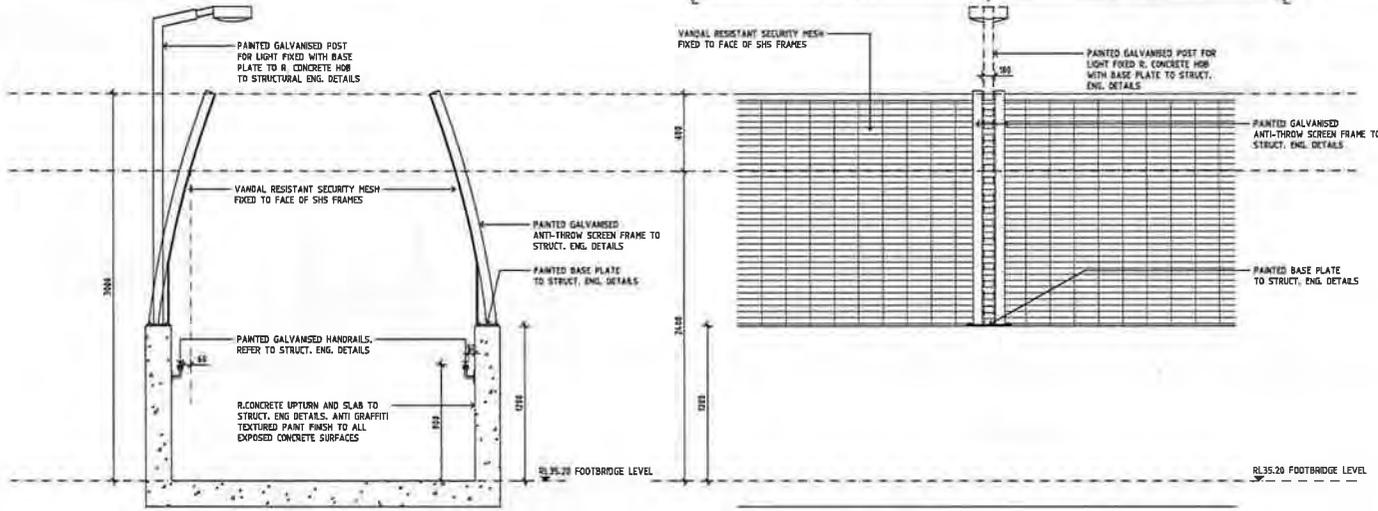
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1	60% ISSUE	16.05.11	EL	EL	EL
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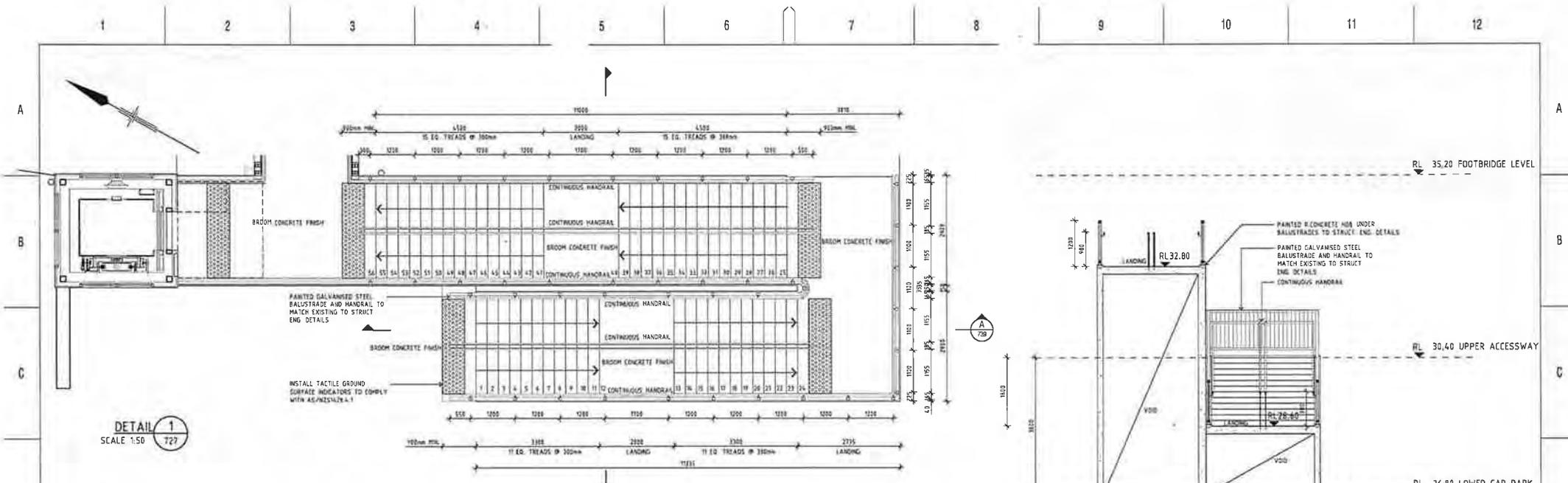
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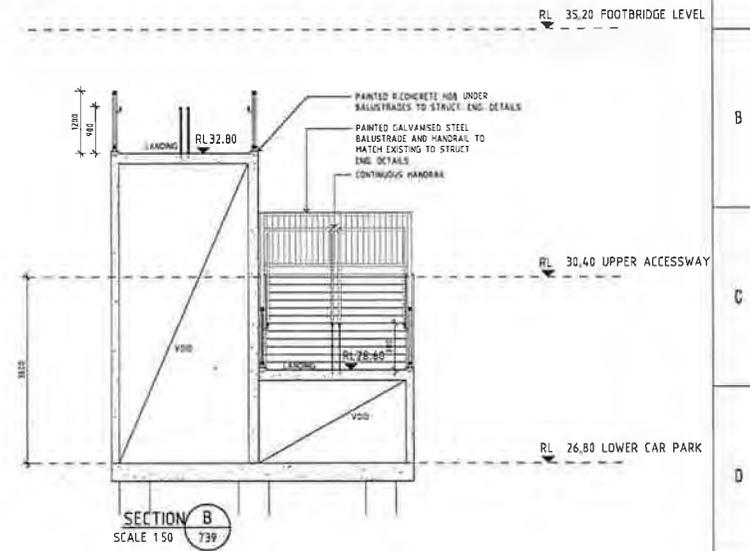
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 MAIN NORTH LINE  
 EASY ACCESS UPGRADE  
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 BALUSTRADE & ANTI-THROW SCREEN DETAILS

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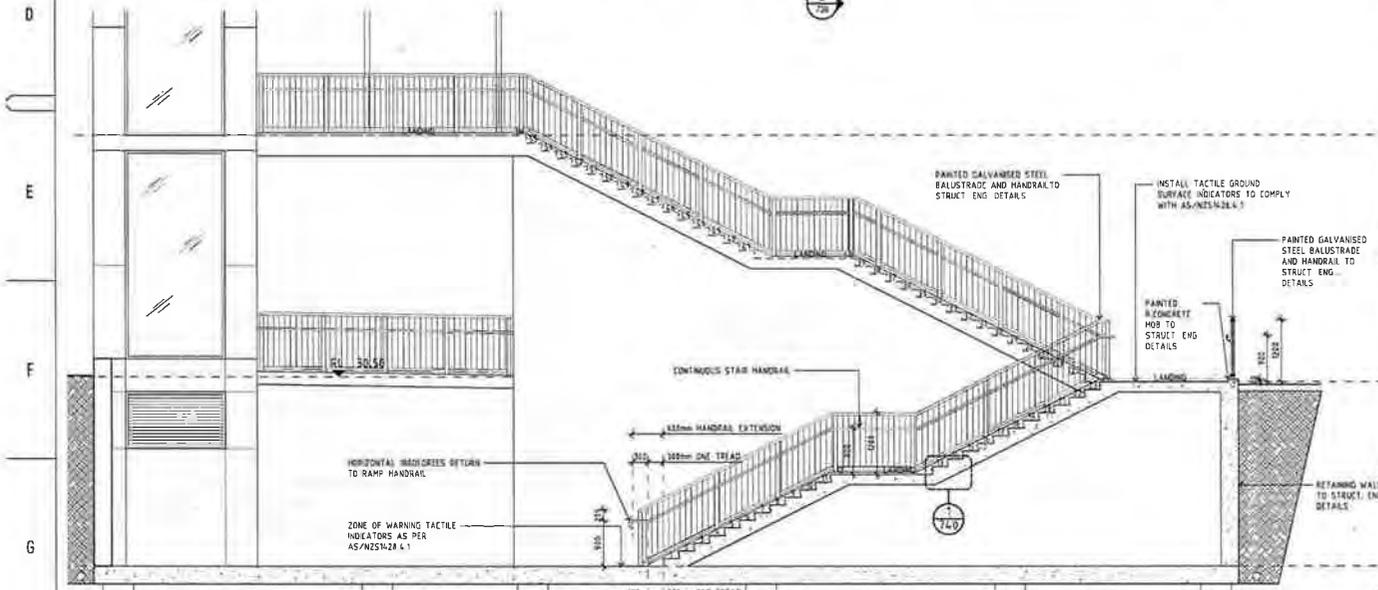
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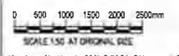
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PROJECT:

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**PRELIMINARY**

**CARDIFF STATION**  
MAIN NORTH LINE  
EASY ACCESS UPGRADE  
ARCHITECTURE  
STAIR DETAILS SHEET 1 OF 2

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STATUS: PRELIMINARY  
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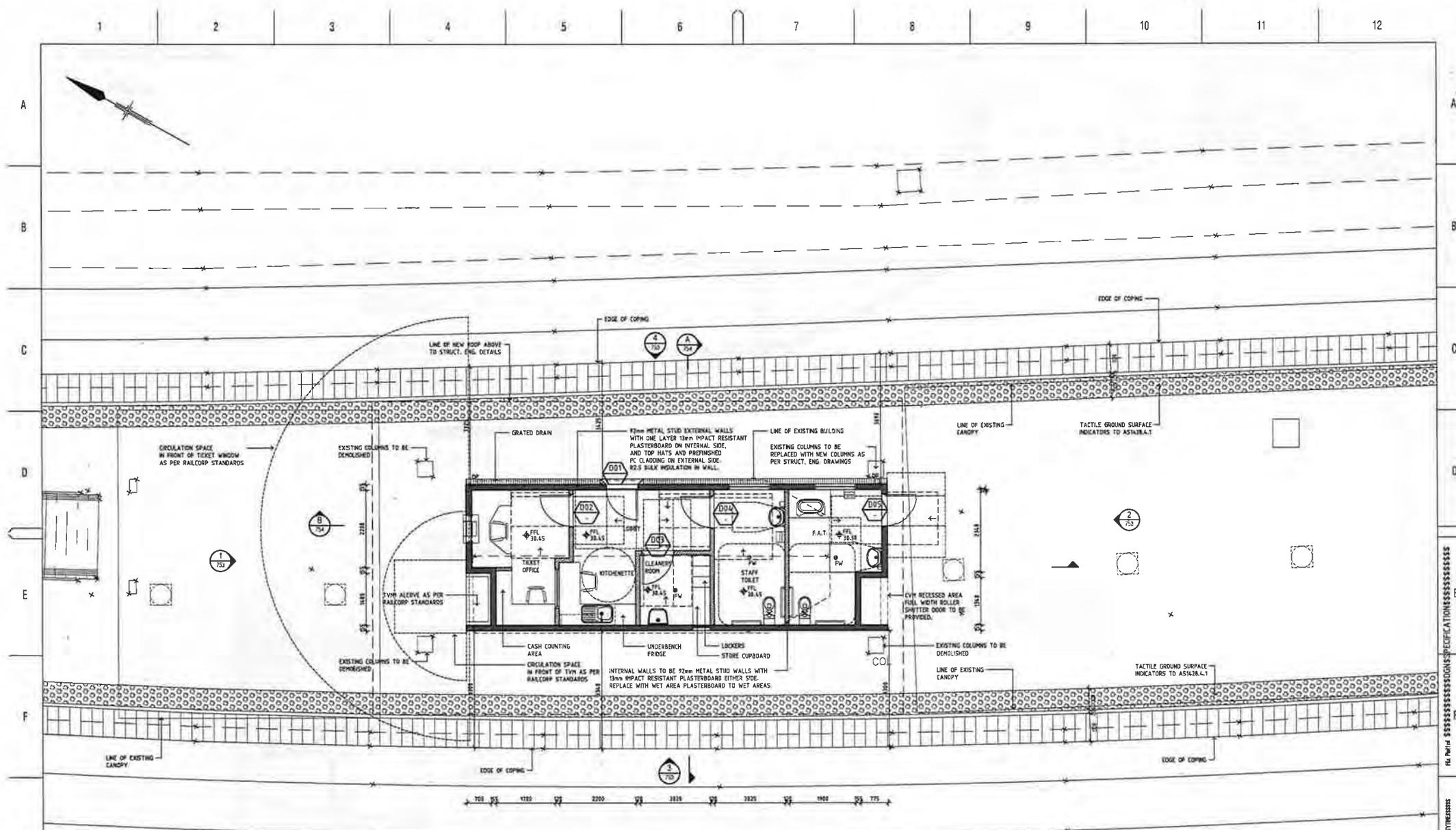
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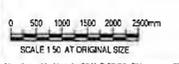






← TO SYDNEY

TO KOTARA →



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CV 0420753	PLATFORM ELEVATIONS				
CV 0420754	PLATFORM SECTIONS				
1				15.02.11	16.03.11
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APPROVED:

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**PRELIMINARY**

**CARDIFF STATION**  
MAIN NORTH LINE  
EASY ACCESS UPGRADE  
ARCHITECTURE  
NEW STATION BUILDING PLAN

FILE NO. SHEET 1 OF 1  
STATUS: PRELIMINARY  
CV0420750 1

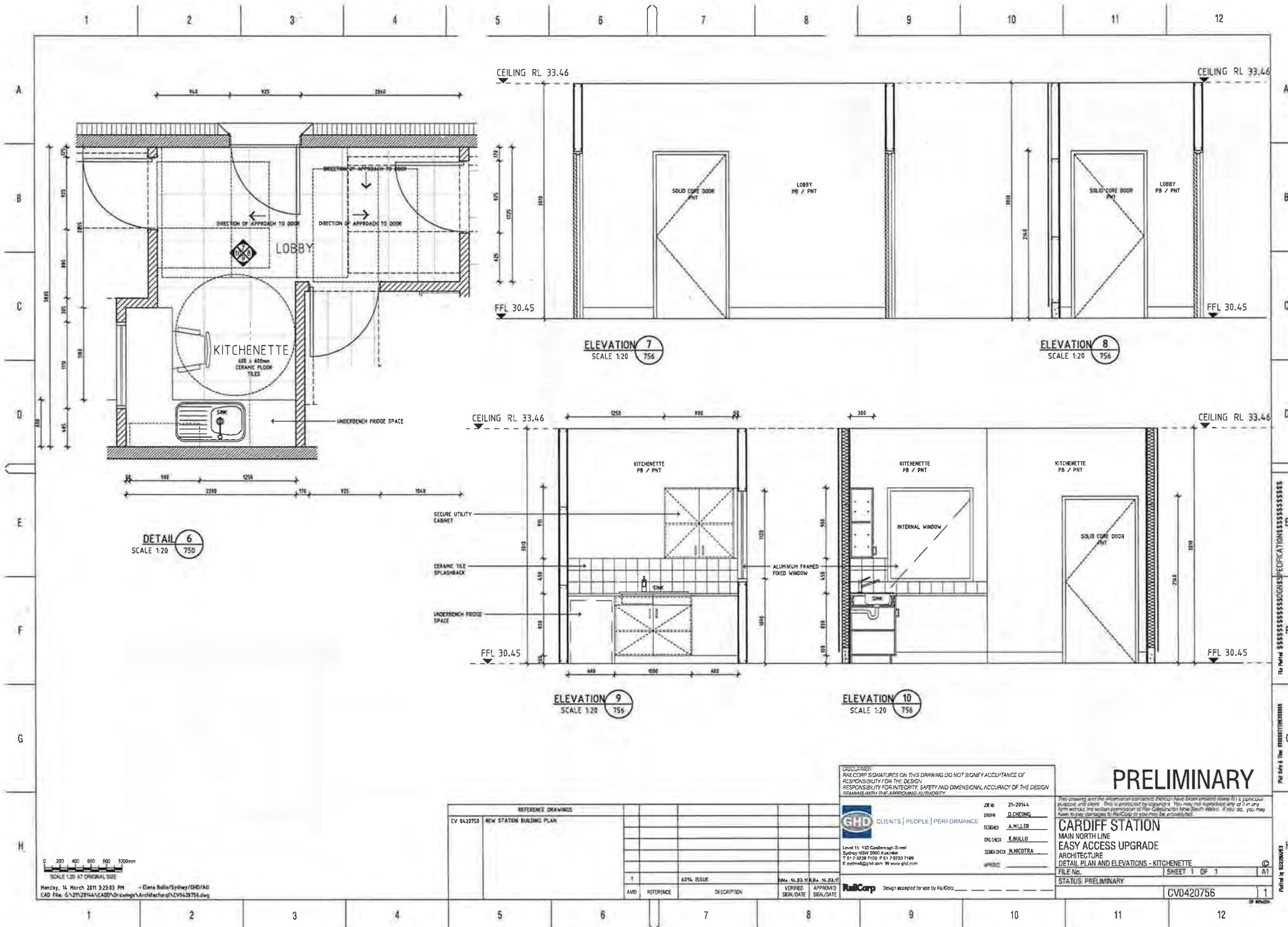
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**DETAIL 6**  
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**ELEVATION 7**  
SCALE 1:20 756

**ELEVATION 8**  
SCALE 1:20 756

**ELEVATION 9**  
SCALE 1:20 756

**ELEVATION 10**  
SCALE 1:20 756

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<b>PRELIMINARY</b>		
<b>CARDIFF STATION</b>		
MAIN NORTH LINE		
EASY ACCESS UPGRADE		
ARCHITECTURE		
DETAIL PLAN AND ELEVATIONS - KITCHENETTE		
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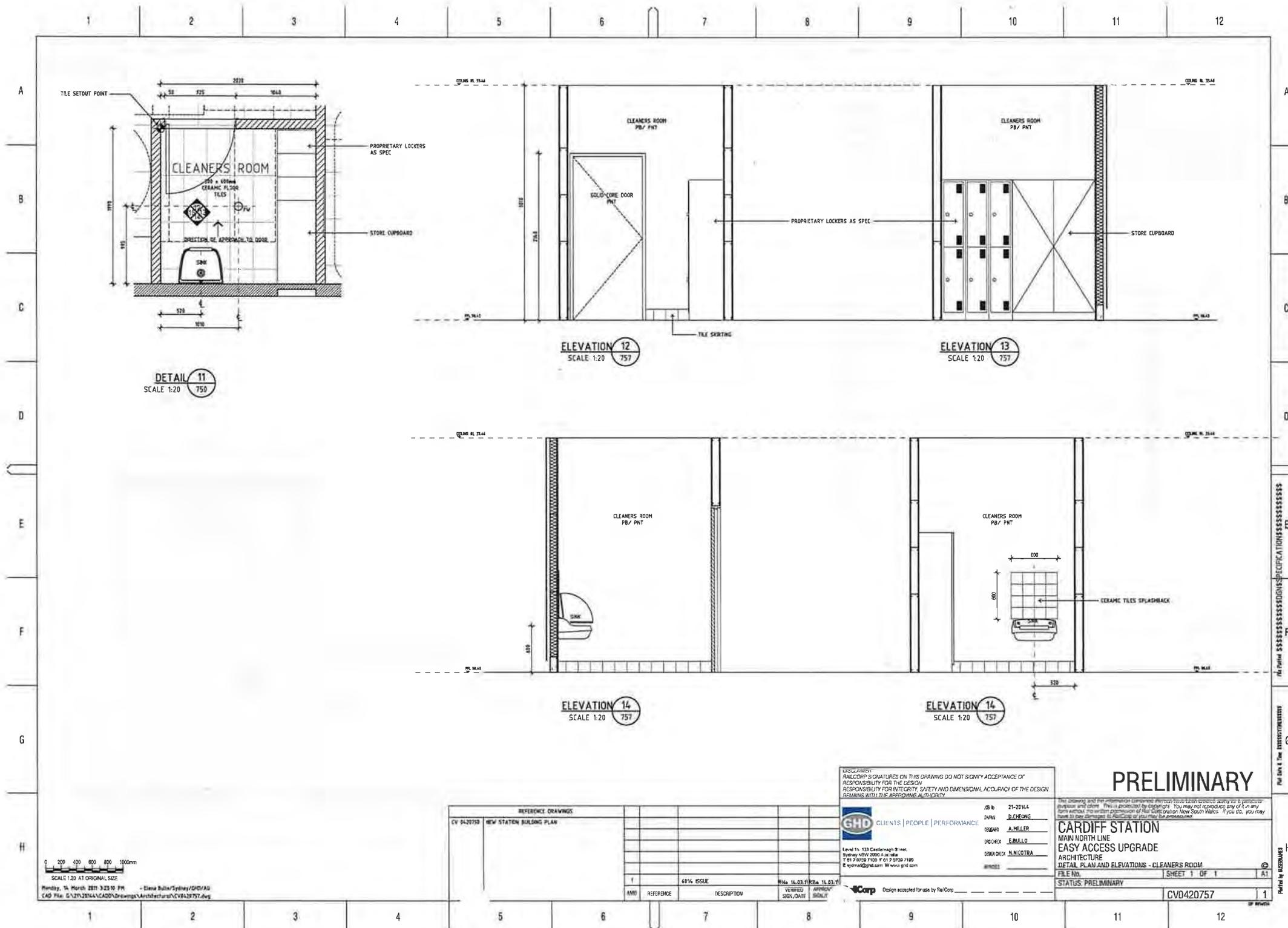
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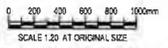
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**ELEVATION 12**  
SCALE 1:20 757

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SCALE 1:20 757

**ELEVATION 14**  
SCALE 1:20 757

**ELEVATION 14**  
SCALE 1:20 757



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DESIGNED BY: E. BULLO  
DESIGNED BY: N. MICOTRA

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**CARDIFF STATION**  
MAIN NORTH LINE  
EASY ACCESS UPGRADE  
ARCHITECTURE  
DETAIL PLAN AND ELEVATIONS - CLEANERS ROOM

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**EXHIBIT E - CONTRACT SPECIFIC REQUIREMENTS**

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# Exhibit E – Contract Specific Requirements

Transport Access Program

Cardiff Station Upgrade

Document Number: 1780182\_2

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## 1 Definitions and Terms

Unless stated otherwise, terms within this Contract Specific Requirements have the same meaning as those defined within the General Conditions.

In addition, the following definitions apply:

**"Area"** means the areas within the Worksites.

**"Control"** of an Area or Worksite means undertaking all the activities required to manage all access to and across the Area or Worksite, and maintaining the temporary infrastructure required for the Area or Worksite provided by the Contractor or RailCorp. Such activities will include managing and maintaining the security of the Area or Worksite, conducting familiarisation and safety inductions to, and for all those accessing, the Area or Worksite (but not inductions specific to Other Contractors' activities), operating and maintaining the wheel wash and other facilities involved, managing parking areas and liaising with Authorities in relation to the temporary infrastructure for which the Contractor in Control is responsible.

**"Establish"** an Area or a Worksite means providing all the temporary infrastructure required by the Contractor for its use of the part of the Site involved, including obtaining all Authority Approvals, survey for and construction of all perimeter fences, clearing vegetation, and providing all temporary Services, construction roads, signage, traffic management, car wash bays, drainage, perimeter security management, environmental management measures, pedestrian access, road changes off the Site to provide access, hard stand areas, wheel wash facilities and other facilities required for the Worksite, with all the Contractor's establishment such as offices and amenities (including those for the Principal where required). Other Contractors are responsible for providing their own establishment, including offices and amenities, and to adjust and augment (and maintain such augmentations to) any of the temporary infrastructure to suit their activities.

**"Reinstate"** an Area or Worksite means restoring the Area or Worksite to a condition not less than that existing immediately prior to the Contractor obtaining access to the Area or Worksite (except for flora growth and improved surfaces that grow), in compliance with conditions of the Planning Approval and any additional conditions required by relevant Authorities, but excluding any change to temporary infrastructure required for use of the Area or Worksite after the reinstatement.

**"Worksites"** means the worksites described in clause 2.1 to this Contract Specific Requirements.

## 2 Site

### 2.1 Description of the Site

The Site consists of two Worksites:

Worksite A the rail corridor within DP 92170 Lots 1 and 2 extending 50 metres beyond the end of the new platform extensions, and

Worksite B the area indicated for stage 2 works within the council car park in DP 8186 Lots 19 and 20;

as shown on the drawings in Appendix A.

## 2.2 Setting-Out and Survey

### 2.2.1 General

The Contractor must:

- (a) check and verify all dimensions and levels on the Site and the location of existing Services on and within the Site;
- (b) set out and survey in accordance with the MGA coordinate system;
- (c) verify positions of grids and levels from survey marks;
- (d) verify and confirm its acceptance of the cadastral survey and all property boundaries provided by the Principal's Representative;
- (e) set out the Works using permanent survey marks for the sole purpose of the Works. The permanent survey marks must be coordinated with the cadastral survey;
- (f) preserve and maintain in their true position all survey marks;
- (g) give the Principal's Representative at least two (2) Business Days notice of the Contractor's intention to perform any part of the setting out or levelling, so that suitable arrangements can be made for review of such work by the Principal's Representative; and
- (h) provide adequate recovery pegs in suitable locations within or adjacent to the Site.

### 2.2.2 RailCorp Detailed Site Survey

When conducting RailCorp detailed site surveys, the Contractor must comply with the RailCorp requirements described in the following documents:

- (a) RailCorp Detailed Site Survey Accurate Field Drawing Procedure (EP0491);
- (b) RailCorp Detailed Site Survey Data Capture Procedure (EP0492);
- (c) RailCorp Detailed Site Survey Infrastructure Services Data Policy (EP0495);
- (d) RailCorp Detailed Site Survey Plan Symbols & Interpretation Guidelines (EP0511);
- (e) RailCorp Detailed Site Survey Scope Procedure (EP0493);
- (f) RailCorp Detailed Site Survey Specification for Collection of Services Data (EP0496); and
- (g) RailCorp Detailed Site Survey Work as Executed Procedure (EP0494).

The Contractor must ensure that the personnel performing the RailCorp detailed site surveys are competent and familiar with rail survey requirements.

## 2.3 Site Compound

The Contractor's site compound must be located within the Area of Worksite A known as the upper accessway.

The Contractor must:

- (a) submit a 100% design for the site compound and fence to the Principal's Representative for approval two weeks prior to the planned commencement of the site compound and fence or otherwise as agreed with the Principal's Representative;

- (b) notify the Principal's Representative that it proposes to use the area at least one week prior to the planned commencement of construction of the site compound and fence or otherwise as agreed with the Principal's Representative; and
- (c) prior to Completion, restore the Site to its original or improved condition and remove all temporary site access roads.

## 2.4 Facilities for use by the Principal

Unless otherwise agreed by the Principal's Representative, the Contractor must:

- (d) provide a 6m x 3m lockable accommodation (as a minimum) with power, including a meeting table (3m x 1.2 m approximately) with 6 chairs, for the joint use of the Principal and the Contractor's site foreman, and a desk and chair and a secure lockable filing cabinet for the exclusive use of the Principal's Representative or other authorised persons; and
- (e) allow the Principal's Representative and authorised persons the reasonable use of the Contractor's telephone, fax, photo-copy machine, tea making facilities, and toilet facilities.

The Contractor is responsible for the cleaning of these facilities.

## 2.5 Site Access and Controls

The Contractor must:

- (a) Establish, Control and Reinstate Areas within Worksite A as necessary to construct the Works, allow train operations, and ensure safe use of the station by the public and RailCorp staff during operational periods; and
- (b) Establish, Control and Reinstate Areas within Worksite B as necessary to construct the Works

The Contractor must ensure that access to all Areas are restricted to authorised personnel and registered visitors.

The Contractor must submit details of the Areas to the Principal's Representative prior to their establishment and comply with any reasonable conditions required to ensure safe and uninterrupted operations of the railway and council carpark.

Site access is generally restricted to the existing access points off Main Road and Mary Street for the Rail Corridor and the council carpark respectively. The Contractor must maintain a vehicular access route for RailCorp through the Site to the existing rail track at all times. RailCorp operations and emergency vehicles will use this access on a periodic and emergency basis. A 24 hour contact telephone number will be required by RailCorp to ensure access to the site and their property. If RailCorp access is to be temporarily unavailable, prior approval will be required from the Principal's Representative.

Access to the existing council car park and station must be maintained at all times. The Contractor must comply with the Licensee obligations contained in the Deed of Licence with the City of Lake Macquarie, given in Exhibit H.

The Contractor must maintain in good condition the existing temporary stairs (installed and removed by Other Contractor) between the council carpark and the upper access way for the duration of the Works.

Site access controls must include:

- (a) a secure perimeter to any part of the Site or Area where hazards exist;
- (b) minimisation of access points;
- (c) control of all access points with gates kept closed during working hours and locked when the Site or Area is unoccupied;
- (d) a notice at the main gate of the site compound stating the name and the 24 hour contact number of the person who has custody of the keys to access the site compound; and
- (e) clear and prominently positioned directional, information and safety signage in regard to visitors, site safety, emergency egress and assembly points, the wearing of personal protective equipment, emergency contact numbers and Site conduct in general.

## **2.6 Existing Public Thoroughfares and Rights of Way**

The Contractor must provide unimpeded and uninterrupted access twenty four hours a day, seven days a week:

- (a) for existing formalised pedestrian access to any adjoining railway station;
- (b) for adjoining and nearby property owners, occupiers and users to areas adjacent to and outside the Site or Areas;
- (c) to RailCorp and other contractors requiring access to the Rail Corridor through any access gate;
- (d) for emergency services; and
- (e) RailCorp maintenance vehicles and personnel.

## **2.7 Existing Property Condition**

The Contractor, when preparing Condition Surveys required under clause 3.12 of the General Conditions, must comply with the following requirements.

Prior to commencing any work which may cause damage, the Contractor must make an inspection and produce a comprehensive written and photographic record of the condition of all property (including assets and services below ground level) on and adjacent to the Site or Areas and in the sphere of influence of the Contractor's Activities, including all premises, buildings, structures, utilities, and railway system assets (including all RailCorp property) ('Condition Survey'). The Condition Survey must describe and identify the property, its location and its existing condition, prior to the commencement of the Contractor's Activities and document the activities most likely to cause damage and the monitoring frequency proposed by the Contractor.

All areas that show evidence of existing damage or failure must be photographed and carefully recorded, including the location and extent of the damage and the date when the photograph was taken.

The results of the Condition Survey must be embodied in a written report and submitted to the Principal's Representative prior to commencing the Contractor's Activities.

The condition of the property covered by the Condition Survey must be regularly monitored during the carrying out of the Contractor's Activities and the Condition Survey augmented to address any change to the conditions observed.

The Contractor must notify the Principal's Representative immediately of any damage to property caused by the Contractor's Activities whether the property was part of the Condition Survey or not and submit to the Principal's Representative details on the rectification measures the Contractor proposes to undertake.

Within one month of Completion, the Contractor must:

- (a) survey, review and record the current condition of each property included in the previous Condition Survey and confirm:
  - i. the condition of the property relative to that recorded previously; and
  - ii. that any damage caused by the Contractor's Activities has been repaired;
- (b) obtain the Principal's Representative's agreement that the Contractor's record represents the true condition of their property; and
- (c) provide a copy of the record to the Principal's Representative within 14 days of the completion of the survey of the property.

## **2.8 Site Parking**

The Contractor must make its own arrangements for parking facilities.

The Contractor is responsible for the provision of parking for construction vehicles and to ensure there is minimal impact to on-street parking during the Contractor's Activities.

## **2.9 Unloading Zones**

The Contractor must make its own arrangements regarding loading zones and pay all necessary Authority fees etc.

## **2.10 Existing Services**

The information available on the location of existing Services including utilities and/or structures is approximate only and in some cases may be inaccurate or incomplete. Without limiting clause 3.6 of the General Conditions, the Principal accepts no responsibility for and does not guarantee or make any representation as to the accuracy, adequacy, suitability or completeness of the information.

The Contractor must make such further enquiries and investigations, including carrying out any Services searches, as are required to ensure existing Services including utilities and/or structures remain undamaged.

The existence of underground Services may not shown on the drawings listed in the Works Brief, or may be in location or elevations different from those shown on the drawings listed in the Works Brief. The Contractor must ascertain the exact location of each underground Services prior to doing any work that may damage any such Service.

Any damage to the existing Services including utilities and/or structures must be repaired at the Contractor's cost either by the Contractor to the satisfaction of the Authority concerned, or if the relevant Authority so elects, repairs will be effected by the relevant Authority.

The cost of making further enquiries and investigation to ensure the existing Services including utilities and/or structures remain undamaged and the protection and maintenance of existing the existing Services including utilities and/or structures is included in the Original Contract Price.

Where the Contractor's method of working results in additional adjustments to any existing Services being deemed necessary by any Authority having statutory rights in relation to the Service, the Contractor must arrange for and bear all costs in relation to those additional adjustments, notwithstanding that the Principal's Representative may have approved the method of working.

The Contractor is to test, validate and undertake its own assessment of existing Services terminations prior to the commencement of the works in accordance with the WHS Legislation.

The Contractor must deal with any related existing Services encountered, obstructed, or damaged in the course of performing the Contractor's Activities, as follows:

- (a) if the Service is to be continued: repair, divert, relocate as required; and
- (b) if the Service is to be abandoned: cut and seal or disconnect, and make safe and/or remove - in accordance with the requirements of the Principal's Representative and the relevant Authorities.

The Contractor must liaise with the appropriate Authorities and resolve all issues with respect to existing Services in accordance with the Contract and the requirements of any relevant Authorities.

## **2.11 Site Storage**

The Contractor is responsible for the care of the Contractor's Activities including providing safe and proper storage of all Construction Plant and on-Site materials used for or in carrying out the Contractor's Activities.

The Contractor is responsible for the provision of any security enclosures that may be required around or within storage areas. All proper precautions must be taken by the Contractor to keep all poisons and other injurious substances in places secured against access by unauthorised persons.

All Construction Plant and materials on the Site must be stored in accordance with statutory requirements and in such a manner as to prevent mechanical and climatic damage. Storage areas must be kept in a neat and tidy manner to minimise hazards to persons, materials and equipment.

## **2.12 Rectification of Roads and Footpaths**

The Contractor must rectify any and all damage to all roads and footpaths affected by the Contractor's Activities in a timely manner.

## **2.13 Cleaning and Protection of Work**

Whilst undertaking the Contractor's Activities the Contractor must clean and protect the Works, the Temporary Works and the Site. The Site must be in a clean and tidy state at all times (including free from graffiti).

The Contractor must entirely at its own cost remove daily from the Site all materials removed during the course of construction, unless the Principal's Representative indicates that some of these are to be retained by the Principal.

The Contractor must entirely at its own cost, remove from the Site at regular intervals but not less than weekly, refuse (including food scraps) resulting from the Contractor's Activities including any

work performed during the Defects Rectification Period. The Contractor must handle refuse in a manner so as to confine the materials completely and prevent dust and odour emissions.

No fires or burning off are permitted on the Site

The Contractor must properly dispose of solid, liquid and gaseous contaminants in accordance with the Law.

The Contractor must protect newly installed Works to ensure no damage or deterioration occurs. The Contractor must also clean and perform maintenance on newly installed Works as frequently as necessary in accordance with the manufacturers' and other relevant cleaning, protection and maintenance requirements until Completion.

The Contractor must remove protection when directed by the Principal's Representative. The Contractor must clean and make good, re-work or re-build any Works soiled, marred or damaged.

## 2.14 Final Cleaning

The Contractor must provide final cleaning of the Works when directed by the Principal's Representative, or in the absence of such direction immediately prior to Completion. This must consist of cleaning each surface of unit of work to a clean condition expected from a first class building cleaning and maintenance program.

The Contractor must comply with the manufacturer's instructions for cleaning operations.

The necessary cleaning work includes, but is not limited to, the following:

- (a) removal of labels that are not required as permanent labels;
- (b) cleaning of exposed exterior and interior hard surfaced finishes to be free from dirt, fingermarks, films and any foreign substances and marks;
- (c) except as otherwise indicated by the Works Brief or as directed by the Principal's Representative, avoid disturbance of natural weathering of exterior surfaces;
- (d) restore reflective surfaces to original and new reflective condition;
- (e) wiping the surface of mechanical and electrical equipment clean, including lift equipment and similar equipment and remove excess lubrication and other substances;
- (f) removal of debris and surface dust from limited access spaces, paying particular attention to concealed spaces such as plumbing ducts, shafts, pits, cupboards and false ceiling spaces;
- (g) vacuum cleaning of floors, including concrete floors, in areas intended to be occupied;
- (h) thorough sweeping, cleaning and where required vacuuming, of all floors to ensure a clean and dust free surface;
- (i) cleaning light fixtures and lamps so as to function with full efficiency (re-lamp non functioning lamps); and
- (j) cleaning signage.

The Contractor must employ experienced workers or professional cleaners for final cleaning operations.

## 2.15 Properties Adjacent to the Site

The Contractor must prevent nuisance to the owners, tenants or occupiers of properties adjacent to or within the Site, and to the public generally, and must take all steps necessary to maintain clear unobstructed access to buildings still under occupation and neighbouring buildings.

The Contractor must execute the Contractor's Activities in a manner so as to avoid pollution or Contamination of the Site and its surroundings (including not causing any inconvenience to adjoining properties).

## 2.16 Site Meetings

The Contractor, appropriate Subcontractors and as required by the Principal's Representative must attend weekly site progress and co-ordination meetings. The meetings will be chaired and minuted by the Principal's Representative or its representative. The location of the progress meetings will be within the Contractor's site offices, unless instructed otherwise by the Principal's Representative.

The site progress meetings and coordination meetings referred to in the paragraph above will be held weekly as a minimum requirement unless otherwise approved by the Principal's Representative and the Contractor must allow for any additional meetings and discussions which are necessary to fully inform the Principal's Representative of the progress of the Contractor's Activities.

The Contractor must, at the first site meeting, submit the names and telephone numbers of all responsible persons who may need to be contacted after hours during the course of the Contractor's Activities.

## 2.17 Track Possessions

Track Possessions are made available to the contractor by the Principal (at no cost for the Contractor) for the Contractor to carry out Contractor's Activities. The Track Possessions listed are subject to change.

The configuration 9 Track Possessions generally commence at 0200 hours Saturday and cease 0200 hours Monday.

Configuration No.	Possession Weekend No.	Duration	Dates	Comments
9	50	3 days	9-11 June 2012	Full possession with power out and no freight trains
9	11	12 days	10-21 September 2012	Peak am/pm services running with power on and freight trains
9	15	2 days	13-14 October 2012	Freight trains operating during possession
9	24	2 days	15-16 December 2012	Full possession with power out and no freight trains

9	32	2 days	9-10 February 2013	Full possession with power out and no freight trains
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The construction program must be coordinated with these possessions. Additional possessions may be available but these would be subject to agreement from RailCorp and the Contractor would be responsible for all associated costs.

### 3 Materials and Workmanship

#### 3.1 Means, Methods, Techniques, Sequences and Procedures

##### 3.1.1 Information

When proposing an alternative work method, technique, sequence of activities or procedures for approval by the Principal's Representative, the Contractor must provide at its cost all available technical information, and any other relevant information requested by the Principal's Representative. If requested by the Principal's Representative, the Contractor must at its cost obtain and submit reports on relevant tests by an independent testing authority with respect to such work method, technique, sequence of activities or procedures.

##### 3.1.2 Alterations

The information provided to the Principal's Representative by the Contractor pursuant to clause 3.1.1 of this Contract Specific Requirements must include whether the use of the alternative will require alteration to any other part of the Contractor's Activities. If the alternative is approved by the Principal's Representative and adopted, the Contractor must carry out any such alteration at its cost.

#### 3.2 Proprietary Items

##### 3.2.1 Definition

A proprietary item is any item identified by graphic representation in the drawings or specifications listed in the Works Brief, or by naming one or more of the following: manufacturer, supplier, installer, trade name, brand name, catalogue or reference number, and the like.

##### 3.2.2 Implication

The identification of a proprietary item must not necessarily imply exclusive preference for the item so identified, but must be deemed to indicate the required properties of the item. Where the proprietary item is not obtainable, the Contractor may propose an alternative provided it is equal to or better than the original item. The Principal's Representative must not unreasonably withhold approval or reject any proposed alternative provided that any obligations under a sales contract are not compromised.

##### 3.2.3 Claims

The Contractor will not be entitled to make any claim arising out of or in connection with any rejection or adoption of an alternative, unless otherwise agreed.

### 3.2.4 Information

When proposing an alternative for approval by the Principal's Representative, the Contractor must provide at its cost all available technical information, and any other relevant information requested by the Principal's Representative. If requested by the Principal's Representative, the Contractor must obtain and submit reports on relevant tests by an independent testing authority at its cost.

### 3.2.5 Alterations

The information provided to the Principal's Representative by the Contractor pursuant to clause 3.2.4 of this Contract Specific Requirements must include whether the use of the alternative will require alteration to any other part of the Contractor's Activities. If the alternative is approved by the Principal's Representative and adopted, the Contractor must carry out any such alteration at its cost.

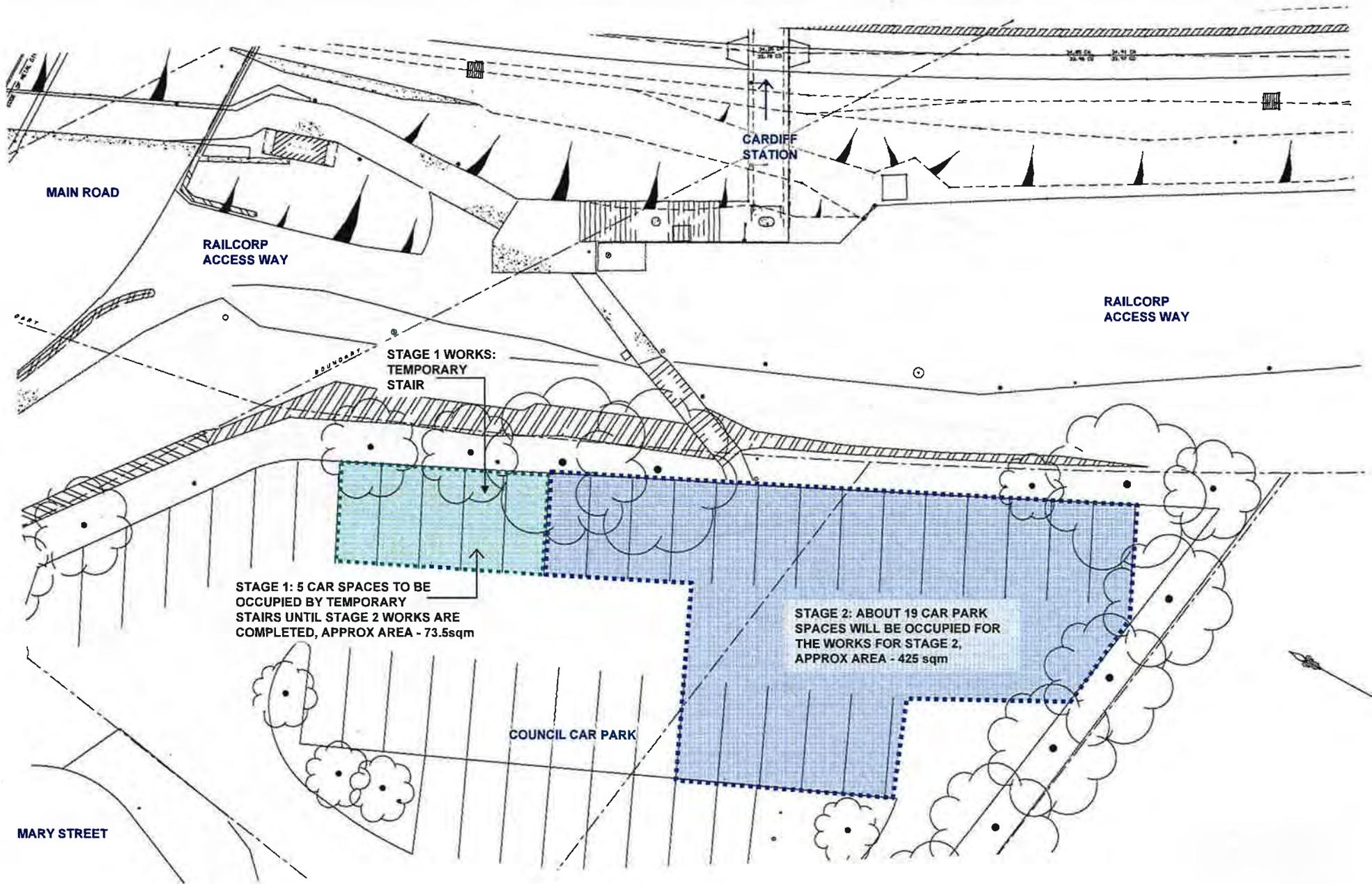
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**Appendix A – Site Plans**

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**CARDIFF ACCESSIBILITY UPGRADE**  
 REQUIRED COUNCIL CAR PARK SPACES FOR EASY ACCESS UPGRADE WORKS

01/03/2012

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**EXHIBIT F – REPORTS**


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**List of Reports**

Item	Description	Author / Source	Date
A1.1	Environmental Management Plan. Cardiff Railway Station Upgrade.	GHD	July 2011
A1.2	Geotechnical Assessment for Proposed Easy Access at Cardiff Railway Station, Main Road, Cardiff, NSW (ref 21820ZRrpt)	Jeffery and Katauskas Pty Ltd	10 Mar 2008
A1.3	Geotechnical Investigation. Proposed Station Upgrade – New Canopies. Cardiff Railway Station. Main Road, Cardiff, NSW (JG09294D-r1)	GeoEnviro Consultancy Pty Ltd	Oct 2009
A1.4	Geotechnical Investigation for Platform Extension at Cardiff	RailCorp	1 Mar 2011
A1.5	Hazardous Materials Register	RailCorp	24 Jun 2010





CLIENTS | PEOPLE | PERFORMANCE

**RailCorp New South Wales**  
**Environmental Management Plan**  
**Cardiff Railway Station Upgrade**  
July 2011



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- B Regulatory Requirements



## List of Abbreviations

ACM	Asbestos Containing Material
B[a]P	Benzo[a]pyrene
BTEX	Benzene, toluene, ethyl benzene and total xylenes
DEC	NSW Department of Environment and Conservation (now the Office of Environment and Heritage)
DECC	NSW Department of Environment and Climate Change (incorporating the EPA)
DMP	Dewatering Management Plan
DP	Deposited Plan
EIL	Environmental Investigation Level
EPA	NSW Environment Protection Authority (now part of the DECC)
HBM	Hazardous Building Material
HIL	Health Investigation Level
mg/Kg	Milligrams per Kilogram
NEPM	National Environmental Protection Measure
NOHSC	National Occupational Health and Safety Commission
OCP	Organochlorine pesticides
OEH	Office of Environment and Heritage
OH&S or OHS	Occupational Health and Safety
PAHs	Polycyclic Aromatic hydrocarbons
PCBs	Polychlorinated Biphenyl's
PID	Photo Ionisation Detector
POEO Act	Protection of the Environment Operations Act
PPE	Personal Protective Equipment
QA	Quality Assurance
QC	Quality Control
TPH	Total petroleum hydrocarbons
UCL	Upper Confidence Limit



# 1. Introduction

## 1.1 Project Overview

GHD Pty Ltd (GHD) was engaged by Rail Corporation New South Wales (Rail Corp) to prepare an Environmental Management Plan (EMP) to manage potential site contamination issues during the Cardiff Railway Station Upgrade, located at Cardiff, NSW (the Site).

As part of the development, there is a need to excavate soil from various areas for re-grading and to facilitate the installation of infrastructure. An environmental investigation was previously conducted to provide in-situ waste classification in the event that off-site disposal of material is required during the development works as part of the accessibility upgrade. The results of the targeted soil assessment demonstrated that the material within the proposed excavation areas is suitable, from a contamination perspective, for use under a commercial/industrial land use and as such, material would be suitable for re-use on site.

This EMP has been prepared for the purpose of protecting workers and the environment from potential contamination at the Site. The EMP is not designed for the purpose of protecting the workers and the environment from site activities (site safety / work plans will need to be prepared to address this, as discussed in **Section 1.2**).

## 1.2 Objectives of EMP

This EMP details provisions for the management of environmental, health and safety risks that may arise from potential soil contamination. The key objectives of this EMP are as follows:

- ▶ Identify potential contamination issues at the Site requiring management.
- ▶ Describe management procedures to mitigate risks of harm posed by potential contamination to site workers, contractors and the environment (including the surrounding community).
- ▶ Provide a framework for managing potentially contaminated media in accordance with legislative requirements.
- ▶ Outline roles and responsibilities for implementation and control of the EMP.

If unanticipated changes in site or working conditions occur which are not addressed by the EMP, Rail Corp is responsible for ensuring their management. Future operations or extensive disturbance of the Site may involve activities that have not been anticipated by this EMP and hence additional procedures would need to be prepared addressing the specific activities to be undertaken outside the provisions of this EMP.

As this EMP is specifically to provide guidance with respect to potential site contamination issues, it is intended that Rail Corp incorporate this EMP into their site management procedures for the broader OH&S and environmental issues associated with operational works at the Site.



## 2. Regulatory Requirements

Works on the Site are required to be in accordance with various environmental legislation and government guideline documents. The primary Acts, Regulations and Guidelines are listed in **Appendix B**. Please note, however, that the list is not intended to be a comprehensive listing of Acts and Regulations and their specific requirements. Property owners and contractors are required to satisfy themselves that all applicable permits and licences have been obtained and their conditions satisfied.

All references to Acts, Regulations and Guidelines are current as of the time of preparation of this EMP. These should be checked and updated as required, and the intent of the EMP is to require reference to Acts, Regulations and Guidelines current at the time of use.



## 3. Site Location and Description

### 3.1 Site Location

The Site is located at Cardiff Railway Station, off Main Road, Cardiff, NSW, 2285. Further site details are summarised in **Table 3-1**. The area covered by this EMP is shown on **Figure 1, Appendix A**.

**Table 3-1 Site Location Summary**

<b>Street Address</b>	Main Road Cardiff, NSW, 2285
<b>Approximate Grid Co-Ordinates</b>	6354393N 374996E
<b>Title Identifiers</b>	Lot 1 DP1120089 and Lot 1 DP921702
<b>Local Government Area</b>	City of Lake Macquarie
<b>Current Land Use</b>	Operational Train Station
<b>Local Land Use Zoning</b>	Under the Local Environmental Plan 2004, Zoning Map 7 the Site is zoned 5 Infrastructure Zone.

### 3.2 Site Description

Based on information provided by Rail Corp, GHD understands that eight areas of the site have been identified for the proposed upgrade works. These include:

- ▶ **Zone 1:** Located between the Council car park and upper access-way to enable installation of new access-way and three stop lift;
- ▶ **Zone 2:** Installation of two stop lift from footbridge to Island platform;
- ▶ **Zone 3:** Island platform extension – 74 m at the city end and 10 m at the country end;
- ▶ **Zone 4:** Council car park – re-grading of five car-parking spaces adjacent to new access-way and lift;
- ▶ **Zone 5:** Upper access way re-grading;
- ▶ **Zone 6:** Access pathway re-grading;
- ▶ **Zone 7:** Re-grading of track levels -170 m of track; and
- ▶ **Zone 8:** Installation of rainwater tank on island platform.

The site layout, identifying each of the eight zones, is shown on **Figure 1**.



## 4. Summary of Potential Contamination Issues

Given the site's location within and adjacent to the rail corridor, and the potential historical uses of the site, there is a potential for this soil from these areas to be contaminated. Due to the site's limited space and the limited opportunities for recycling and reuse as part of the development, the excavated soil is proposed to be disposed of off-site to landfill.

A summary of the subsurface conditions encountered in the boreholes at each zone is provided below:

- ▶ **Zone 1:** Ballast and road based gravelly fill to a maximum of 0.3 m, underlain by silty sandy clay grading to clay/ sandy clay.
- ▶ **Zone 2:** Topsoil, underlain by clay with sands and minor gravels to the end of the borehole.
- ▶ **Zone 3:** Ballast fill to 0.1 m, underlain by gravelly clay grading to clay at approximately 0.3 m.
- ▶ **Zone 4:** Light brown, gravelly clay with sands to 0.3 m.
- ▶ **Zone 5:** Ballast and road based gravel fill, underlain by sandy, gravelly clay with some silty sands to a maximum depth of 0.5 m.
- ▶ **Zone 6:** Cement ground cover to 0.1 m. Underlain by a mixture of clay with sand and gravels.
- ▶ **Zone 7:** Saturated ground cover in parts with topsoil. Gravelly clays from 0.05 m to 0.4 m, with gravel composition increasing with depth; and
- ▶ **Zone 8:** Silty sand with trace gravels to 1.0 m, with increasing gravel content to 2.7 m. Underlain by gravelly silty sands.

No visual or olfactory signs of contamination were noted at any of the sampling locations.

The results were compared to the Health Based Investigation Levels listed in the NSW EPA (2006) "*Guidelines for the NSW Site Auditor Scheme*" (HIL F) and the NSW DECC (2009) *Waste Classification Guidelines, Part 1: Classifying Waste*. A summary of results of the material against investigation levels is presented in **Table 4-1**. The results are summarised as follows:

- ▶ Within all 8 zones, the majority of samples reported concentrations less than the laboratory practical quantitation limit. Detections of metals all fell below the adopted health investigation level for commercial/industrial use.
- ▶ The concentrations of contaminants were compared to the criteria outlined in Tables 1 and 2 of the NSW DECC (2009) *Waste Classification Guidelines, Part 1: Classifying Waste*. Based on the results of laboratory analyses, the waste classification of the material present at the site would be *general solid waste* within all 8 zones.



**Table 4-1 Summary Results**

Zone	Summary Results	Waste Classification
1	Concentrations of all CoPC were reported below the practical quantitation limit of the laboratory or HIL(F). No asbestos detected	Concentrations reported below CT1. Material would be suitable for re-use on site or off-site disposal as <b>General Solid Waste</b>
2	Concentrations of all CoPC were reported below the practical quantitation limit of the laboratory or HIL(F). No asbestos detected	With the exception of lead in surface sample Z2/1, all concentrations were reported below CT1. Leachable concentration of lead was low and the material would be suitable for re-use on site or off-site disposal as <b>General Solid Waste</b> .
3	Concentrations of all CoPC were reported below the practical quantitation limit of the laboratory or HIL(F). No asbestos detected	Concentrations reported below CT1. Material would be suitable for re-use on site or off-site disposal as <b>General Solid Waste</b>
4	Concentrations of all CoPC were reported below the practical quantitation limit of the laboratory or HIL(F). No asbestos detected	Concentrations reported below CT1. Material would be suitable for re-use on site or off-site disposal as <b>General Solid Waste</b>
5	Concentrations of all CoPC were reported below the practical quantitation limit of the laboratory or HIL(F). No asbestos detected	With the exception of lead in two samples (Z5/1/0.5 and Z5/3/0.25), all concentrations were reported below CT1. Leachable concentration of lead was low and the material would be suitable for re-use on site or off-site disposal as <b>General Solid Waste</b> .
6	Concentrations of all CoPC were reported below the practical quantitation limit of the laboratory or HIL(F). No asbestos detected	With the exception of lead and benzo(a)pyrene, all concentrations were reported below CT1. Leachable concentration of lead and benzo(a)pyrene were low and the material would be suitable for re-use on site or off-site disposal as <b>General Solid Waste</b> .
7	Concentrations of all CoPC were reported below the practical quantitation limit of the laboratory or HIL(F). No asbestos detected.  GHD understands that ballast is to be re-used on site. No samples of ballast were collected for analysis.	With the exception of lead in two samples (Z7/2/0.4 and Z7/7/0.4), all concentrations were reported below CT1. Leachable concentration of lead was low.  Material underlying the ballast would be suitable for re-use on site or off-site disposal as <b>General Solid Waste</b> .
8	Concentrations of all CoPC were reported below the practical quantitation limit of the laboratory or HIL(F). No asbestos detected	Concentrations reported below CT1. Material would be suitable for re-use on site or off-site disposal as <b>General Solid Waste</b>

Groundwater was not encountered during the environmental investigation and as such the contamination status and depth to groundwater is not known.



## 5. Potential Health, Safety and Environmental Risks

The environmental investigation did not identify soil contamination at the Site with the potential to pose a risk to health, safety and/or the environment. However, this EMP provides guidance aimed to minimise the potential for exposure to potential contamination not identified in the environmental investigation, thus minimising the potential for risk to health and safety, or the environment.

The risks posed by potential hazards not identified at the Site are summarised below:

- ▶ Exposure to contaminated soil by way of ingestion (e.g. from hand to mouth transfer).
- ▶ Exposure to contaminated soil by way of inhalation (e.g. of dust).
- ▶ Exposure to contaminated soil by way of dermal adsorption (prolonged skin contact), as well as contaminants being taken home on soil clothing which could result in chronic health effects.
- ▶ Migration of contaminated soil or groundwater into the environment (e.g. by stormwater runoff) may result in pollution of offsite areas and water ways.

As noted in **Section 1**, this EMP does not cover other risks outside the site area as shown in **Figure 1, Appendix A**, or risks other than those related to contamination.



## 6. Application of EMP, Roles and Responsibilities

The following table outlines the main parties who have involvement in the EMP, and their respective roles and responsibilities. This table is not intended to list all responsibilities under relevant legislation (eg including but not limited to the OH&S Act and regulations), but is presented as a brief clarification of the parties' respective responsibilities in implementing this EMP.

**Table 6-1 Roles and Responsibilities**

Title	Responsibility
Site Owner – Rail Corp	Responsible for promoting good environmental and OH&S management.
Site Manager / Operator – Rail Corp	Responsible for: <ul style="list-style-type: none"> <li>▶ Taking all practical measures to ensure the workplace under their supervision is operating according to the agreed principles of the EMP, and without risks to health or the environment.</li> <li>▶ Ensuring all personnel under their control entering the Site are inducted to an appropriate level in environmental and emergency procedures.</li> <li>▶ Implementing, controlling and maintaining the EMP.</li> <li>▶ Responding to any OH&amp;S or environmental incident.</li> <li>▶ Providing subcontractors with the requirements of this EMP prior to commencement of work.</li> <li>▶ Ensuring that all changes to the EMP are communicated to all personnel working on site, including subcontractors.</li> <li>▶ Where encountered, reporting of previously unidentified areas of contamination or differences in subsurface conditions to those noted in <b>Section 4</b> to Rail Corp.</li> </ul>
Subcontractors	All subcontractors are required to comply with the EMP and to comply with directions from Rail Corp in this respect. Where encountered, reporting of previously unidentified areas of contamination or differences in subsurface conditions to those noted in <b>Section 4</b> to Rail Corp.
Employees and Visitors to Site	Responsible for attending appropriate induction and training sessions, following procedures and making Rail Corp aware of any actual or potential breaches of procedures. Where encountered, reporting of previously unidentified areas of contamination or differences in subsurface conditions to those noted in <b>Section 4</b> to Rail Corp.



## 7. Environmental Management of Intrusive Works

### 7.1 Introduction

Site works should be conducted in a manner designed to minimise environmental impacts. This section describes the processes that should be considered prior to undertaking any intrusive works across the Site.

### 7.2 Soil and Water Management

The following management measures will apply:

- ▶ Any excavated material brought to the surface and placed in stockpiles will be placed on dedicated parts of the Site as approved by the Site Manager.
- ▶ All stockpiles will be covered if left for more than 24 hours.
- ▶ Perimeter silt fencing or appropriate stormwater diversion bunds around the work area will be installed to ensure that potentially contaminated materials do not migrate laterally from the excavation or stockpile area(s).
- ▶ Stockpiles are to be located away from concentrated stormwater flow paths including drainage lines, gutters, stormwater pits and inlets as appropriate.
- ▶ If excavated material appears or is suspected of being contaminated the material shall be kept segregated to allow for assessment.
- ▶ Where encountered, reporting of previously unidentified areas of contamination or differences in subsurface conditions to those noted in **Section 4** to Rail Corp.

### 7.3 Dust and Odour Management

Works will be undertaken in a manner that minimises dust and odour emissions. The following measures will be undertaken:

- ▶ Careful handling of the excavated material in a manner that minimises dust emissions.
- ▶ Minimal spraying of soil with water.
- ▶ Use of tarpaulins to cover loads (incoming and outgoing).

### 7.4 Waste Management

All wastes generated at the Site will be classified, managed and disposed in accordance with the *Environmental Guidelines: Assessment, Classification and Management of Liquid & Non Liquid Wastes* (DECC 2009).

### 7.5 Emergency Preparedness and Response

The following procedure will be followed in the event of an emergency:

- ▶ Assess the risks associated with the release of the material from the site and ensure that appropriate procedures are included in the response to address such hazards.



- ▶ Identify the reason behind the release of the material and isolate/contain, including suspension of any activities which will result in additional material being generated/released.
- ▶ Recover the fill material which was released as far as practicable (for example, sweep spill material from the area).
- ▶ Place the recovered material in an appropriate secure location.
- ▶ Complete the incident response form.
- ▶ Identify any additional controls/procedures to minimise the chance for similar releases to occur in the future.



## 8. Health and Safety Management

### 8.1 Regulatory Requirements

Safe work method statements (SWMS) must be prepared prior to undertaking intrusive investigations across the Site. As a minimum, SWMS's must:

- ▶ Provide a description of the work to be undertaken.
- ▶ Identify the safety risks.
- ▶ Describe the control measures to be implemented as part of the works.
- ▶ Describe the equipment to be used in the work.
- ▶ Describe relevant codes / standards applicable to the work.
- ▶ Provide details on the training and qualifications of persons undertaken the work.

### 8.2 Site Access Control

All workers entering the Site are required to meet the applicable personal protective equipment (PPE) requirements. Access to the Site is permitted by the site manager only after persons entering the Site have been advised of the potential contamination hazards as described in **Section 5**.

Any authorised person accessing the Site shall do so in accordance with the environmental, health and safety requirements as indicated in this plan.

### 8.3 Hazard Controls

#### 8.3.1 Overview

All personnel working on the Site are to avoid contact with soil as it may be potentially contaminated and follow strict personal hygiene.

#### 8.3.2 Personal Protective Equipment (PPE)

All workers shall wear the following personal protective equipment if in direct contact with potentially contaminated soil:

- ▶ Steel capped boots.
- ▶ High visibility vest.
- ▶ Long sleeve shirt.
- ▶ Long pants.
- ▶ Chemical and water resistant gloves.
- ▶ Dust masks if exposure to dust is likely.



### **8.3.3 Personal Hygiene**

All workers on the Site shall observe the following personal hygiene rules:

- ▶ Heavily soiled clothing shall be removed before leaving the Site and cleaned or laundered separately. Consider the use of disposable overalls if heavy soiling is likely.
- ▶ Good hygiene facilities and practices will minimise additional employee exposure to potential contaminants via ingestion or inhalation, and prevent potential contamination of workers' vehicles and homes.
- ▶ Hand-washing facilities shall be used to wash hands and face hands prior to eating, drinking or smoking.
- ▶ Eating facilities shall be clean and accessible areas for employees and subcontractors. The work area should not be used as eating areas.

### **8.3.4 Training and certification**

The Site Manager shall ensure that awareness training is undertaken prior to any works being undertaken at the Site which disturb or result in contact with potentially contaminated soil.

The Site Manager must keep a record of the training undertaken.

## **8.4 Management of Subcontractors**

Subcontractors working on-site will be required to adopt the provisions of this plan and will be advised of potential safety and environmental issues on site during site-specific induction training. This induction will include the occupational health and safety responsibilities, requirements and controls for all subcontractors working on site. All subcontractor activities will be monitored by the Site Manager to ensure compliance with the requirements of this plan.

Contractors and subcontractors whose work will be performed on-site, or who otherwise could be exposed to health and safety hazards, will be advised of known hazards through distribution of site information contained in this plan.

They shall be solely responsible for the health and safety of their employees and shall comply with all applicable laws and regulations.

### **8.4.1 Incident Management and Emergency Response**

The Site Manager is to ensure proper coordination of incident and emergency response systems.

A written Incident Report Form must be completed for any incident or near-miss which may have resulted in an injury. Incident Report Forms are to be completed by the Site Manager within 24 hours of becoming aware of the incident.

### **8.4.2 Incident Response**

Once a safety issue or incident is brought to the attention of the Site Manager, the Site Manager will:

1. Order all work to cease immediately.



2. Attempt to contain the situation and administer first aid (if appropriate).
3. Seek any medical help as required.
4. Notify any necessary agencies.

The site safety representative will report environmental or OH&S incidents in an Incident Form which is to be completed detailing corrective and preventative actions taken.

Any non-conformance issues shall be corrected to the satisfaction of the Site Manager prior to work continuing.



## 9. Revision of EMP

This EMP is a "working" document, and will be modified or updated as required by Rail Corp to reflect changing environmental conditions and / or incidents. This will ensure that the EMP remains effective in mitigating the potential environmental impacts on the Site.

As outlined in **Section 1**, environmental investigations to assess contamination in soils at the Site did not identify contamination. However, if different subsurface conditions, staining, odours or suspected contamination is observed during works, Rail Corp should cease work in that area and assess the potential for contamination. In this instance, it may be necessary to revise the EMP to reflect the results from further investigation works. It may also from time to time be necessary to revise the EMP to reflect changes to legislation, changes on site and / or improvements in technologies or knowledge.

Revision of the EMP should be undertaken by suitable qualified or experienced persons or organisations on behalf of Rail Corp.

All revisions of the document should be tracked through an appropriate document control system. The copies of the revised EMP should be distributed to the current stakeholders in the site for ongoing implementation.



## 10. References

ANZECC (2000), "National Water Quality Management Strategy, Paper No. 4, Australian and New Zealand Guidelines for Fresh and Marine Water Quality", October 2000, Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ).

GHD 2011: *Cardiff Railway Station Accessibility Upgrade In-situ Waste Classification*, 13 July 2011.

NSW DEC 2006: "*Guidelines for the NSW Site Auditor Scheme (2<sup>nd</sup> edition)*", NSW DEC, April 2006.

NSW DECCW 2009 "*Waste Classification Guidelines, Part 1: Classifying Waste* ", NSW DECCW, December 2009.

NSW DECC (2009), "*Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997*".

NSW EPA 1994: "*Guidelines for Assessing Service Station Sites*", NSW EPA, 1994.

NSW EPA 1995: "*Sampling Design Guidelines*", NSW EPA, 1995.

NSW EPA 1997: "*Guidelines for Consultants Reporting on Contaminated Sites*", NSW EPA, 1997.

NEPC 1999, National Environment Protection (Assessment of Site Contamination) Measure (NEPM), 1999.



## 11. Limitations

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- were limited to those specifically detailed in section 1 of this Report and GHD proposal dated 20 May 2011 document number 164543; and*
- were undertaken in accordance with current profession practice and by reference to relevant environmental regulatory authority and industry standards, guidelines and assessment criteria in existence as at the date of this Report.*

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*Subsurface conditions can vary across a particular site and cannot be exhaustively defined by the investigations carried out prior to this Report. As a result, it is unlikely that the results and estimations expressed or used to compile this Report will represent conditions at any location other than the specific points of sampling. A site that appears to be unaffected by contamination at the time of the Report may later, due to natural causes or human intervention, become contaminated.*

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## Appendix A Figures





## Appendix B Regulatory Requirements



All references to Acts, Regulations and Guidelines are current as of the time of preparation of this EMP. These should be checked and updated as required, and the intent of the EMP is to require reference to Acts, Regulations and Guidelines current at the time of use.

***Protection of the Environment Operations Act 1997 (POEO Act)***

The POEO Act aims to protect, restore and enhance the quality of the environment. Under the Act, it is an offence to pollute the environment. The Act has consolidated several pieces of previous environmental legislation. The Act administers a number of related regulations, and also controls the transport and disposal of wastes.

***Contaminated Land Management Act 1997 (CLM Act)***

The CLM Act controls the assessment of contamination and requirement of remediation of soils and groundwater. The act also allows for accreditation of Site Auditors.

***Water Act 1912 and Water Management Act 2000***

These Acts include requirements for licensing and approval for groundwater extraction.

***Waste Avoidance and Resource Recovery Act 2001 (WARR Act)***

The WARR Act replaced the *Waste Minimisation and Management Act 1995* and controls waste generation and waste reduction.

***Environmentally Hazardous Chemicals Act 1985 (EHC Act)***

The EHC Act contains guidance for waste classification and disposal of some waste types. It also provides for the licensing of related activities.

***Protection of the Environment Amendment (Scheduled Activities and Waste) Regulation 2008***

This regulation contains general environmental obligations for waste activities, waste facilities and waste transporters, and special provisions relating to matters such as contaminant immobilisation approvals and the management of particular wastes (including asbestos waste).

***State Environmental Planning Policy (SEPP) 55 'Remediation of Land'***

SEPP 55 relates to the decision making process in undertaking remediation of land and making planning decisions in regard to contaminated and potentially contaminated land. SEPP 55 includes requirements for notification of remediation works.

***NSW DECC Waste Classification Guidelines 2009***

Provides practical guidance in the relevant requirements of the POEO Act and the Waste Regulations.

***ANZECC/ARMCANZ Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000***

Sets water quality guidelines for discharges into fresh and marine water resources.



***Lake Macquarie City Council – Policy for Managing Contaminated or Potentially Contaminated Land in Lake Macquarie, Version 02, 2010***

Provides a framework to assist Council, residents and proponents of current and proposed development to respond positively and proactively to contaminated land based hazards and risks, both past and present.

***Lake Macquarie City Council – Lake Macquarie City Development Control Plan No. 1, Principals of Development, Revision 06, 2011.***

Sets guidelines for the management of contaminated land and remediation works. Sets guidelines for determining level of statutory approvals required for remediation works.

***National Environment Protection (Assessment of Site Contamination) Measure 1999***

Sets guidelines for the assessment of land contamination. Includes recommended soil and groundwater assessment criteria for a variety of land uses.

***Occupational Health and Safety Act, 2000***

The overarching Act for NSW setting law relating to employee health and safety and employer responsibilities.

***Occupational Health and Safety Regulation, 2001***

Sets Regulations and details the duties for employers to achieve required employee health and safety performance.

***Asbestos - Code Of Practice For The Management and Control Of Asbestos In The Workplace [NOHSC: 2018 (2005)]***

This national code of practice has been developed to assist persons with control of premises and/or plant to control the risks of asbestos-containing materials (ACM) in workplaces. It sets out the steps to be taken to eliminate or otherwise minimise the risks of exposure to airborne asbestos fibres, including the identification of ACM, risk assessments and the implementation of control measures. The objective of these measures is to prevent workplace exposure to airborne asbestos fibres and thereby reduce the incidence of asbestos-related diseases such as mesothelioma, asbestosis and lung cancer.

***Code of Practice for the Safe Removal of Asbestos [NOHSC:2002(2005)]***

Outlines the basic principles for the safe removal of asbestos-based materials and is aimed at minimising or eliminating the concentration of airborne asbestos fibres.

***Working with Asbestos - Guide, WorkCover NSW, 2008***

Provides specific directions for the safe handling and removal of asbestos-based materials.

***Polychlorinated biphenyl (PCB) chemical control order 1997***

Provides specific requirements for the management control, storage, transport and disposal of PCB containing materials and waste.



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**Document Status**

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	K. Douglas-Hill	J. Hallchurch		Lee Gedge		22/7/2011



**REPORT**

**TO**

**CALDIS COOK GROUP**

**ON**

**GEOTECHNICAL ASSESSMENT**

**FOR**

**PROPOSED EASY ACCESS**

**AT**

**CARDIFF RAILWAY STATION, MAIN ROAD, CARDIFF,**

**NSW**

**10 March 2008**

**Ref:21820ZRrpt**

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**FIGURE 1: GEOTECHNICAL SITE PLAN**

**FIGURE 2: GEOTECHNICAL MAPPING SYMBOLS**

**PLATES 1 TO 5: PHOTOGRAPHIC PLATES**

**APPENDIX A: LANDSLIDE RISK MANAGEMENT TERMINOLOGY**

**REPORT EXPLANATION NOTES**



## **1 INTRODUCTION**

This report presents the results of our geotechnical assessment of the existing railway cuttings and existing retaining wall within the station platform area and car park area at Cardiff Station, Main Road, Cardiff, NSW. The assessment was commissioned by Mr Stephen Caldis (Caldis Cook Group) in a letter dated 11 December 2007 in accordance with our proposal (Ref: P14663ZA) dated 18 September 2007.

We understand that it is proposed to construct an 'Easy Access' to the existing station together with an upgrade of the existing car parking areas. Based on provided undated architectural drawings (DWG. No. SK-01 Sheets 1 to 3, DWG. No. SK-02 Sheets 1 & 2 and DWG. No. SK-03 Sheets 1 & 2) prepared by Caldis Cook Group, we understand that three options are being considered:

### ***Option 1***

A new lift to be provided at the northern end of the station platform; extension of the northern end of the platform (8.2m additional length) will be required. A new canopy over the southern end of the platform will be constructed. The footpath adjacent to the eastern end of the footbridge will be regraded.

### ***Option 2***

A new lift to be provided at the northern end of the station platform; extension of the northern end of the platform (46m additional length) will be required. There may also be an additional lift located at the western end of the footbridge. A new canopy over the southern end of the platform and the footbridge will be constructed.

### ***Option 3***

A new lift to be provided at the northern end of the station platform; extension of the northern end of the platform (8.2m additional length) will be required. The footbridge would also be extended to the west and a new lift provided at the



western end of the footbridge extension. A new canopy over the platform and the footbridge will be constructed.

Based on discussions with Mr Stephen Caldis (Caldis Cook Group) and Mr Greg Simpson (Hughes Trueman) we also understand that Railcorp have raised concerns regarding the stability of an existing retaining wall lining the eastern side of the lower station car park; recent collapse of a section of the retaining wall has occurred. We understand that Railcorp are considering stabilisation of this wall. However, only the architectural drawings for Option 1 make mention of this likely aspect of the works.

Based on discussions with Mr Neil Morris (Caldis Cook Group) we understand that consideration is being given to re-configuration of the existing car parks. However, details have yet to be finalised with Railcorp and as such no comments are provided in this report.

The purpose of the assessment was to assess the existing stability of the car park retaining wall and cut slopes within the station platform area, assess the need and scope of stabilisation measures to improve stability of the retaining wall and provide preliminary comments and recommendations regarding geotechnical issues relating to the proposed 'Easy Access' options.

## **2 ASSESSMENT PROCEDURE**

The subject site comprised the eastern and western sides of the Cardiff Railway Station platform cutting, which extends to the south from the Main Road overbridge, together with the car park areas to the west of the station.

An Associate carried out the assessment on 10 January 2008. The assessment was completed from the Main Road overbridge, existing pedestrian overbridge and car



park areas and included a detailed inspection of the topographic, surface drainage and geological conditions of the site and its immediate environs.

Any identified potentially unstable features were compared to those of other similar lots in neighbouring locations to provide a comparative basis for assessing the risk of instability affecting the site. The attached Appendix A defines the terminology adopted for the risk assessment together with a flow chart illustrating the Risk Management Process based on the guidelines given in AGS 2007 (Reference 1).

A summary of our observations and assessment of likely subsurface conditions is presented in Section 3 below. Our comments regarding risk levels with regard to the existing retaining walls and railway cut slopes are provided in Section 4. Our specific recommendations regarding proposed retaining wall stabilisation measures and the geotechnical aspects of the proposed 'Easy Access' options are discussed in Sections 5.1 and 5.2, respectively.

The attached Figure 1 presents a geotechnical sketch plan of the site showing the principal geotechnical features present at the site. Figure 1 is based on the provided survey plans (Drawing No's 3534-01-B to 3534-06-B, dated 25 September 2007) prepared by Meadows Consulting Pty Ltd, supplemented with hand held tape and measuring wheel measurements, inclinometer and compass techniques. Should any of the features be critical to the proposed development, we recommend they be located more accurately using instrument survey techniques. Figure 2 presents an explanation of geotechnical mapping symbols. Plates 1 to 5 provide a photographic record of the site and are presented in the attached photographic portfolio.



### **3 RESULTS OF ASSESSMENT**

#### **3.1 Summary of Observations**

We recommend that the summary of observations which follows be read in conjunction with the attached Figure 1, and the attached photographic portfolio (Plates 1 to 5). For descriptive purposes the railway line has been assumed to be orientated north-south.

The site is located on a hillside that generally slopes down to the west at between approximately 10° and 15°. For ease of description the site has been sub-divided into two sections; the railway station cutting and the car park areas.

#### **Railway Station Cutting**

Where a track kilometrage has been referenced below, it has been referenced as follows: track kilometrage 154.910km has been presented as 154.910km. The track kilometrage has been estimated from the OHWS locations indicated on the provided survey plans.

- The railway cutting within the subject site was about 170m long, extending to the south from the Main Road overbridge (154.83km) to 155.00km. The base of the cutting was a maximum of about 20m wide and contained a station platform structure (about 135m long) and two tracks supported on a railway ballast subgrade. At approximately 154.86km, a concrete footbridge extended over the northern end of the station platform from Main Road west to the upper car park. With regard to the station platform, we note the following additional features:
  - The bitumen surfaced platform was supported by brick walls (about 1m high). Due to OH&S access restrictions, close observation of the condition of the walls was not possible. The platform bitumen



surfacing was uneven and contained a number of longitudinal cracks (maximum 10mm wide); some crack repairs were evident.

- The concrete panel office and steel frame awnings located along the platform appeared to be in reasonably good condition.
- Over the length of the subject site, the downside cut face sloped down to the west at about 45° with a maximum vertical height of about 10m. Generally, the cut face was thickly vegetated although towards the northern end of the cut face (in particular below the Main Road overbridge) weathered conglomerate bedrock was revealed. Over the downside cut face, we note the following specific features:
  - Close to the crest of the cut slope in the vicinity of 154.90km, an old fenceline comprising what appeared to be old steel rail lines was misaligned and leaning over to the west.
  - The vegetated cut slope face south of the footbridge appeared to be uneven and contained intermittent sub-vertical faces (about 1m maximum height). Further, the slope face appeared to be slightly concave.
  - Below the footbridge what appeared to be a wash-out feature was located at the toe of the cut slope. The wash-out was about 3m long, 1.5m wide, a maximum of about 0.5m deep and revealed weathered conglomerate bedrock.
  - Below the Main Road overbridge, the cut slope face revealed weathered conglomerate bedrock which contained a near surface slump feature approximately 4m long, 3m wide and about 0.5m deep. Immediately to the north of this eroded portion of the cut face a concrete surface had been provided over the lower portion of the cut slope.



- At the northern end of the subject site, the upside cut face sloped down to the east at about 45°. However, south of the footbridge, the cut face sloped down to the east at a maximum of about 15°. The cut face attained a maximum vertical height of about 3m at the northern end of the site and reduced to 0m by about 154.91km. Over the upside cut face, we note the following specific features:
  - Below the Main Road overbridge, the cut slope face revealed weathered conglomerate bedrock which contained a number of erosion rills which extended back under the base of the concrete edge to the asphaltic concrete (AC) paved pathway leading under the overbridge.
  - From approximately 154.825km a concrete crib wall about 15m long and 2.5m maximum height lined the toe of the cut slope and supported the above mentioned AC pathway. Based on observations from the footbridge, the crib wall appeared to be in reasonably good condition although occasional cracked and displaced cribs were noted towards the crest and base of the wall.
  - South of the crib wall, the concave cut slope was thickly vegetated. The upper sub-vertical portion of the cut slope (about 05m high) revealed weathered conglomerate bedrock.

### **Car Park Areas**

The chainages provided below are indicated on the attached Figure 1 and are based on site measurements and do not relate to the track kilometrage referenced above. The car parks comprised an upper area accessed from Main Road and which lined the western margin of the upside track and a lower area accessed from Mary Street.

### **Upper Car Park**

The entry into the upper car park sloped down to the south at a maximum of about 15°. West from the car park entry a concrete paved footpath extended downslope and



lined a vegetated surface that sloped down to the south at a maximum of about 35° to the crest of a crib wall below. The crib wall is described in more detail below. The concrete footpath was in poor condition with vertical displacements across construction joints of the order of 50mm; the fence lining the crest of the slope was also visibly leaning over to the south.

Below the eastern side of the entry an existing cut face sloped down to the east at about 45°. The cut face revealed weathered conglomerate which contained a number of erosion rills. The AC surface lining the western side of the upper car park entry comprised a raised edge (about 0.1m high). Below the edge of the AC surface, a grassed surface sloped down to the south at a maximum of about 35°. However, close to the edge of the AC surface, the upper portion of the slope was sparsely vegetated and the natural soil surface was eroded revealing the edge and underside of the AC surface. The grass surfaced slope extended down to the crest of the sandstone block wall and concrete crib wall which lined the eastern and north-eastern edge of the lower car park; the walls are described in more detail below. The grassed slope was a maximum of about 1.5m vertical height (about chainage 60m).

The remainder of the upper AC paved car park was generally flat and contained occasional hairline to 5mm wide cracks. A flat grass surfaced area extended beyond the southern end of the paved car park. The site surface to the east of the flat portion of car park was vegetated, at a similar surface level and extended to the ballast surface of the railway line.

The western side of the flat portion of the upper paved car park was lined by a concave vegetated slope that extended down to the crest of the sandstone block retaining wall lining the eastern side of the lower car park (chainage 0m to 60m). Between about chainage 25m and 30m, the upper approximately 0.2m of the slope



was sub-vertical with signs of erosion of the soil surface. The sandstone block wall is described in more detail below.

For a distance of about 50m to the south of chainage 0m, the paved car park surface extended to the fenceline. The western side of this remaining portion of paved car park and the flat grass surfaced portion of the site to the south comprised a stepped vegetated slope of maximum 2m vertical height with an overall slope down to the west of a maximum of about 30°. Neighbouring gently sloping grass surfaced rear yards of residences extended west from the toe of the slope. We note that the slope was thickly vegetated and observations were therefore limited.

The fenceline lining the western side of the upper car park was leaning over to the west.

#### ***Lower Car Park***

The AC paved car park surface sloped down to the west at a maximum of about 10° with vegetated verge and planter bed areas lined by concrete kerbs. Based on a cursory inspection the paved car park surface was in a reasonable condition with some cracking and signs of localised surface repair evident. Hairline to 10mm cracking was recorded within the concrete kerbing.

Site surfaces were generally similar over the western (Mary Street) frontage of the car park and the southern side of the car park; a neighbouring yard area lined the southern site boundary. However, the eastern and northern sides of the car park were lined by a sandstone block wall and concrete crib wall. The walls extended over a length of approximately 85m (chainage 0m to 85m) and are described in more detail below:

Between chainage 0m and 60m the sub-vertical wall was of stacked sandstone block construction and was of maximum 2.5m vertical height. In some areas the wall face



sloped down to the west at between 60° and 70°. The blocks within the wall ranged between about 0.1m and 0.4m long, between 0.1m and 0.15m high and the wall was about 0.2m thick at the crest. The vegetated verge area at the toe of the wall was approximately 2m wide. In addition, we note the following specific features:

- Chainage 10m to 12m: the upper 0.5m of the wall had collapsed revealing sandy fill with gravel and cobble sized sandstone inclusions.
- Chainage 15m: a small tree was growing out of the wall face.
- Chainage 20m to 22m: the wall had collapsed over this section and at least 1m to the north and south the adjacent wall face was bulging. Voids of up to about 0.2m width were present behind the wall face and there was some evidence of sandstone rubble which may represent backfill or the remains of a previously collapsed wall. Behind the crest of the wall, the slope surface revealed natural clayey gravel.
- Chainage 22m to 25m: occasional cracks of up to 5mm width were recorded within the wall blocks.
- Chainage 28m to 31m: this section corresponded with the most recent area of reported wall collapse and which extended up the southern side of the concrete paved access steps. The section of wall at the toe of the steps had been re-stacked. However, the upper portion of the wall collapse had not been repaired and a sub-vertical face of maximum 2m vertical height revealed extremely weathered conglomerate bedrock. Some temporary timbers with steel 'star pickets' had been used to support the western edge of the AC paved car park surface at the top of the steps.



- Chainage 32m to 60m: the verge area contained occasional traces of rotting low height log walls. Occasional sandstone blocks believed to be derived from the wall face were present within the verge area. In addition, an intermittently buried 150mm diameter PVC pipe ran parallel to the toe of the wall. The side of the pipe also contained holes (about 50mm diameter). We assume the pipe discharges stormwater run-off although the pipeline was unable to be traced beyond the wall toe area.

Beyond chainage 60m, the retaining wall was of variable construction as described below:

- Chainage 60m to 62m: the interface between the stacked sandstone wall and the concrete crib wall comprised a stacked concrete block wall of about 2.5m to 3m vertical height. Within the concrete blocks occasional cracking up to 15mm width was recorded. The sloping backfill surface above the wall sloped down to the west at between about 25° and 30° and was about 2m vertical height. Trees were growing within the sloping surface above the blocks and through the concrete block wall.
- Between chainage 62m and 85m the sub-vertical wall generally comprised a concrete crib wall (maximum 3.6m vertical height) with concrete gravel and cobble sized rubble backfill. The top surface of what appeared to be a concrete footing was intermittently revealed at the verge surface and occasional concrete fragments assumed to be from the wall backfill were also present along the verge surface. Occasional concrete cribs were out of vertical alignment by a maximum of about 10mm.

From chainage 85m to 90m, the vegetated slope to the west of the crib wall sloped down to the south at a maximum of about 30° and extended beyond the concrete steps leading down from Main Road. Although observations were restricted by the



vegetation, there appeared to be a short length of sub-vertical rubble of maximum 2m vertical height.

### **3.2 Expected Subsurface Conditions**

Reference to the 1:250,000 geological map of Newcastle indicates that the site is underlain by Newcastle Coal Measures comprising a variable bedrock sequence that includes conglomerate, sandstone, tuff, shale and coal.

We note that we have been provided with a copy of a structural drawing (Drawing No. PTC 1170 - 2A, dated 22 March 1983) prepared by MacDonald Wagner & Priddle Pty Ltd. The drawing provides details of the footbridge structure which now spans over the station platform area and also includes the locations of three boreholes (BH2, BH5 and BH6) which were drilled in the vicinity of the proposed footbridge location. Summary borehole logs are also provided on the drawing. We also note that we have completed a recent investigation approximately 1km to the south-east of the station.

Based on a review of the provided borehole logs, the results of our recent nearby investigation and our site observations we provide below our assessment of expected subsurface conditions across the site.

#### ***Fill***

Sand and ash fill (maximum about 0.5m thick was encountered in the boreholes beneath the platform surface (BH2) and the upper car park paved surface (BH6). Within BH2, we have interpreted the clay layer beneath the sand and ash to comprise fill which extended to 1.1m depth. This would then indicate that the walls supporting the station platform also support fill which forms the station platform subgrade.



Within the upper car park area, BH6 then encountered clayey fill down to a depth of 1.9m. We note that some localised fill is likely to be encountered along the length of the western side of the upper car park. Based on our observations, the fill may well form at least the upper portion of sections of the sloping backfill surface above the stacked sandstone wall, particularly at the southern end.

### ***Residual Soils***

The three footbridge boreholes encountered residual soils comprising sandy or clayey gravel or clay with gravel inclusions and was interpreted as 'decomposed conglomerate' on the borehole logs. We concur with this assessment, although current soil description terminology would class the material as residual soil. The gravels have been assessed to be dense and the clay as hard. In BH2 and BH6, the residual soils were 0.6m and 2.1m thick, respectively over the station platform and upper car park area. BH5 indicated that the residual soils were at least 5.95m thick. BH5 and BH6 were terminated within the soil profile. The indicated thickness of the residual soil profile over the eastern side of the railway cutting (BH5) generally corresponds with our site observations; what appeared to be extremely weathered (XW) conglomerate and/or residual soils derived from conglomerate bedrock appeared to form the cut batter faces where vegetation was not present.

Our nearby investigation encountered residual soils of similar composition. However, we note the following:

- The cohesive (clayey) soils were assessed to be of medium to high plasticity and of variable strength; very soft to soft and very stiff. Laboratory testing indicated the clays to have a moderate potential for shrink-swell reactivity with changes in moisture content. A laboratory Standard compaction and four day soaked CBR test returned a CBR value of 2% for the clayey residual soil.
- The granular soils were assessed to be very loose.



### ***Bedrock***

In BH2 (station platform) conglomerate bedrock assessed to be extremely weathered and weak was encountered at 1.7m depth below the platform surface.

We note that our site observations within the site identified conglomerate bedrock which, where access was permissible was assessed to be extremely weathered and of extremely low strength. Near surface slumping of the conglomerate cut faces within the railway cutting are interpreted to indicate that the conglomerate revealed within the cut faces is generally XW and of extremely low strength. We also note that what was interpreted to be fine grained sandstone bands were also observed over sections of the eastern cut face.

Our boreholes drilled at the nearby site encountered an interbedded sequence of sandstone (0.3m to 1.5m thick) and conglomerate (0.2m to 2.5m thick). The bedrock was typically assessed to be slightly to distinctly weathered and of variable strength; low to high.

### ***Groundwater***

BH2 (station platform) was the only borehole to encounter groundwater. Seepage was noted at 1.3m depth, within the gravelly residual soils. No other groundwater observations were recorded.

## **4 STABILITY OF RETAINING WALLS, CUT SLOPES AND RISK ASSESSMENT**

### **4.1 Existing Retaining Walls**

The existing stacked sandstone retaining wall lining the eastern side of the lower car park is of limited thickness and appears to be a facing to a sub-vertical cut face through extremely weathered conglomerate bedrock. We note that the retained surface above the wall is moderately steep and based on the observed condition and



form of the wall we do not consider that it has been designed to support the additional surcharge of the sloping retained surface. Furthermore, there appears to be no evidence of formal drainage behind the wall or through the wall. However, we note that the stacked nature of the wall would allow some through-flow of water.

We understand from Railcorp representatives that the recent area of wall collapse (adjacent to the steps) occurred within the last 12 months. This and previous areas of collapse have occurred at night and the wall debris has extended into the car park area. Railcorp representatives also reported that stormwater run-off from the upper car park flows directly downslope and over the wall.

Based on our observations, the concrete crib wall appears to be performing satisfactorily. The crib wall has been assumed to be supporting a profile comprising possibly some localised fill, residual soils and extremely weathered conglomerate bedrock. The granular rubble backfill to the crib wall may be regarded as free draining however no other indications of behind wall drainage were observed. In this regard we assume that the wall has been engineer designed although we have not been provided with any design information. In addition, we assume that the wall has been designed to support the surcharge effects of the sloping retained surface above the wall.

We have no information regarding the retaining wall comprising a short length of stacked concrete blocks located at the interface between the crib wall and stacked sandstone wall. In addition, we have no information regarding the overgrown rubble to the west of the crib wall.

#### **4.2 Risk Assessment**

We note the contents of the "Geotechnical Problems Affecting Rail Operations – Risk Assessment and Hazard Management Guidelines", dated October 2005 prepared by



Railcorp which deals with the probability and consequences of potential geotechnical hazards affecting the rail track. However, as the area of potential wall instability will not affect the rail track, we have undertaken a preliminary geotechnical assessment of the risk of instability affecting the car park areas and persons within the car parks based on the methodology proposed by AGS 2007 (Reference 1) and our site observations. For comments relating to cut slope stability the rail track could be affected and therefore the Railcorp guidelines have been adopted.

#### **4.2.1 Car Park Retaining Walls**

The potential landslide hazards for the sloping area of the site between the upper and lower car parks are:

1. Collapse of the stacked sandstone wall.
2. Collapse of the stacked concrete block retaining wall and overgrown rubble wall.
3. Collapse of the concrete crib wall.
4. Erosion and near surface slumping of the sloping backfill surfaces above the retaining walls.

The following Table A summarises our preliminary assessment of risk to property for the above potential landslide hazards.



**TABLE A**  
**Preliminary Assessment of Risk to Property – Existing Conditions**

	<b>Potential Geotechnical Hazards</b>			
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
	<b>Collapse of stacked sandstone wall.</b>	<b>Collapse of stacked concrete block retaining wall &amp; overgrown rubble wall.</b>	<b>Collapse of concrete crib wall.</b>	<b>Erosion and near surface slumping of the sloping backfill surfaces above the retaining walls.</b>
<b>Likelihood</b>	Almost Certain	Possible	Unlikely	Almost Certain
<b>Consequences</b>	Medium – wall, parked vehicle Insignificant – car parks	Medium – wall, parked vehicle, upper car park entry Insignificant – lower car park	Medium – wall, parked vehicle, upper car park entry and footpath Insignificant – lower car park	Minor – wall, parked vehicle, upper car park entry and footpath Insignificant – lower car park
<b>Risk</b>	<b>Very High</b> – wall, parked vehicle. Moderate – car parks	Moderate – wall, parked vehicle and upper car park entry Very Low - lower car park	Low – wall, parked vehicle, upper car park entry and footpath Very Low - lower car park	<b>High</b> – wall, parked vehicle, upper car park entry and footpath Very Low - lower car park

In relation to the criteria given in the attached Reference 1, High and Very High risk levels may be regarded as 'unacceptable', Moderate risk levels may be regarded as 'tolerable' and low risk levels may be regarded as 'acceptable'.

We have also used the indicative annual probability associated with the assessed likelihood of Hazard 2 occurring to calculate the risk to life for users of the car park above and below the sloping area between the two car parks and people on the footpath above (including people entering the station and heading towards the footbridge). We have assumed:



- An average annual occupancy of ½ hour per day.
- A 4m length of wall or sloping backfill surface collapses.
- A 50% probability of evacuating the area if the collapse occurred.
- A 50% vulnerability to life for an individual if the collapse occurred.

These assumptions probably err towards the side of caution.

On this basis, under existing conditions, our calculated risk to life is as follows:

- For a person standing above or below the stacked sandstone wall would be about  $3.5 \times 10^{-5}$ .
- For a person standing above or below the stacked concrete block wall or overgrown rubble wall would be about  $5.2 \times 10^{-6}$ .
- For a person standing above or below the crib wall would be about  $8.3 \times 10^{-8}$ .
- For a person standing above or below the sloping retained surface would be about  $2.5 \times 10^{-5}$ .

The above levels of risk to life would be regarded as 'acceptable' in relation to the criteria given in the attached Reference 1.

With the recommendations in Section 5 fully implemented, risk to property would be reduced to 'acceptable' levels and the risk to life would remain at 'acceptable', but improved, levels. These recommendations form an integral part of the Landslide Risk Management (LRM) process.

#### **4.2.2 Railway Cut Slopes**

Table B (see below) has been completed using the Geotechnical Risk Assessment and Hazard Management Guidelines, dated October 2005 prepared by Railcorp and



summarises our qualitative assessment of each identified potential landslide hazard based on our observations. The potential landslide hazards are as follows:

- Near surface instability of cut slopes.
- Deep seated instability of cut slopes.
- Collapse of existing concrete crib wall.

**TABLE B**

**Railway Cut Slopes - Preliminary Assessment of Risk Under Existing Conditions**

Potential Geotechnical Hazard	Probability of Potential Geotechnical Hazard Occurring and Affecting Track	Consequences	Risk Category
Near surface instability of cut slopes	M	S	3 Priority 1
Deep seated instability of cut slopes	VL	E	4
Collapse of existing concrete crib wall	VL	MC	5

Table B indicates that the consequence to life and property (the train and rail infrastructure) typically varies between Extreme and Moderate. Based on our observations, it is clear that on-going degradation and near surface instability affects the cut slopes within the weathered conglomerate bedrock. However, fragments within the slip debris are relatively small (less than cobble or boulder size) and the mass of slump debris is expected to be of low volume. We have no information as to the frequency of slumps within the cut slopes and it would be beneficial to obtain information from Railcorp so as to refine the above preliminary risk assessment.



Further, Table B provides the risk category for each potential geotechnical hazard. This risk category can be used to outline the required inspection regime in accordance with the Railcorp Guidelines. Further advice on the scope of stabilisation measures is provided in Section 5.1.4 below.

#### **4.3 Additional Comments**

It is recognised that, due to the many complex factors that can affect a site, the subjective nature of a risk analysis, and the imprecise nature of the science of geotechnical engineering, the risk of instability for a site cannot be completely removed. It is, however, essential that risk be reduced to at least that which could be reasonably anticipated by the community in everyday life and that landowners be made aware of reasonable and practical measures available to reduce risk as far as possible. Hence, risk cannot be completely removed, only reduced, as removing risk is not currently scientifically achievable.

In preparing our recommendations given below we have assumed that no activities on surrounding land which may affect the risk on the subject site would be carried out. We have further assumed that all buried services within and surrounding the site are, and will be regularly maintained to remain, in good condition.

### **5 COMMENTS AND RECOMMENDATIONS**

#### **5.1 Stabilisation Measures**

To improve risk levels we recommend the following stabilisation measures be implemented:

1. Improve stormwater run-off drainage within the upper car park area.
2. Re-construction and/or strengthening of the stacked sandstone wall and concrete block wall.



3. Support/regrading of the sloping retained surface above the retaining walls.
4. Provide reinforced shotcrete supported by rock bolts to control the near surface instability of the railway cut slopes.

The geotechnical aspects of each of the above stabilisation measures are outlined below.

#### **5.1.1 Stormwater Drainage**

Currently, there appears to be little control of run-off from the upper car park discharging down over the sloping retained surface and the walls below. If not controlled, such run-off will continue to erode the soil profile above and behind the walls.

We recommend that a concrete kerb and/or dish drain be provided along the entire length of the eastern side of the upper car park, upper car park entry and the footpath leading down Main Road from the upper car park entry. The drainage line should discharge in a controlled manner to the stormwater system. Any discharge over the sloping retained surface or walls below must be via PVC pipes. The drainage measures should be designed by a hydraulic engineer.

#### **5.1.2 Wall Strengthening and/or Re-Construction**

##### ***Stacked Sandstone Wall***

As a minimum, the sections of stacked sandstone wall that have collapsed or are showing signs of distress should be replaced. The reader is referred to the following Section 5.2.4 which discusses the geotechnical aspects of proposed 'Easy Access 'Option 3' and its potential impact on this wall.

We understand that there are no heritage issues with regard to the sandstone wall and so similar construction techniques are not necessarily required; although similar



construction may be selected for aesthetic reasons. However, based on our observations, we do not consider that the current wall construction would comply with current design standards; this should be checked by a structural engineer.

In any event, the replaced sections of wall should be designed in accordance with the advice provided below.

To allow re-construction of the stacked sandstone wall, temporary excavation batters would need to be laid back to an angle of about 1 Vertical (V) in 1.5 Horizontal (H). However, such batters would potentially de-stabilise the sloping backfill surface above. This may be mitigated by provision of shotcrete and rock bolts (see Section 5.1.3, below). Otherwise, the temporary batters would need to be extended to the car park level above or steeper batters excavated and temporarily supported with raking props; construction in short panel lengths on a 'hit 1 miss 2' basis would likely be required to maintain temporary stability.

We note the above works would potentially impact on the lift locations and footbridge extension outlined for 'Easy Access' Options 2 and 3. Timing of the retaining wall stabilisation works and 'Easy Access' construction will therefore need to take these potential impacts into account.

The following characteristic earth pressure coefficients and subsoil parameters may be adopted for the design of re-constructed walls:

- The wall design may be based on a triangular lateral earth pressure distribution and an 'active' earth pressure coefficient,  $K_a$ , of 0.85, assuming a sloping retained surface of maximum 30°.
- A bulk unit weight of 20kN/m<sup>3</sup> should be adopted for the retained profile.



- Any surcharge (including construction traffic, compaction stresses etc) affecting the wall should be allowed in the design using a  $K_a$  value of 0.35.
- The walls should be designed as drained and provision made for permanent and effective drainage of the ground behind the walls. Subsurface drains should incorporate the non-woven geotextile fabric, such as Bidim A34, to act as a filter against subsoil erosion.
- Lateral toe restraint can be calculated using a triangular earth pressure distribution with a 'passive' earth pressure coefficient,  $K_p$ , of 3 (but with a factor of safety of at least 2 to limit deformations), assuming horizontal ground in front of the wall. The passive pressure due to the upper 0.5m below the adjacent verge surface should be ignored in the analysis to take account of possible buried services and excavation tolerances. Where the wall is socketted into bedrock, an allowable lateral stress of 200kPa may be adopted for toe restraint, assuming the rock surface is near horizontal in front of the wall.

We note that this would only improve the sections repaired and only over these sections would risk levels to property be regarded as 'acceptable'. Over the remaining lengths of stacked sandstone wall the risk levels would remain at 'unacceptable' levels. However, some improvement in the performance of the remaining lengths of the stacked sandstone wall could be provided by re-pointing the wall with mortar and providing weep holes through the base of the wall. These measures, together with control of run-off and some monitoring (as outlined below in section 5.1.5) would improve risk to property levels to at least 'tolerable' levels.

#### ***Stacked Concrete Block Wall and Overgrown Rubble Wall***

Assuming that there are no aesthetic concerns regarding the short length of stacked concrete block wall or overgrown rubble wall, these sections of wall could be strengthened using reinforced shotcrete supported by rock bolts with drainage behind the shotcrete.



Rock bolts would need to be installed in drill holes orientated at a downward angle of at least 15°. The bond length should be calculated beyond a theoretical failure plane projected up from the rear of the base of the existing wall at an angle of 35°. The rock bolts should be bonded into weathered conglomerate bedrock of at least low strength; an allowable bond strength of 100kPa may be assumed in their design.

Detailed design of such stabilisation measures is beyond the scope of this report. However, once the scope and extent of stabilisation measures has been agreed upon, further advice can be provided.

Alternatively, the walls could be replaced with an engineer designed sandstone wall or crib wall. Any of the above measures would improve risk to property to 'acceptable' levels. With only run-off from above controlled, the concrete block wall could be regularly monitored and this would improve risk to 'tolerable' levels.

### **5.1.3 Support/Regrading of Sloping Retained Surface**

The sloping retained surface should be protected from potential erosion by protection with reinforced shotcrete supported by rock bolts as outlined above. This would improve risk to property to 'acceptable' levels. However, we note that provided the stormwater run-off is controlled (Section 5.1.1, above) then additional planting with rapid growing vegetation together with regular monitoring would improve risk to 'tolerable' levels.

### **5.1.4 Stabilisation of Railway Cut Slopes**

The existing non-vegetated railway cut slopes close to the Main Road overbridge should be protected using reinforced shotcrete supported by rock bolts with drainage behind the shotcrete. Consideration could be given to extending this treatment over the entire length of the vegetated cut slope on the down side of the track but



extensive vegetation clearance would be required. At this stage, the vegetation appears to be providing stability to the near surface materials and monitoring by Railcorp is believed to be sufficient at this stage.

Detailed design of such stabilisation measures is beyond the scope of this report. However, once the extent of stabilisation measures has been agreed upon, further advice can be provided.

### **5.1.5 Monitoring**

Depending on the scope of stabilisation measures selected (as discussed above) then there may well be a need for periodic monitoring of the retaining walls lining the eastern and northern sides of the lower car park, the sloping retained surfaces and paved surfaces above the walls.

Periodic monitoring may be defined as visual inspections on an annual basis and after periods of heavy or prolonged rainfall. It is imperative that such inspections/monitoring be formally documented and that the required frequency of reporting (and to whom) is clearly defined. We would suggest that Railcorp carry out the inspections/monitoring and report to a nominated consulting engineer so that if there are any causes for concern, further advice can be provided. The need for any additional remediation can then be assessed.

With regard to monitoring the railway cut slopes, the required inspection regime should be completed in accordance with the Railcorp Guidelines for the assessed risk levels provided in Table B, above.



## **5.2 Preliminary Geotechnical Advice**

### **5.2.1 Overview**

We note that a preferred option for the 'Easy Access' works has not yet finalised and the geotechnical advice provided below is of a preliminary nature. More specific design advice can be provided once the final option has been selected and will likely need to be confirmed by geotechnical investigation and/or regular geotechnical inspections during construction.

### **5.2.2 Option 1**

#### ***New Lift***

The excavations for the new lift are expected to be of the order of 2m and will extend through fill, natural soils and probably weathered conglomerate bedrock. Temporary excavation batters of 1V in 1.5H (natural soil) and 1V in 1H (weathered bedrock) are likely to be appropriate. However, such batters have the potential to de-stabilise the northern end of the platform and possibly the footbridge footings. Care will therefore need to be exercised and appropriate propping of existing structures will be required.

The lift pit base is expected to be founded in weathered conglomerate bedrock and may be designed on the basis of an allowable bearing pressure of 800kPa, subject to geotechnical inspection.

The following characteristic earth pressure coefficients and subsoil parameters may be adopted for the design of lift pit walls:



- The wall design may be based on a triangular lateral earth pressure distribution and an 'at rest' earth pressure coefficient,  $K_a$ , of 0.55, assuming a horizontal retained surface.
- A bulk unit weight of  $20\text{kN/m}^3$  should be adopted for the retained profile.
- Any surcharge (including construction traffic, nearby footings, sloping backfill, compaction stresses etc) affecting the wall should be allowed in the design using the above earth pressure coefficient.
- The walls should either be designed for a hydrostatic pressure equivalent to the adjacent railway ballast surface or be designed as drained and provision made for permanent and effective drainage of the ground behind the walls; a sump and pump system would likely be required. Subsurface drains should incorporate the non-woven geotextile fabric, such as Bidim A34, to act as a filter against subsoil erosion.

### ***New Canopy***

If any new supports are required for the new platform canopy, we recommend that they be founded in bedrock. In order that no surcharge is transferred to the station platform walls the footings should also be founded below a theoretical zone of influence defined by a line projected up from the rear of the wall at an angle of  $45^\circ$ . Temporary excavation batters as outlined above for the lift pit are appropriate together with the warnings regarding potential de-stabilisation of nearby structures.

### ***Platform Extension***

The new station platform walls should be founded in weathered bedrock (using the above allowable bearing pressure) and founded below the invert levels of nearby drainage lines and/or buried service trenches.

If the station platform slab is suspended from the walls, then no backfilling will be required.



If the additional platform area is to be backfilled, the new walls will need to be designed to support the fill in accordance with the guidelines for the lift pit walls, assuming that the new platform slab props the station walls.

Prior to placing engineered fill the existing soil subgrade will need to be proof rolled as outlined below (Footpath Re-Grading section). However, the subgrade is likely to comprise railway ballast which will very likely be contaminated; such potentially contaminated material will need to be removed (see Section 6 for comments regarding classification of waste in accordance with Department of Environment & Conservation (NSW) guidelines).

We recommend that engineered fill comprise clean granular materials (such as recycled concrete or building rubble) with a maximum particle size of 40mm compacted to a minimum Density Index of 70%. Density testing should be regularly carried out on the fill to confirm the above specifications are achieved. We recommend at least Level 2 control of fill compaction as defined in AS3798. Preferably, the geotechnical testing authority should be engaged directly by the client rather than the earthworks subcontractor. Care will need to be exercised during fill compaction so as not to damage or de-stabilise the new platform walls, particularly when compacting under vibration. The vibration levels affecting the platform walls should be qualitatively monitored by site staff. If transmitted vibrations are considered excessive, proof rolling should be completed using the static mode with no vibration.

### ***Footpath Re-Grading***

Following re-grading of the footpath adjacent to the eastern end of the footbridge, the design subgrade surface should be proof rolled with a light roller (say 2 tonne) or a hand held vibrating plate compactor. The purpose of the proof rolling will be to improve the near surface compaction of the subgrade and detect any soft or



unstable areas which would need to be removed and replaced with engineered fill (as described above).

We note that the works would be carried out close to the crest of the railway cutting and there is the potential for localised instability of the upper portion of the cut slope. Care will need to be exercised during proof rolling. In addition, prior to works commencing, we recommend that the vegetation be cleared from this area of the cut slope and further geotechnical inspection carried out to check for any signs of slope instability. If there are stability concerns, then stabilisation measures such as shotcrete and rock bolts would likely be required.

Any potential surface run-off from the paved surface above the cut slope should be controlled and, all but prevented from discharging onto the cut slope as there is the potential for on-going erosion which may lead to cut slope instability.

### **5.2.3 Option 2**

#### ***New Lift***

For the new lift to be located at the northern end of the platform, the reader is referred to the comments provided for Option 1.

With regard to the possible location of the lift at the western end of the proposed footbridge extension, the lift pit base would need to be founded in weathered bedrock. Pile footings may need to be provided as weathered bedrock was not encountered over the depth of BH6 (5.8m). Bored piles would be suitable although there is the potential for collapse of the fill materials during pile boring and the use of temporary liners may be required. Bored piles would need to be witnessed by a geotechnical engineer as to confirm that bedrock has been penetrated.



### ***Footbridge Extension***

We recommend that the new extension to the footbridge is founded in bedrock and as outlined above for the new lift, bored piles would be required. We assume that the existing footbridge was founded in bedrock and this should be confirmed by Railcorp. If not, then additional settlement analyses will need to be undertaken to assess the affects of potential differential settlements, particularly if the extension is structurally connected to the existing footbridge.

### ***New Canopy***

See comments for Option 1.

### ***Platform Extension***

See comments for Option 1.

## **5.2.4 Option 3**

### ***New Lift***

For the new lift to be located at the northern end of the platform, the reader is referred to the comments provided for Option 1.

With regard to the possible location of the lift at the western end of the proposed footbridge extension, the lift pit base would need to be founded in weathered bedrock. We do not have any geotechnical information below the lower car park surface although we expect bedrock would be at shallow depth (say of the order of 2m). On this basis, the lift pit base could probably be constructed directly onto the bedrock surface, subject to geotechnical inspection. However, if bedrock is not encountered at shallow depth, then pile footings may be required and in this regard the comments provided for Option 2 apply.



With regard to the possible lift location at the western end of the proposed footbridge extension we also note the following:

Temporary excavations would extend below the stacked sandstone wall and there would be the potential for the existing wall to be de-stabilised. We note our previous comments regarding options for repair of the stacked sandstone wall. The selection of wall repair option should be made with due regard for the selected 'Easy Access' option. If Option 3 is selected, we would recommend that the sandstone wall be repaired following construction of the lift pit; some interim stabilisation option would need to be considered to control risk levels in the short term.

#### ***Footbridge Extension***

We recommend that the new extension to the footbridge is founded in bedrock and the reader is referred to the above comments regarding likely bedrock levels provided for the proposed new lift. We assume that the existing footbridge was founded in bedrock and this should be confirmed by Railcorp. If not, then additional settlement analyses will need to be undertaken to assess the affects of potential differential settlements, particularly if the extension is structurally connected to the existing footbridge.

#### ***New Canopy***

See comments for Option 1.

#### ***Platform Extension***

See comments for Option 1.



### **5.3 Further Geotechnical Work**

The following summarises the scope of further geotechnical work recommended within this report, for future detailed design development, construction documentation and construction stages. For specific details reference should be made to the relevant sections of this report.

- Specific detailed design advice on the selected wall stabilisation options and 'Easy Access' option.
- Subsurface investigations.
- Inspection of the railway cut slope beneath the regraded footpath (if selected).
- Inspection of footing and lift pit bases.
- Witnessing the drilling of bored piles.
- Witnessing construction of wall stabilisation measures.
- Proof rolling of exposed sub-grade.
- Qualitative vibration monitoring proof rolling and engineered fill compaction.
- Density testing of engineered fill.

## **6 GENERAL COMMENTS**

The recommendations presented in this report include specific issues to be addressed during the implementation of the proposed stabilisation measures. In the event that any of the recommendations presented in this report are not implemented, the general recommendations may become inapplicable and Jeffery and Katauskas Pty Ltd accept no responsibility whatsoever for the performance of the stabilisation measures where recommendations are not implemented in full and properly tested, inspected and documented.

It is possible that the subsurface soil, rock or groundwater conditions encountered during construction may be found to be different (or may be interpreted to be different) from those inferred from our surface observations in preparing this report.



Also, we have not had the opportunity to observe surface run-off patterns during heavy rainfall and cannot comment directly on this aspect. If conditions appear to be at variance or cause concern for any reason, then we recommend that you immediately contact this office.

This report provides advice on geotechnical aspects for the proposed civil and structural design. As part of the documentation stage of this project, Contract Documents and Specifications may be prepared based on our report. However, there may be design features we are not aware of or have not commented on for a variety of reasons. The designers should satisfy themselves that all the necessary advice has been obtained. If required, we could be commissioned to review the geotechnical aspects of contract documents to confirm the intent of our recommendations has been correctly implemented.

The offsite disposal of soil will most likely require classification in accordance with the Department of Environment & Conservation (NSW) guidelines as inert, solid, industrial or hazardous waste. We can complete the necessary classification and testing if you wish to commission us. As testing requires about seven days to complete, allowance should be made for such testing in the construction program unless testing is completed prior to construction. If contamination is found to be present then substantial further testing and delays should be expected. We strongly recommend this issue be addressed prior to commencement of excavation on site.

This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose. Copyright in this report is the property of Jeffery and Katauskas Pty Ltd. We have used a degree of care, skill and diligence normally exercised by consulting engineers in similar circumstances and locality. No other warranty expressed or implied is made or intended. Subject to payment of all fees



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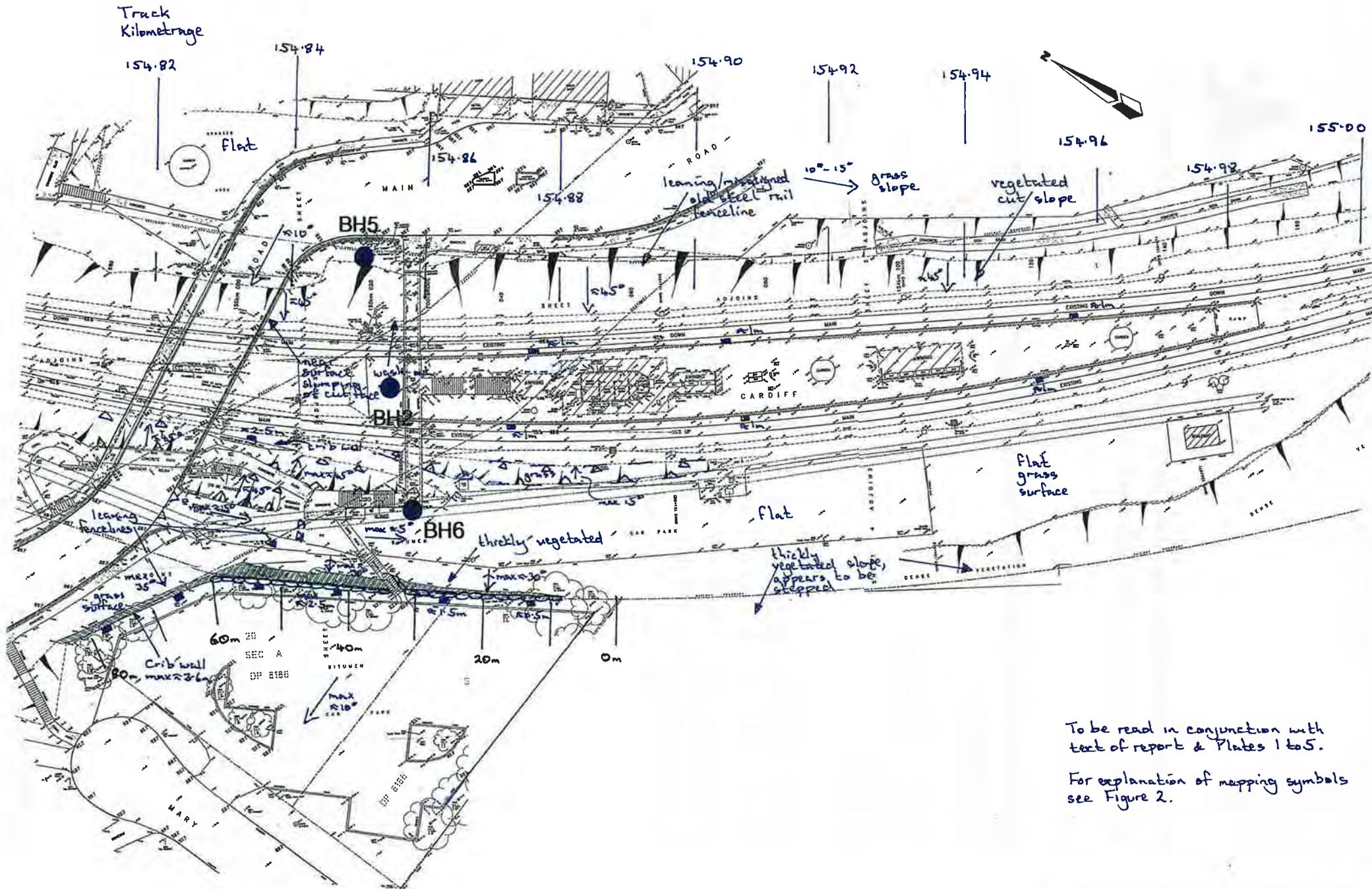
Should you have any queries regarding this report, please do not hesitate to contact  
the undersigned.

Paul Roberts  
Associate

Agi Zenon  
Senior Associate

For and on behalf of  
JEFFERY AND KATAUSKAS PTY LTD.

**Reference 1:** AGS (2007). *“Practice Note Guidelines For Landslide Risk Management 2007”*, prepared  
by Australian Geomechanics Society Landslide Taskforce, Landslide Practice Note Working Group,  
Australian Geomechanics, Vol 42, No 1, March 2007.



To be read in conjunction with text of report & Plates 1 to 5.

For explanation of mapping symbols see Figure 2.

**GEOTECHNICAL SITE PLAN**

# TOPOGRAPHY

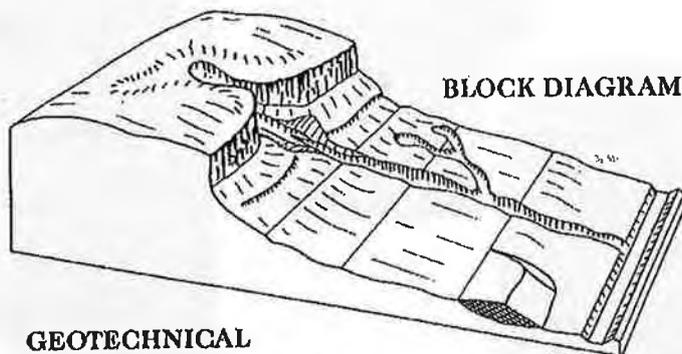
## Symbol Ground Profile

		convex	} well defined or angular break of slope
		concave	
		convex	} poorly defined or smooth change of slope
		concave	
		breaks of slope	} convex and concave too close together to allow the use of separate symbols
		changes of slope	
		sharp	} ridge crest
		rounded	
		Cliff or escarpment or sharp break 40° or more (estimated height in metres)	
		15 → Uniform Slope	} Slope direction and angle (Degrees)
		10 (→ Concave Slope	
		8 ) → Convex Slope	
		Top	} Cut or fill slope, arrows pointing down slope
		Bottom	
		Hummocky or irregular ground	

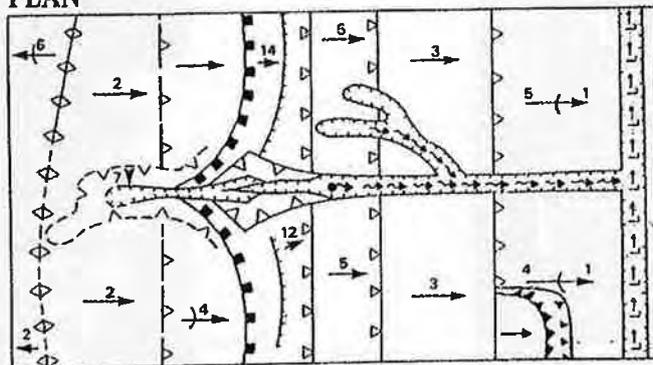
## OTHER FEATURES

	Boulder
	Seepage/spring
	Swallow hole for runoff
	Natural water course
	Open drain, unlined
	Open drain, lined
	Fence line
	Property boundary
	Dry Stone Wall
	J — J Major joint in rock face (opening in millimetres)
	- T - T - Tension crack (opening in millimetres)
	Masonry or concrete wall
	Ponding water
	Boggy or swampy area

## EXAMPLE OF USE OF TOPOGRAPHIC SYMBOLS:



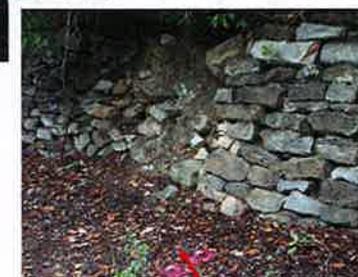
## GEOTECHNICAL PLAN



Chainage 60m



Chainage 30m



Chainage 85m



Chainage 0m



To be read in conjunction with text of report.



Chainage 60m



General view of upper carpark



Steps leading down to lower carpark (Chainage 31m)



Main Road



Footbridge (≈154.86km)

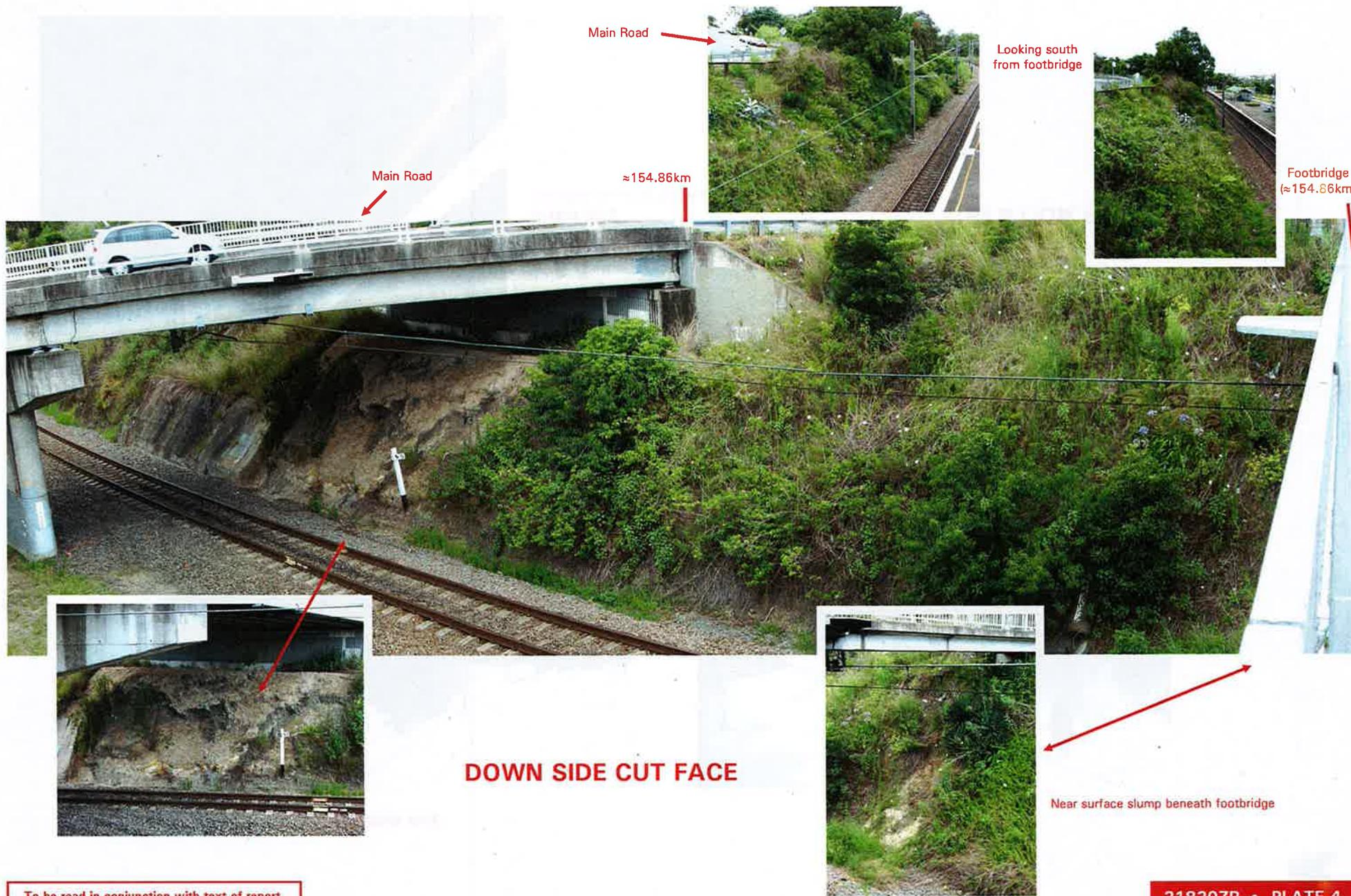


Upper carpark



To be read in conjunction with text of report.

UP SIDE CUT FACE



To be read in conjunction with text of report.



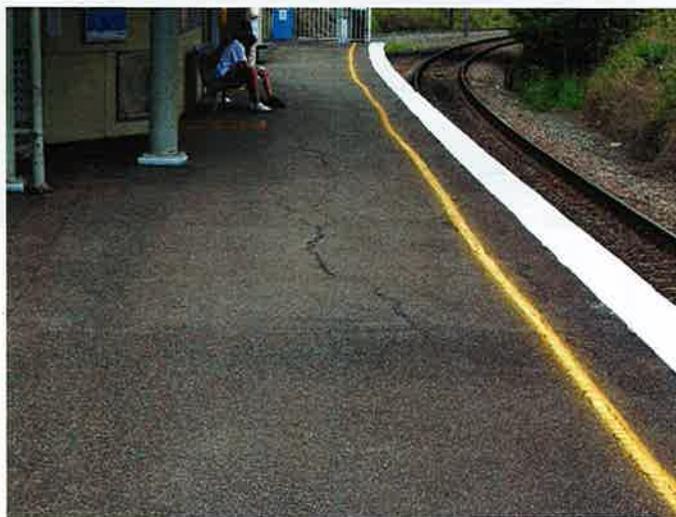
**DOWN SIDE**



**UP SIDE**



(Looking towards Newcastle)



**DOWN SIDE**  
(Looking towards Sydney)

## **GENERAL VIEWS OF STATION PLATFORM**

To be read in conjunction with text of report.



# **APPENDIX A**

## **LANDSLIDE RISK MANAGEMENT TERMINOLOGY**



## APPENDIX A

### LANDSLIDE RISK MANAGEMENT

#### DEFINITION OF TERMS

**Risk** – A measure of the probability and severity of an adverse effect to health, property or the environment.

Risk is often estimated by the product of probability x consequences. However, a more general interpretation of risk involves a comparison of the probability and consequences in a non-product form.

**Hazard** – A condition with the potential for causing an undesirable consequence (*the landslide*). The description of landslide hazard should include the location, volume (or area), classification and velocity of the potential landslides and any resultant detached material, and the likelihood of their occurrence within a given period of time.

**Elements at Risk** – Meaning the population, buildings and engineering works, economic activities, public services utilities, infrastructure and environmental features in the area potentially affected by landslides.

**Probability** – The likelihood of a specific outcome, measured by the ratio of specific outcomes to the total number of possible outcomes. Probability is expressed as a number between 0 and 1, with 0 indicating an impossible outcome, and 1 indicating that an outcome is certain.

**Frequency** – A measure of likelihood expressed as the number of occurrences of an event in a given time. See also Likelihood and Probability.

**Likelihood** – used as a qualitative description of probability or frequency.

**Temporal Probability** – The probability that the element at risk is in the area affected by the landsliding, at the time of the landslide.

**Vulnerability** – The degree of loss to a given element or set of elements within the area affected by the landslide hazard. It is expressed on a scale of 0 (no loss) to 1 (total loss). For property, the loss will be the value of the damage relative to the value of the property; for persons, it will be the probability that a particular life (the element at risk) will be lost, given the person(s) is affected by the landslide.

**Consequence** – The outcomes or potential outcomes arising from the occurrence of a landslide expressed qualitatively or quantitatively, in terms of loss, disadvantage or gain, damage, injury or loss of life.

**Risk Analysis** – The use of available information to estimate the risk to individuals or populations, property, or the environment, from hazards. Risk analyses generally contain the following steps: scope definition, hazard identification, and risk estimation.



**Risk Estimation** – The process used to produce a measure of the level of health, property, or environmental risks being analysed. Risk estimation contains the following steps: frequency analysis, consequence analysis, and their integration.

**Risk Evaluation** – The stage at which values and judgements enter the decision process, explicitly or implicitly, by including consideration of the importance of the estimated risks and the associated social, environmental, and economic consequences, in order to identify a range of alternatives for managing the risks.

**Risk Assessment** – The process of risk analysis and risk evaluation.

**Risk Control or Risk Treatment** – The process of decision making for managing risk, and the implementation, or enforcement of risk mitigation measures and the re-evaluation of its effectiveness from time to time, using the results of risk assessment as one input.

**Risk Management** – The complete process of risk assessment and risk control (*or risk treatment*).

**Individual Risk** – The risk of fatality or injury to any identifiable (named) individual who lives within the zone impacted by the landslide; or who follows a particular pattern of life that might subject him or her to the consequences of the landslide.

**Societal Risk** – The risk of multiple fatalities or injuries in society as a whole: one where society would have to carry the burden of a landslide causing a number of deaths, injuries, financial, environmental, and other losses.

**Acceptable Risk** – A risk for which, for the purposes of life or work, we are prepared to accept as it is with no regard to its management. Society does not generally consider expenditure in further reducing such risks justifiable.

**Tolerable Risk** – A risk that society is willing to live with so as to secure certain net benefits in the confidence that it is being properly controlled, kept under review and further reduced as and when possible.

In some situations risk may be tolerated because the individuals at risk cannot afford to reduce risk even though they recognise it is not properly controlled.

**Landslide Intensity** – A set of spatially distributed parameters related to the destructive power of a landslide. The parameters may be described quantitatively or qualitatively and may include maximum movement velocity, total displacement, differential displacement, depth of the moving mass, peak discharge per unit width, kinetic energy per unit area.

**Note:** Reference should also be made to Figure A1 which shows the inter-relationship of many of these terms and the relevant portion of Landslide Risk Management.

*Reference should also be made to the paper referenced below for Landslide Terminology and more detailed discussion of the above terminology.*



**TABLE A1: LANDSLIDE RISK ASSESSMENT  
QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY**

**Qualitative Measures of Likelihood**

Level	Descriptor	Description	Indicative Annual Probability
A	ALMOST CERTAIN	The event is expected to occur.	$> \approx 10^{-1}$
B	LIKELY	The event will probably occur under adverse conditions.	$\approx 10^{-2}$
C	POSSIBLE	The event could occur under adverse conditions.	$\approx 10^{-3}$
D	UNLIKELY	The event might occur under very adverse circumstances.	$\approx 10^{-4}$
E	RARE	The event is conceivable but only under exceptional circumstances.	$\approx 10^{-5}$
F	NOT CREDIBLE	The event is inconceivable or fanciful.	$< 10^{-6}$

**Note:** " $\approx$ " means that the indicative value may vary by say  $\pm 1/2$  order of magnitude, or more.

**Qualitative Measures of Consequences to Property**

Level	Descriptor	Description
1	CATASTROPHIC	Structure completely destroyed or large scale damage requiring major engineering works for stabilisation.
2	MAJOR	Extensive damage to most of structure, or extending beyond site boundaries requiring significant stabilisation works.
3	MEDIUM	Moderate damage to some of structure, or significant part of site requiring large stabilisation works.
4	MINOR	Limited damage to part of structure, or part of site requiring some reinstatement/stabilisation works.
5	INSIGNIFICANT	Little damage.

**Note:** The "Description" may be edited to suit a particular case.

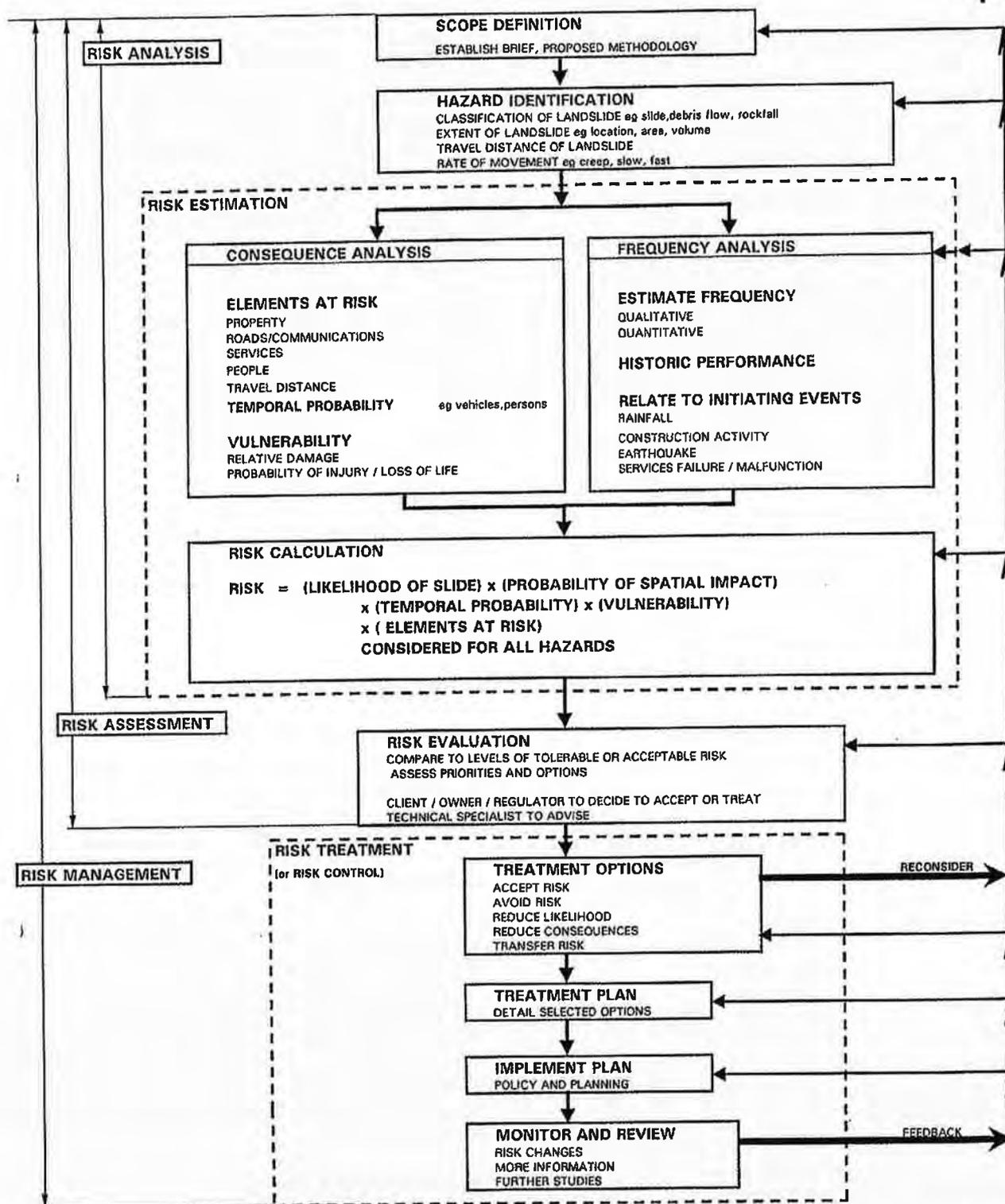
**Qualitative Risk Analysis Matrix – Level of Risk to Property**

LIKELIHOOD	CONSEQUENCES to PROPERTY				
	1: CATASTROPHIC	2: MAJOR	3: MEDIUM	4: MINOR	5: INSIGNIFICANT
A – ALMOST CERTAIN	VH	VH	H	H	M
B – LIKELY	VH	H	H	M	L-M
C – POSSIBLE	H	H	M	L-M	VL-L
D – UNLIKELY	M-H	M	L-M	VL-L	VL
E – RARE	M-L	L-M	VL-L	VL	VL
F – NOT CREDIBLE	VL	VL	VL	VL	VL

**Risk Level Implications**

Risk Level	Example Implications <sup>(1)</sup>
VH VERY HIGH RISK	Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to acceptable levels; may be too expensive and not practical.
H HIGH RISK	Detailed investigation, planning and implementation of treatment options required to reduce risk to acceptable levels.
M MODERATE RISK	Tolerable provided treatment plan is implemented to maintain or reduce risks. May be accepted. May require investigation and planning of treatment options.
L LOW RISK	Usually accepted. Treatment requirements and responsibility to be defined to maintain or reduce risk.
VL VERY LOW RISK	Acceptable. Manage by normal slope maintenance procedures.

- Note:** (1) The implications for a particular situation are to be determined by all parties to the risk assessment; these are only given as a general guide.  
 (2) Judicious use of dual descriptors for Likelihood, Consequence and Risk to reflect the uncertainty of the estimate may be appropriate in some cases.



**FIGURE A1: FLOWCHART FOR LANDSLIDE RISK MANAGEMENT**

This figure is an extract from LANDSLIDE RISK MANAGEMENT CONCEPTS AND GUIDELINES as presented in Australian Geomechanics Vol35, No1, 2000 which discusses the matter more fully.



## REPORT EXPLANATION NOTES

### INTRODUCTION

These notes have been provided to amplify the geotechnical report in regard to classification methods, field procedures and certain matters relating to the Comments and Recommendations section. Not all notes are necessarily relevant to all reports.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Geotechnical engineering involves gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and time when the investigation was carried out.

### DESCRIPTION AND CLASSIFICATION METHODS

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, the SAA Site Investigation Code. In general, descriptions cover the following properties – soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geotechnical practice.

Soil types are described according to the predominating particle size and behaviour as set out in the attached Unified Soil Classification Table qualified by the grading of other particles present (eg sandy clay) as set out below:

Soil Classification	Particle Size
Clay	less than 0.002mm
Silt	0.002 to 0.06mm
Sand	0.06 to 2mm
Gravel	2 to 60mm

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Test (SPT) as below:

Relative Density	SPT 'N' Value (blows/300mm)
Very loose	less than 4
Loose	4 – 10
Medium dense	10 – 30
Dense	30 – 50
Very Dense	greater than 50

Cohesive soils are classified on the basis of strength (consistency) either by use of hand penetrometer, laboratory testing or engineering examination. The strength terms are defined as follows.

Classification	Unconfined Compressive Strength kPa
Very Soft	less than 25
Soft	25 – 50
Firm	50 – 100
Stiff	100 – 200
Very Stiff	200 – 400
Hard	Greater than 400
Friable	Strength not attainable – soil crumbles

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc. Where relevant, further information regarding rock classification is given in the text of the report. In the Sydney Basin, 'Shale' is used to describe thinly bedded to laminated siltstone.

### SAMPLING

Sampling is carried out during drilling or from other excavations to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, moisture content, minor constituents and, depending upon the degree of disturbance, some information on strength and structure. Bulk samples are similar but of greater volume required for some test procedures.

Undisturbed samples are taken by pushing a thin-walled sample tube, usually 50mm diameter (known as a U50), into the soil and withdrawing it with a sample of the soil contained in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling used are given on the attached logs.

### INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application. All except test pits, hand auger drilling and portable dynamic cone penetrometers require the use of a mechanical drilling rig which is commonly mounted on a truck chassis.



**Test Pits:** These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for an excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

**Hand Auger Drilling:** A borehole of 50mm to 100mm diameter is advanced by manually operated equipment. Premature refusal of the hand augers can occur on a variety of materials such as hard clay, gravel or ironstone, and does not necessarily indicate rock level.

**Continuous Spiral Flight Augers:** The borehole is advanced using 75mm to 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and layers may become mixed. Information from the auger sampling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability due to mixing or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table is of even lesser reliability than augering above the water table.

**Rock Augering:** Use can be made of a Tungsten Carbide (TC) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock fragments. This method of investigation is quick and relatively inexpensive but provides only an indication of the likely rock strength and predicted values may be in error by a strength order. Where rock strengths may have a significant impact on construction feasibility or costs, then further investigation by means of cored boreholes may be warranted.

**Wash Boring:** The borehole is usually advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from "feel" and rate of penetration.

**Mud Stabilised Drilling:** Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilise the borehole. The term 'mud' encompasses a range of products ranging from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is only possible from intermittent intact sampling (eg from SPT and U50 samples) or from rock coring, etc.

**Continuous Core Drilling:** A continuous core sample is obtained using a diamond tipped core barrel. Provided full core recovery is achieved (which is not always possible in very low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, an NMLC triple tube core barrel, which gives a core of about 50mm diameter, is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as CORE LOSS. The location of losses are determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the top end of the drill run.

**Standard Penetration Tests:** Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils as a means of indicating density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" – Test F3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In the case where full penetration is obtained with successive blow counts for each 150mm of, say, 4, 6 and 7 blows, as

$$N = 13 \\ 4, 6, 7$$

- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm, as

$$N > 30 \\ 15, 30/40mm$$

The results of the test can be related empirically to the engineering properties of the soil.

Occasionally, the drop hammer is used to drive 50mm diameter thin walled sample tubes (U50) in clays. In such circumstances, the test results are shown on the borehole logs in brackets.

A modification to the SPT test is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the SPT. The results of this Solid Cone Penetration Test (SCPT) are shown as "N<sub>c</sub>" on the borehole logs, together with the number of blows per 150mm penetration.



**Static Cone Penetrometer Testing and Interpretation:** Cone penetrometer testing (sometimes referred to as a Dutch Cone) described in this report has been carried out using an Electronic Friction Cone Penetrometer (EFCP). The test is described in Australian Standard 1289, Test F5.1.

In the tests, a 35mm diameter rod with a conical tip is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the frictional resistance on a separate 134mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are electrically connected by wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) the information is output as incremental digital records every 10mm. The results given in this report have been plotted from the digital data.

The information provided on the charts comprise:

- Cone resistance – the actual end bearing force divided by the cross sectional area of the cone – expressed in MPa.
- Sleeve friction – the frictional force on the sleeve divided by the surface area – expressed in kPa.
- Friction ratio – the ratio of sleeve friction to cone resistance, expressed as a percentage.

The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and occasionally very soft clays, rising to 4% to 10% in stiff clays and peats. Soil descriptions based on cone resistance and friction ratios are only inferred and must not be considered as exact.

Correlations between EFCP and SPT values can be developed for both sands and clays but may be site specific.

Interpretation of EFCP values can be made to empirically derive modulus or compressibility values to allow calculation of foundation settlements.

Stratification can be inferred from the cone and friction traces and from experience and information from nearby boreholes etc. Where shown, this information is presented for general guidance, but must be regarded as interpretive. The test method provides a continuous profile of engineering properties but, where precise information on soil classification is required, direct drilling and sampling may be preferable.

**Portable Dynamic Cone Penetrometers:** Portable Dynamic Cone Penetrometer (DCP) tests are carried out by driving a rod into the ground with a sliding hammer and counting the blows for successive 100mm increments of penetration.

Two relatively similar tests are used:

- Cone penetrometer (commonly known as the Scala Penetrometer) – a 16mm rod with a 20mm diameter cone end is driven with a 9kg hammer dropping 510mm (AS1289, Test F3.2). The test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various Road Authorities.
- Perth sand penetrometer – a 16mm diameter flat ended rod is driven with a 9kg hammer, dropping 600mm (AS1289, Test F3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.

## LOGS

The borehole or test pit logs presented herein are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on the frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will enable the most reliable assessment, but is not always practicable or possible to justify on economic grounds. In any case, the boreholes or test pits represent only a very small sample of the total subsurface conditions.

The attached explanatory notes define the terms and symbols used in preparation of the logs.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than "straight line" variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

## GROUNDWATER

Where groundwater levels are measured in boreholes, there are several potential problems:

- Although groundwater may be present, in low permeability soils it may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes and may not be the same at the time of construction.
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must be washed out of the hole or 'reverted' chemically if water observations are to be made.



More reliable measurements can be made by installing standpipes which are read after stabilising at intervals ranging from several days to perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from perched water tables or surface water.

#### FILL

The presence of fill materials can often be determined only by the inclusion of foreign objects (eg bricks, steel etc) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably determine the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density, strength and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse engineering characteristics or behaviour. If the volume and quality of fill is of importance to a project, then frequent test pit excavations are preferable to boreholes.

#### LABORATORY TESTING

Laboratory testing is normally carried out in accordance with Australian Standard 1289 *'Methods of Testing Soil for Engineering Purposes'*. Details of the test procedure used are given on the individual report forms.

#### ENGINEERING REPORTS

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. a three storey building) the information and interpretation may not be relevant if the design proposal is changed (eg to a twenty storey building). If this happens, the company will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical aspects and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions – the potential for this will be partially dependent on borehole spacing and sampling frequency as well as investigation technique.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of persons or contractors responding to commercial pressures.

If these occur, the company will be pleased to assist with investigation or advice to resolve any problems occurring.

#### SITE ANOMALIES

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed that at some later stage, well after the event.

#### REPRODUCTION OF INFORMATION FOR CONTRACTUAL PURPOSES

Attention is drawn to the document *'Guidelines for the Provision of Geotechnical Information in Tender Documents'*, published by the Institution of Engineers, Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Copyright in all documents (such as drawings, borehole or test pit logs, reports and specifications) provided by the Company shall remain the property of Jeffery and Katauskas Pty Ltd. Subject to the payment of all fees due, the Client alone shall have a licence to use the documents provided for the sole purpose of completing the project to which they relate. License to use the documents may be revoked without notice if the Client is in breach of any objection to make a payment to us.

#### REVIEW OF DESIGN

Where major civil or structural developments are proposed or where only a limited investigation has been completed or where the geotechnical conditions/ constraints are quite complex, it is prudent to have a joint design review which involves a senior geotechnical engineer.

#### SITE INSPECTION

The company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related.

Requirements could range from:

- i) a site visit to confirm that conditions exposed are no worse than those interpreted, to
- ii) a visit to assist the contractor or other site personnel in identifying various soil/rock types such as appropriate footing or pier founding depths, or
- iii) full time engineering presence on site.

# GRAPHIC LOG SYMBOLS FOR SOILS AND ROCKS

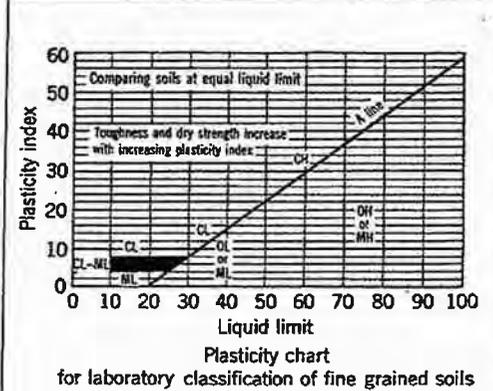
SOIL		ROCK		DEFECTS AND INCLUSIONS	
	FILL		CONGLOMERATE		CLAY SEAM
	TOPSOIL		SANDSTONE		SHEARED OR CRUSHED SEAM
	CLAY (CL, CH)		SHALE		BRECCIATED OR SHATTERED SEAM/ZONE
	SILT (ML, MH)		SILTSTONE, MUDSTONE, CLAYSTONE		IRONSTONE GRAVEL
	SAND (SP, SW)		LIMESTONE		ORGANIC MATERIAL
	GRAVEL (GP, GW)		PHYLLITE, SCHIST	<b>OTHER MATERIALS</b>	
	SANDY CLAY (CL, CH)		TUFF		CONCRETE
	SILTY CLAY (CL, CH)		GRANITE, GABBRO		BITUMINOUS CONCRETE, COAL
	CLAYEY SAND (SC)		DOLERITE, DIORITE		COLLUVIUM
	SILTY SAND (SM)		BASALT, ANDESITE		
	GRAVELLY CLAY (CL, CH)		QUARTZITE		
	CLAYEY GRAVEL (GC)				
	SANDY SILT (ML)				
	PEAT AND ORGANIC SOILS				



# UNIFIED SOIL CLASSIFICATION TABLE

Field Identification Procedures (Excluding particles larger than 75 µm and basing fractions on estimated weights)		Group Symbols	Typical Names	Information Required for Describing Soils	Laboratory Classification Criteria		
Coarse-grained soils More than half of material is larger than 75 µm sieve size	Gravels More than half of coarse fraction is larger than 4 mm sieve size	Clean gravels (little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	GW	Well graded gravels, gravel-sand mixtures, little or no fines	<p>Determine percentages of gravel and sand from grain size curve Depending on percentage of fines (fraction smaller than 75 µm sieve size) coarse grained soils are classified as follows: Less than 5% GW, GP, SP, SW More than 5% GM, GC, SM, SC Borderline cases requiring use of dual symbols</p> $C_U = \frac{D_{60}}{D_{10}} \text{ Greater than 4}$ $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} \text{ Between 1 and 3}$ <p>Not meeting all gradation requirements for GW</p> <p>Atterberg limits below "A" line, or PI less than 4</p> <p>Atterberg limits above "A" line, with PI greater than 7</p> <p>Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols</p> $C_U = \frac{D_{60}}{D_{10}} \text{ Greater than 6}$ $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} \text{ Between 1 and 3}$ <p>Not meeting all gradation requirements for SW</p> <p>Atterberg limits below "A" line or PI less than 5</p> <p>Atterberg limits below "A" line with PI greater than 7</p> <p>Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols</p>	
		Gravels with fines (appreciable amount of fines)	Predominantly one size or a range of sizes with some intermediate sizes missing	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines		
		Sands More than half of coarse fraction is smaller than 4 mm sieve size	Clean sands (little or no fines)	Nonplastic fines (for identification procedures see ML below)	GM		Silty gravels, poorly graded gravel-sand-silt mixtures
			Sands with fines (appreciable amount of fines)	Plastic fines (for identification procedures, see CL below)	GC		Clayey gravels, poorly graded gravel-sand-clay mixtures
	Sands More than half of coarse fraction is smaller than 4 mm sieve size	Clean sands (little or no fines)		Wide range in grain sizes and substantial amounts of all intermediate particle sizes	SW		Well graded sands, gravelly sands, little or no fines
			Predominantly one size or a range of sizes with some intermediate sizes missing	SP	Poorly graded sands, gravelly sands, little or no fines		
		Sands with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures, see ML below)	SM	Silty sands, poorly graded sand-silt mixtures		
			Plastic fines (for identification procedures, see CL below)	SC	Clayey sands, poorly graded sand-clay mixtures		
	Fine-grained soils More than half of material is smaller than 75 µm sieve size (The 75 µm sieve size is about the smallest particle visible to naked eye)	Identification Procedures on Fraction Smaller than 380 µm Sieve Size					
		Silt and clays liquid limit less than 50	Dry Strength (crushing characteristics)	Dilatancy (reaction to shaking)	Toughness (consistency near plastic limit)		ML
None to slight			Quick to slow	None	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
Medium to high			None to very slow	Medium	OL	Organic silts and organic silt-clays of low plasticity	
Slight to medium			Slow	Slight	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
Slight to medium			Slow to none	Slight to medium	CH	Inorganic clays of high plasticity, fat clays	
High to very high			None	High	OH	Organic clays of medium to high plasticity	
Silt and clays liquid limit greater than 50		Medium to high	None to very slow	Slight to medium			
		Highly Organic Soils	Readily identified by colour, odour, spongy feel and frequently by fibrous texture		Pt	Peat and other highly organic soils	

Use grain size curve in identifying the fractions as given under field identification



NOTE: 1) Soils possessing characteristics of two groups are designated by combinations of group symbols (e.g. GW-GC, well graded gravel-sand mixture with clay fines).

2) Soils with liquid limits of the order of 35 to 50 may be visually classified as being of medium plasticity.



## LOG SYMBOLS

LOG COLUMN	SYMBOL	DEFINITION												
Groundwater Record		Standing water level. Time delay following completion of drilling may be shown.												
		Extent of borehole collapse shortly after drilling.												
		Groundwater seepage into borehole or excavation noted during drilling or excavation.												
Samples	ES	Soil sample taken over depth indicated, for environmental analysis.												
	U50	Undisturbed 50mm diameter tube sample taken over depth indicated.												
	DB	Bulk disturbed sample taken over depth indicated.												
	DS	Small disturbed bag sample taken over depth indicated.												
	ASB	Soil sample taken over depth indicated, for asbestos screening.												
	ASS	Soil sample taken over depth indicated, for acid sulfate soil analysis.												
Field Tests	N = 17 4, 7, 10	Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'R' as noted below.												
	N <sub>c</sub> =	<table border="1"> <tr> <td>5</td> <td rowspan="3">Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60 degree solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.</td> </tr> <tr> <td>7</td> </tr> <tr> <td>3R</td> </tr> </table>	5	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60 degree solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.	7	3R								
	5	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60 degree solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.												
	7													
3R														
VNS = 25	Vane shear reading in kPa of Undrained Shear Strength.													
PID = 100	Photolionisation detector reading in ppm (Soil sample headspace test).													
Moisture Condition (Cohesive Soils)  (Cohesionless Soils)	MC > PL	Moisture content estimated to be greater than plastic limit.												
	MC ≈ PL	Moisture content estimated to be approximately equal to plastic limit.												
	MC < PL	Moisture content estimated to be less than plastic limit.												
	D	DRY - runs freely through fingers.												
	M	MOIST - does not run freely but no free water visible on soil surface.												
	W	WET - free water visible on soil surface.												
Strength (Consistency) Cohesive Soils	VS	VERY SOFT - Unconfined compressive strength less than 25kPa												
	S	SOFT - Unconfined compressive strength 25-50kPa												
	F	FIRM - Unconfined compressive strength 50-100kPa												
	St	STIFF - Unconfined compressive strength 100-200kPa												
	VSt	VERY STIFF - Unconfined compressive strength 200-400kPa												
	H	HARD - Unconfined compressive strength greater than 400kPa												
	( )	Bracketed symbol indicates estimated consistency based on tactile examination or other tests.												
Density Index/ Relative Density (Cohesionless Soils)		<table border="1"> <thead> <tr> <th>Density Index (I<sub>c</sub>) Range (%)</th> <th>SPT 'N' Value Range (Blows/300mm)</th> </tr> </thead> <tbody> <tr> <td>Very Loose &lt; 15</td> <td>0-4</td> </tr> <tr> <td>Loose 15-35</td> <td>4-10</td> </tr> <tr> <td>Medium Dense 35-65</td> <td>10-30</td> </tr> <tr> <td>Dense 65-85</td> <td>30-50</td> </tr> <tr> <td>Very Dense &gt; 85</td> <td>&gt; 50</td> </tr> </tbody> </table>	Density Index (I <sub>c</sub> ) Range (%)	SPT 'N' Value Range (Blows/300mm)	Very Loose < 15	0-4	Loose 15-35	4-10	Medium Dense 35-65	10-30	Dense 65-85	30-50	Very Dense > 85	> 50
	Density Index (I <sub>c</sub> ) Range (%)	SPT 'N' Value Range (Blows/300mm)												
	Very Loose < 15	0-4												
	Loose 15-35	4-10												
	Medium Dense 35-65	10-30												
	Dense 65-85	30-50												
Very Dense > 85	> 50													
VL	Very Loose													
L	Loose													
MD	Medium Dense													
D	Dense													
VD	Very Dense													
( )	Bracketed symbol indicates estimated density based on ease of drilling or other tests.													
Hand Penetrometer Readings	300	Numbers indicate individual test results in kPa on representative undisturbed material unless noted otherwise.												
	250													
Remarks	'V' bit	Hardened steel 'V' shaped bit.												
	'TC' bit	Tungsten carbide wing bit.												
	T 60	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.												

# Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS  
ABN 17 003 550 801



## LOG SYMBOLS

### ROCK MATERIAL WEATHERING CLASSIFICATION

TERM	SYMBOL	DEFINITION
Residual Soil	RS	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely weathered rock	XW	Rock is weathered to such an extent that it has "soil" properties, ie it either disintegrates or can be remoulded, in water.
Distinctly weathered rock	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by ironstaining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Slightly weathered rock	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh rock	FR	Rock shows no sign of decomposition or staining.

### ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index (Is 50) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by the International Journal of Rock Mechanics, Mining, Science and Geomechanics, Abstract Volume 22, No 2, 1985.

TERM	SYMBOL	Is (50) MPa	FIELD GUIDE
Extremely Low:	EL	0.03	Easily remoulded by hand to a material with soil properties.
Very Low:	VL	0.1	May be crumbled in the hand. Sandstone is "sugary" and friable.
Low:	L	0.3	A piece of core 150mm long x 50mm dia. may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.
Medium Strength:	M	1	A piece of core 150mm long x 50mm dia. can be broken by hand with difficulty. Readily scored with knife.
High:	H	3	A piece of core 150mm long x 50mm dia. core cannot be broken by hand, can be slightly scratched or scored with knife; rock rings under hammer.
Very High:	VH	10	A piece of core 150mm long x 50mm dia. may be broken with hand-held pick after more than one blow. Cannot be scratched with pen knife; rock rings under hammer.
Extremely High:	EH		A piece of core 150mm long x 50mm dia. is very difficult to break with hand-held hammer. Rings when struck with a hammer.

### ABBREVIATIONS USED IN DEFECT DESCRIPTION

ABBREVIATION	DESCRIPTION	NOTES
Be	Bedding Plane Parting	Defect orientations measured relative to the normal to the long core axis (ie relative to horizontal for vertical holes)
CS	Clay Seam	
J	Joint	
P	Planar	
Un	Undulating	
S	Smooth	
R	Rough	
IS	Ironstained	
XWS	Extremely Weathered Seam	
Cr	Crushed Seam	
60t	Thickness of defect in millimetres	





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## **Report**

### **Geotechnical Investigation Proposed Station Upgrade – New Canopies Cardiff Railway Station Main Road, Cardiff, NSW**

Prepared for  
**Railcorp**  
**C/- Caldis Cook Group**  
**Level 2, 45 Chippen Street**  
**CHIPPENDALE NSW 2008**

**Ref: JG09294D-r1**  
**October 2009**



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28<sup>th</sup> October 2009

JG09294D-r1

Railcorp  
C/- Caldis Cook Group  
Level 2, 45 Chippen Street  
CHIPPENDALE NSW 2008

Attention: Mr Ken Ng

Dear Sir

**Re Geotechnical Report  
Proposed Station Upgrade – New Canopies  
Cardiff Railway Station, Main Road, Cardiff**

We are pleased to submit our geotechnical report for the proposed Station Upgrade project for Cardiff Railway Station at Main Road, Cardiff, NSW.

This report contains information on sub-surface conditions and our comments and recommendations on geotechnical issues for the proposed development.

Should you have any queries, please contact the undersigned.

Yours faithfully  
**GeoEnviro Consultancy Pty Ltd**

Solern Liew CPEng (NPER)  
Director

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Appendix C Explanatory Notes and Graphic Symbols

## 1. INTRODUCTION

This report presents the results of a geotechnical investigation for the proposed station upgrade project for Cardiff Railway Station at Main Road, Cardiff, as shown on Drawing No 1. The investigation was commissioned by Mr Hisham Noori of Caldis Cook Group, acting on behalf of Railcorp. The scope of works were carried out in general accordance with our fee proposal Ref PG09936C dated 29<sup>th</sup> January 2009.

We understand that the project will include construction of new canopy structures on the station platform area. The new canopies will be about 40m long and cover an area of about 300m<sup>2</sup>. The project will also include some resurfacing of the station platform pavements.

The purpose of this investigation was to assess the subsurface ground conditions and based on the information obtained, to provide the following:

- Assessment on site classification to AS2870.
- Recommendations on platform subgrade preparation and resurfacing.
- Recommendation on suitable footing types for the proposed canopies including allowable bearing capacities and foundation depths.

## 2. SITE DESCRIPTION AND PROJECT APPRECIATION

Cardiff Railway Station is located between Main Road and Mary Street at Cardiff. The station consists of an island platform with railway tracks on both sides of the platform and an overhead pedestrian footbridge on the northern side. The station office consists of a single storey building of brick and fibro construction with metal roof. There is a car park located on the western side of the station which was benched at two levels with a height difference of about 3.0m. A railway yard abuts to the upper car park to the south.

The site is situated on undulating to rolling terrain. Surrounding ground surface slopes down to the south-west at an average angle of about 10 degrees.

The railway station is situated about 6m below Main Road to the north east and about the same level as the upper carpark to the south west. The lower carpark further to the south west of the station is situated at Mary Street level. Based on the drawing provided, the island platform is at about Reduced Level (RL) 30.1m Australian Height Datum (AHD).

The 1:250,000 Geological map of Newcastle indicates the site to be underlain by Newcastle Measures consisting of shale, sandstone, conglomerate, tuff, chert and coal seams.

We understand that the project will include construction of new canopy structures on the station platform area and these canopies will be about 40m long starting from the overhead footbridge to the station building. The project will also include some pavement resurfacing on the platform.

### **3. INVESTIGATION METHODOLOGY**

#### **3.1 Fieldwork**

Fieldwork for the investigation was carried out on the 6<sup>th</sup> October 2009 and involved drilling of three boreholes (BH 1 to BH 3). Boreholes No 1 was drilled in the railway yard area using a truck-mounted P160 drill rig equipped for site investigation purpose. This borehole was drilled to a depth of about 10.6m below existing ground surface. To assess the strength of the subsurface soil profile, Standard Penetration Tests (SPT) were carried out in the borehole. Hand penetrometer tests were carried out on the SPT split-tube clayey samples to augment the SPT test results.

Boreholes Nos 2 and 3 were drilled on the existing railway platform using a Dingo drill rig mounted on a rubber tracked machine. These boreholes were drilled using spiral augers to depths of about 2.7m and 2.8m respectively below existing ground surface. Immediate adjacent to these boreholes, Dynamic Cone Penetrometer tests (DCP 1 and DCP 2) were carried in order to aid assessment of the relative densities of subsurface profile.

Prior to boreholes drilling, underground services checks were carried out using available drawings provided by Dial-before-you-dig and Railsearch. An underground services locator equipped with a remote sensing device was engaged as an extra precautionary measure to reduce risk of damage to underground services caused by the borehole drilling.

Details of the subsurface profiles and field tests are summarised on the Borehole Reports in Appendix A. The DCP test results are summarised on the DCP Test Report in Appendix B. Explanatory notes defining the terms and symbols used on the preparation of the Borehole Report are attached in Appendix D.

The site investigation was supervised on a full-time basis by our geotechnical engineer and in the presence of a PO4 safety officer. The works were carried out on general accordance with our Safe Work Method Statement (Ref JG09294D-L1 dated 09<sup>th</sup> June 2009).

### **3.2 Laboratory Testing**

Two disturbed soil samples (BH 2 [0.8-1.0m] and BH 3 [1.8-2.0]) were taken from the site to our NATA accredited laboratory for Atterberg Limit tests to aid assessment of soil characteristics and reactivity to moisture variation.

The laboratory test results are summarised on Laboratory Test Reports in Appendix C.

## 4. RESULTS OF THE INVESTIGATION

### 4.1 Subsurface Conditions

Reference may be made to the Borehole Reports in Appendix A for details of the subsurface conditions encountered in each test location. The following is a generalised description of the subsurface profiles encountered;

#### Railway Yard – BH 1

- Rail Ballast was encountered on surface with thickness of about 200mm.
- Underlying the rail ballast, fill was encountered consisting predominantly of medium plasticity Gravelly Silty Clay with variable quantities of gravel and some rail ballast to a depth of about 2.0m below existing ground surface. At lower depth, Clayey/Gravel fill was encountered. The fill was generally found to be moist to wet. The SPT test results indicate the fill to be loose.
- Natural soil was encountered beneath the fill at a depth of about 2.4m below existing ground surface. The natural clay consists of medium to high plasticity Silty Clay with some conglomerate, gravel and shale. At a depth of about 6.8m below existing ground surface, medium plasticity Gravelly Silty Clay was encountered. Based on the SPT test results, the natural clay soil was generally assessed to be very stiff to hard. Moisture content of the natural clayey soil was found to be approximately equal to the plastic limit.
- The borehole was found to be dry during and shortly after completion of the site investigation.

#### Station Platform – BH 2 and 3

- A thin layer of Asphalt Concrete was encountered on the platform surface with thickness ranging of about 25mm to 30mm.
- Underlying the Asphalt Concrete, fill was encountered predominantly consisting of high plasticity Silty Clay mixture with variable quantities of gravel and rail ballast. Based on the DCP test results, the density of the fill was assessed to be poorly compacted. The fill was found to be moist.

- Natural medium to high plasticity Silty Clay was encountered at depths ranging of about 1.4m to 1.6m below existing platform level. Based on the DCP test results, the natural clay was assessed to be firm to very stiff at the upper 700mm and the natural clay becomes hard at lower depths. Moisture content of the natural clay was found to be approximately equal to the plastic limit.
- The boreholes were found to be dry during and shortly after completion of the site investigation.

#### 4.2 Laboratory Test Results

Based on the laboratory test results, the fill and natural clay soil was assessed to have a highly reactivity to moisture variation. The following is a summary of the Atterberg Limit test results for the samples taken from (BH 2 [0.8-1.0m] and BH 3 [1.8-2.0]);

<b>BH</b>	<b>Liquid Limit (%)</b>	<b>Plastic Index (%)</b>	<b>Plasticity Index (%)</b>	<b>Linear Shrinkage (%)</b>
BH 2 (0.8-1.0m)	46	19	27	11.5
BH 3 (1.8-2.0m)	48	19	29	12.0

## 5. COMMENTS AND RECOMMENDATIONS

### 5.1 Platform Resurfacing

The site investigation revealed the station platform to be underlain by a layer of asphalt concrete (i.e.25mm to 30mm) overlying loosely compacted fill overlying firm to hard natural clay.

We anticipate that the platform resurfacing will require stripping of the existing asphalt concrete and excavation to a depth to suit the design thickness of the proposed new pavement. As the platform fill was assessed to be loose, we recommend the insitu fill be densified prior to construction of new pavement and this may include the following;

- Excavation of the top 0.5m of the fill and stockpiled for reuse as fill at a later stage.
- Rolling of the base of the excavation with a small vibration roller.
- Any soft areas identified during rolling should be further excavated and replaced with select granular fill such as ripped sandstone.
- The excavated clayey fill material may be reuse as fill beneath pavements subject to moisture conditioning. Alternatively, imported good quality fill such as ripped sandstone having a maximum particle size of 40mm may be used.
- The fill material should be compacted in layer not exceeding 250mm loose thickness compacted to a minimum 95% Standard Maximum Dry Density (SMDD) at close to Optimum Moisture Content.

Care should be taken to ensure rolling and compaction of the fill will not destabilise the platform retaining walls.

## 5.2 New Canopies

We understand that the proposed station upgrade project will include construction of new canopy structures on the platform area. The station platform is elevated about 1.2m above the track level and is retained by brick retaining wall.

The site investigation revealed the station platform to be underlain by a 25mm to 30mm thick layer of Asphalt Concrete overlying poorly compacted fill overlying natural clay. Bedrock was not encountered in the platform boreholes and judging from the borehole drilled on the railway yard, bedrock is expected to be deep, greater than 10m.

The DCP test results indicate the upper 0.7m of the natural clay to be firm to stiff and very stiff to hard clay was encountered at about 2.0m below existing platform level. Groundwater was not encountered in the boreholes during and upon completion of the site investigation.

For the proposed canopies, we are of the opinion that suitable footing should consist of pier taken through the fill and founded on natural very stiff to hard clay expected to be present at about 2.0m below platform level (ie below the existing track level).

For piers taken to a minimum depth of about 2.5m below existing platform surface (i.e. RL 28.0m AHD) and at least 0.5m into natural hard clay, an allowable end bearing of 150kPa may be adopted. Deeper piers taken to a minimum depth of 1.5m into natural very stiff to hard clay may be proportioned to an end allowable bearing capacity of 350kPa.

A shaft adhesion of 20kPa may be adopted for the section of piers within the natural clayey soil stratum. Uplift capacity of the piers should be half of the shaft adhesion. Shaft adhesion of the section of piers within the fill should be ignored.

As the site is underlain by a relatively thick layer (i.e. >10m) of clay assessed to be highly reactive, we recommend that the footings of the proposed structures be adequately designed to accommodate shrink-swell movements proportioned to a Class 'H' (Highly Reactive) site in accordance to AS2870 "Residential Slabs and Footings".

## 6. LIMITATIONS

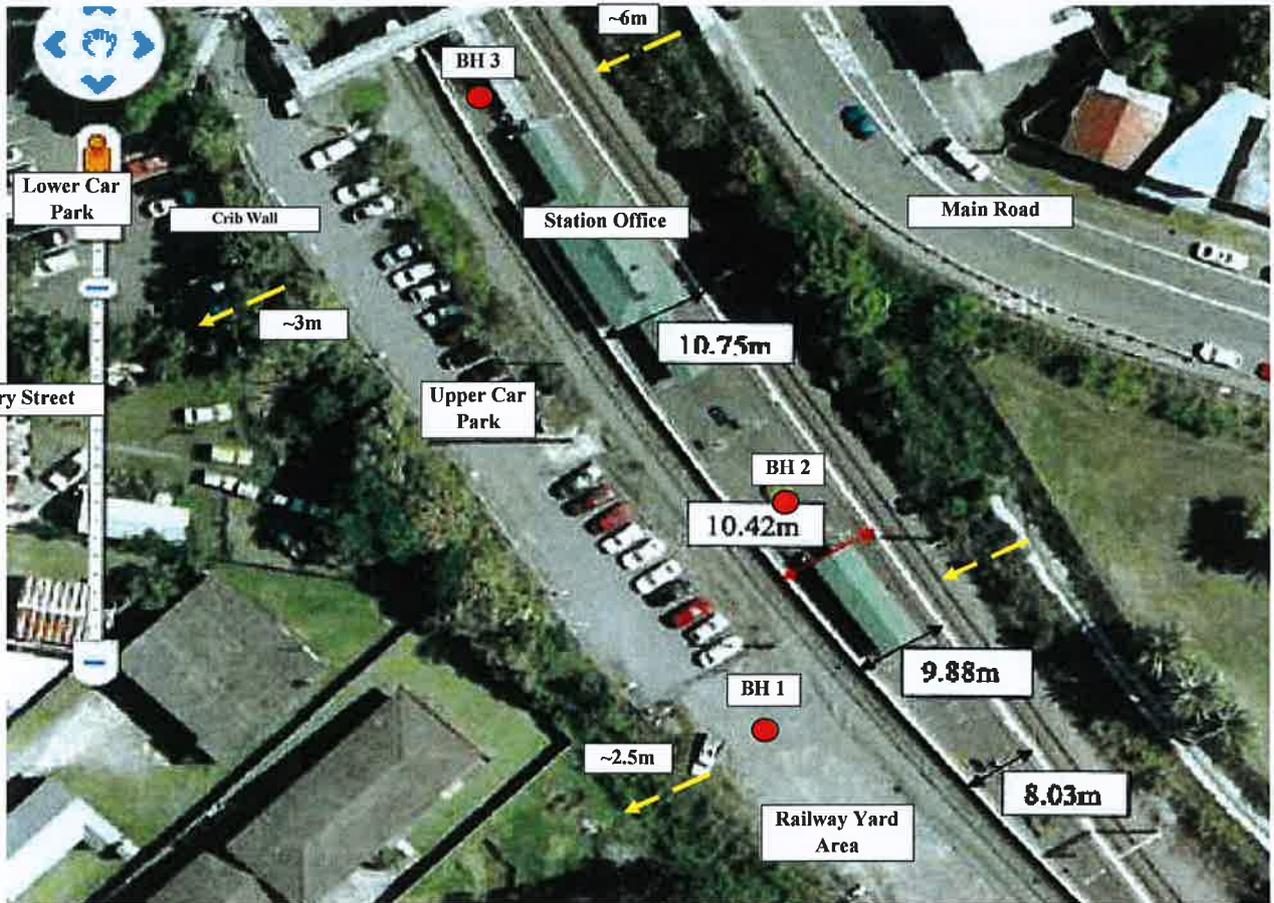
The interpretation and recommendations submitted in this report are based in part upon data obtained from a limited number of boreholes. There is no investigation which is thorough enough to determine all site conditions and anomalies, no matter how comprehensive the investigation program is as site data is derived from extrapolation of limited test locations. The nature and extent of variations between test locations may not become evident until construction.

Groundwater conditions are only briefly examined in this investigation. The groundwater conditions may vary seasonally or as a consequence of construction activities on or adjacent to the site.

In view of the above, the subsurface soil and rock conditions between the test locations may be found to be different or interpreted to be different from those expected. If such differences appear to exist, we recommend that this office be contacted without delay.

The statements presented in this document are intended to advise you of what should be your realistic expectations of this report and to present you with recommendations on how to minimise the risk associated with groundworks for this project. The document is not intended to reduce the level of responsibility accepted by GeoEnviro Consultancy Pty Ltd, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in to doing.

Your attention is drawn to the attached "Explanatory Notes" in Appendix D and this document should be read in conjunction with our report



**Legend**

- Borehole
- ~2.5m → Ground surface drops 2.5m

 <b>GeoEnviro Consultancy Pty Ltd</b>	Drawn: JC	Date: 28-10-09	<b>Caldis Cook Group</b> Cardiff Railway Station, Main Road, Cardiff, NSW <b>Borehole Location Plan</b>	
	Checked By: SL	Date: 28-10-09		
	Revision			
	Scale: Proportional	A4	JG09494D-r1	Drawing No : 1

**APPENDIX A  
Borehole Reports**



# Borehole Report

Borehole no: 1 (Page 1 of 2)

Client: Caldis Cook Group Pty Ltd	Job no: JG09294D
Project: Proposed Station Upgrade - New Canopy	Date: 26/10/2009
Location: Cardiff Railway Station	Logged by: JC
	Checked By: SL

Drill Model and Mounting: P160	Slope: 90 degrees	R.L. Surface: -
Hole Diameter: 100 mm	Bearing: -	Datum: -

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Hand Penetrometer (kPa)	Structure and Additional Observations
V - B I T N I L O C C U R R E N T A T T A C H M E N T N O G R O U N D W A T E R				0.0			Fill: Rail Ballast: thickness=200mm				
				0.5			Fill: Gravelly Silty Clay: medium plasticity, yellow brown	M			The fill appears loosely compacted
			N=5 3,2,3	1.0							
				2.0			Fill: Clayey/Gravel mixture, dark grey brown	M-W			
V - B I T N I L O C C U R R E N T A T T A C H M E N T N O G R O U N D W A T E R			N=7 1,2,5	3.0	CI-CH		Silty Clay: medium to high plasticity, yellow brown	MC=PL	Vst	350-380	
			N=20 5,10,10	4.0			As above, but medium plasticity, grey with a trace of gravel As above, but with some conglomerate and shale	MC<=PL	H	430	
T C - B I T				6.0			As above, but with a trace of gravel and chert	MC=PL			
			N=18 5,8,10	7.0	CI		Gravelly Silty Clay: medium plasticity, grey with some conglomerate and gravel	MC=PL	Vst-H	230	

Continued to next page



# Borehole Report

Borehole no: 1 (Page 2 of 2)

Client:	Caldis Cook Group Pty Ltd	Job no:	JG09294D
Project:	Proposed Station Upgrade - New Canopy	Date:	26/10/2009
Location:	Cardiff Railway Station	Logged by:	JC
		Checked By:	SL

Drill Model and Mounting:	P160	Slope:	90 degrees	R.L. Surface:	-
Hole Diameter:	100 mm	Bearing:	-	Datum:	-

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content MC= PL	Consistency/Density Index Vsr= H	Hand Penetrometer (kPa)	Structure and Additional Observations
T C - B I T	N I L	NO GROUNDWATER ENCOUNTERED		8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0		CI	Gravelly Silty Clay: medium plasticity, grey with some conglomerate, gravel, chert and few cobble				
							End of BH 1 at 10.6m				



# Borehole Report

Borehole no: 2

Client: Caldis Cook Group Pty Ltd	Job no: JG09294D
Project: Proposed Station Upgrade - New Canopy	Date: 26/10/2009
Location: Cardiff Railway Station	Logged by: JC
	Checked By: SL

Drill Model and Mounting: P160	Slope: 90 degrees	R.L. Surface: ~30.1m
Hole Diameter: 100 mm	Bearing: -	Datum: AHD

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Dynamic Cone Penetrometer	Structure and Additional Observations
T C - B I T	N I L	NO GROUNDWATER ENCOUNTERED		0.0	[Cross-hatched symbol]		Asphalt Concrete: thickness=25mm	M		-	The fill appears loosely compacted
				0.5	[Diagonal lines symbol]	Fill: Silty Clay/Gravel mixture: brown with some rail ballast	-				
				1.0	[Diagonal lines symbol]	Fill: Gravelly Silty Clay: medium to high plasticity, yellow brown with some gravel	2			Start of DCP test at 0.5m	
				1.5	[Diagonal lines symbol]		Fill: Silty Clay: high plasticity, yellow brown with some fine gravel		2		
				2.0	[Diagonal lines symbol]	CH	Silty Clay: high plasticity, yellow brown with a trace of gravel	MC=	Vst	5	
				2.5	[Diagonal lines symbol]		As above, but grey	PL		6	
				3.0			End of BH 2 at 2.7m		H	8	
				3.5						8	
				4.0						10	
										11	
										12	
										12	
										10	
										10	
										11	
										13	
										14	
										16	
										16	End of DCP at 3.1m



**APPENDIX B  
DCP Test Report**



# GeoEnviro Consultancy Pty Ltd

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Tel: (02) 96798733 Fax: (02) 96798744

## Dynamic Cone Penetration Test Report

Client/Address: Caldis Cook Group (Chippendale)				Job No. JG09294D			
Project: Proposed Station Upgrade - New Canopy				Date: 26-10-09			
Location: Cardiff Railway Station				Report No. R01A			
Test Procedure: AS 1289 1.1, 1.2.1, 6.3.2							
<b>Test Data</b>							
Test No: 1				Test No: 2			
Test Location: Refer to Drawing No 1				Test Location: Refer to Drawing No 1			
RL: -				RL: -			
Soil Classification: Refer to BH 2				Soil Classification: Refer to BH 3			
Depth (m)	Blows	Depth (m)	Blows	Depth (m)	Blows	Depth (m)	Blows
0.0-0.1	-	3.0-3.1	16	0.0-0.1	-	3.0-3.1	
0.1-0.2	-	3.1-3.2	Terminated	0.1-0.2	-	3.1-3.2	
0.2-0.3	-	3.2-3.3		0.2-0.3	-	3.2-3.3	
0.3-0.4	-	3.3-3.4		0.3-0.4	-	3.3-3.4	
0.4-0.5	-	3.4-3.5		0.4-0.5	-	3.4-3.5	
0.5-0.6	2	3.5-3.6		0.5-0.6	-	3.5-3.6	
0.6-0.7	2	3.6-3.7		0.6-0.7	-	3.6-3.7	
0.7-0.8	6	3.7-3.8		0.7-0.8	-	3.7-3.8	
0.8-0.9	5	3.8-3.9		0.8-0.9	1	3.8-3.9	
0.9-1.0	2	3.9-4.0		0.9-1.0	1	3.9-4.0	
1.0-1.1	2	4.0-4.1		1.0-1.1	2	4.0-4.1	
1.1-1.2	1	4.1-4.2		1.1-1.2	1	4.1-4.2	
1.2-1.3	5	4.2-4.3		1.2-1.3	2	4.2-4.3	
1.3-1.4	4	4.3-4.4		1.3-1.4	2	4.3-4.4	
1.4-1.5	2	4.4-4.5		1.4-1.5	1	4.4-4.5	
1.5-1.6	5	4.5-4.6		1.5-1.6	2	4.5-4.6	
1.6-1.7	5	4.6-4.7		1.6-1.7	3	4.6-4.7	
1.7-1.8	6	4.7-4.8		1.7-1.8	3	4.7-4.8	
1.8-1.9	8	4.8-4.9		1.8-1.9	3	4.8-4.9	
1.9-2.0	8	4.9-5.0		1.9-2.0	3	4.9-5.0	
2.0-2.1	10	5.0-5.1		2.0-2.1	6	5.0-5.1	
2.1-2.2	11	5.1-5.2		2.1-2.2	11	5.1-5.2	
2.2-2.3	12	5.2-5.3		2.2-2.3	12	5.2-5.3	
2.3-2.4	12	5.3-5.4		2.3-2.4	14	5.3-5.4	
2.4-2.5	10	5.4-5.5		2.4-2.5	16	5.4-5.5	
2.5-2.6	10	5.5-5.6		2.5-2.6	19	5.5-5.6	
2.6-2.7	11	5.6-5.7		2.6-2.7	25	5.6-5.7	
2.7-2.8	13	5.7-5.8		2.7-2.8	27	5.7-5.8	
2.8-2.9	14	5.8-5.9		2.8-2.9	Terminated	5.8-5.9	
2.9-3.0	16	5.9-6.0		2.9-3.0		5.9-6.0	
Remarks:						Weight:	9kg
						Drop:	510mm
						Rod Diameter:	16mm

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Form No. R009/Ver05/06/07



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NATA Accredited Laboratory Number: 14208.

Approved Signatory

Principal

Solem Liew Date 26 / 10 /09

APPENDIX C  
Laboratory Test Report



# GeoEnviro Consultancy Pty Ltd

Unit 5, 39-41 Fourth Avenue, Blacktown NSW 2148, Australia  
Tel: (02) 96798733 Fax: (02) 96798744

## Test Results - Atterberg Limits

Client / Address: Caldis Cook Group Pty Ltd (Chippendale)		Job No: JG09294D		
Project: Proposed Station Upgrade - New Canopy		Date: 28-10-09		
Location: Cardiff Railway Station		Report No: R02A		
Test Procedure: AS 1289 2.1.1, 3.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1				
Sample Identification	BH 2 (0.8-1.0m)	BH 3 (1.8-2.0m)		
Sample Register No	SR 5596	SR 5597		
Sample Date	06-10-09	06-10-09		
Test Date	12-10-09	12-10-09		
Test Results				
Liquid Limit (%)	46	48		
Plastic Limit (%)	19	19		
Plasticity Index (%)	27	29		
Linear Shrinkage (%)	11.5	12.0		
Natural Moisture Content %	20.6	16.9		
Material Description	(CH) Silty Clay: high plasticity, yellow brown	(CI-CH) Silty Clay: medium to high plasticity, grey mottled yellow		

c:/lab/reports/R004

Form No R004/Ver 07/06/07



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NATA Accredited Laboratory Number: 14208.

Approved Signatory

Principal

Solern Liew Date 28 / 10 /2009

**APPENDIX D**  
**Explanatory Notes and Graphic Symbols**



**EXPLANATORY NOTES**

**Introduction**

These notes have been provided to amplify the geotechnical report with regard to investigation procedures, classification methods and certain matters relating to the Discussion and Comments sections. Not all notes are necessarily relevant to all reports.

Geotechnical reports are based on information gained from finite sub-surface probing, excavation, boring, sampling or other means of investigation, supplemented by experience and knowledge of local geology. For this reason they must be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

**Description and Classification Methods**

The methods the description and classification of soils and rocks used in this report are based on Australian standard 1726, the SSA Site investigation Code, in general descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions. Identification and classification of soil and rock involves to a large extent, judgement within the acceptable level commonly adopted by current geotechnical practices.

Soil types are described according to the predominating particle size, qualified by the grading or other particles present (eg sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	Less than 0.002mm
Silt	0.002 to 0.6mm
Sand	0.6 to 2.00mm
Gravel	2.00m to 60.00mm

Soil Classification	Particle size
Clay	less than 0.002mm
Silt	0.002 to 0.06mm
Sand	0.06 to 2.00mm
Gravel	2.00mm to 60.00mm

Cohesive soils are classified on the basis of strength, either by laboratory testing or engineering examination. The strength terms are defined as follows:

Classification	Undrained Shear Strength kPa
Very Soft	Less than 12
Soft	12 - 25
Firm	25 - 50
Stiff	50 - 100
Very Stiff	100 - 200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer test (CPT), as below:

Relative Dense	SPT 'N' Value (blows/300mm)	CPT Cone Value (q <sub>c</sub> -Mpa)
Very Loose	Less than 5	Less than 2
Loose	5 - 10	2 - 5
Medium Dense	10 - 30	5 - 15
Dense	30 - 50	15 - 25
Very Dense	> 50	> 25

Rock types are classified by their geological names, together with descriptive terms on degrees of weathering strength, defects and other minor components. Where relevant, further information

regarding rock classification, is given on the following sheet.

**Sampling**

Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provided information on plasticity, grained size, colour, type, moisture content, inclusions and depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin walled sample tube (normally know as U<sub>50</sub>) into the soil and withdrawing a sample of the soil in a relatively undisturbed state. Such Samples yield information on structure and strength and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils. Details of the type and method of sampling are given in the report.

**Field Investigation Methods**

The following is a brief summary of investigation methods currently carried out by this company and comments on their use and application.

**Hand Auger Drilling**

The borehole is advanced by manually operated equipment. The diameter of the borehole ranges from 50mm to 100mm. Penetration depth of hand augered boreholes may be limited by premature refusal on a variety of materials, such as hard clay, gravels or ironstone.

**Test Pits**

These are excavated with a tractor-mounted backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descend into the pit. The depth of penetration is limited to about 3.0m for a backhoe and up to 6.0m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Care must be taken if construction is to be carried out near, or within the test pit locations, to either adequately recompact the backfill during construction, or to design the structure or accommodate the poorly compacted backfill.

**Large Diameter Auger (eg Pengo)**

The hole is advanced by a rotating plate or short spiral auger generally 300mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 05m) and are disturbed, but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers and is usually supplemented by occasional undisturbed tube sampling.

**Continuous Spiral Flight Augers**

The hole is advanced by using 90mm - 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling or insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the augers flights, but they are very disturbed and may be highly mixed with soil of other stratum.

Information from the drilling (as distinct from specific sampling by SPT or undisturbed samples) is of relatively low reliability due to remoulding, mixing or softening of samples by ground water, resulting in uncertainties of the original sample depth.

### Continuous Spiral Flight Augers (continued)

The spiral augers are usually advanced by using a V - bit through the soil profile refusal, followed by Tungsten Carbide (TC) bit, to penetrate into bedrock. The quality and continuity of the bedrock may be assessed by examination of the recovered rock fragments and through observation of the drilling penetration resistance.

### Non - core Rotary Drilling (Wash Boring)

The hole is advanced by a rotary bit, with water being pumped down the drill rod and returned up the annulus, carrying the cuttings, together with some information from the "feel" and rate of penetration.

### Rotary Mud Stabilised Drilling

This is similar to rotary drilling, but uses drilling mud as a circulating fluid, which may consist of a range of products, from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg SPT and  $U_{50}$  samples).

### Continuous Core Drilling

A continuous core sample is obtained using a diamond tipped core barrel. Providing full core recovery is achieved (which is not always possible in very weak rock and granular soils) this technique provides a very reliable (but relatively expensive) method of investigation. In rocks an NMLC triple tube core barrel which gives a core of about 50mm diameter, is usually used with water flush.

### Portable Proline Drilling

This is manually operated equipment and is only used in sites which require bedrock core sampling and there is restricted site access to truck mounted drill rigs. The boreholes are usually advanced initially using a tricone roller bit and water circulation to penetrate the upper soil profile. In some instances a hand auger may be used to penetrate the soil profile. Subsequent drilling into bedrock involves the use of NMLC triple tube equipment, using water as a lubricant.

### Standard Penetration Tests

Standard penetration tests are used mainly in non-cohesive soils, but occasionally also in cohesive soils, as a means of determining density or strength and of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289 "Methods of testing Soils for Engineering Purpose"- Test F31.

The test is carried out in a borehole by driving a 50mm diameter split sample tube under the impact of a 63Kg hammer with a free fall of 769mm. It is normal for the tube to be driven in three successive 150mm increments and the "N" value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rocks, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In a case where full penetration is obtained with successive blows counts for each 150mm of, say 4, 6, and 7 blows.

$$\begin{array}{l} \text{as } 4, 6, 7 \\ N = 13 \end{array}$$

- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm.

$$\text{as } 15,30/40\text{mm}$$

The results of the tests can be related empirically to the engineering properties of the soil. Occasionally the test

methods is used to obtain samples in 50mm diameter thin walled samples tubes in clays. In these circumstances, the best results are shown on the bore logs in brackets.

### Dynamic Cone Penetration Test

A modification to the SPT test is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The cone can be continuously driven into the borehole and is normally used in areas with thick layers of soft clays or loose sand. The results of this test are shown as 'N<sub>c</sub>' on the bore logs, together with the number of blows per 150mm penetration.

### Cone Penetrometer Testing and Interpretation

Cone penetrometer testing (sometimes referred to as Dutch Cone-CPT) described in this report, has been carried out using an electrical friction cone penetrometer and the test is described in Australian Standard 1289 test F5.1.

In the test, a 35mm diameter rod with cone tipped end is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig, which is fitted with a hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separate 130mm long sleeve, immediately behind the cone. Transducer in the tip of the assembly are connected by electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) the information is output on continuous chart recorders. The plotted results in this report have been traced from the original records. The information provided on the charts comprises:

- Cone resistance - the actual end bearing force divided by the cross sectional area of the cone, expressed in Mpa.
- Sleeve friction - the frictional force on the sleeve divided by the surface area, expressed in kPa.
- Friction ratio - the ratio of sleeve friction to cone resistance, expressed in percentage.

There are two scales available for measurement of cone resistance. The lower "A" scale (0-5Mpa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main "B" scale (0-50Mpa) is less sensitive and is shown as a full line.

The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative frictions in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and very soft clays, rising to 4% to 10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range:

$$q_c \text{ (Mpa)} = (0.4 \text{ to } 0.6) N \text{ (blows per 300mm)}$$

In clays the relationship between undrained shear strength and cone resistance is commonly in the range:

$$q_c = (12 \text{ to } 18) C_u$$

Interpretation of CPT values can also be made to allow estimate of modulus or compressibility values to allow calculation of foundation settlements. Inferred stratification, as shown on the attached report, is assessed from the cone and friction traces, from experience and information from nearby boreholes etc.



### **Cone Penetrometer Testing and Interpretation continued**

This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties and where precise information or soil classification is required, direct drilling and sampling may be preferable.

#### **Portable Dynamic Cone Penetrometer (AS1289)**

Portable dynamic cone penetrometer tests are carried out by driving a rod in to the ground with a falling weight hammer and measuring the blows per successive 100mm increments of penetration.

There are two similar tests, Cone Penetrometer (commonly known as Scala Penetrometer) and the Perth Sand Penetrometer. Scala Penetrometer is commonly adopted by this company and consists of a 16mm rod with a 20mm diameter cone end, driven with a 9kg hammer, dropping 510mm (AS 1289 Test F3.2).

#### **Laboratory Testing**

Laboratory testing is carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedures are given on the individual report forms.

#### **Engineering Logs**

The engineering logs presented herein are an engineering and/or geological interpretation of the sub-surface conditions and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, however, this is not always practicable or possible to justify economically. As it is, the boreholes represent only a small sample of the total sub-surface profile. Interpretation of the information and its application to design and construction should take into account the spacing of boreholes, frequency of sampling and the possibility of other than "straight line" variations between the boreholes.

#### **Ground water**

Where ground water levels are measured in boreholes, there are several potential problems:

- In low permeability soils, ground water although present, may enter the hole slowly, or perhaps not at all, during the investigation period.
- A localised perched water table may lead to a erroneous indication of the true water table.
- Water table levels will vary from time to time, due to the seasons or recent weather changes. They may not be the same at the time of construction as indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must be washed out of the hole if any water observations are to be made.

More reliable measurements can be made by installing stand pipes, which are read at intervals over several days, or weeks for low permeability soils. Piezometers sealed in a particular stratum may be interference from a perched water table or surface water.

#### **Engineering Reports**

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal is changed, say to a twenty storey building. If this occurs, the company will be pleased to review the report and sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of sub-surface conditions, discussions of geotechnical aspects and recommendations or suggestions for design and construction. However, the company cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on bore spacing and sampling frequency.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of contractors responding to commercial pressures.

If these occur, the company will be pleased to assist with investigation or advice to resolve the matter.

#### **Site Anomalies**

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the company request immediate notification. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

#### **Reproduction of Information for Contractual Purposes**

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information trader Documents", published by the Institute of Engineers Australia. Where information obtained for this investigation is provided for tender purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or make additional copies of the report available for contract purpose, at a nominal charge.

#### **Site Inspection**

The Company will always be pleased to provide engineering inspection services for geotechnical aspect of work to which this report is related. This could range from a site visit to confirm that the conditions exposed are as expected, to full time engineering presence on site

#### **Review of Design**

Where major civil or structural developments are proposed, or where only a limited investigation has been completed, or where the geotechnical conditions are complex, it is prudent to have the design reviewed by a Senior Geotechnical Engineer.



## Graphic Symbols For Soil and Rock

SOIL		ROCK	
	Fill		Shale
	Topsoil		Sandstone
	Gravel (GW , GP)		Siltstone, Mudstone, Claystone
	Sand (SP, SW)		Granite, Gabbro
	Silt (ML, MH)		Dolerite, Diorite
	Clay (CL, CH)		Basalt, Andesite
	Clayey Gravel (GC)		<b>Other Materials</b>
	Silty Sand (SM)		Concrete
	Clayey Sand (SC)		Bitumen, Asphaltic Concrete, Coal
	Sandy Silt (ML)		Ironstone Gravel
	Gravelly Clay (CL, CH)		Organic Material
	Silty Clay (CL, CH)		
	Sandy Clay (CL, CH)		
	Peat or Organic Soil		

## MEMORANDUM

**To:** Project Design Engineer  
Civil and Structure Design,  
RailCorp  
477 Pitt Street  
Attn: John Nash / Jonathan Barnes

**From:** J Singh  
Group Leader Geotechnical

**Date:** 1 March 11 **Reference:** Proj 8643

**Subject:** **Geotechnical investigation for Platform Extension at Cardiff**

---

### 1.0 INTRODUCTION

At the request of the Project Design Engineer, RailCorp Geotechnical Services carried out an investigation for the proposed extension of platform at Cardiff Station.

The purpose of the investigation was to provide necessary geotechnical information for the platform footing design.

This report presents the results of the field investigation and provides geotechnical parameters for the platform foundation.

The client informed that the precast concrete U section units will be used for the proposed construction of the platform extension.

### 2.0 SITE INVESTIGATION

RailCorp Geotechnical Services carried out the fieldwork on the 1<sup>st</sup> September 2010. This included drilling of three (3) boreholes (BH) using hand auger and proline drilling commencing from the existing ground level.

The Dynamic Cone Penetrometer (DCP) tests carried out in all three test locations.

(See Appendix for test locations and logs).

### 3.0 BORING

The borehole 1 (BH1) was carried out on the Sydney side of the platform approximately at 154.965 km commenced by using the hand auger method up to a depth of 0.60 m and continued with diamond coring with proline equipment up to a depth of 3.00 m below the ground level.

The borehole 2 (BH2) was carried out on the Sydney side of the platform approximately at 155.010 km by hand auger up to a depth of 0.40 m and continued with coring to a depth of 3.00 m below the ground level.

The borehole 3 (BH3) was carried out on the country side of the platform approximately at 155.150 km by hand auger up to a depth of 3.0 m below the ground level.

The Dynamic Cone Penetrometer test was performed in all three test locations commencing from 500 mm below the ground level at BH1, commencing from the ground level at BH2 and BH3. (See the site plan for BH locations).

#### **4.0 SUBSURFACE CONDITIONS**

The substrata encountered during the field investigation is presented in Engineering borehole logs.

The subsurface materials and conditions are given below.

##### **4.1 Borehole 1 (BH1)**

The BH 1 was drilled on the Sydney side of the platform approximately at 154.965 km at a distance of about 3.8 m from the Up rail of the Down Main commencing from the ground level to a depth of 3.0 m below the ground level.

The fill material consisting of ballast, trace silt and sands was encountered to a depth of about 500 mm below the ground level and dense in compactness.

Residual soil consisting of medium to coarse grained sand, trace gravels and trace clay was encountered to a depth of about 1.55 m below the ground level.

Conglomerate sandstone bedrock is believed to be encountered at a depth of about 1.55 m below the ground level. There was no recovery up to the depth of the investigation of about 3.00 m below the rail level. This is inferred from the DCP test results and the rock outcrop exposed in the cuttings.

The DCP test commenced at a depth of 500 mm below ground level and indicated loose to medium dense conditions to a depth of about 1200 mm below ground level. The ground conditions then improved from a depth of about 1200mm to the depth of the investigation of about 1550 mm below the existing ground level. The DCP test refused at 1.550 m below the ground level.

##### **4.2 Borehole 2 (BH2)**

The BH2 was carried out on the Sydney side of the platform approximately at 155.010 km at a distance of about 4.6m from the Up rail of the Down Main commencing from the ground level to a depth of 3.0 m below the ground level.

Fill material consisting of medium dense silty sand and fine to medium grained coarse grained gravel was encountered to a depth of about 400 mm below the ground level.

The residual soil consisting of medium to coarse grained sand with trace gavel and clay was encountered underlying the fill layer to a thickness of about 400 mm.

Conglomerate sandstone bedrock is believed to be encountered at a depth of about 800 mm below the ground level. There is no recovery up to the depth of the

investigation of about 3.00 m below the rail level. This is inferred from the DCP test results and the rock outcrop exposed in the cuttings.

The DCP test indicated mostly dense ground conditions from the ground level to the depth of the investigation of about 850 mm below the existing ground level.

#### **4.3 Borehole 3 (BH3)**

The borehole 3(BH3) was carried out on the country end of the platform approximately at 155.150 km at a distance of about 3.34m from the Up rail of the Down Main commencing from the ground level to a depth of 3.0 m below the ground level.

A 5mm thin asphalt concrete layer was encountered on the surface.

The fill material was encountered up to a depth of about 900 mm below the ground level comprises firm to stiff silty clay, trace coal, gravels and medium to coarse grained sand.

Residual soil/fill medium to coarse grained sand, trace gravels, silts and clay was encountered underlying the fill to the depth of the investigation. This layer was medium dense in compactness.

The DCP test indicated medium dense to dense ground conditions from the ground level to the depth of the investigation.

### **5.0 DISCUSSION AND RECOMMENDATIONS**

The client has reported that precast concrete U sections will be used for the proposed extension of the platform. The proposed depth of footing for U shaped precast concrete units is about 1.0 m below the Design rail level. The required ultimate bearing capacity at the underside of the unit is 290 kpa.

#### **5.1 Engineering Considerations**

##### **5.1.1 Sydney side of the platform**

Based on field test results, it is recommended to remove the material to a depth of 1.5 m below the existing rail level. Proof roll and backfill with cement stabilised roadbase layer compacted to RailCorp standard to the proposed foundation level.

The exposed surface at this depth would be medium dense to dense sands.

Based on borehole data an Ultimate Limit State Design Pressure of 300 kPa is recommended for medium dense to dense sand at a depth of 1.5 m below the rail level.

The material reduction factor for ultimate limit state design can be taken as 0.5.

##### **5.1.2 Country end of the platform**

Based on field test results, it is recommended to remove the material to a depth of 1.2 m below the existing rail level. Proof roll and backfill with cement stabilised roadbase layer compacted to RailCorp standard to the proposed foundation level.

The exposed surface at this depth will be medium dense sands.

Based on borehole data an Ultimate Limit State Design Pressure of 300 kPa is recommended for medium dense sand at a depth of 1.2 m below the rail level. The material reduction factor for ultimate limit state design can be taken as 0.5.

It is recommended that the founding levels are inspected by a Geotechnical Engineer.

## 6.0 Other Comments

Interpretation and recommendations given in this report are based on the inspection and testing of the ground and are directly relevant to the locations where the test were carried out and is believed to be reported accurately based on judgement and experience.

However, the characteristics and properties may vary from place to place and can change with time. The report is based on gathering of limited facts in order to make recommendations as practical as possible.

This report is for internal RailCorp use only.

**Written By:**

*P. Ganewatta*

**Priyani Ganewatta  
Geotechnical Engineer**

**Reviewed By:**

*Jatinder Singh*

**J Singh  
Group Leader Geotechnical**

Enclosed: Borehole logs  
DCP Test Results  
Site Plan





# ENGINEERING BOREHOLE LOG

HOLE N° **8643-3**

PROJECT **CARDIFF**  
 FEATURE **FOUNDATION INVESTIGATION FOR PLATFORM EXTENSION**  
 LOCATION **CARDIFF PLATFORM @ 155.150KM, Country end**

SURFACE ELEVATION **RL 30.418m**  
 ANGLE FROM HORIZONTAL **90°**  
 DIRECTION **Down**

PHYSICAL DESCRIPTION		GRAPHIC LOG	DEPTH	WEATHERING	ROCK STRENGTH Field estimation	VISUAL	DEFECTS DESCRIPTION	FRAGMENTATION	SPACING (mm)	ADDITIONAL SOIL / ROCK DATA	MOISTURE	SAMPLES (type)	TESTS	PROGRESS
TYPE OF DEPOSIT	CHARACTERISTICS Material, colour, grain size, structure													
FILL	Asphaltic concrete, grey.		0						Dense	Dry			↑ HAND AUGER ↓	
	Sand, fine to medium grained, trace coarse grained gravel, brown.								Dense	Moist	BS1			
	Silty clay, trace coal, trace coarse grained gravel, trace medium to coarse grained sand, light brown.								Firm to Stiff	MC>PL	BS2			
	As above, light grey.													
RESIDUAL SOIL / FILL	Sand, medium to coarse grained, trace gravel, trace silt, trace clay, light brown.		1			Subrounded gravels to approx 60x40x30mm recovered.			Medium Dense	Damp	BS3			
								Medium Dense	Damp					
	Sand, medium to coarse grained, trace silty clay, some medium grained gravel, light brown.		2				Rounded gravels to approx 10mm diameter recovered.			Medium Dense	Damp	BS5		
		3												

**EOH @ 3.00m**



**Transport RailCorp**  
**Geotechnical Services**

9-13 Unwins Bridge Road SYDENHAM 2044  
 Ph: 02 9563 7111 Fax: 02 9563 7786

OVERBURDEN		ROCK
DRILL BIT TYPE	HAND AUGER	
DRILLERS	DG / ST	
COMMENCED	31/08/10	COMPLETED 31/08/10
INCLINOMETER	<input type="checkbox"/>	To .....m depth
PIEZO / Standpipe	<input type="checkbox"/>	To .....m depth
CORE PHOTOGRAPHED	<input type="checkbox"/>	

REMARKS  
 Bore Hole collar 3.34m to Up Rail, Down Main

See Explanatory Notes for abbreviations and explanations.

Logged: RC Date: 31/08/10

Drawn: HC Date: 06/09/10

Checked: PG Date: 18/02/11

Core Checked: Date:

SHEET **1** OF **1**

RAIL CORP  
GEOTECHNICAL SERVICES

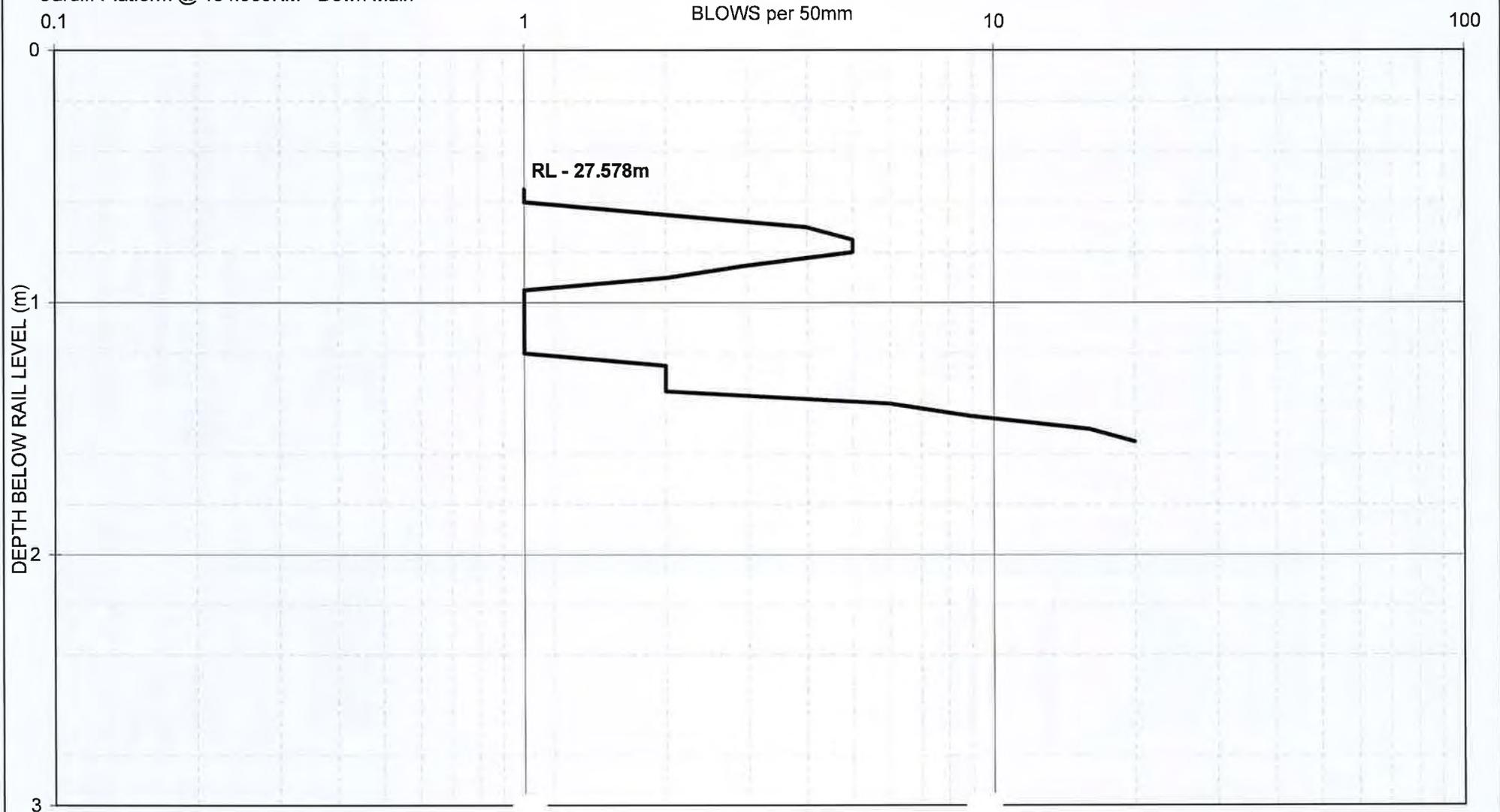


DYNAMIC CONE PENETROMETER TEST  
(IN ACCORDANCE WITH AS 1289 6.3.2)

DCP N° 8643-1

CARDIFF : Platform Extension Investigation  
Cardiff Platform @ 154.965KM - Down Main

Date: 31/08/10



RAIL CORP  
GEOTECHNICAL SERVICES

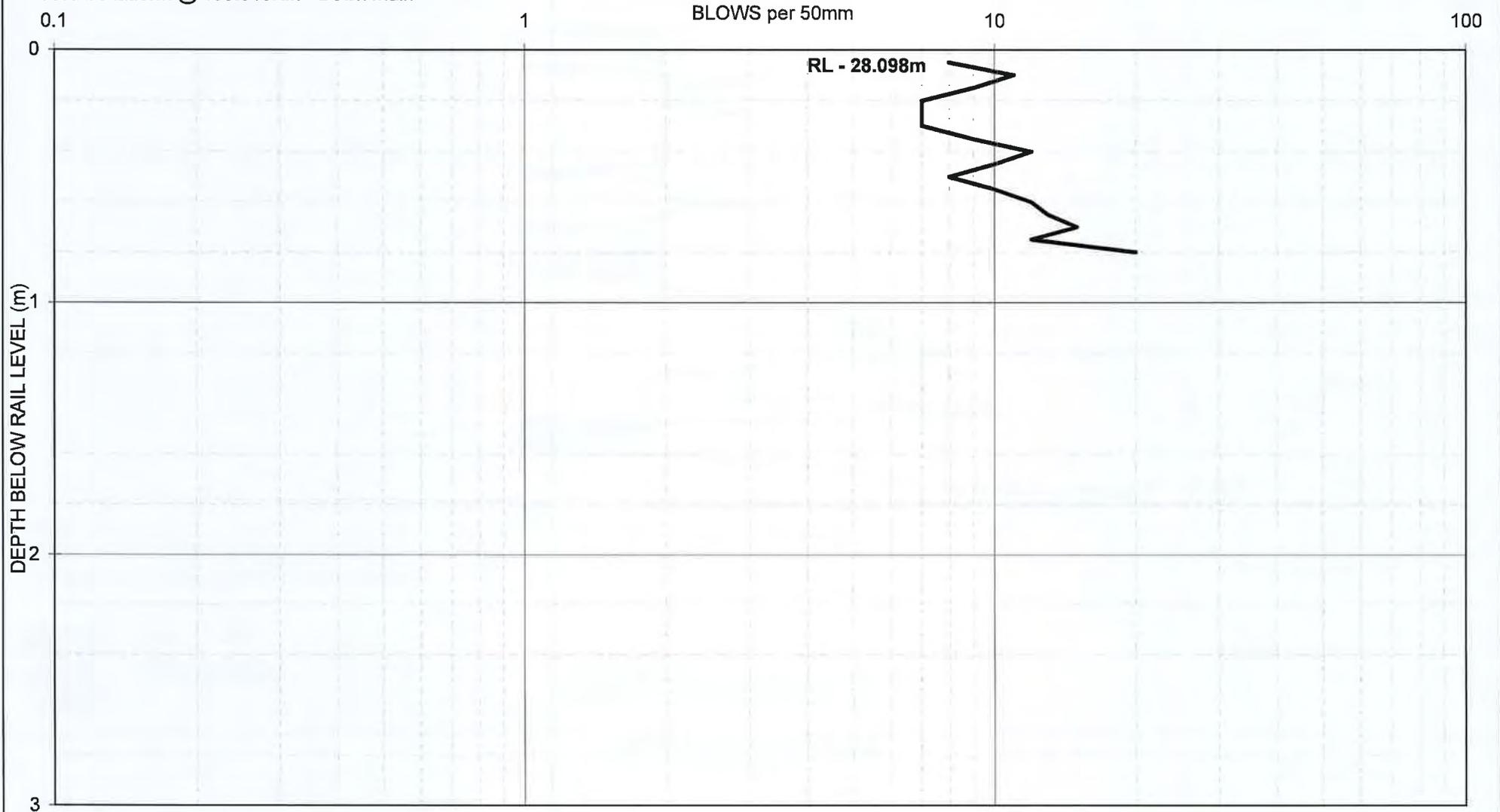


DYNAMIC CONE PENETROMETER TEST  
(IN ACCORDANCE WITH AS 1289 6.3.2)

DCP N° 8643-2

CARDIFF : Platform Extension Investigation  
Cardiff Platform @ 155.010KM - Down Main

Date: 31/08/10



RAIL CORP  
GEOTECHNICAL SERVICES

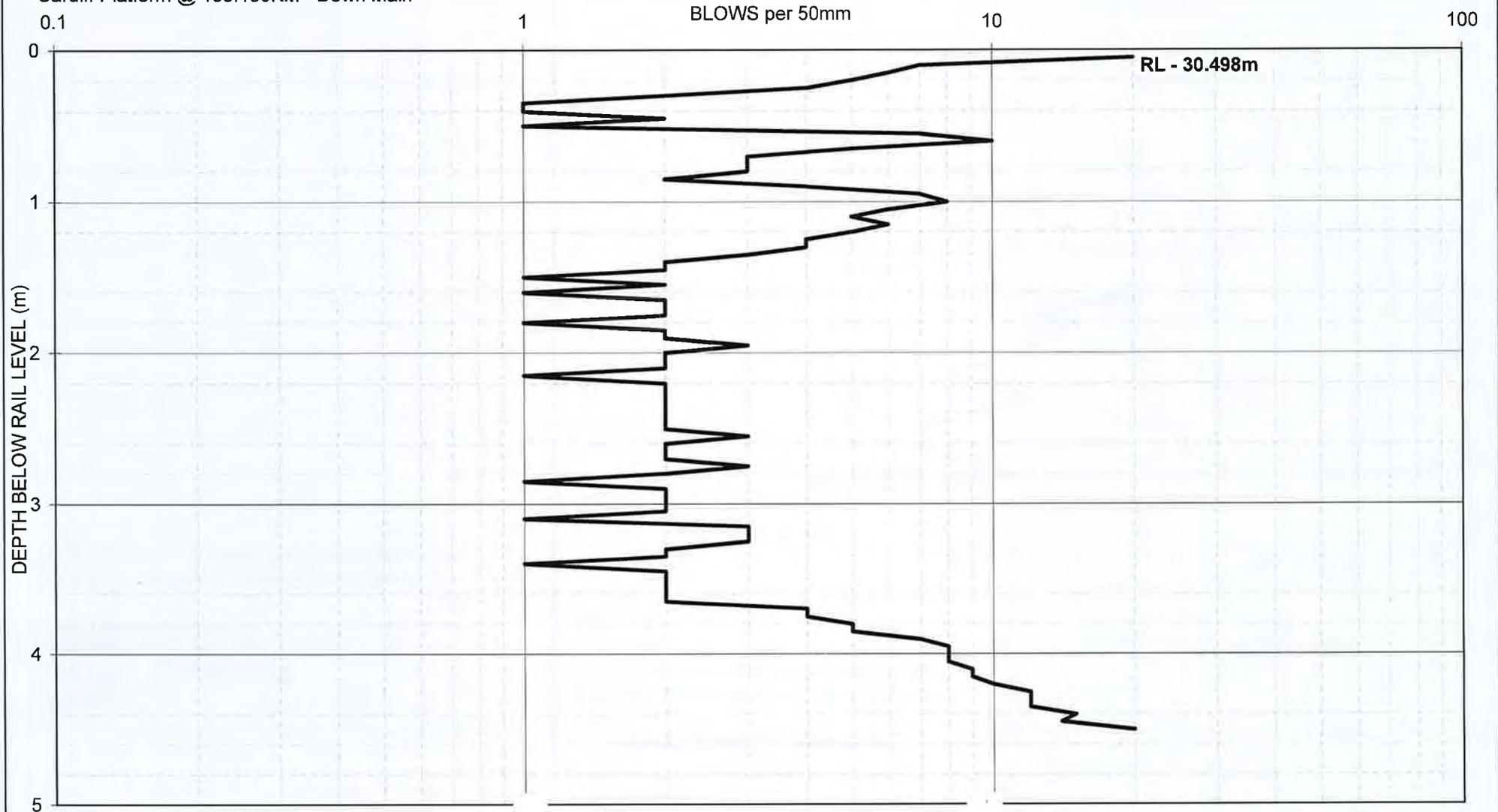


DYNAMIC CONE PENETROMETER TEST  
(IN ACCORDANCE WITH AS 1289 6.3.2)

DCP N° 8643-3

CARDIFF : Platform Extension Investigation  
Cardiff Platform @ 155.150KM - Down Main

Date: 31/08/10



1 2 3 4 5 6

← From Sydney

To Newcastle →

A

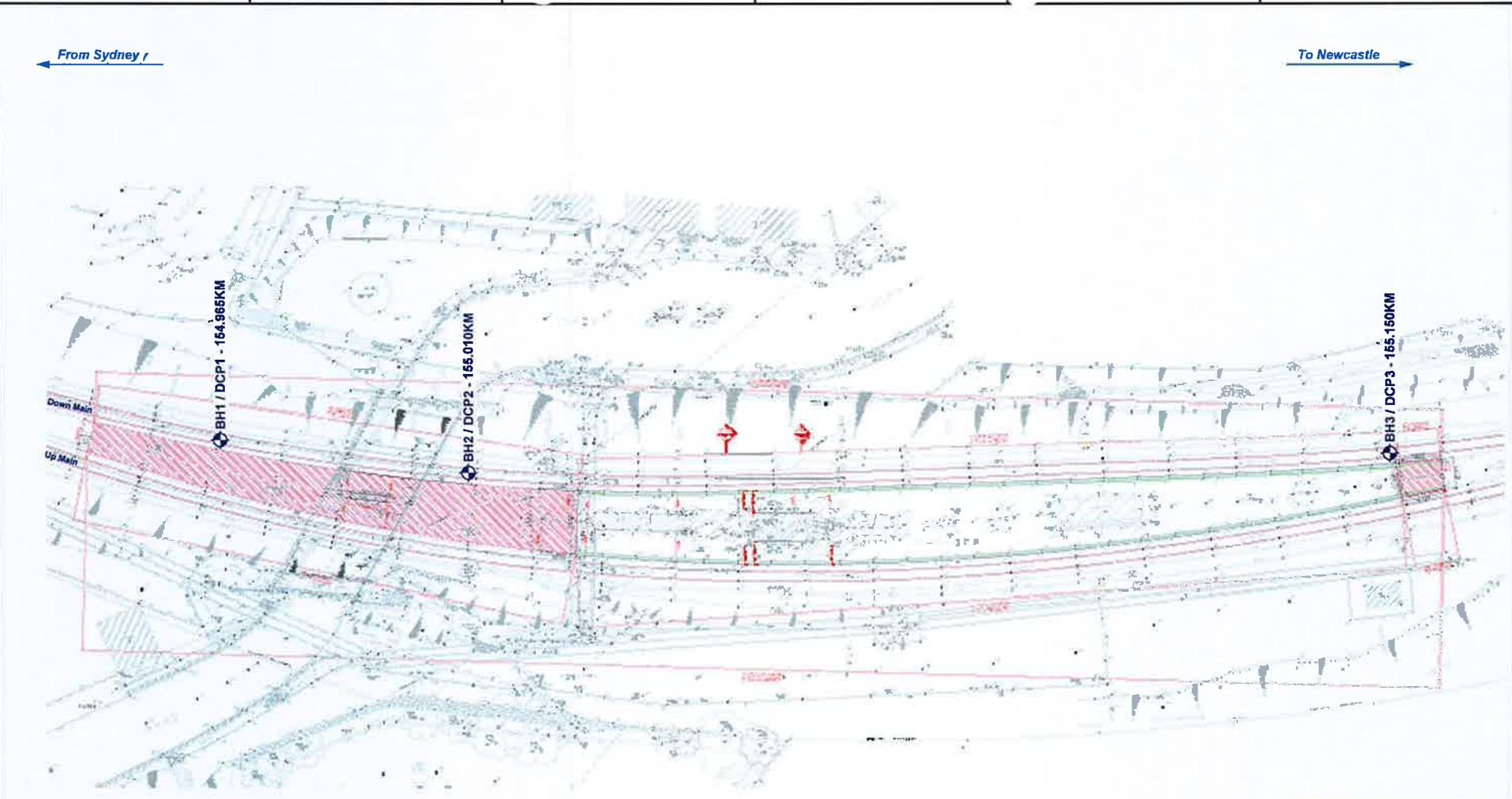
A

B

B

C

C



**BORE HOLE LOCATION**  
Not to Scale

**LEGEND**

Bore Hole / DCP

D

D

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AMD	REFERENCE	DESCRIPTION	SIGN/DATE

DRAWN H. Corssadden 07/09/10

DRG CHECK P. Ganewatta 25/02/11

*John Syt* 02/03/11

per / PRINCIPAL GEOTECHNICAL ENGINEER DATE

**Transport RailCorp**

ENGINEERING & PROJECTS GROUP  
PROFESSIONAL SERVICES DIVISION

**GEOTECHNICAL SERVICES**

9-13 Urwins Bridge Road Sydenham NSW 2044  
phone 9565 7111 fax 9593 7765 DX7047 RS

**CARDIFF**

154.965KM to 155.150KM - DOWN MAIN

**BORE HOLE LOCATION PLAN**

CAD FILENAME: GS 10 8643 SI 1	SHEET 1 OF 1	A3
DWG No. GS10-8643 SI 1		

1 2 3 4 5 6



### Hazardous Materials Register

Cardiff Station - Hazardous Material Register

Site: Cardiff Station

Consultant/Hygienist: Claudia Heidemann

Register owner: Building Maintenance Manager - Infrastructure  
Facilities - Building Maintenance North

Address: Main Road, CARDIFF

Inaccessible areas: Foundation spaces and wall cavities

Register issue date: 24-Jun-10

Next item review date: 17-Jun-13

Last item inspection date: 18-Jun-10

Legend: CH - Chrysotile, A - Amosite, C - Crocidolite, SMF - Synthetic Mineral Fibres, VFT - Vinyl Floor Tiles, AC - Asbestos Cement, FC - Fibre Cement

Date	Event	LOCATION					MATERIAL DESCRIPTION								RISK MANAGEMENT				CORRECTIVE ACTIONS			
		Station	Platform	Building	Room	Surface	Material Application	Quantity	Units	Sample Type	Sample ID No.	Photo No.	Analytical Result	Material Condition as Surveyed	Risk Status	Control Recommendations / Comments	Review interval (Months after Date)	Review date	Consultant/Hygienist Name	Control Action Taken (or SKMS Reference)	Date actioned	Contractor details
13/07/2006	1	Cardiff	1	Main Building	Kitchen	N/A	Hot water unit	1	sq. m	Fabric	N/A	1	Positive	Good	Low	Maintain material in current condition. Remove prior to refurbishment/demolition. Inspected on 7/06/07 by BMM North. Condition unchanged. Inspected 17/06/10, condition unchanged - DMM North.	36	17-Jun-13				
13/07/2006	2	Cardiff	1	Main Building	Ceiling	Ceiling Space	SMF insulation	200	sq. m	Fabric	N/A	2	N/A	Good	Low	Maintain material in current condition. Remove prior to refurbishment/demolition. Inspected on 7/06/07 by BMM North. Condition unchanged. Inspected 17/06/10, condition unchanged - DMM North.	36	17-Jun-13				
13/07/2006	3	Cardiff	1	Main Building	Ceiling	Ceiling Space	Hot water unit	1	sq. m	Fabric	N/A	3	N/A	Good	Low	Maintain material in current condition. Remove prior to refurbishment/demolition. Inspected on 7/06/07 by BMM North. Condition unchanged. Inspected 17/06/10, condition unchanged - DMM North.	36	17-Jun-13				
13/07/2006	4	Cardiff	1	Main Building	Ceiling	Ceiling Space	Sarking	200	sq. m	Fabric	N/A	4	N/A	Good	Low	Maintain material in current condition. Remove prior to refurbishment/demolition. Inspected on 7/06/07 by BMM North. Condition unchanged. Inspected 17/06/10, condition unchanged - DMM North.	36	17-Jun-13				
13/07/2006	5	Cardiff	1	Main Building	External Panels	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No hazardous materials identified - no further action required						
13/07/2006	6	Cardiff	1	Main Building	Station Manager's Office	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No hazardous materials identified - no further action required						
13/07/2006	7	Cardiff	1	Main Building	Booking Office	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No hazardous materials identified - no further action required						
13/07/2006	8	Cardiff	1	Commuter Shelter	Shelter	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No hazardous materials identified - no further action required						
13/07/2006	9	Cardiff	1	External areas and fence line	Exterior	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No hazardous materials identified - no further action required						



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**EXHIBIT G – LIST OF WARRANTIES REQUIRED FROM SUBCONTRACTORS**

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**List of Warranties Required from Subcontractors**

Description of Equipment	Period of Years
Roofing and roofing installation	25
Waterproofing	25

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**EXHIBIT I – (NOT USED)**

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