Sydney Trains Environmental Management System
Site Environmental Management Plan (SEMP)

Introduction

Sydney Trains is the proponent and determining authority for this activity. This environmental impact assessment is being completed in accordance with Division 5.1 of the Environmental Planning and Assessment Act 1979 (EP&A Act) and Part 8 of the Environment Planning and Assessment Regulation 2021 (EP&A Reg). This SEMP forms the assessment when paired with the associated Environmental Work Method Statements.

The activity covered by this assessment is routine maintenance or ancillary works associated with the ongoing safe operation and management of the Sydney Trains rail network in accordance with NSW and Federal statutory objectives. As such, and in respect to this assessment, the cumulative impacts of the routine maintenance and ancillary works are negligible and alternatives to undertaking the works have not been assessed.

1 Project / Program details

Project / Program Details		
Project/Program Name	Croydon Station Platform 5 Embankment Stabilisation Works	
Project/Program No	P.0053895	
Scope of Works	• Post and Panel Retaining wall - Croydon Station – Paisley Road • Installing new retaining wall and back fill the embankment at Platform 5	
What is the cost of the scope of works?	☑ Routine maintenance - any value ☐ Capital investment - less than $5 million ☐ Capital investment - more than $5 million	
Location	Croydon Station	
Attach applicable Environmental Work Method Statement (EWMS)	EWMS Number	EWMS Title
	EMS-03-EW-0266	Cutting and Embankment Stabilisation
	EMS-03-EW-0292	Service Route Installation
Is any of the proposed work outside of the EWMS' scope?	☑ No: Continue to next question	
	☐ Yes: *Contact your environmental officer to determine how the works' environmental assessment can proceed*	
Does this work have any steps or equipment that are not covered by the EWMS?	☑ No: Continue to next question ☐ Yes: Provide details below	
Is the work part of a larger job?	☑ No: Continue to *Part 2 Project Timing and Location* ☐ Yes: Provide details of larger job and relationship to these works	

	Contact your local environmental officer. The larger project may have environmental controls that need to be applied to this job. *All relevant conditions and controls need to be added to PART 5. Summary of approvals and control measures*

2 Project timing and location(s)

2.1 Project timing

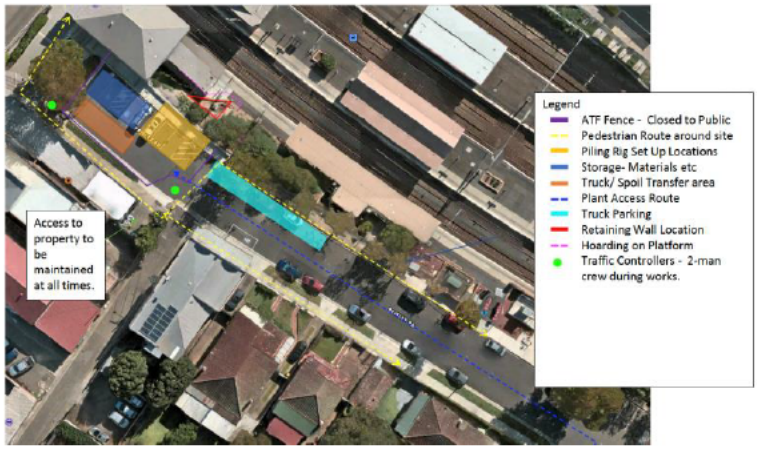
Activity	Dates & work hours, noting any 'Out of hour' periods (Out of hour = outside of 7am–6pm Monday to Friday or 8am–1pm Saturday)
Works/program commencement: *Including pre-works, site establishment (including access, laydown/stockpiles, site amenities, parking), installation of erosion and sediment controls, etc*	Between 17th - 21st April – Aim to complete de-vegetation and minor hand excavation. Wednesday 26th April – 7am – 4pm- Starting set up Thursday – Friday 27th – 28th April -7am – 4pm -gear mobilisation and materials WE44 - 29th - 30th April – Start 5am Saturday to 10pm Sunday. Around the clock - Piling, concreting, and installing posts. 1st – 2nd May – demobilise plant off site. 7am – 4pm 8th – 12th May (7am – 4pm) Install panels, backfill, and demobilise all gear off site.
Site construction and/or periodic maintenance activities *For programs/ recurring maintenance detail recurrence frequency and work hours of activities*	Between 17th -21st April – Aim to complete deveg and minor hand excavation. Wednesday 26th April – 7am – 4pm- Starting set up Thursday – Friday 27th – 28th April -7am – 4pm - gear mobilisation and materials WE44 -29th - 30th April – Start 5am Saturday to 10pm Sunday. Around the clock - Piling, concreting, and installing posts. 1st – 2nd May – demobilise plant off site. 7am – 4pm 8th – 12th May (7am – 4pm) Install panels, backfill, and demobilise all gear off site.
Works/program completion: *Including demobilisation and removal of all site offices, equipment and materials.*	Complete and off site by 12th May.

2.2 Existing environment

Where multiple sites are to be covered by this form each location is to be identified separately in the following question set (e.g. Site 1, Site 2, etc)

The descriptions are to be derived from desktop studies such as aerial photos, overlays and databases (e.g. WebGIS ME) and are to be confirmed, modified and expanded by a pre-work site inspection and. Descriptions must include aspects such as acute slope/fall, waterways, drains, vegetation and individual trees, heritage items or curtilage, difficult access, traffic, nearest neighbours etc

Site 1: Platform 3

	Local environment includes: ☐ In, or near, residential area ☐ In, or near, customer areas ☐ Tunnel/underground location ☑ Easement/off corridor areas ☑ Open spaces ☑ Sparsely vegetated spaces ☐ Thickly vegetated spaces ☐ In, or near, waterways or drains ☐ Other (specify):

3 Consultation requirements

3.1 Consultation with adjoining land managers

Do the works require consultation with other land managers[1]?	
Will the works result in substantial impacts on Council related infrastructure and services or locally listed heritage items? (i.e. local heritage items, stormwater, traffic, sewerage, water or impact on public place or footpaths, or works that impact flood prone areas or coastal areas)	☑ No: Continue to next question ☐ Yes: Identify requirements and how they were addressed: .....
Are the works adjacent to land reserved under the *National Parks & Wildlife Act 1974?*	☑ No: Continue to next question ☐ Yes: Identify requirements and how they were addressed: .....
Consultation required with other stakeholders (e.g. Roads, Crown Land, Private landholder etc.)	☑ No: Continue to next question ☐ Yes: Identify requirements and how they were addressed: .....
(1) Where consulted, all land managers must have a minimum 21 days to provide comments. Comments received must be considered and appropriate actions identified in *Part 5.1*	

3.2 Community consultation

Could there be community interest in the works?	
☑ No: Community consultation assessment not required	☐ Yes: Complete **EMS-03-FM-0104 *EIA Public Engagement Assessment*** and identify the assessment outcome; ☐ 'Outrage' risk management ☐ Targeted public consultation ☐ Public engagement not required Actions arising from this assessment are to be identified in *Part 5 Summary of approvals and control measures*

4 Environmental assessment

4.1 Working outside the Active Operational Zone (AoZ)

Are any works to be completed outside the AoZ?	
☑ No: Continue to Section *4.2 Vegetation condition*	☐ Yes: *Contact your environmental officer for support.* ***EMS-03-FM-0249 EWMS activities outside AoZ** must be completed by an environmental officer and must be attached to this SEMP.*

Vehicle access across land that is not in the control of Sydney Trains via roads, access ways, easements, or with the consent of the relevant landowner is not considered to form part of the works outside the AOZ

4.2 Vegetation condition

Has all the vegetation within the worksite been maintained(1) within the last 10 years?	
☐ Yes: Continue to Section 4.3	☑ No/Don't know Vegetation removal will be in accordance with arborist report and recommendations, replacement planting of *Callistemon spp* will be completed.
Note (1): 'Maintained' means pruned, weeded, mowed or other activity that significantly disturbed the vegetation.	

4.3 Sensitive sites

For works undertaken outside of the AOZ the following section is to include all sites identified by the environmental officer in the activities' **EMS-03-FM-0249 *EWMS activities outside AOZ.***

Will the works be located in, or within 100m of a Sensitive Site? (Ref: Web GIS ME)	
• Aboriginal heritage site or Environmentally Sensitive Site?	☐ Yes ☑ No
• Contaminated Site?	☐ Yes ☑ No
• Non-Aboriginal Heritage site?	☑ Yes ☐ No

A separate line is to be completed in the following table for each site/location identified		
Location and distance (m) from the worksite	**Nature of site** (Details from database or register)	**Potential for the works to impact [2]**
0m	Heritage Act - s.170 NSW State agency heritage register Croydon Railway Station Group 4801110	Low

Notes:
- Information about sensitive sites must be sufficient to be able to make an informed decision on potential impacts and appropriate project controls.
- Additional assessments may be required for works in or adjacent to some sensitive sites. Please see the

environmental officer and/or individual subject matter procedures for specific requirements.

- Where works have the potential to impact sensitive sites the required additional controls, approvals, notifications, etc must be listed in the relevant section of *Part 5 Summary of approvals and control measures*

4.4 Noise and vibration assessment of the works

A. Are there any noise sensitive receivers (1) within 350m of works?	
☐ No Works do not need further noise assessment, go to Section 5.	☑ Yes Describe receivers and continue to Part B. Receivers: Residential Distance: 100m

B. Track work on a moving face		
Will work be limited to track work on a moving face, be undertaken for less than five (5) consecutive days and consist only of one or more of the following activities: ☐ Ballasting or ballast clean ☐ Resurfacing (tamping, stabilising, regulating) ☐ Rail profiling ☐ Continuous track welding / rail adjusting	☐ Yes	Works do not need noise and vibration assessment, go to Section 5.
	☑ No	Continue to Part C.

C. Answer the following		
Will there be any equipment producing noise levels of: ☐ more than 80 dBA (2) during Standard Hours (3), and/or ☑ more than 60 dBA (2) outside of Standard Hours (3) or ☑ Will the works use pile drivers, hydraulic hammers or vibratory rollers (or similar vibration inducing plant)? or ☐ Will works at any one location last more than 3 weeks in duration?	☐ No	Works do not need further noise and vibration assessment, go to Section 5.
	☑ Yes	Complete **EMS-09-FM-0166 *Maintenance Quantified Noise and Vibration Assessment*** and include any resulting actions in Section 5.

(1) Noise sensitive receivers include residences, hospitals, places of worship, schools, aged, childcare facilities, etc.
(2) Noise levels are for the loudest equipment's 'Modified 10m Sound Pressure' as given in **EMS-09-FM-0166 *Maintenance Quantified Noise and Vibration Assessment*** ('SoundPressure' Table, 'References' Tab).
(3) Standard Hours' = 7am-6pm Monday to Friday and 8am-1pm Saturday

5 Summary of approvals and control measures

For works undertaken outside of the AOZ, the following section is also to include all actions and controls arising from the project's **EMS-03-FM-0249 *EWMS Activities Outside of AOZ***.

5.1 Permits, approvals and consultation

Describe all relevant permits, approvals and consultation requirements for the works.

Environmental Hazard	Permits/Other Requirements	Timing	Responsibility
Damage to Heritage	Heritage Approval (Section 60) Application under	Approved	PM/Contractor

Environmental Hazard	Permits/Other Requirements	Timing	Responsibility
Fabric	section 60 of the Heritage Act 1977 Croydon Railway Station Group State Heritage Register No. 01125		
Burwood Council	Temporary Road Closure Permit # 23/15487 - Road closure for work zone to facilitate piling and retaining wall works at Croydon Train Station.	Approved	PM/Contractor

5.2 Environmental controls

Environmental Hazard	Work controls and responsibility *including those from the EWMS, PART 4 of this SEMP, specialist reports and/or licences and all other relevant activities*
Works community notification:	*Project manager* Letterbox notification provided: Local ☐ Possession ☑
Awareness and responsibility: *Staff unaware of the works' environmental controls and their responsibilities*	*Site supervisor* • Undertake site pre-work briefings and local inductions using the SEMP and the SECM to cover the work's environmental risks and controls and the workers environmental responsibilities • Delivery toolbox talks relevant to the environmental hazards • Maintain a readily accessible copy of the environmental approval (including all associated specialist approvals and plans) at the worksite whenever work is being undertaken. • Display prominently on site, where possible, the SECM and make sure it is accurate and used
Dust: *Emissions of dust leaving site from earthworks, stockpiles and works traffic*	• Use water cart to dampen exposed surfaces including access roads, work areas and stockpiles • Cover long term stockpiles • Keep vehicles to existing access roads • Minimise removal of vegetation from worksite • Daily inspections
Environmentally sensitive sites: *Unintentional or unapproved impact on environmentally sensitive sites*	• Maintain tape or other suitable fencing around "no go zones" • Clear minimal vegetation, only as approved. • Trim or remove trees under direction of an arborist. • Keep vehicles and equipment away from vegetation. Preserve wildlife / habitat where possible. • Contact WIRES as required for injured animals. • Remove weeds from plant before leaving infested sites. • Use weed control process (spray qualifications, data sheets) • Cap filled embankment with 600mm of crushed sandstone prior to revegetation • Revegetate disturbed areas using locally native, appropriate species, in an approved vegetation plan.
Erosion and sedimentation: *Loss of soil and sediment from worksite to surrounding environment, including tracking onto public roads*	• Develop erosion and sediment control plan for site and install erosion and sediment control structures prior to commencing site work • Maintain erosion and sediment control structures during works and until site has stabilised after completion of works • Provide sediment protection to stockpiles

Environmental Hazard	Work controls and responsibility *including those from the EWMS, PART 4 of this SEMP, specialist reports and/or licences and all other relevant activities*
	• Engage street sweeper to keep public roads used to access site clean of mud tracking and silt • Daily inspections
Heritage: *Unintentional or unapproved impact on Aboriginal and non-Aboriginal heritage*	• Works comply with the conditions set out within the Application under section 60 of the Heritage Act 1977 Croydon Railway Station Group State Heritage Register No. 01125 (approved 30 November 2022).
Incidents and emerging issues *An incident or emerging issue is not controlled and causes an environmental impact*	*Project Manager* • Support management of emerging issues and incident management, notification, investigation, and the completion of corrective and preventative actions *Site supervisor* • Complete daily inspections of the site, plant and equipment and the surrounding area • Implement incident procedures on unapproved impacts, spills, and other environmental incidents • Notify incidents to the Incident and Injury Hotline 1800 772 779 or enter incident directly into SHEM
Light spill: *Impact of work light sources on neighbouring residents and properties - particularly the potential for sleep disturbance*	• Ensure parked vehicles headlights do not shine into residences • Daily inspections • Will use flood lights during Saturday 29th April night shift to complete works safely – only will be required for 1 shift. Aim to ensure that lights are not pointed at residents but pointed down to work area.
Noise and vibration: *Impact of works noise and vibration on neighbouring residents and properties – particularly the potential for sleep disturbance*	Wherever practicable implement the following measures: • Notify affected land occupiers within an 250m radius of all works in regard to the construction during out of hours works at least 5 days prior to commencing (to be done as part of general possession notification). • Plant and equipment will be used and operated on Sydney Trains land with furthest practical offset distance from residential receivers. • Implement respite periods. • The noisiest works would be undertaken during normal business hours where feasible. • Where practical orientate plant and equipment to reduce noise impact. • Conduct toolbox talks on minimising noise including all out of hours works • Scheduling works to limit impacts on sensitive receivers.
Plants and animals: *Unintentional or unapproved impact on native and protected plants, animals and communities and the spread of noxious weeds*	**Vegetation and wildlife management** • Vegetation removal and pruning conducted in accordance with the Arboricultural Assessment Memorandum prepared for British Concrete for Croydon Railway Station Upgrade (March 2023). • The abovementioned arboricultural assessment was undertaken on the 8th of March 2023, by a suitably qualified AGS arborist. The subject trees were assessed to have 'low' Retention Value due to their low amenity, ecological and heritage value. • It is recommended that, where practicable, any proactive tree removal is carried out in conjunction with considered Compensatory Replanting to offset canopy loss, recommended replacement species: ***Myrtacaea*** | ***Callistemon viminalis*** | **Weeping Bottle**
Plant and equipment emissions: *Smoke, fumes., odours and other emissions from plant and equipment*	• Maintain equipment in accordance with manufacturer's written specification • Ensure daily plant checklists completed and repairs made as required

Environmental Hazard	Work controls and responsibility *including those from the EWMS, PART 4 of this SEMP, specialist reports and/or licences and all other relevant activities*
Soil contamination: *Contamination of worksite from stockpiling and chemical storage and use*	• Identify potential contaminants prior to commencing work on site • Develop stockpile management plan to ensure segregation of potentially contaminated materials from clean materials • Implement stockpile plan • Daily inspection
Spills: *Unintentional loss of hydrocarbons, chemicals and materials from plant, equipment, storage and use*	• Ensure daily plant checklists completed and repairs made as required • Ensure all plant has suitable spill kits and operators trained in use and disposal of used materials • Notify Pollution Incidents to the Safety Incident and Injury Hotline 1800 772 779 • Ensure SDS is onsite for all stored chemicals
Traffic: *Traffic disruption to community and other users around worksite*	• Implement Traffic Management Plan • Plan all vehicle movements to occur outside of local peak traffic periods • Ensure offsite staging areas in low impact areas • Utilise qualified traffic control staff • Traffic control will be installed during works. Council permits to close the compound space as been approved. Will follow council approval requirements.
Visual impact: *Visual impact on community due to works and worksite facilities and activities*	• Place stockpiles and site amenities away from residents and remove them as soon as possible. • Create or maintain existing visual screens using vegetation, shade cloth on fences or natural site features
Waste: *Unnecessary generation of wastes and poor or illegal disposal of wastes*	**Construction waste (e.g. spoil, concrete, litter, etc)** • Do not overestimate quantities of materials required. • Separate wastes into recyclable categories • Ensure wastes are placed in appropriate containers • Minimise mixing of new ballast and spoil • Daily inspections • Check and clean spoil wagons / trucks before leaving worksite. • Remove stockpiles as soon as possible. • No spreading of weed infested material within corridor • Wash out containers prior to disposal.
The works' SECM must illustrate the relevant work areas and site environmental controls described above	

5.3 Biodiversity offset

Is a Biodiversity Offset required for the project?	
☑ No: Continue	☐ Yes: Provide the following information: Value[1]: _____
(1) All calculations are to be in accordance with ***EMS-06-WI-0177* Biodiversity Offsets Calculator**	

5.4 SEMP documents

For environmental planning and assessment purposes the SEMP for this job comprises of:

☑ This SEMP

☑ The Environmental Work Method Statement (EWMS) referred to in Section 1

☑ The attached project's Site Environmental Control Map

Plus (tick as appropriate):

☐ **EMS-03-FM-0248 *EWMS Scope Exception***

☐ **EMS-09-FM-0249 *EWMS Activities outside AOZ*** (see Section 4.1)

☑ **EMS-09-FM-0166 *Maintenance Quantified Noise and Vibration Assessment*** (see Section 4.3)

☐ Additional environmental studies, approvals (including Aboriginal and non-Aboriginal heritage)

5.5 Environmental review requirements

Is review required by an environmental assessor?	
Is this for a program of work?	☐ Yes ☑ No
Is any of the work to be completed outside of the Active Operational Zone (AOZ)?	☐ Yes ☑ No
Is any work being undertaken or will impact on land controlled by others?	☐ Yes ☑ No
Is access required across land controlled by others that is not a road, easement or right of way?	☑ Yes ☐ No
Were any sensitive sites identified in Section 4.2?	☑ Yes ☐ No
Is any work being undertaken in embankments, cuttings or on the boundary fence?	☐ Yes ☑ No
Is extensive Council or other Authority consultation required?	☐ Yes ☑ No
Are environmental impacts "likely" and "significant"	☐ Yes ☑ No
Was an **EMS-10-FM-0166 *Maintenance Quantified Noise Assessment*** required (Section 4.3) AND was a work phase identified as High Risk?	☑ Yes ☐ No
Is work likely to cause community concern (other than noise)?	☐ Yes ☑ No
Were additional environmental studies or approvals (e.g. heritage) required?	☐ Yes ☑ No
Were any biodiversity Offsets required for the project?	☐ Yes ☑ No

If "Yes" to any of the above, this form must be submitted to the local environmental officer for assessment at least 4 weeks prior to the planned commencement date of the works.

Report all pollution and environment incidents immediately to SHEM or the Incident and Injury Hotline (1800 772 779) and your local environment officer.

8 Determination

The works covered by this document have been determined to proceed under Division 5.1 of the *Environmental Planning & Assessment Act 1979* and Part 8 of the *Environmental Planning & Assessment Regulation 2021* subject to the implementation of all mitigation measures and actions identified in this document.

Position of Determiner: Project Manager

Date of Determination: 14/04/2023

This version of the document has been redacted to remove personal information.

To provide comments on this EIA please complete a Sydney Trains Feedback Form or call the Sydney Trains Feedback Line on 131 500.

Acknowledgement of Country

Sydney Trains acknowledges the traditional custodians of the land on which we work and live. We pay our respects to Elders past and present and celebrate the diversity of Aboriginal people and their ongoing cultures and connections to the lands and waters of NSW.

Cutting and embankment stabilisation

Environmental Work Method Statement

Sydney Trains Incident Hotline
1800 772 779

Scope of EWMS:

EWMS works are limited to cutting and embankment stabilisation works including:

- Shotcreting
- Cutting widening
- Rock bolting
- Embankment widening

Not in Scope:

Works not in scope include:

- Significantly changed landforms, (>2500 square metres of disturbance)
- Retaining walls (see EMS-03-EW-0268 *Retaining walls*)

Note: Works not in scope may require a different form of environmental assessment and approval, Contact local environmental officer for guidance

Project manager requirements:

- Has a Sydney Trains employee number
- Completed *Environmental Management for Projects* (online) and *SEMP Masterclass* training

External notifications:

Parties outside of Sydney Trains that are likely to require works' notification

- Letter box drop to residents (if identified in SEMP)
- Local Council when affecting Council infrastructure e.g. stormwater drainage
- NPWS (e.g. when adjoining land or within National Park

Permits / licences:

Licences and permits not issued by Sydney Trains that are likely to be needed for works

- Heritage approval (if identified SEMP)
- Road closure permits (if identified in SEMP

Plant and equipment

- excavator
- backhoe
- grader
- water cart
- trucks
- roller
- chainsaws
- mulcher
- dump truck
- rock hammers
- rock grinders
- water cart
- bobcat
- loader
- Drilling rig
- EWP
- concrete truck & pumps
- spray unit
- air compressor
- hand tools
- mulch blowers

Environmental Hazard Matrix

Job steps	Environmental hazard														
	Awareness and responsibility	Biodiversity	Chemical and fuel storage and decant	Dust	Erosion and sedimentation	Heritage	Incidents and emerging issues	Light Spill	Noise and vibration	Pesticides	Plant and equipment emissions and spills	Soil and water contamination	Traffic	Visual impacts	Waste
Site establishment (including material / plant delivery, establish site amenities, place skip bins, install erosion and sed control, etc)	Y	Y	Y	Y	Y	Y	Y	-	Y	-	Y	Y	Y	Y	Y
Access road maintenance (see EMS-03-EW-0263)	-														
Excavation works (rock removal, prepare shotcrete, fill embankment)	Y	Y	Y	Y	Y	-	Y	Y	Y	-	Y	Y	Y	-	Y
Installation of rock bolts, dowels	Y	-	Y	Y	Y	-	Y	-	Y	-	Y	Y	Y	-	Y
Grouting, shotcreting, fibrecreting, mesh blowdown	Y	-	Y	-	Y	-	Y	-	Y	-	Y	Y	Y	-	Y
Stockpile and disposal of waste (e.g. excavated spoil, vegetation)	Y	Y	-	Y	Y	-	Y	-	Y	-	Y	Y	Y	-	Y
Site demobilisation (including final waste disposal, site reinstatement, etc)	Y	Y	-	Y	Y	-	Y	-	Y	-	Y	Y	Y	-	Y

Hazard Control Table

Environmental Hazard	Control and responsibility	Control reference
Awareness and responsibility: *Staff unaware of the works' environmental controls and their responsibilities*	*Project manager* • *SEMP*: The SEMP is signed by the site supervisor and they are aware of the environmental controls and conditions, including those within the SEMP's specialist studies and approvals *Site supervisor* • Undertake site pre-work briefings and inductions using the SEMP and the SECM to cover the work's environmental risks and controls and the workers environmental responsibilities • Delivery tool-box talks relevant to the environmental hazards • Maintain a readily accessible copy of the environmental approval (including all associated specialist approvals and plans) at the worksite whenever work is being undertaken. • Display prominently on site, where possible, the SECM and make sure it is accurate and used	• Site Environmental Management Plan • **SMS-06-OP-3114 *Pre-work Briefings***
Biodiversity: *Unintentional or unapproved impacts on native and protected plants, animals and ecological communities*	*Project manager* • *DESIGN*: Minimise impacts on native flora and fauna, particularly protected species and communities as far as practical • *DESIGN*: Revegetate disturbed areas using locally native, appropriate species, in an approved vegetation plan • *SEMP*: Identify and obtain appropriate approvals for biodiversity impacts. Include controls in SEMP Section 5.2. *Site supervisor* • Remove weeds from plant before leaving weed infested areas • Use tape or other suitable fencing around "no go zones" • Clear minimal vegetation and do not clear any vegetation outside of approved scope • Trim or remove trees under direction of an arborist • Keep vehicles and equipment away from areas of vegetation • Contact WIRES as required for injured animals • Complete post-work site rehabilitation works, maintenance and inspections and transfer ownership to operational area at end of responsibility	• Site Environmental Management Plan • **EMS-06-OR-1006 *Biodiversity***

Environmental Hazard	Control and responsibility	Control reference
Chemical and fuel storage and decant: *Unintentional loss of chemicals and fuels during storage and decanting*	*Project Manager* • *SEMP*: Check SDS for any chemicals being used to determine if special storage and preparation controls are needed. Include controls in SEMP Section 5.2. *Site supervisor* • Maintain current SDS's onsite for all stored chemicals and follow any special precautions • Chemicals and fuels are stored in appropriately labelled and approved containers • Bund temporary fuel and chemical storage and decant facilities away from drains and waterways	• Site Environmental Management Plan • Safety Data Sheets (SDS)
Dust: *Emissions of dust leaving worksite from earthworks, stockpiles and works traffic.*	*Project manager* • *DESIGN*: Minimise and stage removal of vegetation from worksite during design and works planning *Site supervisor* • Select plant and equipment for the task that is fit for purpose and minimises dust generation • Use water cart to dampen exposed surfaces including access roads, work areas and stockpiles • Cover long term stockpiles • Minimise removal of vegetation from worksite • Keep vehicles to existing access roads	• Site Environmental Management Plan. • **EMS-05-GD-0013 *Air Quality Guide***
Erosion and sedimentation: *Loss of soil and sediment from worksite to surrounding environment, including tracking onto public roads*	*Project manager* • *SEMP*: Develop erosion and sediment control plan for site using suitably trained and qualified personnel. Note: level of ESC training required is dependent upon the area of ground to be disturbed. *Site supervisor* • Site supervisor to have completed Level 1 Erosion and Sediment Control course • Install and maintain erosion and sediment control structures from prior to commencing site work until site has stabilised after the completion of works • Use a street sweeper to regularly remove mud and silt from public roads used for site access • Include sediment control in stockpile management • Complete post-work site rehabilitation and erosion and sediment control maintenance and inspections (transfer ownership to operational area at end of responsibility)	• Site Environmental Management Plan • **EMS-14-PR-0012 *Erosion and Sediment Control***

Environmental Hazard	Control and responsibility	Control reference
Heritage: *Unintentional or unapproved impact on Aboriginal and non-Aboriginal heritage*	*Project manager* • *SEMP*: Use SEMP to identify and manage impact to Aboriginal and Non-Aboriginal Heritage sites. Contact a Transport Heritage Specialist for advice regarding approval to impact heritage sites. Add controls from approval to SEMP Section 5.2. *Site supervisor* • Isolate and demarcate heritage sites to prevent accidental damage • If a heritage or archaeological item is uncovered, immediately stop further disturbance, demarcate the site, contact your environmental support and follow **EMS-09-PR-0164 *Unexpected Archaeological Finds***	• **EMS-03-FM-0249 *EWMS Activities outside the AoZ*** • Site Environmental Management Plan • TAHE (former RailCorp) Section 170 Heritage and Conservation Register • Sydney Trains environment WebGIS • **EMS-09-PR-0164 *Unexpected Archaeological Finds***
Incidents and emerging issues *An incident or emerging issue is not controlled and causes an environmental impact*	*Project Manager* • *SITE*: Support management of emerging issues and incident management, notification, investigation and the completion of corrective and preventative actions *Site supervisor* • Complete daily inspections of the site, plant and equipment and the surrounding area to identify unexpected impacts and future potential impacts • Consider how changes in the weather could affect the works and the works controls (e.g. during high winds, heavy rainfall, etc) • Contact your environmental officer if the NSW EPA or other external party conducts an environmental site visit • Implement incident procedures on unapproved impacts, spills and other environmental incidents • If a spill occurs, then immediately notify incidents to the Incident and Injury Hotline 1800 772 779 or enter incident directly into SHEM • Refer all complaints to the *Sydney Trains & NSW TrainLink Environmental Feedback Line* on 1300 500 or https://transportnsw.info/contact-us	• Site Environmental Management Plan • **EMS-03-PR-0224 *Incident Environmental Management*** • **EMS-02-WI-0214 *Notify Pollution Incidents*** • **EMS-09-PR-0164 *Unexpected Archaeological Finds***
Light spill: *Impact of work light sources on neighbouring residents and properties - particularly the potential for sleep disturbance*	*Site supervisor* • Locate portable lighting towers so that they are not directed at residential properties • Ensure parked vehicles headlights do not shine into residences,	• Site Environmental Management Plan

Environmental Hazard	Control and responsibility	Control reference
Noise and vibration: *Impact of works noise and vibration on neighbouring residents and properties – particularly the potential for sleep disturbance*	*Project manager* • *SEMP*: Identify potentially sensitive noise receivers and identify relevant controls through the noise assessment (as required by SEMP) *Site supervisor* • Schedule more noisy work for 'standard hours' (7am to 9pm Monday to Friday, 8am to 1pm Saturday), where practical • Limit operating and idling plant and equipment on site, where practical • Locate noisy equipment, parking areas and assembly areas away from sensitive receivers, where practical and instruct workers to minimise noise during shift changes and at crib areas • Use non-tonal reversing alarms on vehicles, where practical • All plant and equipment to be operated with effective noise attenuation equipment (e.g. mufflers)	• Site Environmental Management Plan • **EMS-10-GD-0083 *Guide to Rail Infrastructure Noise and Vibration Management*** • **EMS-10-FM-0166 Maintenance Quantified Noise and Vibration Assessment**
Plant and equipment emissions and spills: *Smoke, fumes., odours and other emissions from plant and equipment. Spills of hydrocarbons from plant and equipment*	*Project Manager* • SEMP: Specify plant and equipment for the task that is fit for purpose and minimises offsite impacts (e.g. smoke, exhaust, noise, etc) *Site supervisor* • Plant and equipment is operated and maintained in a proper and efficient manner with all of its pollution control equipment in place and functioning • Plant and equipment not used when needing repair • Plant and equipment is regularly checked for wear, leaks, odours, fumes and smoke • All plant to have suitable spill kits and operators trained in their use and the disposal of used spill kit materials	• Site Environmental Management Plan • **SMS-16-OP-3076 *Inspection, Testing and Monitoring***

Environmental Hazard	Control and responsibility	Control reference
Soil and water contamination: *Contamination of worksite from stockpiling and chemical use*	*Project manager* • *DESIGN* and *SEMP*: Identify potential contaminants prior to commencing work on site • *DESIGN* and *SEMP:* Check SDS for any chemicals being used to determine if special use controls are needed. Add any controls to SEMP Section 5.2. *Site supervisor* • Develop a stockpile management plan to segregate potentially contaminated materials from clean materials • Undertake daily inspections for spills and contamination (e.g. vehicle tracking, unauthorised material movement, containment failures, etc) • Check all imported material for contamination (including weeds, construction wastes, etc)	• Site Environmental Management Plan • **EMS-07-PR-0004 *Contaminated Land Management***
Traffic: *Traffic disruption to community and other users around worksite*	*Project manager* • *SEMP*: Develop a Traffic Management Plan, where appropriate *Site supervisor* • Plan all vehicle movements to occur outside of local peak traffic periods • Place offsite staging areas in low impact areas • Obtain a Road Occupancy Licence, as necessary • Utilise qualified traffic control staff	• Site Environmental Management Plan
Visual impact: *Visual impact on community due to works and worksite facilities and activities*	*Project manager* • *DESIGN*: Consider visual amenity of structure or item (e.g. retaining walls) in design, e.g. tiering, climbing plants or other measures to soften structure *Site supervisor* • Place stockpiles and site amenities away from residents, and remove them as soon as possible • Create or maintain existing visual screens such as using vegetation, shade cloth on fences or natural site features • Keep the site tidy and free of litter	• Site Environmental Management Plan • **EMS-03-GD-0014 *Visual Amenity Guide***

Environmental Hazard	Control and responsibility	Control reference
Waste: *Unnecessary generation of wastes and poor or illegal disposal of wastes*	**Construction waste (e.g. spoil, concrete, litter and rubbish, etc)** *Project manager* • *SEMP:* Develop a Waste Management Plan if the works will generate a significant quantity of wastes, difficult wastes or waste of an unknown quantity/contamination *Site supervisor* • Do not overestimate quantities of materials required • Separate wastes, place all wastes in appropriate containers and dispose of them as they are generated • Prevent the mixing of similar new and waste materials • Classify all wastes in accordance with the NSW EPA Waste Classification Guidelines • Only use approved waste contractors and dispose of all wastes leaving site to facilities licenced to receive the waste • Keep records of all waste classification, transport, disposal, reuse and recycling activities	• Site Environmental Management Plan • **EMS-13-OR-1013 *Waste Management*** • EPA Waste Classification Guidelines
	Slurry wastes (e.g. concrete, supersucker, etc) *Site supervisor* • Ensure proper and immediate disposal of slurry offsite, or construct a correctly sized, impermeable slurry holding facility and properly dispose of all dewatered wastes	• Site Environmental Management Plan • **EMS-13-WI-0183 *Hydrovac Slurry Management***
	Vegetation management waste (e.g. clippings, branches, etc) *Site supervisor* • Ensure wastes are placed in appropriate bags or containers • All cut vegetation (clippings (mower/whipper sniping clippings, leaves, branches & other) to be removed from site and recycled (where possible) • No spreading of weed infested material within corridor	• Site Environmental Management Plan • **EMS-13-OR-1013 *Waste Management***

Acknowledgement of Country

Sydney Trains acknowledges the traditional custodians of the land on which we work and live. We pay our respects to Elders past and present and celebrate the diversity of Aboriginal people and their ongoing cultures and connections to the lands and waters of NSW.

Retaining walls

Environmental Work Method Statement

Scope of EWMS:

EWMS works are limited to:

- Construction, rebuilding or major maintenance to retaining walls

Not in Scope:

Works not in scope include:

- Revetment in a waterway

Note: Works not in scope may require a different form of environmental assessment and approval, Contact local environmental officer for guidance

Project manager requirements:

- Has a Sydney Trains employee number
- Completed *Environmental Management for Projects* (online) and *SEMP Masterclass* training

External notifications:

Parties outside of Sydney Trains that are likely to require works' notification

- Letter box drop to residents (if identified in SEMP)
- Local Council (if. impacts on Council infrastructure)

Permits / licences:

Licences and permits not issued by Sydney Trains that are likely to be needed for works

- As identified by SEMP

Sydney Trains Incident Hotline
1800 772 779

Plant and equipment

- backhoe
- bobcat
- chainsaws
- concrete truck
- drill rig
- excavator
- grader
- grout
- hand tools
- loader
- mulch blowers
- mulcher
- pile driver
- plate compactor
- pumps
- rock grinders
- rock hammers
- roller
- tip trucks
- trucks
- water cart
- work train and spoil wagons

Environmental Hazard Matrix

Job steps	Environmental hazard														
	Awareness and responsibility	Biodiversity	Chemical and fuel storage and decant	Dust	Erosion and sedimentation	Heritage	Incidents and emerging issues	Light Spill	Noise and vibration	Pesticides	Plant and equipment emissions and spills	Soil and water contamination	Traffic	Visual impacts	Waste
Site establishment (including material / plant delivery, establish site amenities, place skip bins, install erosion and sed control, etc)	Y	Y	Y	Y	Y	Y	Y	-	Y	-	Y	-	Y	Y	Y
Access road maintenance (see EMS-03-EW-0263)															
Excavation works	Y	Y	Y	Y	Y	-	Y	Y	Y	-	Y	Y	Y	-	Y
Piling works – driven, cast in situ	Y	-	Y	Y	Y	-	Y	Y	Y	-	Y	Y	Y	-	Y
Concrete works	Y	-	Y	Y	Y	-	Y	-	Y	-	Y	Y	Y	-	Y
Backfill (engineering grade fill)	Y	-	Y	Y	Y	-	Y	-	Y	-	Y	-	Y	-	Y
Stockpile and disposal of waste (e.g. excavated spoil, vegetation)	Y	Y	-	Y	Y	-	Y	-	Y	-	Y	Y	Y	Y	Y
Site demobilisation (including final waste disposal, site reinstatement, etc)	Y	Y	Y	Y	Y	-	Y	-	Y	-	Y	Y	Y	-	Y

Hazard Control Table

Environmental Hazard	Control and responsibility	Control reference
Awareness and responsibility: *Staff unaware of the works' environmental controls and their responsibilities*	*Project manager* • *SEMP*: The SEMP is signed by the site supervisor and they are aware of the environmental controls and conditions, including those within the SEMP's specialist studies and approvals *Site supervisor* • Undertake site pre-work briefings and inductions using the SEMP and the SECM to cover the work's environmental risks and controls and the workers environmental responsibilities • Delivery tool-box talks relevant to the environmental hazards • Maintain a readily accessible copy of the environmental approval (including all associated specialist approvals and plans) at the worksite whenever work is being undertaken. • Display prominently on site, where possible, the SECM and make sure it is accurate and used	• Site Environmental Management Plan • **SMS-06-OP-3114 *Pre-work Briefings***
Biodiversity: *Unintentional or unapproved impacts on native and protected plants, animals and ecological communities*	*Project manager* • *DESIGN*: Minimise impacts on native flora and fauna, particularly protected species and communities as far as practical • *DESIGN*: Revegetate disturbed areas using locally native, appropriate species, in an approved vegetation plan • *SEMP*: Identify and obtain appropriate approvals for biodiversity impacts. Add controls from approvals to SEMP Section 5.2 *Site supervisor* • Remove weeds from plant before leaving weed infested areas • Use tape or other suitable fencing around "no go zones" • Clear minimal vegetation and do not clear any vegetation outside of approved scope • Trim or remove trees under direction of an arborist • Keep vehicles and equipment away from areas of vegetation • Contact WIRES as required for injured animals • Complete post-work site rehabilitation works, maintenance and inspections and transfer ownership to operational area at end of responsibility	• Site Environmental Management Plan • **EMS-06-OR-1006 *Biodiversity***

Environmental Hazard	Control and responsibility	Control reference
Chemical and fuel storage and decant: *Unintentional loss of chemicals and fuels during storage and decanting*	*Project Manager* • *SEMP*: Check SDS for any chemicals being used to determine if special storage and preparation controls are needed. Include controls in SEMP Section 5.2. *Site supervisor* • Maintain current SDS's onsite for all stored chemicals and follow any special precautions • Chemicals and fuels are stored in appropriately labelled and approved containers • Bund temporary fuel and chemical storage and decant facilities away from drains and waterways	• Site Environmental Management Plan • Safety Data Sheets (SDS)
Dust: *Emissions of dust leaving worksite from earthworks, stockpiles and works traffic.*	*Project manager* • *DESIGN*: Minimise and stage removal of vegetation from worksite during design and works planning *Site supervisor* • Select plant and equipment for the task that is fit for purpose and minimises dust generation • Use water cart to dampen exposed surfaces including access roads, work areas and stockpiles • Cover long term stockpiles • Minimise removal of vegetation from worksite • Keep vehicles to existing access roads	• Site Environmental Management Plan. • **EMS-05-GD-0013 *Air Quality Guide***
Erosion and sedimentation: *Loss of soil and sediment from worksite to surrounding environment, including tracking onto public roads*	*Project manager* • *SEMP*: Develop erosion and sediment control plan for site using suitably trained and qualified personnel. Note: level of ESC training required is dependent upon the area of ground to be disturbed. *Site supervisor* • Site supervisor to have completed Level 1 Erosion and Sediment Control course • Install and maintain erosion and sediment control structures from prior to commencing site work until site has stabilised after the completion of works • Use a street sweeper to regularly remove mud and silt from public roads used for site access • Include sediment control in stockpile management • Complete post-work site rehabilitation and erosion and sediment control maintenance and inspections (transfer ownership to operational area at end of responsibility)	• Site Environmental Management Plan • **EMS-14-PR-0012 *Erosion and Sediment Control***

Environmental Hazard	Control and responsibility	Control reference
Heritage: *Unintentional or unapproved impact on Aboriginal and non-Aboriginal heritage*	*Project manager* • SEMP: Use SEMP to identify and manage impact to Aboriginal and Non-Aboriginal Heritage sites. Contact a Transport Heritage Specialist for advice regarding approval to impact heritage sites. Add controls from approval to SEMP Section 5.2. *Site supervisor* • Isolate and demarcate heritage sites to prevent accidental damage • If a heritage or archaeological item is uncovered, immediately stop further disturbance, demarcate the site, contact your environmental support and follow **EMS-09-PR-0164 *Unexpected Archaeological Finds***	• **EMS-03-FM-0249 *EWMS Activities outside the AoZ*** • Site Environmental Management Plan • TAHE (former RailCorp) Section 170 Heritage and Conservation Register • Sydney Trains environment WebGIS • **EMS-09-PR-0164 *Unexpected Archaeological Finds***
Incidents and emerging issues *An incident or emerging issue is not controlled and causes an environmental impact*	*Project Manager* • *SITE*: Support management of emerging issues and incident management, notification, investigation and the completion of corrective and preventative actions *Site supervisor* • Complete daily inspections of the site, plant and equipment and the surrounding area to identify unexpected impacts and future potential impacts • Consider how changes in the weather could affect the works and the works controls (e.g. during high winds, heavy rainfall, etc) • Contact your environmental officer if the NSW EPA or other external party conducts an environmental site visit • Implement incident procedures on unapproved impacts, spills and other environmental incidents • If a spill occurs, then immediately notify incidents to the Incident and Injury Hotline 1800 772 779 or enter incident directly into SHEM • Refer all complaints to the *Sydney Trains & NSW TrainLink Environmental Feedback Line* on 1300 500 or https://transportnsw.info/contact-us	• Site Environmental Management Plan • **EMS-03-PR-0224 *Incident Environmental Management*** • **EMS-02-WI-0214 *Notify Pollution Incidents*** • **EMS-09-PR-0164 *Unexpected Archaeological Finds***
Light spill: *Impact of work light sources on neighbouring residents and properties - particularly the potential for sleep disturbance*	*Site supervisor* • Locate portable lighting towers so that they are not directed at residential properties • Ensure parked vehicles headlights do not shine into residences,	• Site Environmental Management Plan

Environmental Hazard	Control and responsibility	Control reference
Noise and vibration: *Impact of works noise and vibration on neighbouring residents and properties – particularly the potential for sleep disturbance*	*Project manager* • *SEMP*: Identify potentially sensitive noise receivers and identify relevant controls through the noise assessment (as required by SEMP) *Site supervisor* • Schedule more noisy work for 'standard hours' (7am to 9pm Monday to Friday, 8am to 1pm Saturday), where practical • Limit operating and idling plant and equipment on site, where practical • Locate noisy equipment, parking areas and assembly areas away from sensitive receivers, where practical and instruct workers to minimise noise during shift changes and at crib areas • Use non-tonal reversing alarms on vehicles, where practical • All plant and equipment to be operated with effective noise attenuation equipment (e.g. mufflers).	• Site Environmental Management Plan • **EMS-10-GD-0083 *Guide to Rail Infrastructure Noise and Vibration Management*** • **EMS-10-FM-0166 Maintenance Quantified Noise and Vibration Assessment**
Plant and equipment emissions and spills: *Smoke, fumes., odours and other emissions from plant and equipment. Spills of hydrocarbons from plant and equipment*	*Project Manager* • SEMP: Specify plant and equipment for the task that is fit for purpose and minimises offsite impacts (e.g. smoke, exhaust, noise, etc) *Site supervisor* • Plant and equipment is operated and maintained in a proper and efficient manner with all of its pollution control equipment in place and functioning • Plant and equipment not used when needing repair • Plant and equipment is regularly checked for wear, leaks, odours, fumes and smoke • All plant to have suitable spill kits and operators trained in their use and the disposal of used spill kit materials	• Site Environmental Management Plan • **SMS-16-OP-3076 *Inspection, Testing and Monitoring***

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Environmental Hazard	Control and responsibility	Control reference
Waste: *Unnecessary generation of wastes and poor or illegal disposal of wastes*	**Construction waste (e.g. spoil, concrete, litter and rubbish, etc)** *Project manager* • *SEMP:* Develop a Waste Management Plan if the works will generate a significant quantity of wastes, difficult wastes or waste of an unknown quantity/contamination *Site supervisor* • Do not overestimate quantities of materials required • Separate wastes, place all wastes in appropriate containers and dispose of them as they are generated • Prevent the mixing of similar new and waste materials • Classify all wastes in accordance with the NSW EPA Waste Classification Guidelines • Only use approved waste contractors and dispose of all wastes leaving site to facilities licenced to receive the waste • Keep records of all waste classification, transport, disposal, reuse and recycling activities	• Site Environmental Management Plan • **EMS-13-OR-1013 *Waste Management*** • EPA Waste Classification Guidelines
	Slurry wastes (e.g. concrete, supersucker, etc) *Site supervisor* • Ensure proper and immediate disposal of slurry offsite, or construct a correctly sized, impermeable slurry holding facility and properly dispose of all dewatered wastes	• Site Environmental Management Plan • **EMS-13-WI-0183 *Hydrovac Slurry Management***
	Vegetation management waste (e.g. clippings, branches, etc) *Site supervisor* • Ensure wastes are placed in appropriate bags or containers • All cut vegetation (clippings (mower/whipper sniping clippings, leaves, branches & other) to be removed from site and recycled (where possible) • No spreading of weed infested material within corridor	• Site Environmental Management Plan • **EMS-13-OR-1013 *Waste Management***

Acknowledgement of Country

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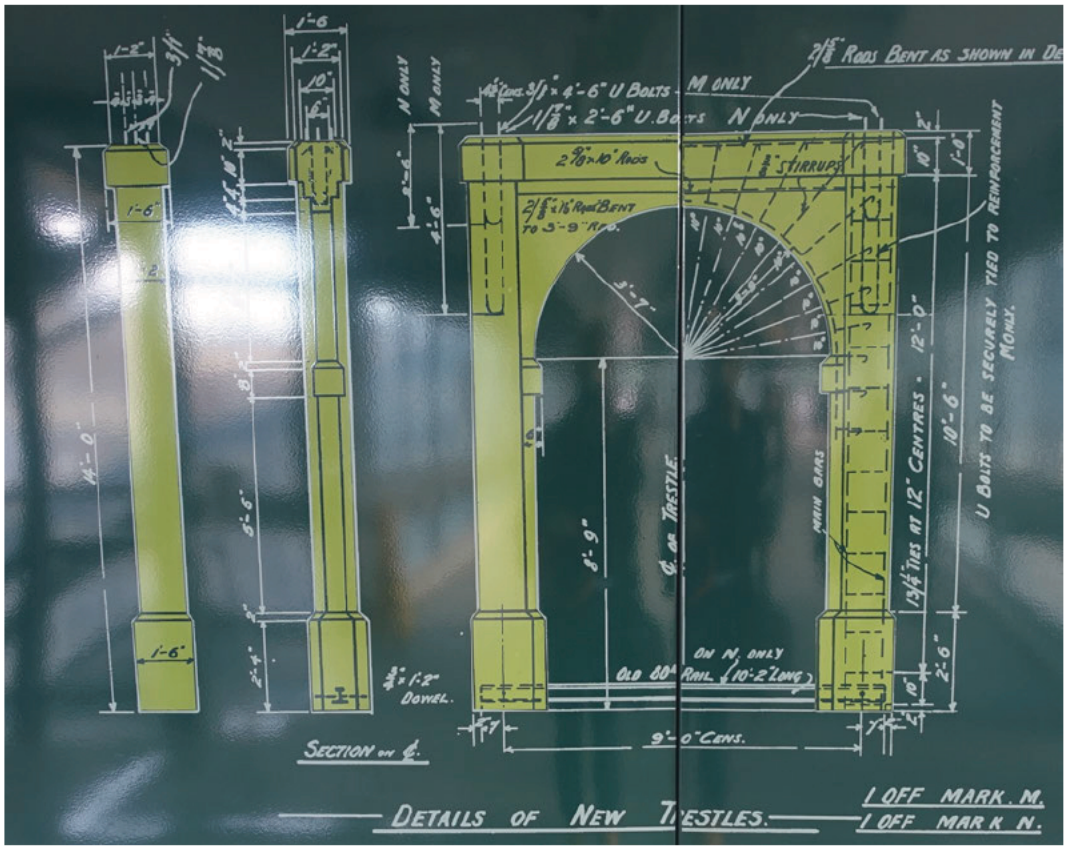
Long Blackledge
Architects

CROYDON STATION
PLATFORM 5 RETAINING WALL

STATEMENT OF HERITAGE IMPACT



Prepared for

Sydney Trains

Issue A

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NSW Reg 9057

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Member Australian Institute of Architects

CONTENTS:

1. Preamble

1.1 Background

An embankment of cut back shale adjacent to the platform 5 stair up to the concourse has been become unstable and requires retaining. Approval is sought to insert a precast concrete retaining wall to support the cutting.

1.2 The Purpose of this report

This report supports an application under s60 of the Heritage Act for approval to undertake the works.

1.3 Referenced documents

- TTW drawing SS0011 rev 01
- TTW Retaining Wall Options Study

1.4 Location

Figure 1 Location Source: Six Maps 2022

Statutory Listed status

The station group is State Heritage Listed SHR reference 01125.
See:
https://www.hms.heritage.nsw.gov.au/App/Item/ViewItem?itemId=4801110
The group is part of the Railcorp Section 170 register (SHI number 4801110)

The station is listed as an item of State heritage significance in the Burwood LEP 2012 item number 149.

2 Brief History of the Station

The Main Western line to Parramatta (Granville) was originally completed in 1855. The line opened on 26 September 1855 and was double track from Sydney to Newtown and then single track to Parramatta (but duplicated in 1856). The line was built as a direct connection to Parramatta and, subsequently, for the purpose of connecting Sydney with the major rural railways that were constructed across the Blue Mountains to Bathurst and across the Southern Highlands to Goulburn via Liverpool. There were few stops along the line between Sydney and Parramatta and it was not the original intention of the line to serve suburban development. Changes to the line were more often related to the line's long distance purpose than to the communities along it.

Traffic to the west and south (and later north) of the state brought the need to amplify the line, first in 1891 when it was quadrupled and later in 1927 when it was sextupled (to Homebush) and electrified. With both of these major changes the earlier stations were usually entirely demolished and replaced with a new station. The 1927 work completed this process with the complete replacement of Strathfield and much of Newtown Stations. During this time suburban development also extended west along the line and these new stations were thus specifically designed as full-scale suburban passenger stations rather than rural 'halts'. The Engineer for Existing Lines, George Cowdery (appointed 1863), was a particularly strong influence on the architecture of this line, building particularly elegant stations in the late 1880s ahead of the 1891 quadruplication, in addition to replacing the original stone arch viaduct at Lewisham with iron truss bridges. Sextuplication in 1927 brought less change to most local stations (which were on the southern side), the new tracks being express ones on the northern side.

Croydon Station was opened as Five Dock on 7 January 1875 and renamed Croydon in August 1876. In 1880 a new waiting shed and ticket office were erected, the platforms were lengthened and a cottage erected for the Porter-in-Charge. In 1883 a vertically curved footbridge was erected at the Sydney end of Platforms, near Edwin Street.

In 1890 a mortuary shed was provided at the Sydney end and the south side, together with a post office. The main station building was on the Up or northern platform against a cutting, the remains of this building can still be seen today. The waiting shed on the Down platform was 24m west of Edwin Street and had a post office immediately behind this shed. A footbridge was built at the western end of the platforms and connected to Meta Street by a ramp and to the land on the southern side by steps.

The present station buildings and layout are associated with the quadruplication of 1892 for which an island platform with two side platforms were built to serve both 'fast' and 'slow' pairs of tracks. In 1892 the two additional tracks for the quadruplication were laid on the south side of the station, the contract being awarded to John Ahern for the building of the western footbridge and the new Meta Street overbridge. The Edwin Street level crossing was closed and the post office relocated on the eastern side of the new island platform.

The line was sextuplicated through Croydon in 1926-7, followed by electrification works. Two additional lines were built on the southern side and the old Up ‘fast’ platform was demolished and the post office relocated outside railway land. An overhead booking office was also constructed in 1928. In the 1930s a new building was erected on Platforms 2/3. In c.1947 an overhead parcels office was constructed. The station underwent upgrade works c.1995 including new platform canopies.

The station underwent major changes in 2015 with a new footbridge and lifts.

(Edited from SHI Listing).

3 Description of the site

Figure 2 Context of the proposed works (2022)

With the recent reconstruction of the overbridge and concourse in 2015-16 most of the historic structure close to the proposed retaining wall has been replaced.

The embankment cutting has been cut through the underlying shale layer to accommodate the overhead power line gantry footing and possibly as part of the 2015 works

The proposed retained area overlaps the 2015 steps down to platform 5.

4 Statement of heritage significance

4.1 Statement of Heritage Significance

Croydon Railway Station has State significance as the existing station arrangement with railway structures dating from the 1892 quadruplication and 1927 sextuplication of the line is illustrative of the expansion of the railways in the late 19th and early 20th century undertaken to accommodate suburban development along the line and to the west. Designed under the direction of Commissioner Edward Eddy, the extant 1890s platform building is largely intact and it demonstrates the first use of island platforms in NSW and is one of four extant examples of this type of station building design, known as the 'Standard Eddy'. The 1920s 'initial island' building and 1940s 'Railway Stripped Functionalist' building have aesthetic significance and together are able to demonstrate the shift in the architectural styles employed by the railways during the first half of the 20th century. (SHI Listing)

5 Proposed Works

Figure 5 Platform 5 .

Figure 6 Detail of the cutting through shale

5.1 Retaining structure

It is proposed to stablise the embankment using precast sections supported by steel UC sections. The precast concrete will be cut to a rake to align with the slope of the bank.

The engineers, TTW Structural Engineers prepared an option study for Sydney Trains with 5 options:

- Post and Panel retaining wall
- Cantilever RC retaining wall
- Gabion Cage retaining wall
- Reinforced soil retaining wall and,
- Permanent rock bolts and shotcrete retaining wall.

Of the five options post and panel and shotcrete options were considered the most feasible from an engineering perspective. The post and panel option required further detail on the OHWS footing which has been provided to the engineers.

Figure 7 Perspective of proposed retaining wall. Source:TTW

The steel and concrete can be finished to match the steel and ceramic infill of the overbridge.

6 Assessment of Impact.

6.1 The following aspects of the proposal respect or enhance the heritage significance of the Croydon Railway Station for the following reasons:

- The retaining of the unstable embankment will protect station infrastructure.

All these works respect and enhance the heritage significance of the building.

6.2 The following aspects of the proposal could detrimentally impact on heritage significance and measures to be taken to minimise impacts:

The dominant material of the historic part of the station is brick however the most technically interesting material was the early use of the concrete in the overbridge in 1923-27 where insitu concrete was used for the arched trestles of the bridge as well as pre-cast concrete for the

overhead booking office[1]. These structures are now lost however it is important to note that the concrete panel and steel stanchion is not only visually compatible to the recent 2015 work but also within the tradition of the using concrete at the station.

The tapering of the retaining wall to the slope of the bank is proposed to limit its visual effect. The wall does not affect the existing brick short retaining wall to the platform or the pine log retaining wall above it.

6.3 The following sympathetic solutions have been considered and discounted for the following reasons:

As noted above five options for the retaining the unstable cutting were proposed. Of those options only shotcrete and the proposed post and panel solutions were considered appropriate for technical and visual reasons. The shotcrete solution was considered to be a more expedient solution however it presented a potentially poorer finish compared with the more controllable precast solution being proposed.

7 Recommendations.

The steel should match the finish of the 2015 steel work. The concrete finish colour should match that of the ceramic infilling panelling.

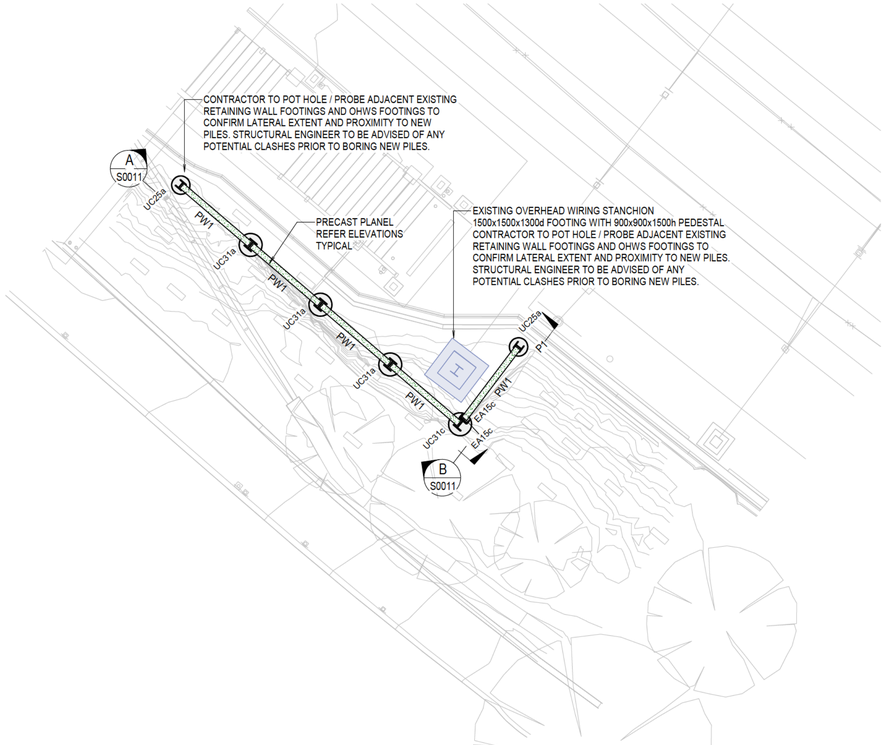
8 Conclusion.

The proposed precast concrete panelled retaining wall is an appropriate visual and technical solution to the stabilisation of the bank. The construction will be visually compatible to the adjacent 2015 work and will not adversely affect the remaining heritage qualities of the station.

1 Sharp, Stuart Croydon Railway Station An experiment in concrete construction 19th January 2013 p9

APPENDIX A TTW drawing S0011rev 01.

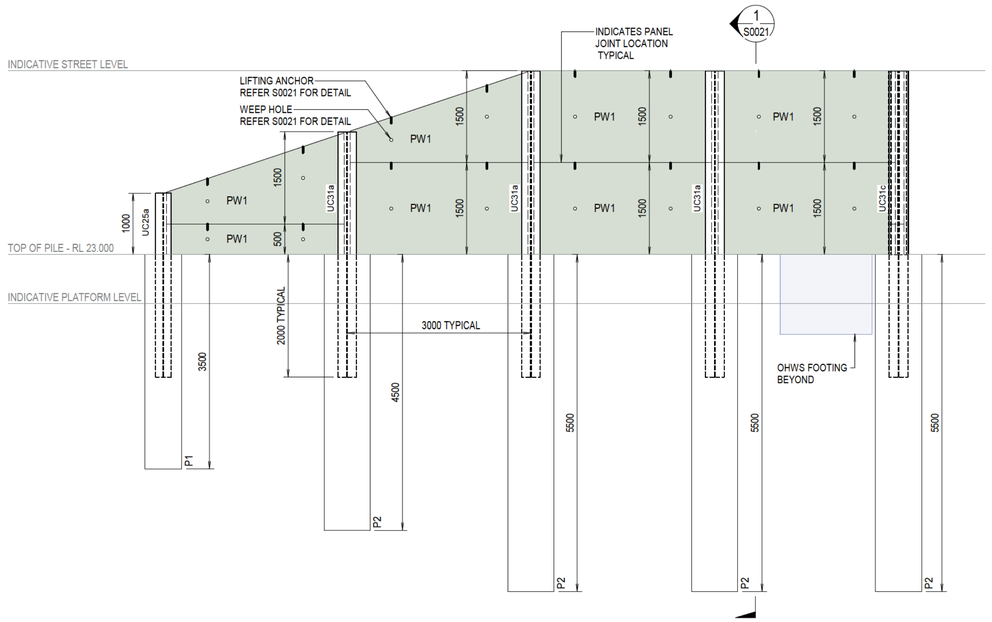
THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT NOTES ON DRAWING NO. S0001



PLATFORM LEVEL OUTLINE PLAN

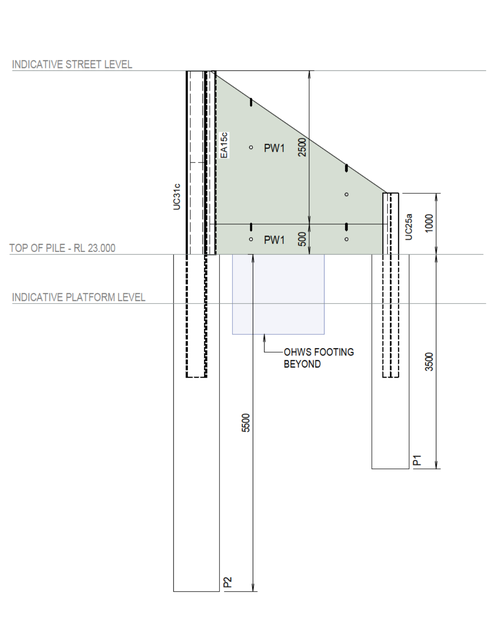
Scale: 1 : 100

NOTE: REFER TO SURVEY DRAWING 41741-AAM-ZZ-ZZ-DR-G-001 BY AAM



ELEVATION A (S0011)

SCALE 1 : 50



ELEVATION B (S0011)

SCALE 1 : 50

PILE SCHEDULE		
MARK	DIAMETER	REINFORCEMENT
P1	600	12N24
P2	750	14N28

STEEL COLUMN SCHEDULE		
MARK	SIZE	COMMENTS
EA15c	150x150x16 EA	HOT DIP GALVANISED TO AS4680
UC25a	250UC72.9	HOT DIP GALVANISED TO AS4680
UC31a	310UC96.8	HOT DIP GALVANISED TO AS4680
UC31c	310UC137	HOT DIP GALVANISED TO AS4680

WALL SCHEDULE	
MARK	THICKNESS
PW1	200

S0011 01
Printed : 27/07/2022 3:40:07 PM

A1 0 1 2 3 4 5 6 7 8 9 10

Rev	Description	Eng	Draft	Date
01	ISSUED FOR CONSTRUCTION	TB	JK	27.07.22

Client
Transport for NSW
PO Box 533, Burwood NSW 1805

Structural Engineer
TTW Structural Civil Traffic Façade
+61 2 9439 7288 | L6 73 Miller Street North Sydney NSW 2060

Project
CROYDON STATION RETAINING WALL

Sheet Subject
PLANS AND ELEVATIONS

Scale : A1: As indicated
Drawn: JK
Authorised: JVR
Job No: 221311
Drawing No: S0011
Revision: 01
27/07/2022 3:40:07 PM

FOR CONSTRUCTION

APPENDIX B TTW Retaining Wall Options Report

16th May 2022

TTW Structural Civil Traffic Façade

Retaining Wall Options Report

Croydon Railway Station

Prepared for Sydney Trains / 16 May 2022 / Revision 01

221311

TTW (NSW) PTY LTD (ACN 649 974 112)
(ABN 74 649 974 112) I Consulting Engineers
Level 6, 73 Miller Street, North Sydney NSW 2060

Your Partner in Engineering

Contents

1.0 Introduction

TTW have been commissioned by Sydney Trains to investigate, propose and design a retention system for an eroded cutting at the Croydon Railway Station. The following report investigates several different retaining wall options for the eroded cutting.

The retention system shall stabilise the crest of the cutting where a Galvanised Steel Trough (GST) and Ground Level Trough (GLT) are present and to prevent further debris slumping down towards the railway tracks.

2.0 Existing Conditions

The existing cutting being investigated is adjacent to Platform 5 and is severely eroded. The cutting is approximately 5m long and tapers in height from a maximum of roughly 3.5m down towards the ticket office building. The predominant material within the cutting consists of highly weathered and jointed Class V shale. Figure 2-1 and Figure 2-2 show the extent of the eroded cutting. The retention system is proposed to approximately follow the extent of the eroded cutting.

Refer to Appendix A for further information regarding the existing conditions of the cutting. Refer to Appendix B for a geotechnical site investigation and report undertaken for the Croydon Railway Station for a previous access upgrade project adjacent to the cutting. Refer to Appendix C for additional site photos of the cutting.

A survey of the cutting and surrounding area shall be undertaken by AAM Survey in due course to confirm the existing ground levels, local obstructions and proximity of critical infrastructure.

Figure 2-1 Plan Extent Eroded Cutting

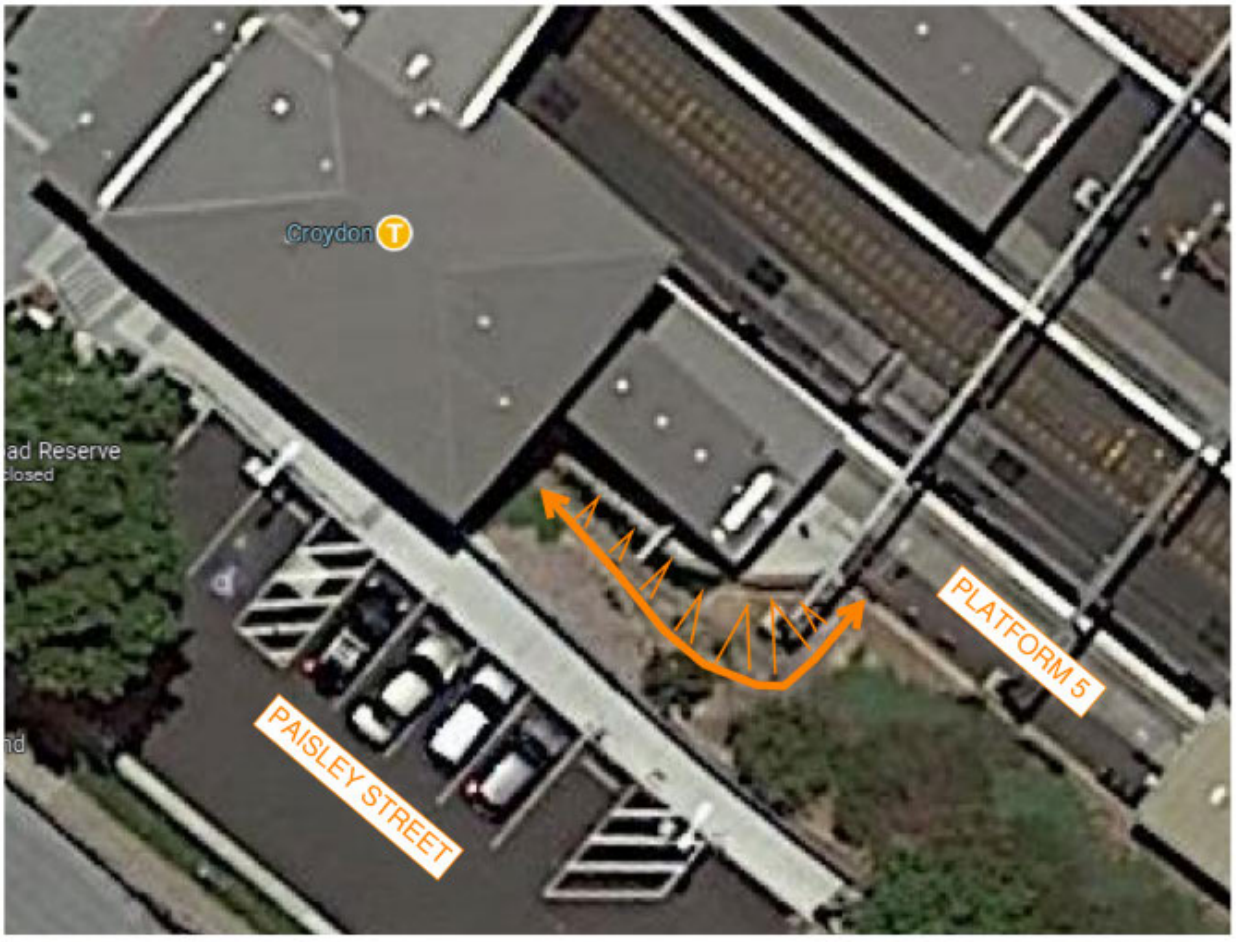


Figure 2-2 Photo of Eroded Cutting

3.0 Retaining Wall Options

All retaining wall options shall have a design life of 120 years. All retaining wall footings or piles shall be founded a minimum of 1300mm below rail level according to the NSW Transport Asset Standards Authority document T HR CI 12060 ST Retaining Walls.

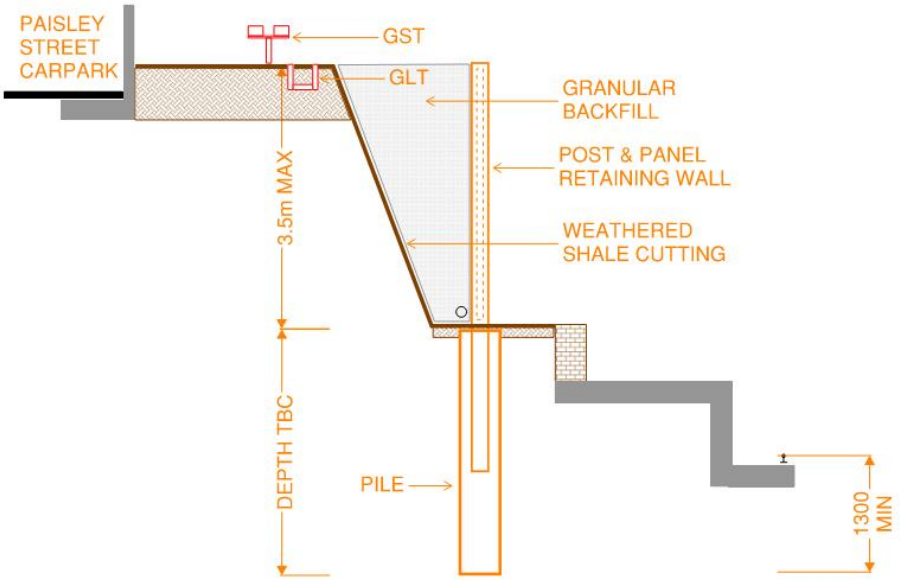
3.1 Post & Panel Retaining Wall

This retaining wall option would involve installing approximately 4no reinforced concrete piles at the base of the eroded cutting. Embedded within each pile, a cantilevered structural steel section (i.e. post) will extend to the elevation of the existing crest. Between each post a precast concrete panel will span horizontally and shall be backfilled against with compacted engineered fill. Figure 3.1-1 shows an indicative cross section of a post & panel retaining wall.

Due to site constraints, the installation of the bored piles could potentially be difficult. The most appropriate method of boring the holes would be to locate a large excavator on the edge of the carpark on Paisley Street. The excavator would have an auger attachment and its boom would extend out and down to the required level (i.e. at the top of the platform timber/masonry retaining wall).

Care would need to be taken to not impact the existing overheard wiring stanchion (OHWS) and it's associated footing adjacent to the proposed retaining wall. Existing drawings and documentation of this critical infrastructure element were unavailable at the time of writing this report but would be required to be reviewed and considered during detailed design.

Figure 3.1-1 Typical Cross Section of Post & Panel Retaining Wall



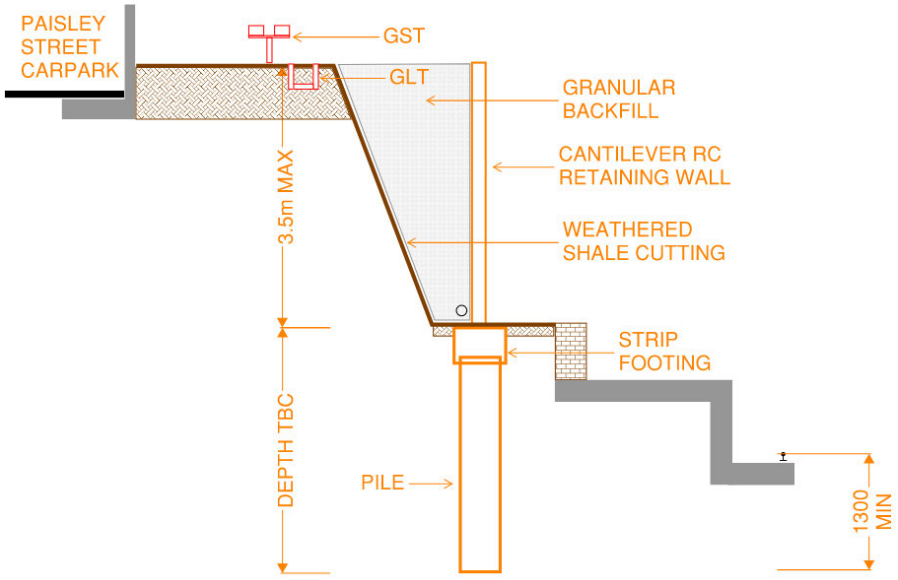
3.2 Cantilever RC Retaining Wall

The requirement for the footings of any retaining wall adjacent to a railway cutting being founded a minimum of 1300mm below rail level would mean a traditional L-shaped RC retaining wall with a shallow footing would require an unfeasible depth of excavation into the existing cutting (towards Paisley Street).

For this reason, a more suitable footing system would consist of closely spaced piles connected to a strip footing, from which the in-situ RC cantilevered stem would extend to the elevation of the existing crest. Once the stem has reached design strength, formwork and temporary propping shall be removed, after which the wall can then be backfilled against using compacted engineered fill. Figure 3.1-2 shows an indicative cross section of a cantilever RC retaining wall.

The installation of the piles for this option would be similarly difficult to that of the post & panel retaining wall.

Figure 3.2-1 Typical Cross Section of Cantilever RC Retaining Wall



3.3 Gabion Cage Retaining Wall

A gabion cage retaining wall is restricted to a maximum height of 1m and cannot be closer than 5m from the railway track centreline. Due to these reasons, an extended batter would be required for this option to be feasible, however this extended batter would likely significantly impact the GLT and GST at the crest.

3.4 Reinforced Soil Retaining Wall

A reinforced soil retaining wall is a gravity stabilised wall consisting of compacted layers of fill, between which steel ladder strips or geosynthetics are anchored by the weight of the soil above. These layers of reinforcement are mechanically connected to the front facing precast wall. As a gravity stabilised retaining wall, typically the ratio of retained height to soil block length is 0.7H, which means for a 3.5m high retaining wall, an approximate length of 2.45m would be required behind the wall to achieve adequate stability. Due to site constraints, this required length will not be possible without significant excavation of the existing cutting, which may have a significant impact on the GST and GLT in addition to the Paisley Street carpark.

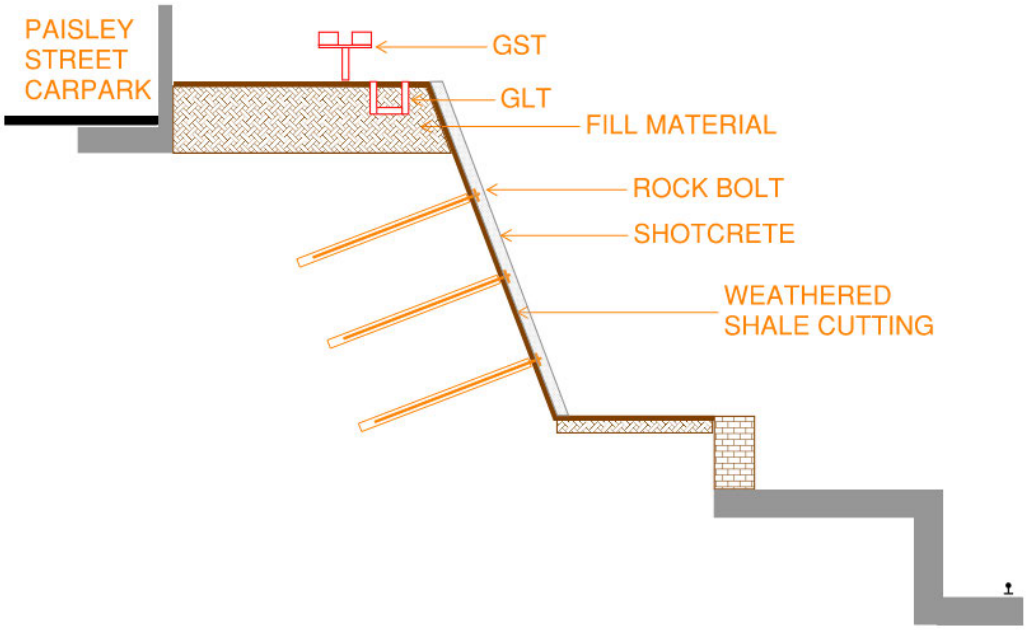
3.5 Permanent Rock Bolts & Shotcrete Retaining Wall

As the cutting consists predominantly of Class V shale, which is highly weathered and jointed, it is susceptible to further erosion. Permanent rock bolts drilled and grouted into the face of the rock mass shall stabilise the cutting. Following the installation of the rock bolts, rebar mesh would be placed on the face of the cutting, after which shotcrete would be applied to the full extent of the cutting.

Residual fill material on top of the crest (~800mm depth) would be required to be removed prior to the shotcrete application. Therefore, the existing GST and GLT would need to be locally temporarily propped and/or relocated. The contractor would also need to confirm that the carpark barrier footing is not undermined during the removal of the residual fill material.

Installation of the rock bolts would take place from light machinery located on Platform 5 or from a larger excavator within the Paisley Street carpark. If the required length of the rock bolts exceeds the site ownership boundary, which is anticipated to be unlikely, permits will be required from the relevant authority or property owner. If the rock bolt passes the site boundary there is also the risk of future excavation damaging or severing the rock bolts.

Figure 3.5-1 Typical Cross Section of Rock Bolt & Shotcrete Retaining Wall



4.0 Recommendations

This report has presented several retaining wall options for the eroded cutting at the Croydon Railway Station. It is recommended that a permanent rock bolt & shotcrete retaining wall solution be adopted for the following reasons:

- Relatively fast and simple to install
- Less disruption to the immediate vicinity during site works
- No requirement for in-situ formwork and temporary propping (e.g. cantilevered RC retaining wall)

DYWIDAG Combo Bolt (or approved equivalent) is recommended to achieve the 120 design life requirement.

A slope stabilisation technique such as a rock bolt & shotcrete wall is a specialist design item and as such would require TTW to engage a sub consultant for further design advice. A review of the permanent works fee would likely be required.

If the constraint of temporarily supporting and/or relocating the GST and GLT during the construction is too onerous, a post & panel retaining wall is recommended as a secondary solution.

The condition of the cutting investigated within this report is anticipated to further deteriorate with time, making the recommendations in this report potentially obsolete. If the client doesn't act on the recommendations within 12 months, then the report cannot be relied upon as an accurate record of the actual conditions of the cutting. A new investigation should be undertaken prior to commissioning rectification works.

If the client does not act on the recommendations contained in this report TTW cannot accept responsibility for any liability arising from a failure relating to the recommendations contained herein.

5.0 Disclaimer

All descriptions, dimensions, references to conditions and necessary permission for use and occupation and other details are given in good faith are believed to be correct but any intending tenderers should not rely on them as statements or representations of fact but must satisfy themselves as to the correctness of each of them.

Taylor Thomson Whitting NSW Pty Ltd gives notice that the particulars set out in this report are for the exclusive use of Sydney Trains and that no responsibility or liability is accepted as a result of the use of this report by any other party.

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Appendix A

Summary report - Cutting instability along the Platform 5 at Croydon

Summary report- Cutting instability along the Platform 5 at Croydon

1. Observations:

The subject site was inspected on 20 March 2020. The followings provide results of observations, risk assessment and recommendations:

- The subject site is a cutting approximately 3-4m high along the platform 5 at Croydon (at 9.428 DN) which has been excavated in highly weathered, highly jointed shale;
- It appears that the cutting has been excavated with a near vertical face to accommodate for OHWS and previously has been covered with erosion control mat;
- Due to steep slope of the cutting, erosion control mat has not been functioning properly and it is now mainly deteriorated;
- There is a layer of residual soil approximately 0.8m thick at top of the cutting, underlain by Class V shale;
- The residual soil at top has partially been undermined due to the slump of materials and may be subject to further slumping, especially in wet weather;
- Crest of the cutting is approximately 3m wide. Some minor tension cracks were observed at top of the critical section which may cause more slumping in future;
- There is a GLT at top of the failed section which may have contributed to the softening and slumping of material by diverting surface runoff towards the cutting face;
- There is a short brick and timber wall along the toe of the cutting;
- Due to heavy rain falls in Feb/ March 2020, the top section of the cutting has been saturated and slumped to the toe of cutting and behind OHWS in the form of debris fall;
- Some photos of the face and top of the cutting are attached.

2- Assessment of the risk

- Though further slumping of the cutting may not reach the tracks, however, it may undermine and damage the GLT at top.

3- Recommendations:

Considering the near vertical face of the cutting and geological nature of the base materials as well as site conditions, the following remedial works are recommended:

- Remove the undermined/ unstable sections of the cutting at top and scale the face;
- Apply reinforced shotcrete to the exposed cutting face.

Though the critical section of the cutting is only 5-6m long, however, it is recommended remedial works to be extended to the pedestrian overbridge.

Photo 1: Location of the failed section adjacent to Platform 5

Photo 2: Failed section of the cutting

Photo 3: Undermined section of cutting at top

Photo 4: GLT at top of failed section

Photo 5: Typical tension cracks at top

Appendix B

Geotechnical Report 26582Srpt by JK Geotechnics dated 1 August 2014

REPORT

TO
CARLONO (NSW/ACT) PTY LTD

ON
GEOTECHNICAL INVESTIGATION

FOR
PROPOSED ACCESS UPGRADE

AT
CROYDON STATION, CROYDON, NSW

1 August 2014
Ref: 26852Srpt
Revision 1

JK Geotechnics
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Date: 1 August 2014
Report No: 26582Srpt
Revision No: 1

Report prepared by:

Adrian Callus
Geotechnical Engineer

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Paul Stubbs
Principal Geotechnical Engineer

For and on behalf of
JK GEOTECHNICS
PO Box 976
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TABLE OF CONTENTS

1 INTRODUCTION

This report presents the results of a geotechnical investigation for the proposed access upgrade at Croydon Station, Croydon, NSW. The investigation was commissioned by Tessa Knox-Grant on behalf of Cardno (NSW/ACT) Pty Ltd, by signed 'Acceptance of Proposal' form dated 26 June 2014. The commission was generally completed on the basis of our proposal (Ref 26852S prop3) dated 29 May 2014.

We have been provided with the following information:

- A survey plan prepared by Cardno (NSW/ACT) Pty Ltd (Drawing No: 89914013CD-02, Sheets 1 and 2, dated 17 September 2013); and
- Architectural drawings prepared by CaldisCook Architects (Croydon Platform and Concourse plan option 2.2, Dwg Nos: 13-164-1 SK A002 undated, and 13-164-1 SK A003^{REV1} and 13-164-1 A004^{REV3} dated 31 January 2013)

Based on the supplied information, we understand that three lifts are to be constructed adjacent to the existing footbridge as part of the proposed access upgrade. One lift will be constructed on the platform along Paisley Road, adjacent to the existing booking office and one on each of the existing island platforms. It is also proposed to widen and extend the existing footbridge to provide access off Hennessy Street and construct new staircases and canopies. The existing booking office is to be demolished and reconstructed. A temporary footbridge and associated staircases is to be constructed over the eastern end of the existing platforms.

We note that for the purposes of this report we have assumed that excavation to a maximum depth of 2m will be required for the construction of the proposed lift overrun pits. We have also assumed that the temporary footbridge is to be founded on adequately designed engineered footings.

The purpose of the investigation was to obtain geotechnical information using portable manually operated equipment on subsurface conditions as a basis for comments and recommendations on excavation conditions and support, retaining wall design parameters and founding conditions.

2 INVESTIGATION PROCEDURE

The fieldwork for the investigation was carried out on 26 and 27 June 2014. Due to access limitations all five boreholes (BH1 to BH4 and BH4A) were initially hand augered to refusal depths between 0.27m and 0.88m. These were augmented by five Dynamic Cone Penetration (DCP) tests (DCP1 to DCP4 and DCP4A) to depths ranging between 0.20m and 0.7m. All boreholes were drilled in the existing platforms.

Four of the boreholes (BH1 to BH4) were then extended into the underlying shale bedrock by rotary diamond coring techniques with a portable Melvelle rig, using a TT56 core barrel with water flush to depths between 1.42m and 2.53m.

The test locations, as shown on the attached Figure 1, were set out by tape measure from existing site features and were electromagnetically scanned for buried services. The plans provided form the basis for Figure 1.

The nature and composition of the subsoils were assessed by logging the materials recovered during drilling. Soil strengths were interpreted from the DCP results. The DCP refusal can also provide an indicative depth to bedrock though we note that refusal can also occur on buried obstructions, 'floaters', other hard layers and not necessarily on bedrock.

Groundwater observations were made during and shortly after completion of drilling at individual boreholes. Long term groundwater monitoring was not carried out. For further details on the investigation procedures adopted, reference should be made to the attached Report Explanation Notes.

The fieldwork was carried out under the full time direction of our geotechnical engineer who nominated the investigation locations, directed electromagnetic scanning, nominated sampling and testing and prepared logs of strata encountered. The borehole logs and DCP test results are presented with this report, together with a glossary of logging terms and symbols used.

On 25 July 2014, our geotechnical engineer, returned to site to inspect the exposed southern cut slope. A summary of the pertinent geotechnical features observed are presented on the attached Figures 2 and 3. An explanation of the geotechnical mapping symbols used is presented on Figure 4

The recovered rock cores were returned to our NATA registered laboratory (Soil Test Services Pty Ltd) where they were photographed and Point Load Strength Index tests were completed. The results of the Point Load Strength Index tests are presented on the enclosed Table A and are also summarised on the cored borehole logs.

3 RESULTS OF INVESTIGATION

3.1 Site Description

Croydon Station occupies a cutting about 6m deep which is oriented roughly east-west. There is a road overbridge about 65m long across the deepest part of the cutting which carries Meta Street across the railway.

The station facilities are situated on the southern side of the cutting where Paisley Road runs parallel to the railway, from which pedestrian access is gained to the station. The batter slopes of the cutting are largely unsupported and typically cut at about 1 Horizontal(H) to 1 Vertical(V), though locally steeper and flatter. Shale bedrock is exposed throughout most of the cutting overlain by a shallow residual clay layer often no more than 1.0m deep.

We note that observations of the northern cut slope (below Hennessey Street) were limited as there was no access to the area from the street, and views to the batter were limited due to overgrown vegetation.

The southern cut slope, directly below the existing ticket office, exposed distinctly weathered shale bedrock of at least low strength, and contained three sections approximately 1m wide which were cut vertically, approximately 2m into the cut slope to allow for the concrete supporting columns. An erosion swale was observed extending from the crest of the cut slope down to the toe of the slope, as shown on the attached Figure 2. Further erosion, spalling and/or fretting of the surface material was noted within the vertically cut sections of the batter slope. No obvious signs of cut slope instability were observed whilst on site.

A pedestrian footbridge provides access to the island platforms from the southern side of the station and there are some redundant support structures adjacent to the existing bridge that would have been associated with previous pedestrian access structures.

3.2 Subsurface Conditions

The 1:100,000 Geological Map of Sydney indicates that the site is underlain by Ashfield Shale of the Wianamatta Group, which comprises black to dark-grey shale and laminite.

The boreholes located on the platforms (BH1 to BH4) disclosed a subsurface profile comprising the asphaltic concrete (AC) platform surface and platform backfill over weathered shale bedrock. BH4A was located within a garden bed, and encountered fill comprising silty sand and sandy gravel. For specific details of the encountered subsurface profile, reference should be made to the attached borehole logs. A summary of the encountered conditions is presented below:

Fill

Fill comprising silty sand overlying sandy gravel was encountered in BH4A. Inclusions in the fill included plastic fragments, roots and root fibres. BH4A encountered refusal within the sandy gravel fill at 0.7m depth from existing surface.

Platform Surfacing

AC between 30mm (BH2) and 70mm (BH1) thick was penetrated from the surface of BH1 to BH4.

Platform Backfill

Fill comprising sandy gravel, gravelly sand and silty clay was encountered below the AC in BH1 to BH4 and extended to depths of about 0.27 (BH1) and 0.88m (BH3). Inclusions in the fill included sandstone, ironstone, shale, igneous gravel, brick, concrete, glass, slag fragments, roots and root fibres.

Weathered Shale Bedrock

Weathered shale bedrock was encountered in boreholes BH1 to BH4 at depths varying between 0.27m and 0.88m. On first contact the shale was distinctly weathered and of low to medium strength. The 'core loss' zones encountered in BH1 to BH4 are inferred to be extremely weathered bands/seams or clay bands/seams that have "washed away" during the coring process.

Groundwater

Groundwater measurements during the fieldwork in BH1 to BH4 were after completion of coring using water flush which affected the levels shown on the borehole logs. Long term groundwater monitoring was not carried out.

3.3 Laboratory Test Results

The results of the Point Load Strength Index tests carried out on the recovered rock cores correlated well with our field assessment of the bedrock strength. The estimated UCSs were between 4MPa and 22MPa.

4 COMMENTS AND RECOMMENDATIONS

The following sections of the report must be complemented by reference to Sydney Trains Standard ESC 350 “Retaining Walls and Platforms”.

4.1 Geotechnical Issues

From a geotechnical perspective, we consider the proposed access upgrade is suitable for the site and will involve common construction techniques and methodologies. We consider the primary geotechnical issues for the proposed access upgrade to be the following:

- The platform backfill and soil materials will require support as a result of the excavation of the lift over run pit in areas where temporary batters are not feasible.
- The proposed lift overrun pit excavations are located immediately adjacent to existing structures, such as the exiting footbridge footings and the redundant support structures which are to be retained.

These constraints can be addressed in the design and must be treated with care during construction. The following sections provide further comments and recommendations.

4.2 Existing Structures

Particular care will be required during excavation of the lift over run pit to avoid undermining and removing lateral support from the steel columns which support the footbridge and the redundant support structures. We recommend that prior to demolition and any excavation commencing, that test pits be excavated adjacent to footings which will be affected by the excavations, to assess the footing details and foundation materials. It seems likely that both the footbridge footings and redundant support structures footings will bear upon the underlying bedrock and should not be affected by excavation in the adjacent fill. The stability of excavations into the fill may be affected by poor shale quality and inclined defects and the effects on the existing structures must therefore be considered. The test pits must be excavated in the presence of, and inspected by a geotechnical engineer and structural engineer, so that further advice can be provided on underpinning, temporary support etc. if appropriate.

Should any buried services extend through the proposed excavations, then these services may need to be diverted or otherwise temporarily supported to allow excavation to proceed.

4.3 Existing Batter Slopes

We note that the contents of TMC 401 “Geotechnical Risk Assessment and Hazard management Guidelines” Version 1.1 dated December 2009, prepared by Sydney Trains, which deals with the probability and consequences of potential geotechnical hazards affecting the rail track.

We have under taken a geotechnical assessment of the risk of instability of the existing southern cut slope, based on our site observations.

We note that due to access constraints we have not been able to carry out an assessment of the northern cut slope. Based on the current performance of both the northern and southern cut slopes, we expect that the condition and risk assessment of the northern cut slope would not be dis-similar to the southern cut slope. We recommend that once of de-vegetation of the northern cut slope has been completed, a geotechnical engineer return to site to inspect the condition of the slope.

4.3.1 Potential Hazards

Based on our site observations, we consider the following potential geotechnical hazards exist at the southern cut slope:

- Erosion, spalling and/or fretting of the cut slope
- Near surface instability of the cut slope, including shallow slumping.

We have considered deep seated instability of the cut face as a potential hazard, but have discounted this hazard due to the presence of shallow bedrock and since there were no obvious signs of instability observed, such as bulging of the existing brick retaining wall at the toe of the cut face or cracking along the concrete pavement at the crest of the cut face.

4.3.2 Risk Assessment

The table below summaries our qualitative assessment of each of the identified potential landslide hazards, based on our site observations.

Potential Geotechnical Hazard	Likelihood of Potential Geotechnical Hazard Occurring	Consequence	Risk Ranking (& Priority)
Erosion, spalling and/or fretting of the cut slope	F4	C1	C-
Near surface instability of the cut slope, including shallow slumping	F2	C2	D
Erosion, spalling and/or fretting of the cut slope – **and Reaching Track**	F1	C2	D
Near surface instability of the cut slope, including shallow slumping – **and Reaching Track**	F1	C3	D

The table above indicates that the risk ranking (& priority) for each of the potential geotechnical hazards varies between Tolerable(C-) to Broadly Acceptable (D).

Based on our observations, surface erosion/degradation is affecting the southern cut slope with minor deposits of weathered and fretted material at the toe of the cut slope. In view of the above and the current performance of cut slope, we recommend that surveillance and monitoring of the cutting in accordance with Table 2 of TMC 401 be completed annually and sufficient course of action, with occasional clearing/cleaning of weathered and fretting material.

If the annual monitoring is not completed, or not preferred, the installation of permanent erosion protection, such as reinforced shotcrete supported on rock bolts, would be required.

4.3.3 Erosion Protection

Erosion protection for the existing cut slopes should be designed and constructed in accordance with the following advice:

- Rock bolts within the weathered bedrock of at least low strength should be preliminary designed for an allowable bond stress of 70kPa. Where appropriate, the bolt heads should be engaged with the reinforcement mesh using face plates and encapsulated in the shotcrete with sufficient cover to achieve corrosion protection.
- All rock bolts shall be N20 size threaded bars, fully grouted and installed in 75mm diameter holes drilled at least 20^{o} below horizontal, at 1.5m to 2.0m horizontal and vertical centres. Subject to detailed design, we envisage rockbolt length to vary from 1m to 2m length.
- Rockbolts should be hot dipped galvanised or stainless steel for long term corrosion protection.

- Reinforcement mesh would comprise SL82 mesh centrally located within shotcrete of at least 100mm minimum thickness. The bolts will need to be engaged with the mesh using rock bolt face plates
- Strip drains should be provided at regular intervals (approximately 1.5m to 2m centres) behind the shotcrete and discharge into the existing concrete dish drain at the base of the brick retaining wall.

4.4 Excavation

Excavation of the proposed lift over run pits is expected to extend through the existing fill profile and into the underlying soil and weathered shale bedrock.

Excavation of the fill is expected to be readily completed using conventional techniques such as a hydraulic excavator. We expect the underlying weathered shale bedrock of extremely low to low strength may also be excavated by bucket excavator, possibly with some ripping. However medium strength shale, if encountered, will require rock excavation techniques such as use of hydraulic impact hammers.

If rock hammers are to be used, such works will need to be completed carefully as there may be direct transmission of ground vibrations to existing structures. We recommend that at the commencement of using a rock hammer for excavation, a geotechnical engineer visit the site to review the excavation methods being employed and to carry out some quantitative vibration monitoring to confirm that vibrations are within tolerable limits and to provide further advice on excavation techniques, if appropriate. By referencing the relevant German Standard DIN4150-3:1999-02 summarised in the attached Vibration Emission Design Goals, the vibrations on existing buildings within the rail corridor should be limited to a peak particle velocity of 5mm/s
If during the use of a rock hammer the transmitted vibrations are found to be excessive, then alternative excavation equipment would be recommended by the geotechnical engineer. This may include the use of a smaller rock hammer of the use of lower vibration emitting equipment such as rock saws or rock grinders.

4.5 Excavation Support

Notwithstanding the additional investigation of the footings of the existing structures detailed in Section 4.2 above, for the limited excavation depths proposed, we consider the fill profile can be temporarily batter at no steeper than 1 Vertical (V) on 1 Horizontal (H). Steeper batter slopes may be feasible subject to geotechnical inspection when the excavation is first commenced for each stage of works, and to stringent controls at all times while the excavation is open. We can complete such inspection, and detail appropriate controls based on the encountered conditions, if

requested to do. In addition, with batter slopes steeper than 1V to 1H, localised slumping may occur along the excavation. If groundwater seepage is encountered, flatter batter slopes or temporary support, eg. sand bags at the soil/bedrock interface would be required.

The major consideration in the selection of earth pressures for the design of retaining walls is the need to limit deformations occurring outside the excavation. The following characteristic earth pressure coefficients and subsoil parameters may be adopted for the preliminary design of the retaining walls:

- For allowable bearing pressure recommendations, reference should be made to Section 4.6 below.
- For free-standing cantilever walls which are retaining areas where movement is of little concern (eg. landscaping walls), a triangular lateral earth pressures distribution may be adopted with an 'active' earth pressure coefficient, K_a, of 0.35, for the retained profile assuming a horizontal retained surface.
- For cantilever walls where the tops are restrained by the permanent structure or which retain areas where movements need to be reduced or for propped walls, a triangular lateral earth pressure distribution should be adopted with an 'at rest; earth pressure coefficient, K_o , of 0.55, for the retained profile assuming a horizontal retained surface.
- The resulting lateral deflections must be determined and if excessive, the wall should be stiffened or permanent anchors considered.
- A bulk unit weight of 20kN/m^3 should be adopted for the soil profile and 24kN/m^3 for the shale.
- All surcharge loads affecting the walls (eg. adjacent construction loads, live loads, compaction stresses etc) should be taken into account in the design, using the appropriate earth pressure coefficient from above. If inclined retained surfaces are proposed, then they should be treated as a surcharge.
- Retaining walls supporting the proposed lift overrun pits should be designed to withstand full hydrostatic pressures as drainage from the pits would not be practical. Other proposed retaining walls should be designed as drained and measures taken to induce complete and permanent drainage of the ground behind the wall.
- For footings embedded into extremely weathered shale bedrock below excavation level, an allowable lateral toe resistance of 150kPa may be adopted. The upper 0.3m depth of the rock socket should not be taken into account to allow for tolerance and disturbance effects during excavation.

- If rock anchors are considered which extend below the neighbouring streets, permission from Council must be obtained prior to installation.

4.6 Footings

4.6.1 Lift Footings

Based on our investigation, we anticipate that weathered shale bedrock of low to medium strength will be encountered within the excavation. Therefore, for uniformity of support we recommend that all footings be supported on the underlying weathered shale bedrock. High level pad or strip footings founded within the weathered shale may be designed for a maximum allowable bearing pressure of 1000kPa.

4.6.2 Abutment Footings

All footings located near the crest or along the batter of the existing cut faces (i.e. for the proposed footbridge extension to Hennessy Street and new booking office), must be founded below a 1V:1.5H line projected from the base of the existing cut faces. In order to achieve this, we anticipate that piled footings would be the most suitable footing option.

Piled footings founded a nominal 0.3m into weathered shale bedrock, below the 1V:1.5H line, may designed for a maximum allowable end bearing pressure of 700kPa. An allowable shaft adhesion value of 70kPa in compression and 35kPa in tension may be utilised within the extremely weathered shale, below the nominal 0.3m socket, provided sockets are clean and rough, otherwise much lower values would apply. We expect that bored piers would be the more cost effective option for this project

4.6.3 Temporary Footbridge

Based on our investigation, we anticipate that weathered shale bedrock of low strength will be encountered at relatively shallow depth. We note that the quality of the shale bedrock in this area is poorer than that encountered adjacent to the existing footbridge, as the proposed temporary footbridge is located at the tail end of the cutting.

Therefore, for uniformity of support we recommend that all footings be supported on the underlying weathered shale bedrock. High level pad or strip footings founded within the weathered shale may be designed for a maximum allowable bearing pressure of 700kPa.

All pad/strip and piled footings should be cleaned out, inspected and poured on the same day as excavation/drilling.

4.7 Additional Geotechnical Input

We summarise below the previously recommended additional work that needs to be carried out:

- Test pits to check the footing detail and foundation materials of the steel footbridge columns, and the redundant support structures.
- Inspection of Northern cut slope to assess instability and carry out risk assessment.
- Footing Inspections.

5 GENERAL COMMENTS

The recommendations presented in this report include specific issues to be addressed during the construction phase of the project. In the event that any of the construction phase recommendations presented in this report are not implemented, the general recommendations may become inapplicable and JK Geotechnics accept no responsibility whatsoever for the performance of the structure where recommendations are not implemented in full and properly tested, inspected and documented.

Occasionally, the subsurface conditions between the completed boreholes may be found to be different (or may be interpreted to be different) from those expected. Variation can also occur with groundwater conditions, especially after climatic changes. If such differences appear to exist, 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.

A waste classification will need to be assigned to any soil excavated from the site prior to offsite disposal. Subject to the appropriate testing, material can be classified as Virgin Excavated Natural Material (VENM), General Solid, Restricted Solid or Hazardous Waste. If the natural soil has been stockpiled, classification of this soil as Excavated Natural Material (ENM) can also be undertaken, if requested. However, the criteria for ENM are more stringent and the cost associated with attempting to meet these criteria may be significant. Analysis takes seven to 10 working days to complete, therefore, an adequate allowance should be included in the construction program unless testing is completed prior to construction. If contamination is encountered, then substantial further testing (and associated delays) should be expected. We strongly recommend that this issue is addressed prior to the 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. If there is any change in the proposed development described in this report then all

recommendations should be reviewed. Copyright in this report is the property of JK Geotechnics. 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 due for the investigation, the client alone shall have a licence to use this report. The report shall not be reproduced except in full.

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SOIL TEST SERVICES
ABN 43 002 145 173

TABLE A
POINT LOAD STRENGTH INDEX TEST REPORT

Client:	JK Geotechnics	**Ref No:**	26852S
Project:	Proposed Access Upgrade	**Report:**	A
Location:	Croydon Station, Croydon, NSW	**Report Date:**	3/07/2014
		Page 1 of 1	

BOREHOLE NUMBER	DEPTH m	$I_{S\,(50)}$ MPa	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)
1	1.15-1.19	0.5	10
	1.86-1.90	1.1	22
2	0.91-0.94	0.2	4
	1.13-1.17	0.7	14
	1.31-1.34	0.6	12
3	1.04-1.07	0.8	16
	1.70-1.74	0.7	14
	2.10-2.14	0.6	12
4	1.09-1.12	0.5	10
	1.71-1.74	0.3	6
	2.08-2.11	0.4	8

NOTES:

1. In the above table testing was completed in the Axial direction.
2. The above strength tests were completed at the 'as received' moisture content.
3. Test Method: RMS T223.
4. For reporting purposes, the $I_{S(50)}$ has been rounded to the nearest 0.1MPa, or to one significant figure if less than 0.1MPa
5. The Estimated Unconfined Compressive Strength was calculated from the point load Strength Index by the following approximate relationship and rounded off to the nearest whole number :
   U.C.S. = 20 $I_{S\,(50)}$

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 1
1/2

Client: CARDNO (NSW/ACT) PTY LTD
Project: PROPOSED ACCESS UPGRADE
Location: CROYDON STATION, CROYDON, NSW

Job No. 26852S **Method:** HAND AUGER **R.L. Surface:** ≈ 22.3m
Date: 26-6-14 **Datum:** AHD
Logged/Checked by: A.P.C./P.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION OF AUGERING	■				REFER TO DCP TEST RESULTS	0		-	ASPHALTIC CONCRETE: 70mm.t FILL: Sandy gravel, fine to coarse grained igneous, grey, fine to coarse grained sand.	D MC>PL			
									FILL: Silty clay, high plasticity, brown, with fine to coarse grained shale gravel, trace of roots and root fibres.				
						1			REFER TO CORED BOREHOLE LOG				
						2							
						3							
						4							
						5							
						6							
						7							


JK Geotechnics
Job No: 26582S
BH1
Start Coring at 0.27m
0
Core Loss 0.58m
1
CL 0.13
End of Hole at 1.98m

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

CORED BOREHOLE LOG

Borehole No. **1** **2/2**

Client: CARDNO (NSW/ACT) PTY LTD
Project: PROPOSED ACCESS UPGRADE
Location: CROYDON STATION, CROYDON, NSW

Job No. 26852S | **Core Size:** TT56 | **R.L. Surface:** ≈ 22.3m
Date: 26-6-14 | **Inclination:** VERTICAL | **Datum:** AHD
Drill Type: MELVELLE | **Bearing:** - | **Logged/Checked by:** A.P.C./P.S.

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION (Rock Type, grain characteristics, colour, structure, minor components.)	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_S(50)$ (EL VL L M H VH EH)	DEFECT DETAILS: DEFECT SPACING (mm) (500 300 100 50 30 10)	DEFECT DETAILS: DESCRIPTION (Type, inclination, thickness, planarity, roughness, coating.) Specific / General
▼		0		START CORING AT 0.27m					
ON COMPLETION OF CORING				SHALE: dark grey and grey, fragmented.	SW	L-M			
				CORE LOSS 0.58m					
		1		SHALE: dark grey and grey, fractured.	SW	M	•		- J, 20° P, S, IS - Cr, 70mm.t
				CORE LOSS 0.13m					
				SHALE: dark grey and grey.	SW	M	•		- J, 20°, P, S, IS - J, 42°, P, S, IS - J, SUBVERTICAL, P, S - J, 20°, P, R
		2		END OF BOREHOLE AT 1.98m					
		3							
		4							
		5							
		6							
		7							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 2
1/2

Client: CARDNO (NSW/ACT) PTY LTD
Project: PROPOSED ACCESS UPGRADE
Location: CROYDON STATION, CROYDON, NSW

Job No. 26852S **Method:** HAND AUGER **R.L. Surface:** ≈ 22.2m
Date: 26-6-14 **Datum:** AHD
Logged/Checked by: A.P.C./P.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DOC OF AUGER-ING ▼ ON COMPLET-ION OF CORING	■				REFER TO DCP TEST RESULTS	0		-	ASPHALTIC CONCRETE: 30mm.t	D			APPEARS MODERATELY COMPACTED
									FILL: Sandy gravel, fine to coarse grained igneous, grey, fine to coarse grained sand.	MC>PL			
								-	FILL: Silty clay, medium plasticity, brown, with fine to medium grained sandstone and shale gravel.	XW	EL		HAND AUGER REFUSAL
						1			SHALE: orange brown and grey. REFER TO CORED BOREHOLE LOG				
						2							
						3							
						4							
						5							
						6							
						7							


JK Geotechnics
Job No: 265825
BH2
Start Coring at 0.61m
0
1
End of Hole at 1.42m

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

CORED BOREHOLE LOG

Borehole No. **2** **2/2**

Client: CARDNO (NSW/ACT) PTY LTD
Project: PROPOSED ACCESS UPGRADE
Location: CROYDON STATION, CROYDON, NSW

Job No. 26852S | **Core Size:** TT56 | **R.L. Surface:** ≈ 22.2m
Date: 26-6-14 | **Inclination:** VERTICAL | **Datum:** AHD
Drill Type: MELVELLE | **Bearing:** - | **Logged/Checked by:** A.P.C./P.S.

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION (Rock Type, grain characteristics, colour, structure, minor components.)	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_S(50)$ EL VL L M H VH EH	DEFECT SPACING (mm) 500 300 100 50 30 10	DEFECT DETAILS DESCRIPTION (Type, inclination, thickness, planarity, roughness, coating.) Specific / General
		0		START CORING AT 0.61m					
FULL RET-URN		1		SHALE: brown and grey.	SW	L-M	•		- J, 30°, P, R - Cr, 80mm.t - XWS, 10°, 20mm.t - J, SUBVERTICAL, P, S - J, 15°, P, S - XWS, 10°, 20mm.t
				SHALE: dark grey and grey.	SW-FR	M	•		
				END OF BOREHOLE AT 1.42m					
		2							
		3							
		4							
		5							
		6							
		7							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 3
1/2

Client: CARDNO (NSW/ACT) PTY LTD
Project: PROPOSED ACCESS UPGRADE
Location: CROYDON STATION, CROYDON, NSW

Job No. 26852S **Method:** HAND AUGER **R.L. Surface:** ≈ 22.3m
Date: 27-6-14 **Datum:** AHD
Logged/Checked by: A.P.C./P.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION OF AUGER-ING	■				REFER TO DCP TEST RESULTS	0		-	ASPHALTIC CONCRETE: 40mm.t	D			APPEARS MODERATELY COMPACTED
	■								FILL: Sandy gravel, fine to coarse grained igneous, grey, fine to coarse grained sand.	M			
ON COMPLET-ION OF CORING						1			FILL: Gravelly sand, fine to coarse grained, brown, with fine to medium grained shale gravel, with slag, brick and concrete fragments.				HAND AUGER REFUSAL COMMENCE WASHBORING
									REFER TO CORED BOREHOLE LOG				
						2							
						3							
						4							
						5							
						6							
						7							


JK Geotechnics
Job No: 26582S
BH3
Start Coring at 0.88m
1
2
End of Hole at 2.39m

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

CORED BOREHOLE LOG

Borehole No. **3** **2/2**

Client: CARDNO (NSW/ACT) PTY LTD
Project: PROPOSED ACCESS UPGRADE
Location: CROYDON STATION, CROYDON, NSW

Job No. 26852S | **Core Size:** TT56 | **R.L. Surface:** ≈ 22.3m
Date: 27-6-14 | **Inclination:** VERTICAL | **Datum:** AHD
Drill Type: MELVELLE | **Bearing:** - | **Logged/Checked by:** A.P.C./P.S.

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION (Rock Type, grain characteristics, colour, structure, minor components.)	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_S(50)$ EL VL L M H VH EH	DEFECT SPACING (mm) 500 300 100 50 30 10	DEFECT DETAILS DESCRIPTION (Type, inclination, thickness, planarity, roughness, coating.) Specific / General
		0		START CORING AT 0.88m					
FULL RET-URN		1		SHALE: dark grey and orange brown.	DW	M	•		- J, 10°, P, S, IS - J, SUB VERTICAL, P, S, IS - J, 40°, P, R, IS - J, 15°, P, R - J, 45°, P, S, IS - J, 10°, Un, S, IS
		2		SHALE: dark grey.	SW		• •		- XWS, 5°, 5mm.t - J, 40°, P, R, IS - J, 50°, P, R, IS - J, 45°, P, R, IS - J, SUB VERTICAL, Un, S, IS - J, 40°, P, R, IS - J, 70°, P, R, IS
				END OF BOREHOLE AT 2.39m					
		3							
		4							
		5							
		6							
		7							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 4
1/2

Client: CARDNO (NSW/ACT) PTY LTD
Project: PROPOSED ACCESS UPGRADE
Location: CROYDON STATION, CROYDON, NSW

Job No. 26852S **Method:** HAND AUGER **R.L. Surface:** ≈ 21.4m
Date: 27-6-14 **Datum:** AHD
Logged/Checked by: A.P.C./P.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION OF AUGERING ▼					REFER TO DCP TEST RESULTS	0			ASPHALTIC CONCRETE: 50mm.t FILL: Sandy gravel, fine to coarse grained igneous, grey, fine to coarse grained sand.	M			
								-	FILL: Sandy gravel, fine to coarse grained shale and igneous, brown and grey, fine to coarse grained sand, with brick, glass and concrete fragments.	XW-DW	EL-VL		
ON COMPLETION OF CORING						1			SHALE: light grey mottled orange brown, with roots and root f bres. REFER TO CORED BOREHOLE LOG				
						2							
						3							
						4							
						5							
						6							
						7							


JK Geotechnics
Job No: 265825
BH 4
Start Coring at 0.83m
Core loss 0.13
1
2
End Of Hole at 2.53m

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

CORED BOREHOLE LOG

Borehole No. 4 **2/2**

Client: CARDNO (NSW/ACT) PTY LTD
Project: PROPOSED ACCESS UPGRADE
Location: CROYDON STATION, CROYDON, NSW

Job No. 26852S **Core Size:** TT56 **R.L. Surface:** ≈ 21.4m
Date: 27-6-14 **Inclination:** VERTICAL **Datum:** AHD
Drill Type: MELVELLE **Bearing:** - **Logged/Checked by:** A.P.C./P.S.

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION (Rock Type, grain character-istics, colour, structure, minor components.)	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_S(50)$ EL VL L M H VH EH	DEFECT SPACING (mm) 500 300 100 50 30 10	DEFECT DETAILS DESCRIPTION (Type, inclination, thickness, planarity, roughness, coating.) Specific / General
		0		START CORING AT 0.83m					
				CORE LOSS 0.13m					
FULL RET-URN		1		SHALE: orange brown mottled light grey.	DW	L			- XWS, 5°, 10mm.t - Cr, 40mm.t - J, SUB VERTICAL, P, R, IS
		2				L-M			- J, 15°, P, R, IS - CS, 2°, 5mm.t - J, 15°, P, S, IS - J, 50°, P, S, CLAY NFILL - J, 20°, P, S, IS - HEALED J, SUB VERTICAL, P, CLOSED - CS, 2°, 20mm.t
				END OF BOREHOLE AT 2.53m					
		3							
		4							
		5							
		6							
		7							

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BOREHOLE LOG

Borehole No. **4A** 1/1

Client: CARDNO (NSW/ACT) PTY LTD
Project: PROPOSED ACCESS UPGRADE
Location: CROYDON STATION, CROYDON, NSW

Job No. 26852S **Method:** HAND AUGER **R.L. Surface:** ≈ 21.6m
Date: 27-6-14 **Datum:** AHD
Logged/Checked by: A.P.C./P.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION OF AUGER-ING	■				REFER TO DCP TEST RESULTS	0			FILL: Silty sand, fine to medium grained, dark brown and brown, with roots and root fibres, trace of plastic fragments.	D			GARDEN BED
									FILL: Sandy gravel, fine to coarse grained igneous, grey, fine to coarse grained sand.				HAND AUGER REFUSAL COMMENCE WASHBORING
						1			END OF BOREHOLE AT 0.7m				WASHBORING REFUSAL ON FILL BOREHOLE LOCATION MOVED
						2							
						3							
						4							
						5							
						6							
						7							

JK Geotechnics

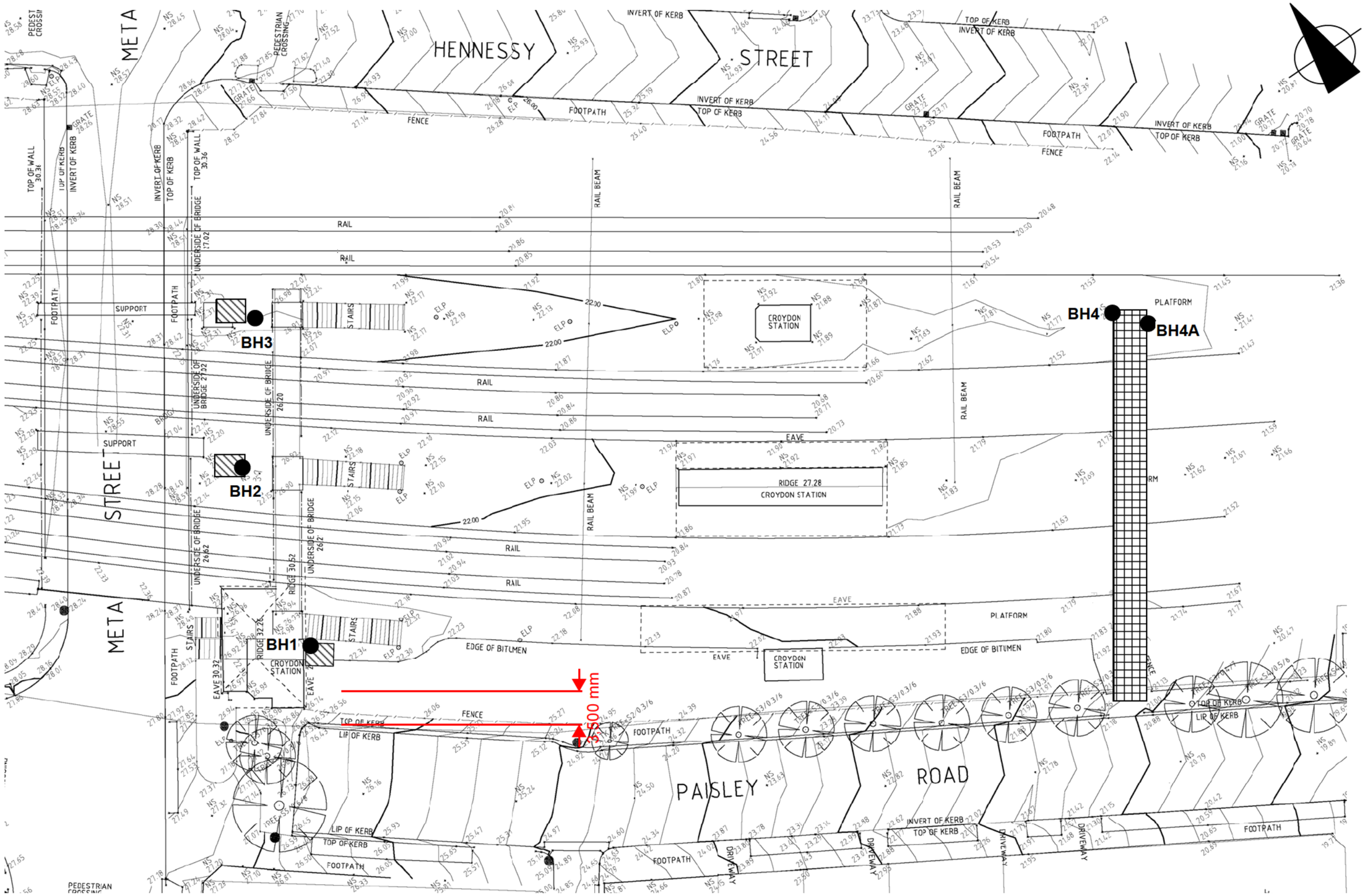
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

DYNAMIC CONE PENETRATION TEST RESULTS

Client:	CARDNO (NSW/ACT) PTY LTD		
Project:	PROPOSED ACCESS UPGRADE		
Location:	CROYDON STATION, CROYDON, NSW		
Job No.	26852S	Hammer Weight & Drop:	9kg/510mm
Date:	26-6-14	Rod Diameter:	16mm
Tested By:	A.P.C.	Point Diameter:	20mm

	Number of Blows per 100mm Penetration						
Test Location	RL 22.3m	RL 22.2m	RL 22.3m	RL 21.6m	RL 21.4m		
Depth (mm)	**1**	**2**	**3**	**4A**	**4**		
0 - 100	2	10	4	PUSHED	5		
100 - 200	14	8	9	↓	10		
200 - 300	REFUSAL	6	6	2	20		
300 - 400		10	2	6	REFUSAL		
400 - 500		17	2	12			
500 - 600		REFUSAL	3	10			
600 - 700			13	REFUSAL			
700 - 800			REFUSAL				
800 - 900							
900 - 1000							
1000 - 1100							
1100 - 1200							
1200 - 1300							
1300 - 1400							
1400 - 1500							
1500 - 1600							
1600 - 1700							
1700 - 1800							
1800 - 1900							
1900 - 2000							
2000 - 2100							
2100 - 2200							
2200 - 2300							
2300 - 2400							
2400 - 2500							
2500 - 2600							
2600 - 2700							
2700 - 2800							
2800 - 2900							
2900 - 3000							

Remarks:
1. The procedure used for this test is similar to that described in AS1289.6.3.2-1997, Method 6.3.2.
2. Usually 8 blows per 20mm is taken as refusal
3. Survey datum is AHD



LEGEND

- BOREHOLE AND DCP TEST
- PROPOSED LIFT LOCATION
- PROPOSED TEMPORAY FOOTING BRIDGE LOCATION

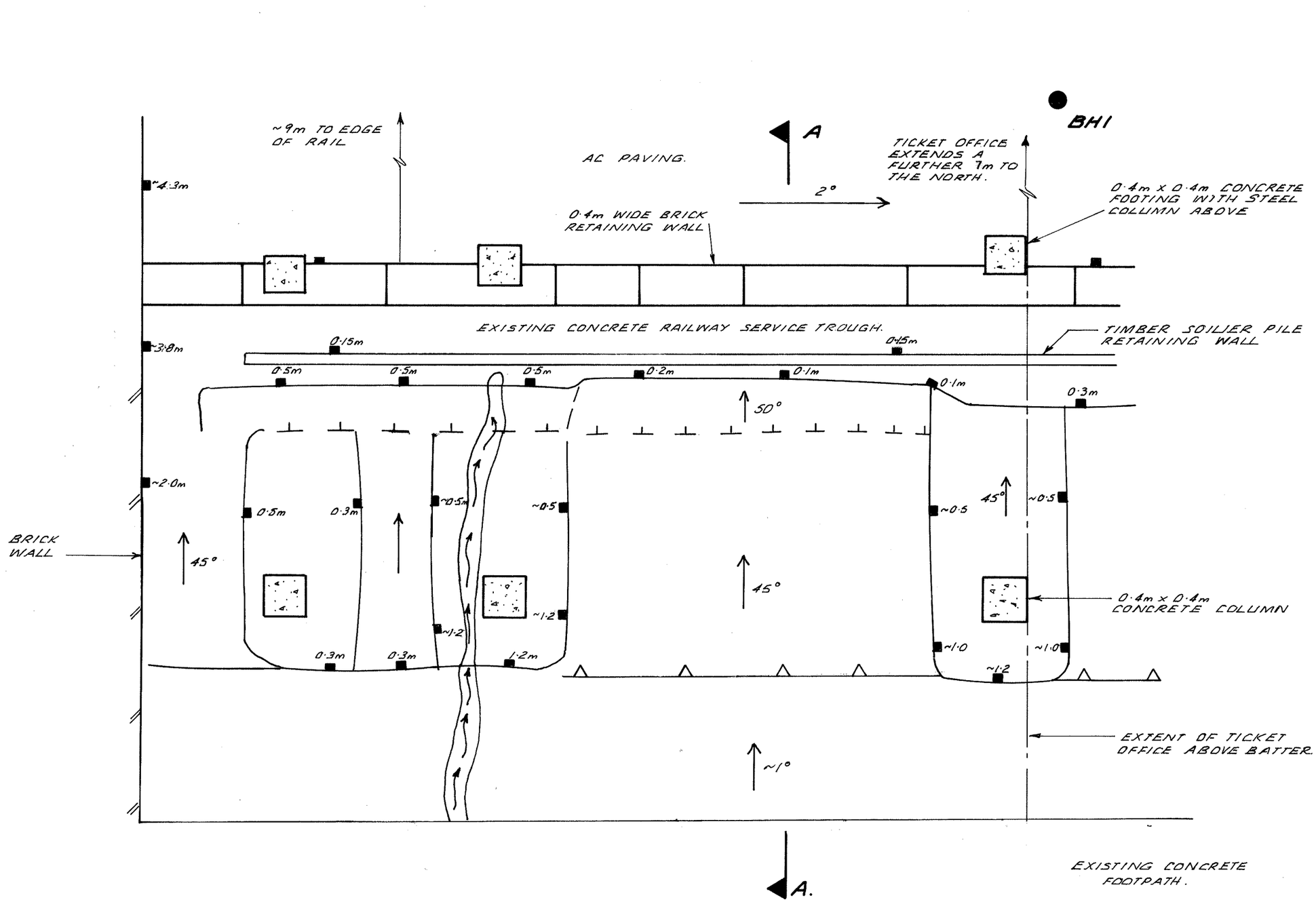
SCALE (m)

0 20

TEST LOCATION PLAN

JK Geotechnics
GEOTECHNICAL & ENVIRONMENTAL ENGINEERS

Report No. 26852S Figure No. 1



NOTE: Refer to Figure 4 for Explanation of Mapping Symbols.

GEOTECHNICAL SITE PLAN

SCALE (m)

0 2

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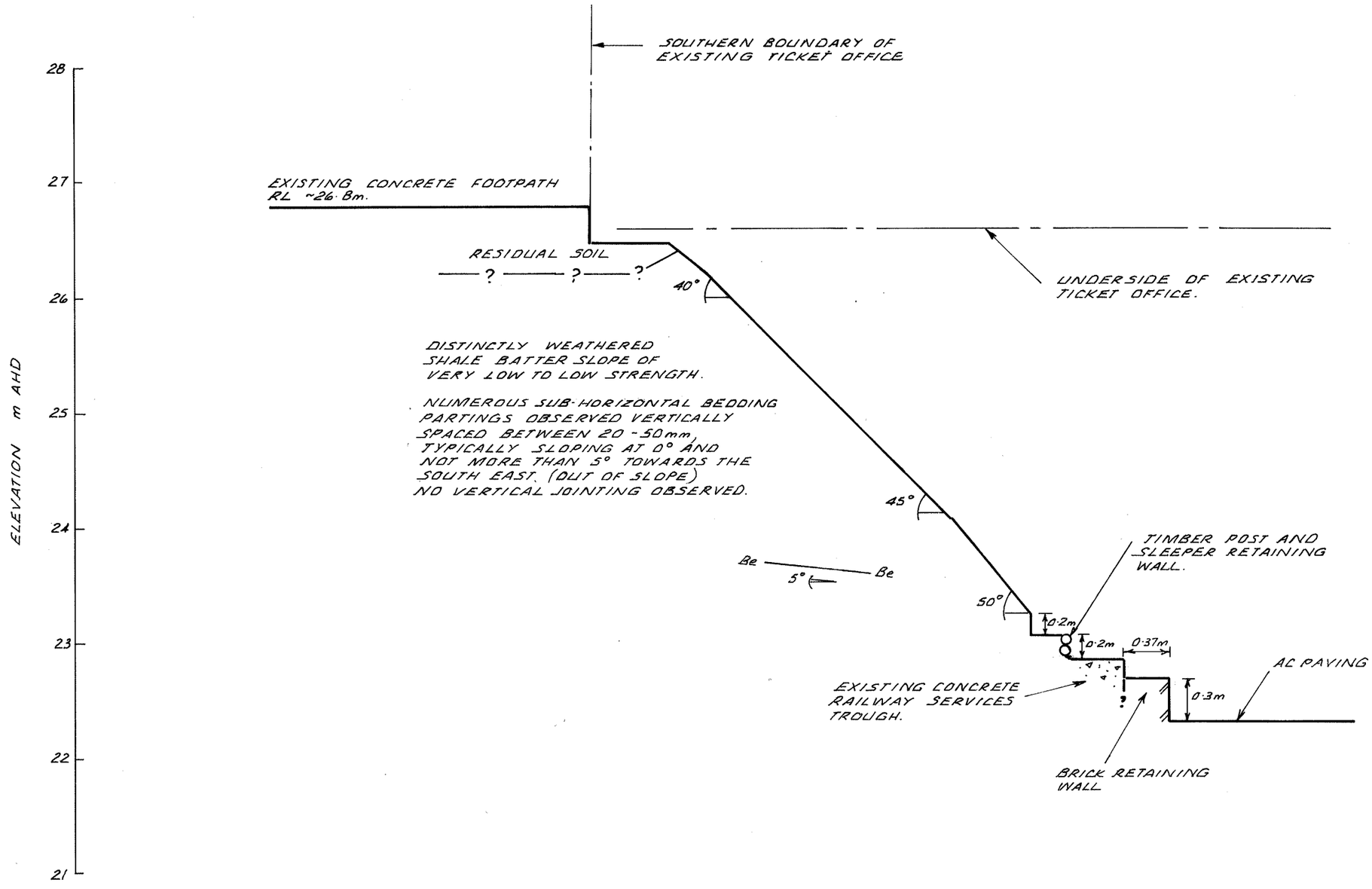
Report No 26852S Figure No. 2



CROSS SECTION A-A

SCALE (m)

0 2

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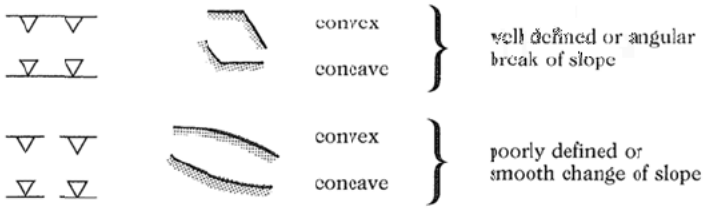
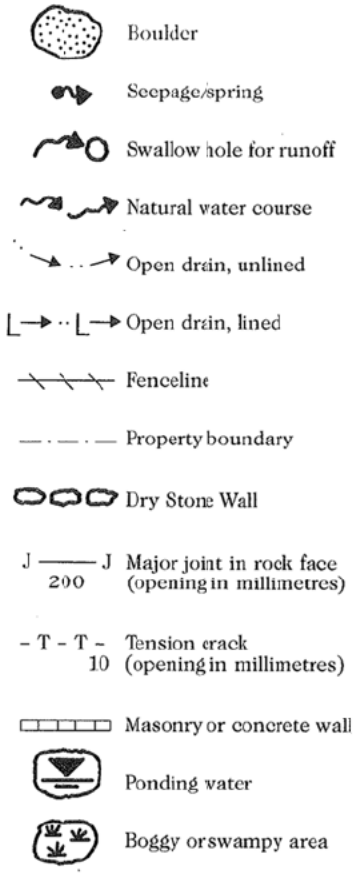
Report No 26852S Figure No. 3

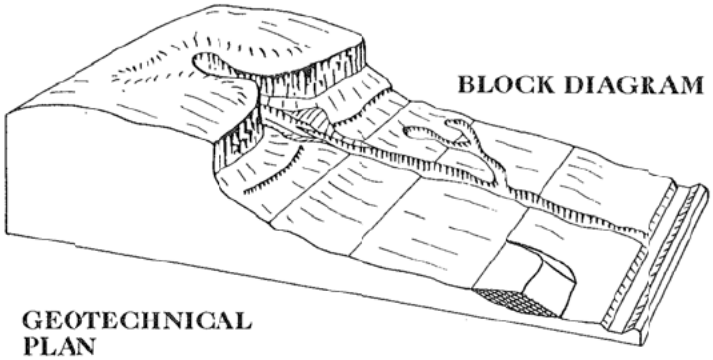
TOPOGRAPHY

Symbol *Ground Profile*



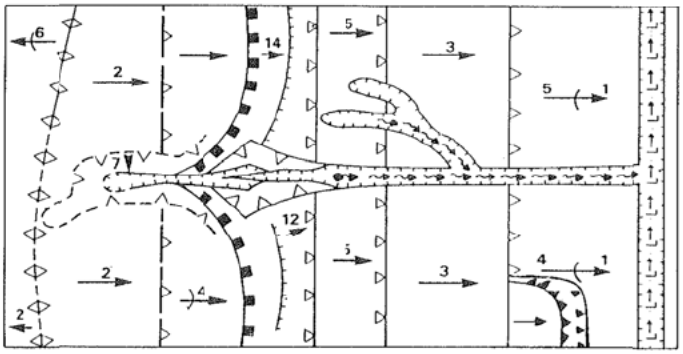
OTHER FEATURES





BLOCK DIAGRAM

GEOTECHNICAL PLAN



(After Gardiner, V & Dackombe, R V (1983), Geomorphological Field Manual; George Allen & Unwin)

GEOTECHNICAL MAPPING SYMBOLS

VIBRATION EMISSION DESIGN GOALS

German Standard DIN 4150 – Part 3: 1999 provides guideline levels of vibration velocity for evaluating the effects of vibration in structures. The limits presented in this standard are generally recognised to be conservative.

The DIN 4150 values (maximum levels measured in any direction at the foundation, OR, maximum levels measured in (x) or (y) horizontal directions, in the plane of the uppermost floor), are summarised in Table 1 below.

It should be noted that peak vibration velocities higher than the minimum figures in Table 1 for low frequencies may be quite 'safe', depending on the frequency content of the vibration and the actual condition of the structures.

It should also be noted that these levels are 'safe limits', up to which no damage due to vibration effects has been observed for the particular class of building. 'Damage' is defined by DIN 4150 to include even minor non-structural effects such as superficial cracking in cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load bearing walls. Should damage be observed at vibration levels lower than the 'safe limits', then it may be attributed to other causes. DIN 4150 also states that when vibration levels higher than the 'safe limits' are present, it does not necessarily follow that damage will occur. Values given are only a broad guide.

Table 1: DIN 4150 – Structural Damage – Safe Limits for Building Vibration

Group	Type of Structure	Peak Vibration Velocity in mm/s			
		At Foundation Level at a Frequency of:			Plane of Floor of Uppermost Storey
		Less than 10Hz	10Hz to 50Hz	50Hz to 100Hz	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design.	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use.	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Group 1 and 2 and have intrinsic value (eg. buildings that are under a preservation order).	3	3 to 8	8 to 10	8

NOTE: For frequencies above 100Hz, the higher values in the 50Hz to 100Hz column should be used.

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 (e.g. sandy clay) as set out below:

Soil Classification	Particle Size
Clay	less than 0.002mm
Silt	0.002 to 0.075mm
Sand	0.075 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_c" 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 sub-surface 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


FILL


TOPSOIL


CLAY (CL, CH)


SILT (ML, MH)


SAND (SP, SW)


GRAVEL (GP, GW)


SANDY CLAY (CL, CH)


SILTY CLAY (CL, CH)


CLAYEY SAND (SC)


SILTY SAND (SM)


GRAVELLY CLAY (CL, CH)


CLAYEY GRAVEL (GC)


SANDY SILT (ML)


PEAT AND ORGANIC SOILS

ROCK


CONGLOMERATE


SANDSTONE


SHALE


SILTSTONE, MUDSTONE, CLAYSTONE


LIMESTONE


PHYLLITE, SCHIST


TUFF


GRANITE, GABBRO


DOLERITE, DIORITE


BASALT, ANDESITE


QUARTZITE

DEFECTS AND INCLUSIONS


CLAY SEAM


SHEARED OR CRUSHED SEAM


BRECCIATED OR SHATTERED SEAM/ZONE


IRONSTONE GRAVEL


ORGANIC MATERIAL

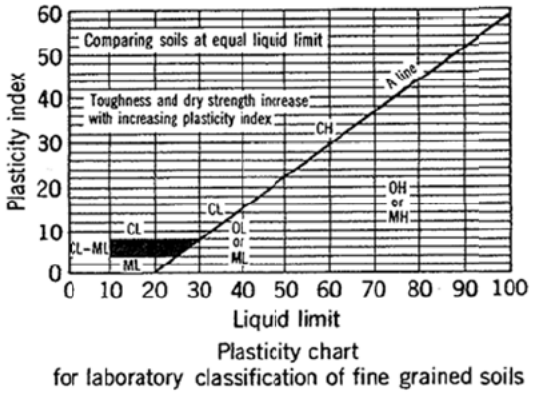
OTHER MATERIALS


CONCRETE


BITUMINOUS CONCRETE, COAL


COLLUVIUM

Field Identification Procedures (Excluding particles larger than 75 μm and basing fractions on estimated weights)				Group Symbols [a]	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[b] (The smallest particle visible to naked eye)	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	Give typical name; indicate approximate percentages of sand and gravel; maximum size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbols in parentheses For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics Example: *Silty sand*, gravelly; about 20% hard, angular gravel particles 12 mm maximum size; rounded and subangular sand grains coarse to fine, about 15% non-plastic fines with low dry strength; well compacted and moist in place; alluvial sand; (*SM*)	Use grain size curve in identifying the fractions as given under field identification 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, SW, SP* More than 12% *GM, GC, SM, SC* 5% to 12% *Borderline* cases requiring use of dual symbols $C_U = \frac{D_{60}}{D_{10}}$ Greater than 4 $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3 Not meeting all gradation requirements for *GW* Atterberg limits below "A" line, or *PI* less than 4 — Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols Atterberg limits above "A" line, with *PI* greater than 7 $C_U = \frac{D_{60}}{D_{10}}$ Greater than 6 $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3 Not meeting all gradation requirements for *SW* Atterberg limits below "A" line or *PI* less than 5 — Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols Atterberg limits below "A" line with *PI* greater than 7
		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		
			Nonplastic fines (for identification procedures see *ML* below)	*GM*	Silty gravels, poorly graded gravel-sand-silt mixtures		
			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					Give typical name; indicate degree and character of plasticity, amount and maximum size of coarse grains; colour in wet condition, odour if any, local or geologic name, and other pertinent descriptive information, and symbol in parentheses For undisturbed soils add information on structure, stratification, consistency in undisturbed and remoulded states, moisture and drainage conditions Example: *Clayey silt*, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (*ML*)	
		Dry Strength (crushing characteristics)	Dilatancy (reaction to shaking)	Toughness (consistency near plastic limit)			
	Silts and clays liquid limit less than 50	None to slight	Quick to slow	None	*ML*	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	
		Medium to high	None to very slow	Medium	*CL*	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
		Slight to medium	Slow	Slight	*OL*	Organic silts and organic silt-clays of low plasticity	
	Silts and clays liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium	*MH*	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
		High to very high	None	High	*CH*	Inorganic clays of high plasticity, fat clays	
		Medium to high	None to very slow	Slight to medium	*OH*	Organic clays of medium to high plasticity	
Highly Organic Soils		Readily identified by colour, odour, spongy feel and frequently by fibrous texture			*Pt*	Peat and other highly organic soils	



Plasticity chart
for laboratory classification of fine grained soils

Note: 1 Soils possessing characteristics of two groups are designated by combinations of group symbols (eg. 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.
	C	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.
	SAL	Soil sample taken over depth indicated, for salinity 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_c = 5 7 3 R	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150 mm penetration for 60 degree solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	VNS = 25	Vane shear reading in kPa of Undrained Shear Strength.
	PID = 100	Photoionisation detector reading in ppm (Soil sample headspace test).
Moisture Condition (Cohesive 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.
(Cohesionless Soils)	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 25-50 kPa
	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)		**Density Index (I_D) Range (%)** / **SPT 'N' Value Range (Blows/300mm)**
	VL	Very Loose: <15 / 0-4
	L	Loose: 15-35 / 4-10
	MD	Medium Dense: 35-65 / 10-30
	D	Dense: 65-85 / 30-50
	VD	Very Dense: >85 / >50
	( )	Bracketed symbol indicates estimated density based on ease of drilling or other tests.
Hand Penetrometer Readings	300 250	Numbers indicate individual test results in kPa on representative undisturbed material unless noted otherwise.
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.

LOG SYMBOLS continued

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		Easily remoulded by hand to a material with soil properties.
		0.03	
Very Low:	VL		May be crumbled in the hand. Sandstone is "sugary" and friable.
		0.1	
Low:	L		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.
		0.3	
Medium Strength:	M		A piece of core 150mm long x 50mm dia. can be broken by hand with difficulty. Readily scored with knife.
		1	
High:	H		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.
		3	
Very High:	VH		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.
		10	
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	

Appendix C

Site Photos


MS9+425


MS9+425


MS9+425

Croydon

MS9+425


Kiss and ride
OPEN 7

THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT NOTES ON DRAWING S0001

CUTTING STABILIZATION - CROYDON

MAIN SUBURBAN LINE - 9.425KM TO CENTRAL

CROYDON PLATFORM 5 POST AND PANEL RETAINING WALL

STRUCTURE

GENERAL NOTES

1. These drawings are for structural purposes only and are to be read in conjunction with the specification, architectural drawings, other contract documentation and the requirements of the relevant authorities.
2. Verify all setting out dimensions with the Architect.
3. Do not obtain dimensions by scaling the structural elements.
4. Should any ambiguity, error, omission, discrepancy, inconsistency or other fault exist or seem to exist in the contract documents, immediately notify in writing to the Superintendent.
5. Maintain the structure in a stable condition during construction. Temporary bracing/shoring shall be provided by the contractor to keep the structure and excavations stable at all times, ensuring that no part of the documented structure becomes overstressed. For all temporary batters obtain geotechnical engineer's recommendations.
6. All workmanship and materials shall be in accordance with the requirements of current Standards Australia codes and the bylaws, ordinances or other requirements of the relevant building authorities.
7. All proprietary items are to be installed and fixed in accordance with the manufacturers specifications and instructions.
8. All work is to be carried out in accordance with all Workcover requirements and occupational health and safety act regulations
9. Construction using these drawings shall not commence until a Construction Certificate is issued by the Principal Certifying Authority.
10. Designed in accordance with AS5100.3.
11. Refer to TfNSW Drawings CV0212048 to CV0212051 for additional details.

BLUE BOX DENOTES VARIATION TO TfNSW DRAWINGS CV0212048 to CV0212051

Refer to Structural Engineer if there are inconsistencies not clouded.

DESIGN LOADS:

Surcharge : 5 kPa

Wind Loads : Vr = 45 Where R = 1000 years
Region = A2
Terrain Category = 2.5

Earthquake Loads: Design Category = 2
Site Sub-soil class = Be
Hazard Factor Z = 0.08
Probability Factor kp = 1.0
Importance Level = 2

Design Life: 100 years

SAFETY IN DESIGN

TTW operates under Safe Work Australia's Code of Conduct for the Safe Design of Structures.
These drawings shall be read in conjunction with the Hazard log.
Under the Code of Conduct it is the Client's responsibility to provide a copy of the Hazard log to the Principal Contractor.
It is the Principal Contractor's responsibility to review the hazards and risks identified during the design process to ensure a safe workplace is maintained for the construction, maintenance and eventual demolition of the structure.

FOOTING NOTES

1. Foundations have been designed for:
   Allowable Bearing Pressure - 700 kPa
   Foundation material is to be inspected and approved by the geotechnical engineer before casting footings.
2. Refer to geotechnical report No. 26852S dated 01/08/14 by JK GEOTECHNICS
3. Locate all pipes, retaining walls and excavation outside a 1:2 (vertical:horizontal) zone of influence from the bottom edge of the footing.
4. Where side shear is required to be developed, clean and roughen the sides of the excavation to the satisfaction of the geotechnical engineer.
5. Footings shall be located centrally under walls and columns unless noted otherwise.
6. Footings to be constructed and backfilled as soon as possible following excavation to avoid softening or drying out by exposure.
7. Contractor is to allow for cost of geotechnical inspections and any required certification.

PILING NOTES

1. Piles are to be designed in accordance with AS2159 by the contractor for the axial loads and moments listed in the piling schedule and all requirements of the specification.
2. The pile design and installation shall follow the recommendations outlined in the geotechnical report No. 26852S prepared by JK Geotechnics. Any additional geotechnical investigation work deemed necessary shall be at the contractor's expense.
3. Pile spacing and pile cap design is based on [600 diameter grout injected auger piles]. Alternative pile systems may be used subject to approval. Any necessary re-design of pile caps to suit alternative systems shall be at the expense of the contractor. For single piles under columns the minimum pile diameter shall be [600mm].
4. All piles or pile groups are to be centred under columns and walls UNO
5. Prior to commencing on site, the contractor must submit for approval:
   A. pile type proposed
   B. pile size(s), reinforcement details, founding depths and design certificate.The design certificate is to certify the pile design is in accordance with AS2159 for the loads listed in the piling schedule and be signed by a NER registered engineer experienced in the type of piling proposed.
   C. a shop drawing setting out all pile locations from grid
6. The contractor is to coordinate the location of all underground services and to be responsible for ensuring that these are either avoided or relocated as appropriate.
7. The contractor shall provide a NER registered engineer to supervise the pile installation.
8. At the satisfactory completion of the work the contractor shall provide an inspection certificate signed by a NER registered engineer.

CONCRETE NOTES

EXPOSURE CLASSIFICATION : External - B1

CONCRETE
Place concrete of the following characteristic compressive strength f'c as defined in AS 1379.

Location	f'c MPa at 28 days
Piles	S50
Walls	S40

1. Use Type 'GP' cement, unless otherwise specified.
2. All concrete shall be subject to project assessment and testing to AS 1379.
3. Consolidate by mechanical v bration. Cure all concrete surfaces as directed in the Specification.
4. For all falls in slab, drip grooves, reglets, chamfers etc. refer to the architect's drawings and specifications.
5. Unless shown on the drawings, the location of all construction joints shall be submitted to engineer for review.
6. No holes or chases shall be made in the slab without the approval of the Engineer.
7. Conduits and pipes are to be fixed to the underside of the top reinforcement layer.
8. Slurry used to lubricate concrete pump lines is not to be used in any structural members.
9. All slabs cast on ground require sand blinding with a Concrete Underlay
10. (175) Indicates slab or band thickness

FORMWORK

1. The design, certification, construction and performance of the formwork, falsework and backpropping is the responsibility of the contractor.
2. The proposed method of installation and removal of formwork is to be submitted to the Superintendent for comment prior to work being carried out.

RETAINING WALL NOTES

1. Drainage shall be provided as shown on the drainage drawings.
2. Backfilling shall be carried out after grout or concrete has reached a minimum strength of 0.85 f'c.
   Backfilling shall be approved granular material compacted in layers not exceeding 200mm to 98% +/- 2 Standard compaction unless noted otherwise.
3. Provide waterproofing to back of walls as specified or noted.
4. Where retaining walls rely on connecting structural elements for stability, do not backfill against the wall unless it is adequately propped or the elements have been constructed and have sufficient strength to withstand the loads.
5. For all temporary batters obtain geotechnical engineers recommendations.
6. Granular backfill

SIEVE APERTURE (mm) TO AS 1152	PERCENTAGE PASSING (BY MASS)
9.5	100
6.7	95-98
4.75	58-78
2.36	37-50
1.38	22-33
0.425	10-17
0.075	2-10

A. Plasticity Index: Not greater than 3%.
B. Liquid Limit: Not greater than 25%.
C. Coefficient of permeability: Not less than 0.1 mm/sec.
D. Non-dispersive (a rating of nil as defined by the 'dispersion test' AS 1289.3.8.1).

TENSION LAPS

BAR SIZE	32 MPa CONCRETE: TOP BARS IN BANDS AND BEAMS	32 MPa CONCRETE: HORIZONTAL BARS IN WALLS & TOP BARS IN SLABS > 330 THICK	32 MPa CONCRETE: ALL OTHER BARS
N12	580	620	480
N16	800	920	700
N20	1130	1240	950
N24	1480	1590	1230
N28	1850	1940	1490
N32	2250	2300	1780
N36	2690	2700	2080
N40	3130	3130	2420

BAR SIZE	40 MPa CONCRETE: TOP BARS IN BANDS AND BEAMS	40 MPa CONCRETE: HORIZONTAL BARS IN WALLS & TOP BARS IN SLABS > 330 THICK	40 MPa CONCRETE: ALL OTHER BARS
N12	580	590	480
N16	770	870	670
N20	1050	1150	890
N24	1370	1440	1100
N28	1700	1740	1340
N32	2070	2070	1590
N36	2420	2420	1870
N40	2800	2800	2150

BAR SIZE	50 MPa CONCRETE: TOP BARS IN BANDS AND BEAMS	50 MPa CONCRETE: HORIZONTAL BARS IN WALLS & TOP BARS IN SLABS > 330 THICK	50 MPa CONCRETE: ALL OTHER BARS
N12	580	580	480
N16	770	780	640
N20	950	1040	800
N24	1230	1290	990
N28	1530	1550	1200
N32	1850	1850	1430
N36	2170	2170	1670
N40	2500	2500	1930

COMPRESSION LAPS

BAR SIZE	LAP
N16	640
N20	800
N24	960
N28	1120
N32	1280
N36	1440
N40	1600

REINFORCEMENT NOTES

1. Fix reinforcement as shown on drawings. The type and grade is indicated by a symbol as shown below. On the drawings this is followed by a numeral which indicates the size in millimetres of the reinforcement.

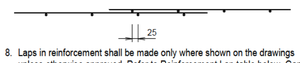
N	Hot rolled ribbed bar	grade D500N
R	Plain round bar	grade R250N
SL	Square mesh	grade 500L
RL	Rectangular mesh	grade 500L

2. Provide bar supports or spacers to give the following concrete cover to all reinforcement unless otherwise noted on drawings.

Footings - 70 top, 70 bottom, 70 sides.
Precast Walls - 35.

3. Cover to reinforcement ends to be 50 mm UNO.
4. Provide N12-450 support bars to top reinforcement as required.
   Tension Lap UNO
5. Maintain cover to all pipes, conduits, reglets, drip grooves etc.
6. All cogs to be standard cogs unless noted otherwise.
7. Fabric end and side laps are to be placed strictly in accordance with the manufacturers requirements to achieve a full tensile lap. Fabric shall be laid so that there is a maximum of 3 layers at any location.

FABRIC LAPS



8. Laps in reinforcement shall be made only where shown on the drawings unless otherwise approved. Refer to Reinforcement Lap table below. Gap between lapped bars to be no more than 3 bar diameters as per AS3600 clause 13.2

PRECAST PANEL NOTES

GENERAL

1. All overall dimensions of panels to be obtained from architectural drawings, refer also other consultants for additional penetrations.
2. Provide all holes, rebates, dummy joints, cleats etc. as required by both architectural and structural drawings.
3. Precast manufacturer is to provide connections and fixings of precast panels in accordance with BCA C1.11 and the specification.
4. All joints to have a minimum fire rating equivalent to wall.

CONCRETE

1. Panel minimum structural thicknesses are as noted on these drawings.
2. Concrete strength to be minimum f'c = 25 MPa before lifting and a minimum concrete strength of f'c = 40 MPa at 28 days. Test cylinders to be supplied to this office on request.
3. The minimum cement content to be not less than 320 kg/m^3 .
4. Precast concrete structures shall comply with AS 5100.

PANEL REINFORCEMENT

1. The reinforcement indicated on the drawings is for service conditions only. Additional reinforcement may be required for lifting and handling. This shall be specified by the precast manufacturer and approved by this office.
2. All cast-in fittings, bolts, ferrules etc. shall be hot dipped galvanized. All ferrules to be minimum M20 ferrule with an R12 bar x 300 long through the base of the ferrule unless otherwise indicated. Ferrules cast-in within 300mm of the edge of a panel are to have an N12 hairpin bar x 1000 long placed around the ferrules.

PANEL DOCUMENTATION

1. The precast manufacturer is respons ble for designing all lifting points, strongbacks and propping points.
2. Detailed shop drawings showing panel dimensions, reinforcement, lifting and propping configurations and all cast in plates and ferrules must be prepared by the panel manufacturer and submitted to this office for review prior to panel fabrication.

PROTECTION AND HANDLING

1. Precast units must be protected against damage from time of removal from mould until erected, in particular protect against local crushing and chafing effects of lifting and transporting equipment. Store panels clear of ground. Handle and support only from designed lifting points and ensure that no overstress or permanent deformation will occur during handling. Adequately brace slender units during erection to prevent lateral deformation.

ERECTION

1. Panels are to be securely propped until either all the steelwork is erected, plumbed and completed, or slabs supported on panels are constructed and cured.
2. All sealants are to be as specified by the Architect.
3. All grout is to be an approved non-shrink, non-staining grout.
4. All bearing pads under the panels are to be an approved non metallic type.
5. All dowel pockets are to be grouted after panels have been erected.
6. Lifting slings are to be of an adequate capacity to safely lift the panels and have a minimum length of 1200mm.

STRUCTURAL STEELWORK NOTES

1. Provide temporary bracing to maintain stability of steelwork during construction.
2. Do not grout under base plates until first level steelwork is plumb and fixed by welding or bolting.
3. Submit all shop drawings to the Superintendent before commencing fabrication.
4. GENERAL UNO
   a. All Steelwork to be fabricated and erected in accordance with AS/NZS 5131.
   b. Use 10mm thick gusset, fin and end plates welded all round.
   c. Provide 8mm seal plate to all open ends of tube members.
   d. Provide all cleats and holes necessary for fixing Timber and other elements to the steel whether or not detailed on the Structural drawings.
   e. Studs are to be fabricated to AS1554.2
   f. Shear studs (composite slab to steel) to be grade 410 MPa.
   g. Threaded studs (steel to steel) grade 380 MPa.
   h. Turnbuckles to be quality grade 'S' to AS2319.
5. BOLTING UNO
   a. All bolts 20mm dia.
   b. All bolts to be grade 8.8/S.
   c. All holding down bolts to be grade 4.6.
   d. All bolts, including holding down bolts are to be hot dip galvanized.
   e. All connections to have a minimum of 2 bolts.
   f. Washers are to be in accordance with AS4100.
      Holes 3mm or more greater than the bolt diameter and slotted holes are to have plate washers of minimum 8mm thickness and are to extend a minimum of 0.5 the bolt diameter past the edge of the hole.
   g. A minimum of two threads shall extend past the nut.

Bolting categories are identified on the drawings in the following manner.

4.6/S Commercial bolts of grade 4.6 snug tightened.
8.8/S High strength bolts of grade 8.8 snug tightened.
8.8/TB High strength bolts of grade 8.8 fully tensioned to AS4100 as a bearing type joint.
8.8/TF High strength bolts of grade 8.8 fully tensioned to AS4100 as a friction type joint with faying surfaces left uncoated.

Note: Grade 8.8 bolts are NOT to be welded. /TB and /TF bolt categories shall be installed using the direct tension indicator method to AS/NZS 5131.

6. WELDING UNO
   a. All welds to be continuous all round fillet U.N.O. as defined in table below

Plate Thickness less than or equal to	Weld Size
16mm	6mm
24mm	8mm
32mm	12mm

   b. All welds to be category SP.
   c. All weld metal is to have a nominal tensile strength as defined in table below

Nominal yield strength of steel to be welded	Nominal tensile strength of weld metal - f_{uw}
All Steel with Grade ≤ 300 MPa	430 MPa
All Steel > 300 MPa & ≤ 450 MPa	490 MPa
Quenched & tempered steel to Grade 690 MPa	760 MPa

   d. Butt weld all flanges at end plates and at all mitre cuts.
   e. Gussets to end plates to be butt welded.
   f. All butt welds shall be full penetration, grade SP.
   g. Chip all welds free of slag.
   h. The contractor is to confirm with Architect as to where exposed welds are to be ground flush / smooth.
   i. Refer to Structural Steel Specification and AS/NZS 5131 for NDE weld testing requirements.

STEEL GRADES

Refer to Strucutral Steel Specification / Steel member schedule.

STEEL FINISHES

All steelwork shall be hot dip galvanised to AS4680

1 0 1 2 3 4 5 m
1:100 FULL SIZE A1

DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR

REV	DESCRIPTION	DESIGNER SIGN./DATE		VERIFIED SIGN./DATE		APPROVED SIGN./DATE	
04	TITLEBLOCK FIX	TB	30.11.22	JVR	30.11.22	KBP	30.11.22
03	REVISED AS NOTED	TB	28.10.22	JVR	28.10.22	KBP	28.10.22
02	REVISED AS NOTED	TB	13.10.22	JVR	13.10.22	KBP	13.10.22
01	ISSUED FOR CONSTRUCTION	TB	27.07.22	JVR	27.07.22	KBP	27.07.22

CO-ORDINATE SYSTEM: ISG | Height Datum: AHD | Scale: 1 : 1

NSW GOVERNMENT Transport for NSW

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Taylor Thomson Whitting
612 9439 7288 I L6 73 Miller Street North Sydney NSW 2060
Structural Engineering

DRAWN	JONATHAN KHATTAR	30.11.22
DESIGNED	TRENT BYRNE	30.11.22
DRG CHECK	FREDERIC RAVION	30.11.22
DESIGN CHECK	JOHN VAN ROOYEN	30.11.22
APPROVED	KEVIN BERRY	30.11.22

CUTTING STABILIZATION - CROYDON
MAIN SUBURBAN LINE - 9.425KM TO CENTRAL
CROYDON PLATFORM 5 POST AND PANEL RETAINING WALL
STRUCTURAL
COVER AND NOTES SHEET

FILE No. S0001 | SHEET: 1 OF 3 | A1
STATUS APPROVED FOR CONSTRUCTION ©

DRG No.	REV	VER	EDMS No.	AMD No.
S0001	04	0	CV0858241	04

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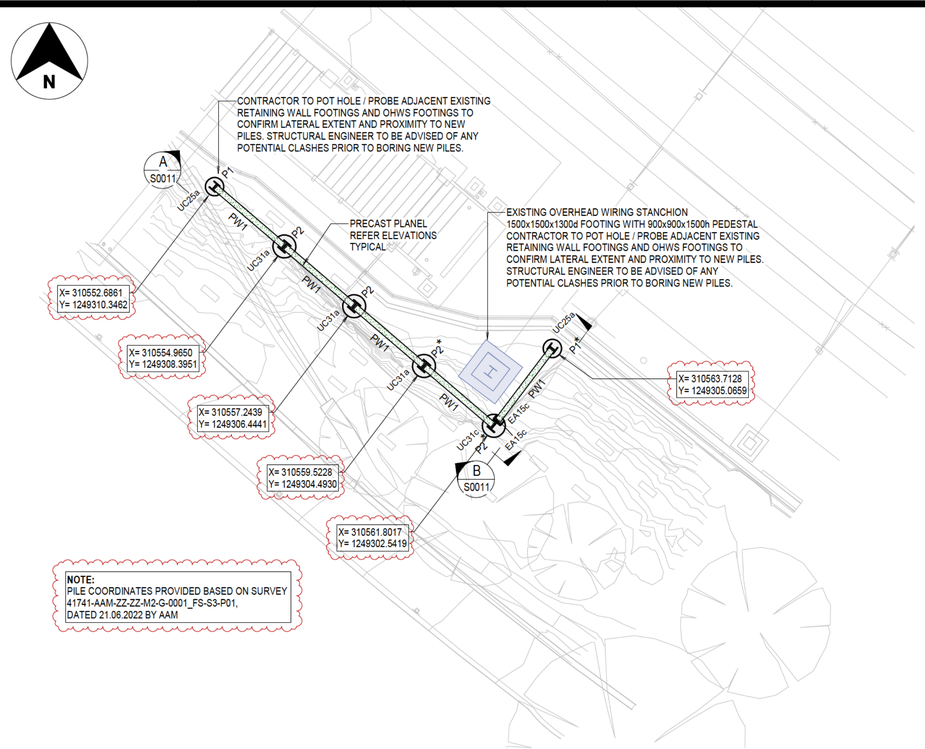
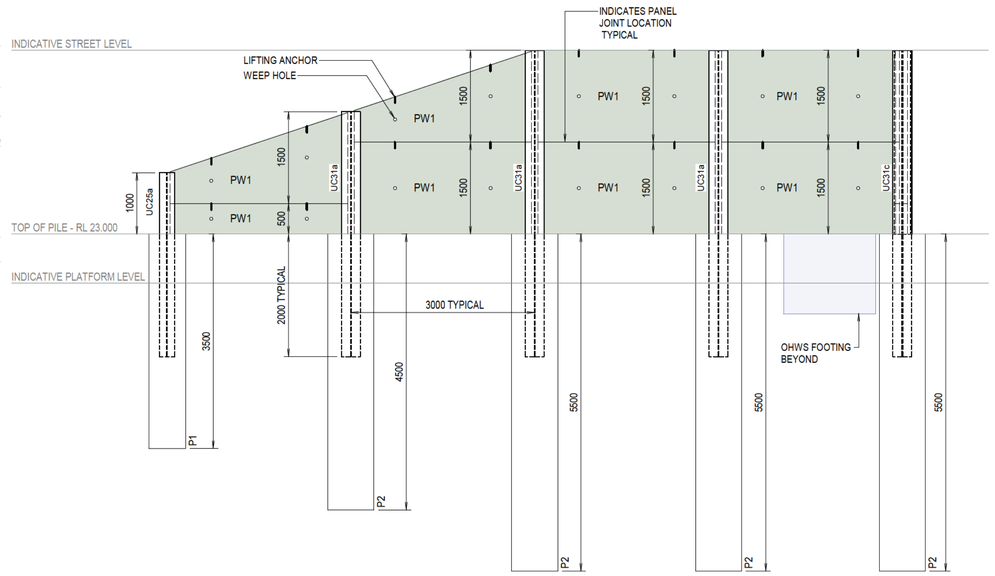
THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT NOTES ON DRAWING S0001



PLATFORM LEVEL OUTLINE PLAN

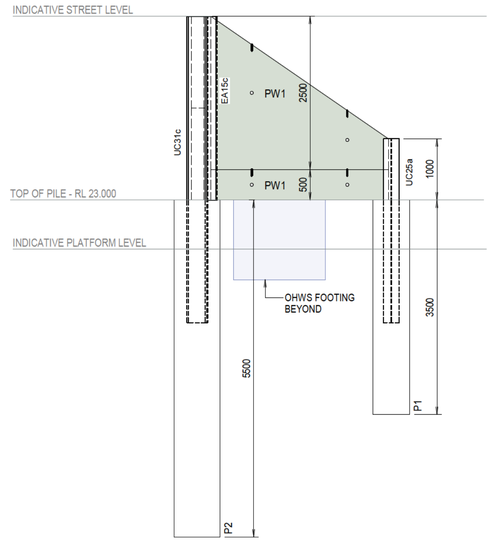
Scale: 1 : 100

NOTE: REFER TO SURVEY DRAWING 41741-AAM-ZZ-ZZ-DR-G-001 BY AAM



ELEVATION A

SCALE 1 : 50 — S0011



ELEVATION B

SCALE 1 : 50 — S0011

PILE SCHEDULE

MARK	DIAMETER	REINFORCEMENT
P1	600	12N24
P2	750	16N28

* DENOTES CASED CFA INSTALLATION TO MINIMISE IMPACT ON OVERHEAD WIRING STRUCTURE (OWS) FOOTING.

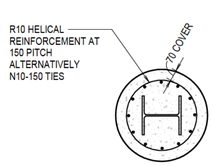
STEEL COLUMN SCHEDULE

MARK	SIZE	COMMENTS
EA15c	150x150x16 EA	HOT DIP GALVANISED TO AS4680
UC25a	250UC72.9	HOT DIP GALVANISED TO AS4680
UC31a	310UC96.8	HOT DIP GALVANISED TO AS4680
UC31c	310UC137	HOT DIP GALVANISED TO AS4680

WALL SCHEDULE

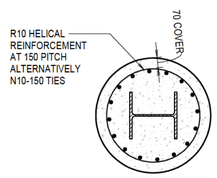
MARK	THICKNESS
PW1	200

REFER TO TfNSW DRAWINGS CV0212048 to CV0212051.
REFER TO STRUCTURAL ENGINEER IF THERE ARE INCONSISTENCIES



TYPICAL P1 DETAIL

Scale: 1 : 20



TYPICAL P2 DETAIL

Scale: 1 : 20

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1:100 FULL SIZE A1

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03	REVISED AS NOTED	TB	07.11.22	JVR	07.11.22	KBP	07.11.22
02	REVISED AS NOTED	TB	28.10.22	JVR	28.10.22	KBP	28.10.22
01	ISSUED FOR CONSTRUCTION	TB	27.07.22	JVR	27.07.22	KBP	27.07.22

CO-ORDINATE SYSTEM: ISG | *Height Datum: AHD* | Scale: As indicated

NSW GOVERNMENT Transport for NSW

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DRG CHECK	FREDERIC RAVION	30.11.22
DESIGN CHECK	JOHN VAN ROOYEN	30.11.22
APPROVED	KEVIN BERRY	30.11.22

CUTTING STABILIZATION - CROYDON

MAIN SUBURBAN LINE - 9.425KM TO CENTRAL

CROYDON PLATFORM 5 POST AND PANEL RETAINING WALL STRUCTURAL

PLANS AND ELEVATIONS

FILE No. S0011		SHEET: 2 OF 3		A1
STATUS APPROVED FOR CONSTRUCTION				Ⓒ
DRG No. S0011	REV 04	VER 0	EDMS No. CV0858242	AMD No. 04

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Plot Date & Time 2/12/2022 10:49:31 AM

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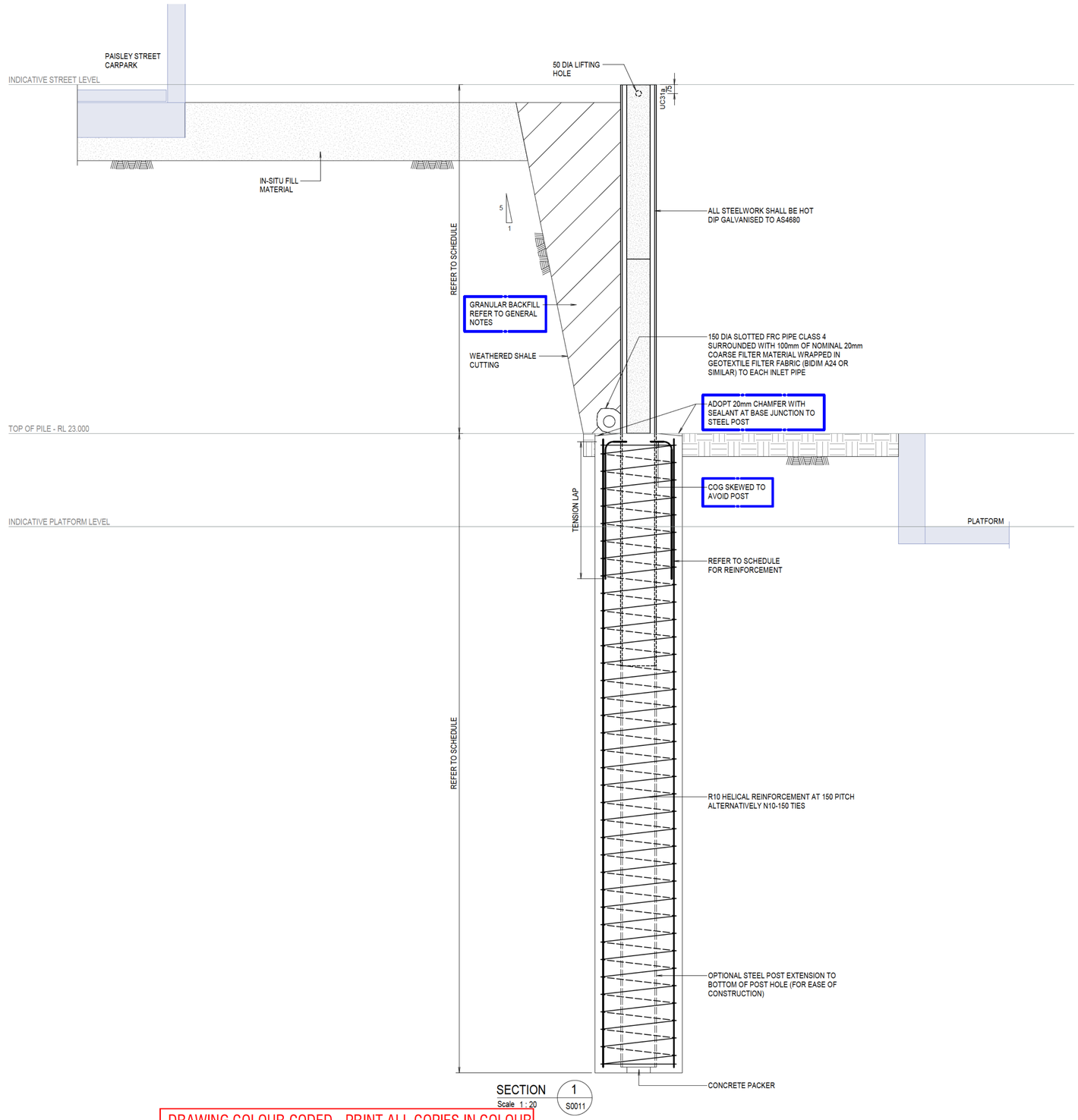

SECTION 1 / S0011
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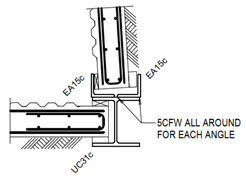

TYPICAL PRECAST PANEL CORNER PLAN
Scale: 1 : 20

REFER TO TfNSW DRAWINGS CV0212048 to CV0212051.
REFER TO STRUCTURAL ENGINEER IF THERE ARE INCONSISTENCIES

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REV	DESCRIPTION	DESIGNER SIGN./DATE		VERIFIED SIGN./DATE		APPROVED SIGN./DATE	
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CO-ORDINATE SYSTEM: ISG | *Height Datum: AHD* | Scale: As indicated

1 0 1 2 3 4 5 m
1:100 FULL SIZE A1

NSW GOVERNMENT **Transport for NSW**

TRANSPORT FOR NSW
PO Box 533
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DESIGN CHECK	JOHN VAN ROOYEN	30.11.22
APPROVED	KEVIN BERRY	30.11.22

CUTTING STABILIZATION - CROYDON
MAIN SUBURBAN LINE - 9.425KM TO CENTRAL
CROYDON PLATFORM 5 POST AND PANEL RETAINING WALL STRUCTURAL
DETAILS AND SECTIONS

FILE No. S0021		SHEET: 3 OF 3	A1
STATUS APPROVED FOR CONSTRUCTION			C
DRG No. S0021	REV 04 / VER 0	EDMS No. CV0858243	AMD No. 04

DF 801*554

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Plot Date & Time 2/12/2022 10:49:32 AM

Heritage NSW

[redacted]

[redacted]

[redacted]

[redacted]

Application under section 60 of the *Heritage Act 1977*
Croydon Railway Station Group
State Heritage Register No. 01125

Address: Great Southern and Western Railway, CROYDON NSW 2132
Proposal: Retaining Wall construction on embankment of Platform 5 Croydon Station
Section 60 fast track application no: HMS ID 1745, received 01.11.2022.

As delegate of the Heritage Council of NSW (the Heritage Council), I have considered the above fast track application, including those matters identified under section 62 of the *Heritage Act 1977*. Pursuant to section 63 of the Act, approval is granted subject to the following conditions:

APPROVED DEVELOPMENT

1. All work shall comply with the information contained within:
   a) Architectural or Engineering drawings, prepared by TTW, as listed below:

Dwg No	Dwg Title	Date	Rev
Project Name: Croydon Station Retaining Wall			
S0001	Cover and Notes Sheet	27.07.2022	01
S0011	Plans and Elevations	27.07.2022	01
S0021	Details and Sections	27.07.2022	01

   b) Report: *Croydon Station Retaining Wall Platform 5 Statement of Heritage Impact*, Issue A, prepared by Long Blackledge, dated 16.08.2022.

EXCEPT AS AMENDED by the conditions of this approval:

SITE PROTECTION

2. Significant built elements are to be protected from potential damage during site preparation and the works. Work must not incur damage to the existing brick and timber log wall along Platform 5. Works planning should include measures to safeguard the platform wall from damage. Protection systems must ensure significant fabric is not damaged or removed.
   Reason: To ensure significant fabric including vegetation is protected during construction.

USE OF APPROPRIATE FINISHES

3. Appropriate finishes are to be used to protect aesthetic values. The retaining wall concrete finish colour should match that of the ceramic infilling panelling of the overbridge. The steel should match the finish of the 2015 upgrade steel work.

   Reason: To ensure aesthetic values are protected.

UNEXPECTED ARCHAEOLOGICAL RELICS

4. The applicant must ensure that if unexpected archaeological deposits or relics not identified and considered in the supporting documents for this approval are discovered, work must cease in the affected area(s) and the Heritage Council of NSW must be notified. Additional assessment and approval may be required prior to works continuing in the affected area(s) based on the nature of the discovery.

   Reason: This is a standard condition to identify to the applicant how to proceed if historical archaeological deposits or relics are unexpectedly identified during works.

COMPLIANCE

5. If requested, the applicant and any nominated heritage consultant may be required to participate in audits of Heritage Council of NSW approvals to confirm compliance with conditions of consent.

   Reason: To ensure that the proposed works are completed as approved.

DURATION OF APPROVAL

6. This approval will lapse five years from the date of the consent unless the building works associated with the approval have physically commenced.

   Reason: To ensure the timely completion of works.

Advice
Section 148 of the *Heritage Act 1977* (the Act), allows people authorised by the Minister to enter and inspect, for the purposes of the Act, with respect to buildings, works, relics, moveable objects, places or items that is or contains an item of environmental heritage. Reasonable notice must be given for the inspection.

Unexpected discoveries during works
If during works under this approval, you unexpectedly discover a relic or believe you may have discovered an historical archaeological 'relic', notification is required under s146 of the *Heritage Act 1977*. If you believe you have unexpectedly discovered an Aboriginal object, notification is required under s89A of the *National Parks and Wildlife Act 1974*.

In these scenarios work must cease in the affected area(s) and the following notifications are required (a relic - the Heritage Council of NSW and an Aboriginal object – Heritage NSW). Additional assessment and approval may be required under the relevant legislation prior to works continuing in the affected area(s) based on the nature of the discovery.

Right of Appeal
If you are dissatisfied with this determination appeal may be made to the Minister under section 70 of the Act.

It should be noted that an approval under the Act is additional to that which may be required from other Local Government and State Government Authorities in order to undertake works.

Stamped documents
Any stamped documents (e.g. approved plans) for this application are available for the Applicant to download from the Heritage Management System at https://hms.heritage.nsw.gov.au under 'My Completed Applications.'

If you have any questions about this correspondence, please contact Ruth Berendt, Senior Assessments Officer, at Heritage NSW on 02 4927 3118 or ruth.berendt@environment.nsw.gov.au.

Yours sincerely

Rochelle Johnston

Rochelle Johnston
Senior Manager, Major Projects
Heritage NSW
Department of Premier and Cabinet
As Delegate of the Heritage Council of NSW

30 November 2022

cc: Inner West Council