APPENDIX C

SYDNEY METRO DOCUMENTS

DEVELOPMENT GUIDELINES WITHIN THE VICINITY OF SYDNEY METRO NETWORK LINE 1 DATED 30 MARCH 2010

GEOTECHNICAL BOREHOLES BY COFFEY GEOTECHNICS

Sydney Metro Authority

CBD Metro

Development Guidelines within the vicinity of Sydney Metro Network Line 1

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1 Introduction

1.1 Metro Line 1 (SMN –Line 1)

Sydney Metro Network Line 1 (SMN Line 1) forms part of the Sydney Metro System and is proposed to be procured in two stages. Stage 1 was previously referred to as the CBD Metro and Stage 2 as the West Metro.

Broadly the CBD Metro consists of a corridor running between Rozelle and Central and will be comprised of approximately 7 kilometres of electrified passenger railway contained within twin driven tunnels, with six new underground stations along the proposed alignment. The new underground stations are located at Central, Town Hall Square, Martin Place, Barangaroo-Wynyard, Pyrmont and Rozelle with a safeguarded station at White Bay. It will also include a train stabling and depot facility at the existing Rozelle railway marshalling yard.

The West Metro (Stage 2) line will extend from the Central metro station generally westward along Parramatta Road through the inner western suburbs passing through key areas of Strathfield, Olympic Park and Parramatta before terminating at Westmead.

The West Metro alignment consists of approximately 24.1 kilometres of twin underground rail tunnels with 12 underground stations. The proposed stations are Westmead, Parramatta, Rosehill, Silverwater, Sydney Olympic Park, Strathfield, Burwood, Canada Bay, Five Dock, Leichhardt, Camperdown and Broadway-Sydney University. An additional two stations at Leichhardt West and Annandale have been proposed as safeguarded stations for future development. Provisions have also been made for train stabling at Sydney Olympic Park and Westmead and a cavern refuge siding near Sydney University.

1.2 Purpose of this Report

This document presents a broad outline of the proposed metro corridor physical Works with associated protection zone,

The information contained in this report and associated drawings is not intended to be exhaustive and is based on standard engineering guidelines that will apply to future development above and close to the major underground elements of the planned SMN- Line 1 Metro system; with particular reference to tunnels, crossover caverns, cut-and-cover stations and cavern stations.

The aim of this document is to provide guidance for future development that will assist owners, designers and builders of third party facilities to design, plan and perform work along the SMN-1 Metro corridor. This information is intended to inform relevant parties so as not to preclude future construction of the metro, In particular, this document provides a basis for considering development applications by Sydney Metro and sets the basis for agreements with developers.

By following these guidelines the structural integrity of future tunnel and station structures will be protected. Potential impacts of future developments to the SMN-1 metro infrastructure will largely depend on such construction details as founding levels, foundation loads, excavation details, site geology and the proximity of the proposed development to the underground infrastructure.

1.3 Definitions

The following definitions apply to these guidelines:

CBD	Central Business District
Protection Zone	The 'Protection Zone' is defined as the corridor surrounding the future SMN-Line 1 Metro which must not be directly encroached upon by any future construction and is defined by the drawings contained in Appendix B of this document.
Zone of Influence	The 'Zone of Influence' is defined as the corridor within which construction activity may adversely affect the future SMN-1 Metro and is defined by the drawings contained in Appendix B of this document.
First (1st) Reserve	The 'First (1st) Reserve' is the area within which loading from developments has most potential to adversely impact the SMN-1 Metro when constructed and is defined by drawings contained in the appendices of this document.
Second (2^{nd}) Reserve	The 'Second (2^{nd}) Reserve' is the area within which development might still have an impact, but to a lesser extent as compared with development within the First (1^{st}) Reserve and is defined on drawings contained in the appendices of this document.
Shallow Foundations	'Shallow Foundations' are generally defined as foundations that bear onto the ground at a depth below surface level which is less than about twice their overall width. This type of foundation includes isolated spread footings, continuous strip footings and mat foundations.
Deep Foundations	'Deep Foundations' are generally defined as piles or drilled piers which transmit a large portion of their supported load to competent soil or rock at some depth below the structure.

Table 1.1

2 Description of the SMN-Line 1 Metro

2.1 General

The Metro general arrangement is presented on the drawings attached to Appendix A of this document. To supplement these drawings some description of the main infrastructure components of the CBD and West Metro is provided in this section.

2.2 CBD Metro (Stage 1)

The CBD Metro consists of seven stations along the alignment, from Central Station to Rozelle. These stations are:

- Central Station – It is proposed that this station will be located under the car park to the west of the existing Central Station concourse, east of Pitt Street. The station will be formed by constructing a 100m long, cut and cover reinforced concrete station box structure. The platforms will extend a further 32m at either end of the box. These sections will be mined as single span caverns.
- Town Hall Square Station – It is proposed that this station will be located directly under Pitt Street, between Bathurst Street and Park Street, and above the Cross City Tunnel structure. The station will be a single cavern mined tunnel that is approximately 160m long, with a span of about 21m.
- Martin Place Station – It is proposed to be located under Castlereagh Street, at the intersection with Martin Place. The station will be a single cavern mined tunnel that is approximately 160m long, with a span of about 21m.
- Barangaroo-Wynyard Station – It is proposed to be located beneath Margaret Street between Clarence Street and Sussex Street. The station will be a single cavern mined tunnel that is approximately 160m long, with a span of about 21m.
- Pyrmont Station – This station is proposed to span beneath Union Square between Pyrmont Street and Mount Street. The station will be a single cavern mined tunnel that is approximately 160m long, with a span of about 21m.
- White Bay (future) Station – It is proposed that this station will be located adjacent to the disused White Bay power station, near to the junction of Victoria Road and Roberts Street. The station will be contained within a cut and cover constructed reinforced concrete box structure.
- Rozelle Station – The proposed location for this station is beneath Victoria Road between Darling Street and Wellington Street. The station will be a single cavern mined tunnel that is approximately 160m long, with a span of about 21m.

2.3 West Metro (Stage 2)

- The West Metro comprises of 12 stations and two safeguarded stations along the alignment from Westmead to Central Station. These stations are:
- Westmead Station – It is proposed that this station will be located beneath the existing T-way stop on Darcy Road. The station will be constructed using the cut and cover method.
- Parramatta Station – It is proposed that this station will be located in the Civic Place site, a master-planned commercial and civic redevelopment, between Parramatta Transport Interchange and Macquarie Street. The station will be constructed using the cut and cover method.

- Rosehill Station- It is proposed that this station will be located to the west of James Ruse Drive at the intersection of Weston Street immediately opposite Rosehill racecourse. This station will be constructed using mined techniques (cavern) so as not to impact upon James Ruse Drive..
- Silverwater – It is proposed that this station will be at north of Carnarvon Street, between Silverwater Road and Wetherill Street. Cut and Cover method is to be used in the station construction.
- Sydney Olympic Park – It is proposed that this station will be located adjacent to the Aquatic Centre on the corner of Dawn Fraser Avenue and Olympic Boulevard. Open cut method will be used for the station construction.
- Strathfield – It is proposed that this station will be located to the north of the CityRail station beneath Everton Road with direct access between rail systems. This station will be constructed using the cut and cover method. Burwood – It is proposed that this station will be located partly under the north eastern corner of Burwood Park, partly under Burwood Road, and partly under land north of Meryla Street. This station will be constructed using the cut and cover method.
- Canada Bay- It is proposed that this station will be north of Parramatta Road between Regatta Road and Harris Road and within an industrial development block. This station will be constructed using the cut and cover method.
- Five Dock – It is proposed that this station will be located at Ramsay Road between Great North Road and Fairlight Street. The station will be constructed using a combination of cut and cover, and cavern methodology.
- Leichhardt – It is proposed that this station will be located north of Parramatta road between Balmain Road and Catherine Street. The station will be constructed using partially cut and cover method and cavern methodology.
- Camperdown – It is proposed that this station will be located under Parramatta Road and at the intersection with Missenden Road. The station will be constructed using mined techniques (cavern) method.
- Broadway-Sydney University – It is proposed that this station will be located south of Parramatta Road in Victoria Park. The station will be constructed using the cut and cover method.

2.4 Running Tunnels

The Metro will generally comprise twin bored tunnels between stations with each containing a separate mainline track. The main tunnel structure will be supported by a waterproof concrete structural lining, designed to resist expected long term ground and groundwater loading.

Available geotechnical information indicates that the mainline tunnel alignment predominantly passes through a range of differing geology from various grades of Hawkesbury Sandstone, Ashfield Shale, Mittagong formation, alluvial and residual soils Localised beds of weaker sandstone and shales will be encountered throughout the tunnel drives and soft ground anticipated at Harbour and water crossings.

2.5 Crossovers

- The Metro includes a number of crossovers along the alignment. These structures are defined by their large open areas, and are described as follows:
- Central Station Crossover – This crossover is to be located immediately to the south of Central Station. The single span cavern containing this crossover will be

approximately 150m long and extend from the southern end of Central Station. The cavern will have a span of about 21m.

- White Bay Maintenance Crossover – This crossover will be located immediately east of the future White Bay Station along the CBD Metro alignment of SMN-1 Metro. The rail crossover will be about 120m long, starting from a position that is 30m east of the station. A section of this rail crossover will be contained within a single span cavern, which will have total span of about 21m.
- Rozelle Station Crossover – This crossover will be located immediately south-east of the station along the CBD Metro alignment. The crossover will be contained with a single span cavern that is over 80m in length.
- Rozelle Stabling Yard Connections - Two depot entrance turnouts will be located west of White Bay Station to allow entrance and exit into the stabling and maintenance facilities. Turnouts will each be about 27m long and will be located approximately at chainage 5440m and 5700m.
- Camperdown Station – This crossover is located to the approximately 150m east of Camperdown Station along the West Metro alignment.
- Westmead Station Crossover – This crossover is to be located immediately south-east of Westmead Station on the West Metro alignment, approximately between chainages 23560 and 23700

3 Potential Impacts on the SMN –Line 1 Metro

3.1 General

In assessing the impact of future construction on the planned SMN –Line 1 Metro, an understanding is required of how the ground might react to new development construction, and how these impacts might then adversely affect planned construction of the underground metro structures. The structures of prime concern in this context are the tunnels, crossover caverns, and cut-and-cover and cavern stations.

It should be pointed out that the discussion in the following sections of possible influencing factors is indicative only and should not be treated as exhaustive. The impacts of these factors would be case dependent.

3.2 Potential Impacts

Adverse impacts may be generated either during construction (e.g. altering of the rock quality and construction loading) and in the longer term when the development is complete (e.g. full loading of structure).

- Ground conditions – It is expected that the predominant tunnelling medium will be sandstone, shale and residual soil. The ability of these types of material to support and respond to imposed loading and remain stable when excavated will differ significantly depending on the stiffness and strength of the ground. For instance a competent rock mass has the ability to arch over excavated openings, such that increases in loading at surface may have a limited impact at depth. This behaviour cannot be assumed in soft ground which has a limited ability to be self supporting, with loading imposed at surface generally being transferred onto tunnel support at depth.
- o Geological features – The presence of geological features, such as fault zones, along some sections of the alignment has the potential to intensify the adverse consequences of future development construction onto underground structures. This is because the quality of the rock mass can be substantially lower than elsewhere and thus far less stable.
- Insitu stress – Stress levels that are currently present within the ground, prior to construction of future surface or underground construction, must be known to fully estimate ground response. The magnitude of insitu ground stress relative to the rock mass strength strongly influences the occurrence overstressing within the rock mass as a consequence of future loading and subsequent tunnel construction. This overstressing has the potential to cause tunnel instability around mined tunnels, particularly in the case of station caverns.
- Adjacent excavations – Excavations of significant size and depth adjacent to planned underground metro structures will alter the stress regime in the ground. This can lead to stress concentration or relief in the surrounding ground due to redistribution of these stresses. This behaviour causes ground movement, which may be significant along any natural discontinuities within the rock mass. Of concern to construction of the Metro is the potential for loading transferred through foundations at the base of excavations to place restrictions on the planning and design of the metro. It is also worth mentioning that tunnel excavation in some circumstances has the potential to cause movement of overlying basement structures. There is also potential for alteration to the stress regime from tunnel excavation below the metro corridor.

- Construction method – Percussive or explosive excavation methods, such as rock-chiselling, pile driving and blasting, can cause excessive vibrations, which can result in the degradation of the surrounding rock mass. Excessive scaling (i.e. removal of loose rock) from a failed region can increase the level of damage to rock in regions of high stress concentrations. Where close to the planned metro, this reduction in rock quality might again adversely affect future metro construction.
- Foundation loading – Loads applied on pad and strip foundations and through piles (acting in end bearing or through skin friction) will significantly alter the local stress regime. If excessively high, these stresses might impact the feasibility of constructing a tunnel beneath the point of loading, if the distance to the tunnel crown is too close. Stress of this magnitude has the potential to deform the tunnel lining and so cause excessive flexural bending. Where tunnels are mined, these stresses could affect the temporary stability of the tunnel or station cavern opening. Load distribution beneath foundations will generally be more onerous in soft ground or weak rock conditions.
- Ground anchors – High concentrated loadings are induced at the fixed ends of ground anchors and so the local stress regime around these anchors will be affected. These stresses have the potential to place design restrictions on metro construction. However, temporary ground anchors are not of concern.

4 Development Constraint Guidelines

4.1 General

The main means of identifying future development that may have an adverse impact on the future construction of the SMN-1 is through the definition of protection zones and reserves that surround the planned tunnel and station infrastructure. These zones are generally defined by vertical and horizontal boundaries. The vertical boundaries when projected to ground level define surface protection reserves.

The definition of these zones and reserves provides a simple first pass approach to assessing whether a proposed development falls within an area of influence. By creating these zones and reserves, restrictions can be placed on future loading of the site, both at surface and below ground level.

4.2 Roadheader Tunnels and Caverns

Immediately surrounding the tunnels and caverns is the Protection Zone. As well as containing the tunnel and stations caverns openings, this area includes support measures, such as the tunnel/cavern structural lining, rock bolts, ground anchors, and forward reinforcement. This zone represents a corridor that can not be directly encroached upon by any future construction. This mainly applies to the excavation of deep basements and the construction of future tunnels or caverns, other than those of SMN-1 Metro.

Where the vertical boundaries of the Protection Zone projects to the surface, they define the extent of the First (1st) Reserve.

Assumptions of load distribution through the ground in combination with a maximum offset of 20m from the edge of the Protection Zone, define the extent of the zone of influence. Where this influence zone extends to the surface, it defines the Second (2nd) Reserve. For guidance purposes load disperse is assumed to be at 45 degrees from the edge of application. In section, the triangular zones formed extend from the invert of the excavated profile.

For stations constructed using cut-and-cover techniques to form a box structure the Protection Zone extends to the surface. In this case the First (1st) Reserve is offset from the outer boundary of the box structure.

4.2.1 First Reserve

The First (1st) Reserve is the surface area within which loading from development has the most potential to have an adverse impact to SMN-1 Metro when constructed.

Surface loading within this area might have a direct influence on the performance of future tunnel or cavern support elements and/or the structural lining. Imposed development constraints for this reserve are generally more onerous. There is scope for these to be relaxed, but only where a comprehensive investigation and assessment has been undertaken that demonstrates the impact of the proposed development is not of concern to SMN-1 Metro. This type of assessment must show that under the most adverse conditions the consequential actions imposed on the proposed structural elements of the metro underground infrastructure are within their capacity, in terms of ultimate and serviceability limit states.

4.2.2 Second Reserve

The Second (2nd) Reserve defines areas where development construction might still have an impact, but to a lesser extent as compared with development within the First (1st) Reserve. For this reason the constraints detailed for the Second (2nd) Reserve in these guidelines are less onerous.

Generally, development within the Second (2nd) Reserve is not a restriction on the development potential of the land. Rather, appropriate design and construction measures must be provided to ensure the integrity of SMN-1 Metro Infrastructure can be retained. It is however important that developers ensure that a tunnel engineering expert is involved in the design process.

4.3 Development Characterisation

The following table outlines guidance on constraints associated with various development construction activities within the zones of influence and defined reserves.

Summary of Condition Guidelines

Protection Zone		Construction Activities	Condition Guidelines
1st Reserve	Inside Protection Zone		Construction and excavations not permitted to directly encroach upon Protection Zone except where it can be demonstrated to the satisfaction of Sydney Metro that the encroachment will not have unacceptable structural or operational impacts on the metro corridor.
	Outside Protection Zone	Surface excavation	Engineering assessment required from developer where surface excavations are proposed directly above station caverns and crossover caverns.
		Foundations, underground excavation, geotechnical investigation, ground anchor, directional drilling and demolition	Developers must demonstrate through an engineering assessment that loading from shallow foundations will not adversely impact the SMN-1 Metro.
2nd Reserve		Surface excavation	An engineering assessment is generally required except where surface excavations are less than 2m in depth and excavations are not for the purpose of development of load bearing footings.

	Foundations	Engineering assessment is not required if calculated bearing pressures are less that 150kPa for shallow footings and strip footings which are less than 3m by 3m in plan. For all other shallow foundations an engineering assessment is required of the developer. Engineering assessment is not required if loading from deep foundations (including shaft friction) is' transferred to below the boundary of the influence zone. Engineering assessment required from developer where the above condition is not satisfied for deep foundations.
	Underground excavation (e.g. tunnel/cavern construction), ground anchors and demolition activities	Developers must demonstrate through an engineering assessment that loading from shallow foundations will not adversely impact the future Line 1 MetroC.
	Geotechnical investigation and directional drilling	Assessment not required.

Table 4.1

5 Engineering Assessments

5.1 General

This section of the document describes the types of assessment that will be needed to quantify and measure the likely effects of future developments that will lie within the described protection zones and reserves.

These engineering assessments should address the following issues:

- Changes in stress distribution within the ground above or surrounding planned metro underground infrastructure as a consequence of development construction. Of particular interest is the increase in vertical and horizontal pressures beneath foundation elements and increases in shear stress along known existing bedding planes in the rock mass.
- Changes to the groundwater regime, including dewatering works or the installation of barriers to groundwater flow that may dam groundwater above the underground infrastructure.
- Increase in structural actions, such as axial loading and flexural bending, to support elements and structural linings of metro underground infrastructure, as a consequence of development loading.
- Deformation of the tunnel and cavern support elements and the surrounding ground. Of particular interest is the potential for encroachment of the structural lining into the contained envelopes (e.g. structure gauge etc), as well as predicted movement along existing bedding planes and their consequent effect on the support elements (e.g. rock bolts).
- Associated excavation methodology, especially where methods employ rock blasting, chiselling, percussive pile driving or similar methods are proposed.
- In circumstances where developments are likely to have a significant impact on the future construction of SMN-Line 1 Metro a comprehensive assessment is needed that should involve the use of numerical modelling to accurately predict imposed actions to the support elements of metro infrastructure. This type of assessment will generally be required for development in the First (1st) Reserve where excavation, or pile driving, will be relatively deep and close to metro infrastructure and/or foundation loading from the development is significant.
- Where developments are expected to be of less concern, such as the case of construction only within the Second (2nd) Reserve, engineering assessments need not be as detailed. These types of assessment might only involve estimation of indicators such as stress changes and deformation within the ground from construction. These types of assessment may involve the use of less rigorous modelling techniques.

5.2 Preliminary Risk Definition

When undertaking preliminary assessment of the impacts to the SMN Line Infrastructure the following risk profiles provides a descriptive categorisation of the assessments.

The risk profile informs the level of engineering assessment required and the response to the development application (i.e. conditions, deed etc).

Low risk

The development will have little or no physical impact on underground metro support systems/structures (either temporary or permanent).

Medium risk

The development will have some physical impact on metro infrastructure. Based on the presented design it is likely that the development structure will impose loading on metro underground support elements (either temporary or permanent) to a level that might result in some movement or deformation of caverns/shafts/tunnel structures. However, it is likely that metro structures will be able to accommodate these induced movements and structural actions, without the need to modify their design. As such, the development (in its current form) and the metro (as described by the reference design) may be able to co-exist, but this must be proven by the developer through analytical assessment.

High risk

The development will have a significant physical impact on metro infrastructure. High stresses will be imposed by the development that will probably cause metro support systems/structures to be loaded beyond, or close, to their capacity. Consequently, these Induced stresses have the potential to cause structural failure and /or significant movement of caverns/shafts/tunnel support structures. It is very likely that the development (in its current form) and the metro (as described by the reference design) will not be able to co-exist, unless significant changes are made to the design of the development, metro or both. Mitigation measures must either result in greater clearance or a reduction in loading imposed onto metro structures.

Appendix A

Protection Drawings Plan and Longitudinal Sections

A1 Plan and Longitudinal Section Drawings

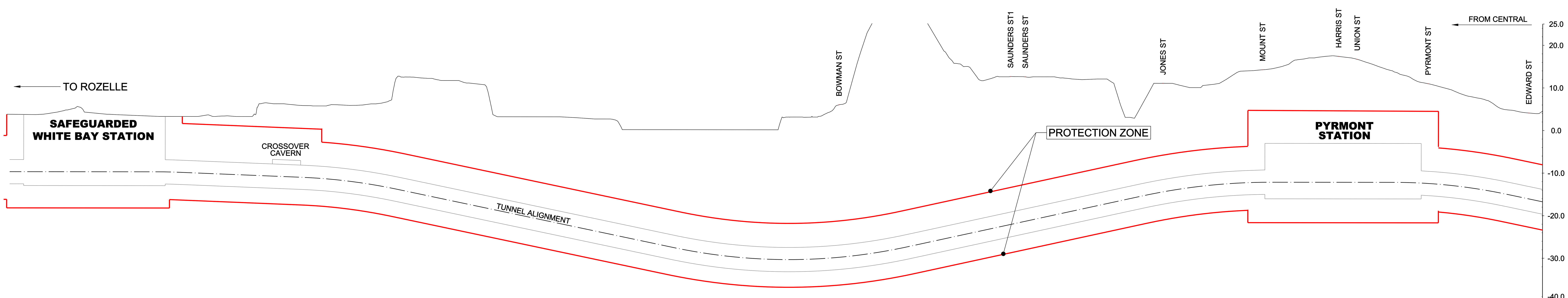
LEGEND

- FIRST RESERVE BOUNDARY
- SECOND RESERVE BOUNDARY
- STATION EXCAVATION SHAFT
- TUNNEL CENTRELINE
- TUNNELS / STRUCTURES

NOTE:

1. SMN LINE 1 PROTECTION BOUNDARIES SHOWN ARE INDICATIVE ONLY AND FOR USE IN PRELIMINARY PLANNING.
2. THIS DRAWING SHOULD BE USED FOR INFORMATION PURPOSES ONLY.
3. ALL DATA SHOWN ON PROFILE REFERS TO DOWN LINE ONLY AND DOES NOT NECESSARILY REFLECT AFFECTS ON TUNNEL CENTRELINE DUE TO CANT.

PLAN



REFERENCE CHAINAGE	5+400.000	5+350.000	5+300.000	5+250.000	5+200.000	5+150.000	5+100.000	5+050.000	5+000.000	4+950.000	4+900.000	4+850.000	4+800.000
EXISTING GROUND LEVEL	3.474	3.814	3.772	3.209	3.000	3.111	6.219	5.574	5.631	8.832	11.760	10.678	3.000
PROPOSED TUNNEL CL LEVEL	-10.003	-10.003	-10.003	-10.003	-10.118	-10.518	-10.918	-11.325	-12.217	-13.881	-15.978	-18.076	-20.175

REFERENCE CHAINAGE	4+750.000	4+700.000	4+650.000	4+600.000	4+550.000	4+500.000	4+450.000	4+400.000	4+350.000	4+300.000	4+250.000	4+200.000	4+150.000
EXISTING GROUND LEVEL	2.960	2.500	0.000	0.000	0.000	0.000	3.156	18.801	26.304	17.876	11.957	12.456	11.965
PROPOSED TUNNEL CL LEVEL	-22.273	-24.371	-26.470	-28.486	-29.849	-30.448	-30.285	-29.358	-27.668	-25.500	-23.325	-21.149	-18.973

REFERENCE CHAINAGE	4+100.000	4+050.000	4+000.000	3+950.000	3+900.000	3+850.000	3+800.000	3+750.000	3+700.000	3+650.000	3+600.000
EXISTING GROUND LEVEL	8.699	11.000	10.304	13.908	15.383	17.451	15.530	11.792	8.914	5.230	4.583
PROPOSED TUNNEL CL LEVEL	-16.798	-14.677	-13.145	-12.339	-12.203	-12.203	-12.203	-12.299	-13.093	-14.691	-16.777

DOWN LINE TUNNEL PROFILE 3+600 - 5+400

No.	BY	DATE	DESCRIPTION	APPD
A	NB	19/03/10	FOR INFORMATION	RL

Key Plan

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	PREPARED	CHECKED	PSC APPROVED
DESIGN	RL	AK	
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Scales: 0 20 40 100 Metres — Scale 1:2500 HOR @ A1; 0 5 10 20 Metres — Scale 1:500 VER @ A1

Professional Services Contractor / Technical Advisor: pbach PB | ARUP | COX | HASSELL

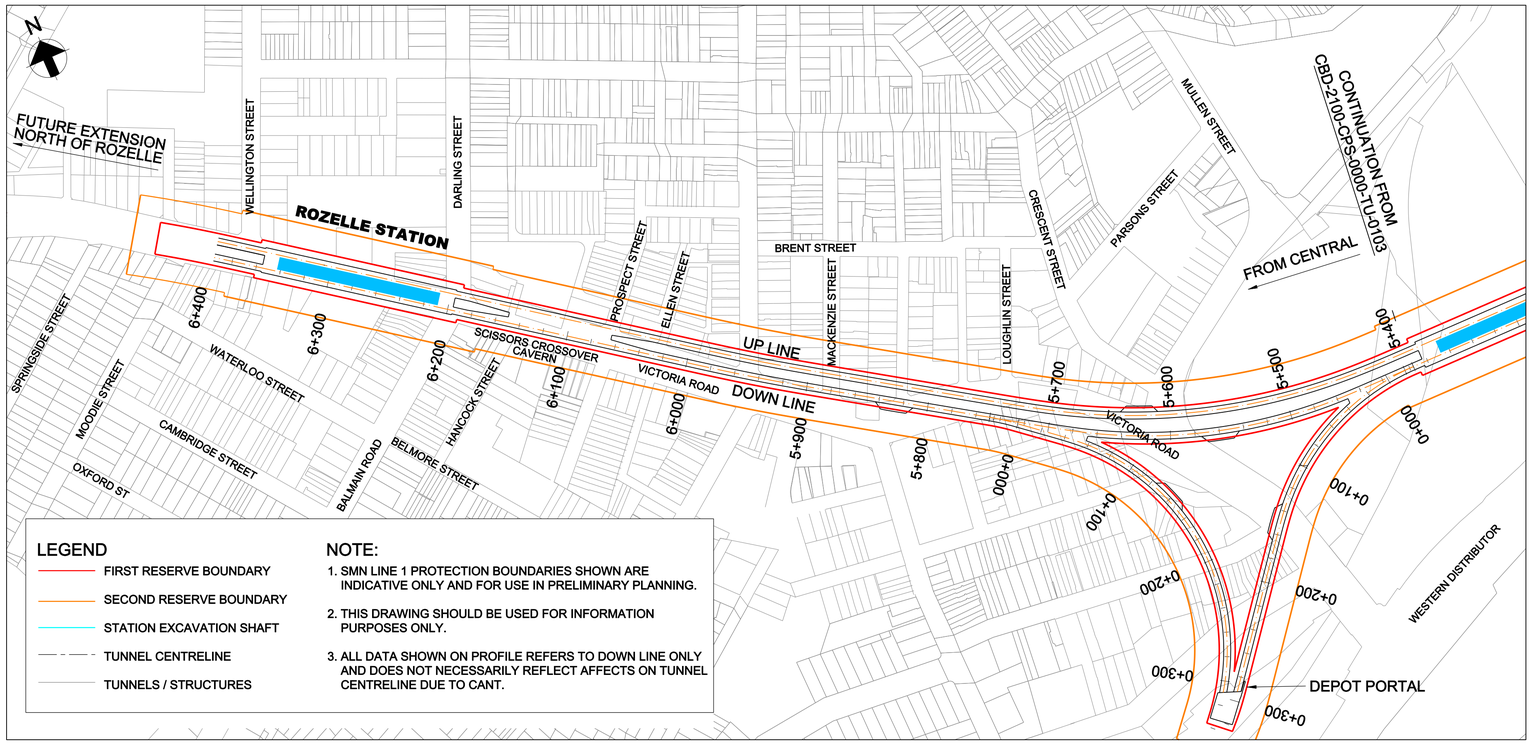
Client: Sydney Metro

Project Title: SYDNEY METRO NETWORK

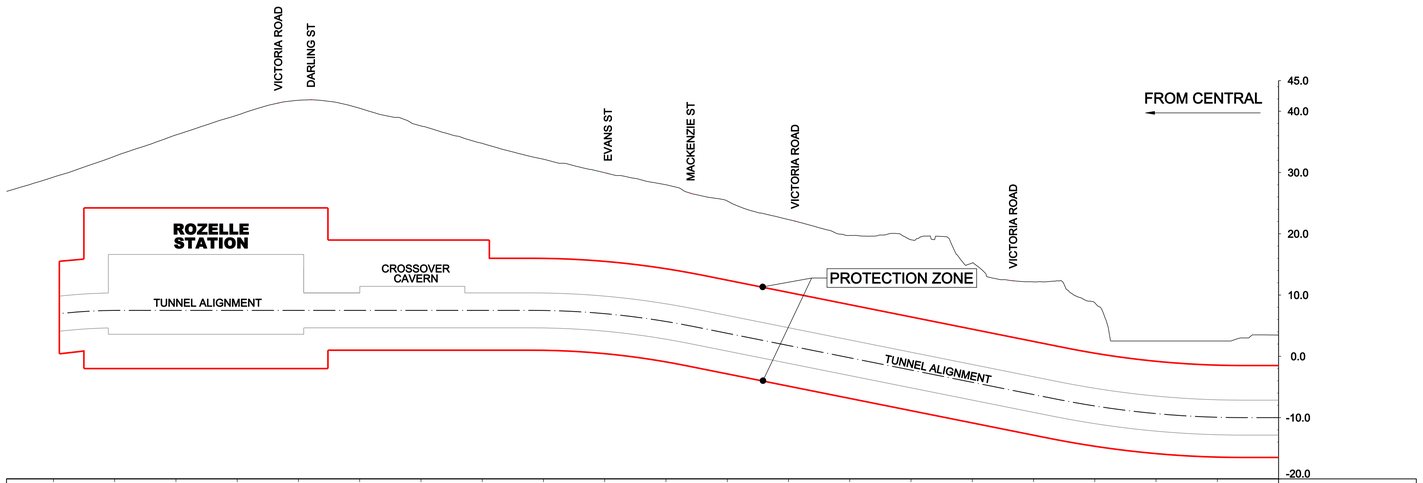
Drawing Title: PROTECTION CORRIDOR STUDY
RAIL PROTECTION RESERVES
PLAN-PROFILE (SHEET 3 OF 19)

Status: FOR INFORMATION | Drg No: SMN-2100-CPS-0000-TU-0103 | Rev: A

A1



PLAN



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5.483	6.824	7.496	7.497	7.497	7.497	7.497	7.497	7.497	7.484	6.956	5.659	3.725	1.725	-0.275	-2.275	-4.276	-6.276	-8.124	-9.359	-9.948	-10.003	PROPOSED TUNNEL CL LEVEL
6+438.260	6+400.000	6+350.000	6+300.000	6+250.000	6+200.000	6+150.000	6+100.000	6+050.000	6+000.000	5+950.000	5+900.000	5+850.000	5+800.000	5+750.000	5+700.000	5+650.000	5+600.000	5+550.000	5+500.000	5+450.000	5+400.000	REFERENCE CHAINAGE

DOWN LINE PROFILE 5+400 - END OF WORKS

No.	BY	DATE	DESCRIPTION	APPD
A	NB	19/03/10	FOR INFORMATION	RL

Key Plan

NOT FOR CONSTRUCTION
FOR INFORMATION ONLY

APPROVED ORIGINAL OF THIS DRAWING SIGNED & DATED AS INDICATED BELOW

	PREPARED	CHECKED	PSC APPROVED
DESIGN	RL	AK	
DRAFTING	NB		DATE

Scales
0 20 40 100 Metres — Scale 1:2500 HOR @ A1
0 5 10 20 Metres — Scale 1:500 VER @ A1

Professional Services Contractor / Technical Advisor
pbach
PB | ARUP | COX | HASSELL

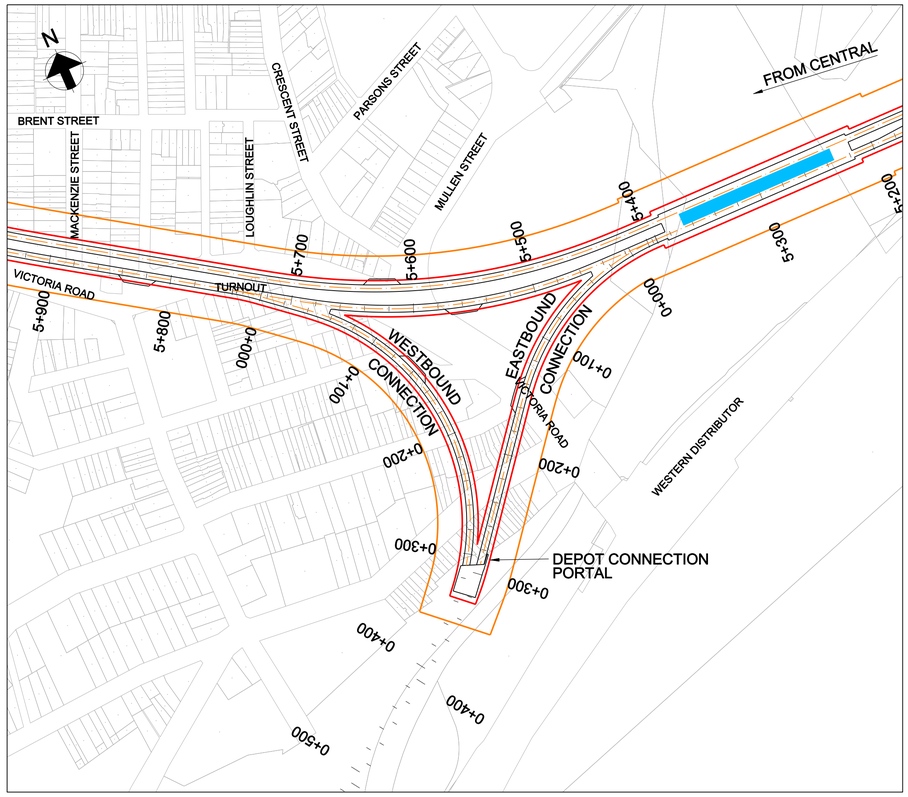
Client
SydneyMetro

Project Title
SYDNEY METRO NETWORK

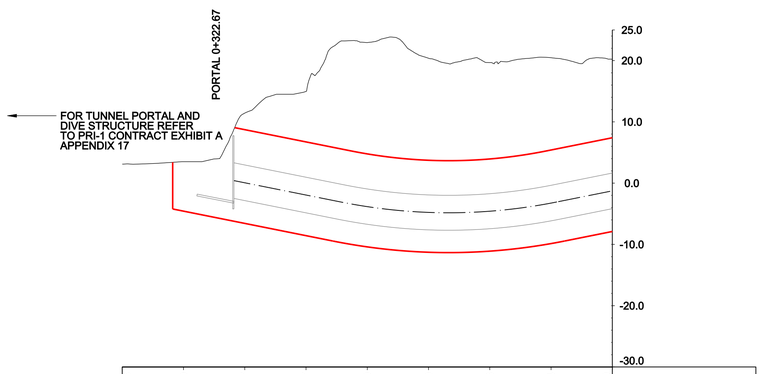
Drawing Title
PROTECTION CORRIDOR STUDY
RAIL PROTECTION RESERVES
PLAN-PROFILE (SHEET 4 OF 19)

Status	Drg No.	Rev.
FOR INFORMATION	SMN-2100-CPS-0000-TU-0104	A

A1

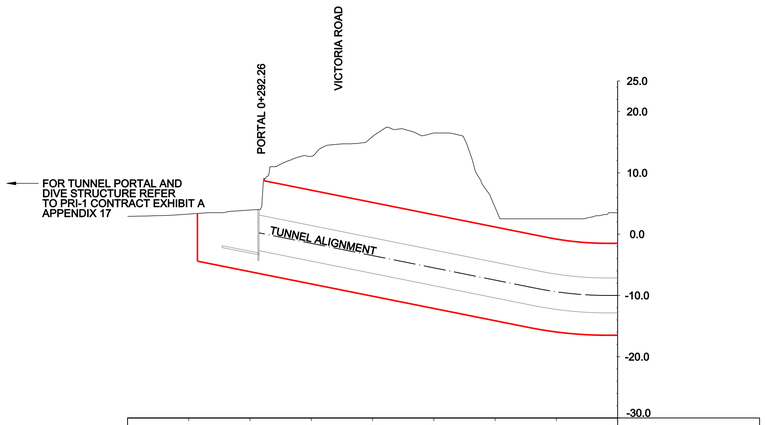


PLAN



3.113	3.500	11.427	14.967	22.940	20.380	19.668	20.464	20.199	APPROXIMATE EXISTING GROUND LEVEL
3.541	2.021	0.021	-1.979	-3.856	-4.779	-4.590	-3.290	-1.299	PROPOSED RAIL LEVEL
0+400.000	0+350.000	0+300.000	0+250.000	0+200.000	0+150.000	0+100.000	0+050.000	0+000.000	REFERENCE CHAINAGE

PROFILE WESTBOUND CONNECTION



2.902	3.271	3.939	12.703	15.934	16.500	4.361	2.500	3.500	EXISTING GROUND LEVEL
3.762	2.462	0.462	-1.538	-3.538	-5.538	-7.538	-9.426	-10.003	PROPOSED TUNNEL CL LEVEL
0+400.000	0+350.000	0+300.000	0+250.000	0+200.000	0+150.000	0+100.000	0+050.000	0+000.000	REFERENCE CHAINAGE

PROFILE EASTBOUND DEPOT CONNECTION

LEGEND

- FIRST RESERVE BOUNDARY
- SECOND RESERVE BOUNDARY
- STATION EXCAVATION SHAFT
- TUNNEL CENTRELINE
- TUNNELS / STRUCTURES

NOTE:

1. SMN LINE 1 PROTECTION BOUNDARIES SHOWN ARE INDICATIVE ONLY AND FOR USE IN PRELIMINARY PLANNING.
2. THIS DRAWING SHOULD BE USED FOR INFORMATION PURPOSES ONLY.
3. ALL DATA SHOWN ON PROFILE REFERS TO DOWN LINE ONLY AND DOES NOT NECESSARILY REFLECT AFFECTS ON TUNNEL CENTRELINE DUE TO CANT.

No.	BY	DATE	DESCRIPTION	APPD
A	NB	19/03/10	FOR INFORMATION	RL

Key Plan

NOT FOR CONSTRUCTION
FOR INFORMATION ONLY

APPROVED ORIGINAL OF THIS DRAWING SIGNED & DATED AS INDICATED BELOW

	PREPARED	CHECKED	PSC APPROVED
DESIGN	RL	AK	
DRAFTING	NB		DATE

Scales: 0 20 40 100 Metres — Scale 1:2500 HOR @ A1; 0 5 10 20 Metres — Scale 1:500 VER @ A1

Professional Services Contractor / Technical Advisor: pbach — PB | ARUP | COX | HASSELL

Client: SydneyMetro

Project Title: SYDNEY METRO NETWORK

Drawing Title: PROTECTION CORRIDOR STUDY
RAIL PROTECTION RESERVES
PLAN-PROFILE (SHEET 5 OF 19)

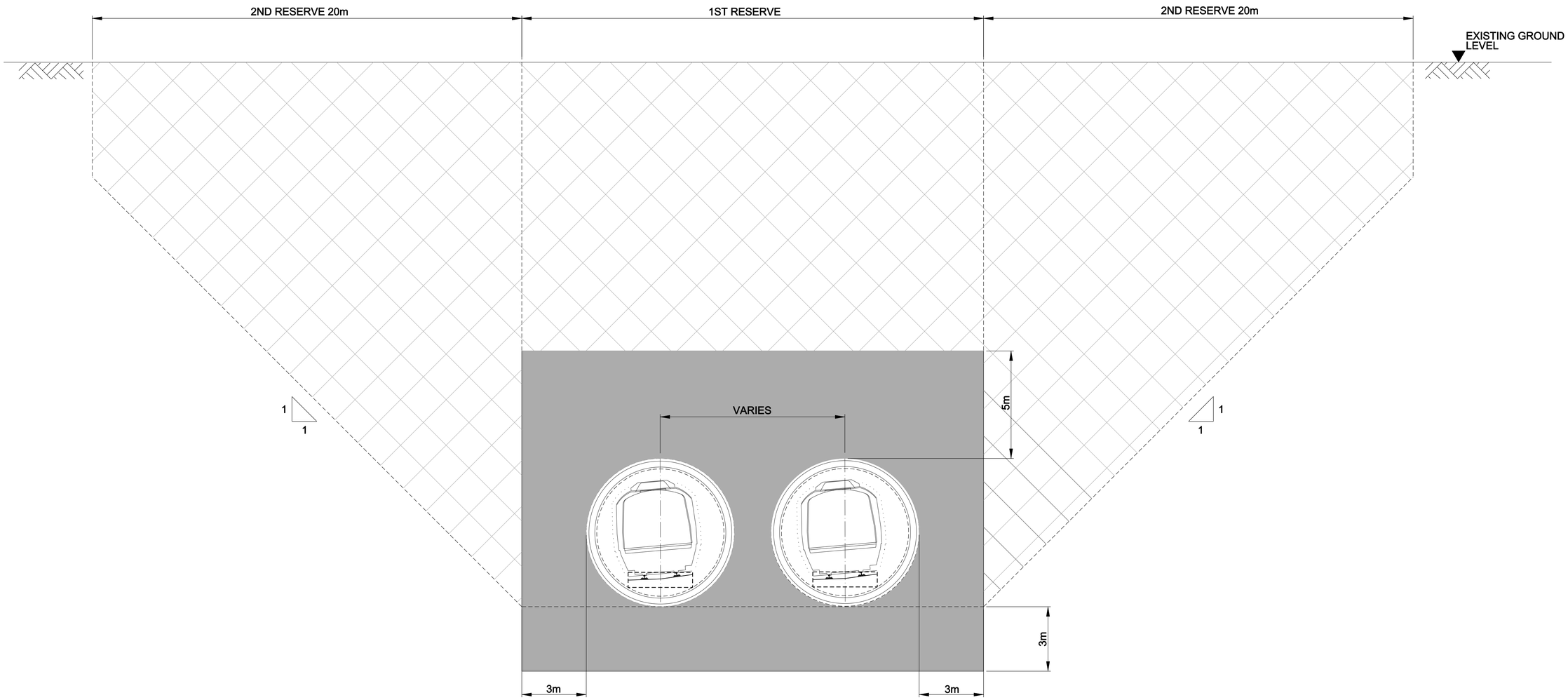
Status	Drg No.	Rev.
FOR INFORMATION	SMN-2100-CPS-0000-TU-0105	A

Appendix B

Protection Drawings Typical Cross Sections

B1 Typical Cross Section Drawings

A1



SMN PROTECTION CORRIDOR RUNNING TUNNELS

LEGEND

PROTECTION ZONE

ZONE OF influence

No.	BY	DATE	DESCRIPTION	APPD
A	PCB	16/03/10	FOR INFORMATION ONLY	RL

Key Plan

APPROVED ORIGINAL OF THIS DRAWING SIGNED & DATED AS INDICATED BELOW

	PREPARED	CHECKED	PSC APPROVED
DESIGN	RL	AK	
DRAFTING			DATE

Scales: N.T.S

Professional Services Contractor / Technical Advisor: pbach — PB | ARUP | COX | HASSELL

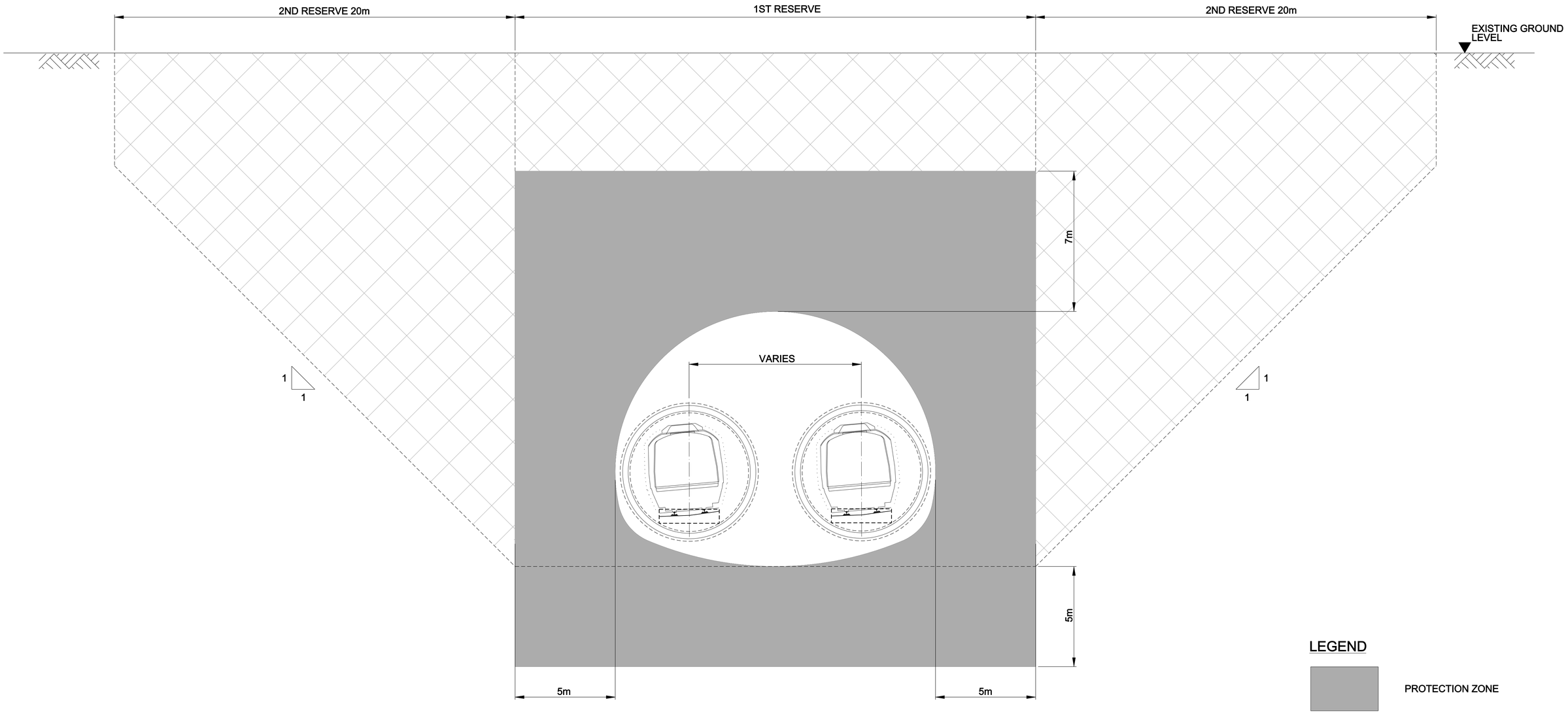
Client: SydneyMetro

Project Title: SYDNEY METRO NETWORK

Drawing Title: CORRIDOR PROTECTION STUDY
RAIL PROTECTION RESERVES
CROSS SECTION - RUNNING TUNNELS
SHEET 1 OF 3

Status	Drg No.	Rev
FOR INFORMATION	SMN-2100-CPS-0000-TU-0120	A

A1



SMN PROTECTION CORRIDOR
STATION CAVERN (EXCEPT CENTRAL STATION)

LEGEND

PROTECTION ZONE

ZONE OF INFLUENCE

No.	BY	DATE	DESCRIPTION	APPD
A	PCB	16/03/10	FOR INFORMATION ONLY	RL

Key Plan

APPROVED ORIGINAL OF THIS DRAWING SIGNED & DATED AS INDICATED BELOW

	PREPARED	CHECKED	PSC APPROVED
DESIGN	RL	AK	
DRAFTING			DATE

Scales: N.T.S

Professional Services Contractor / Technical Advisor: pbach — PB | ARUP | COX | HASSELL

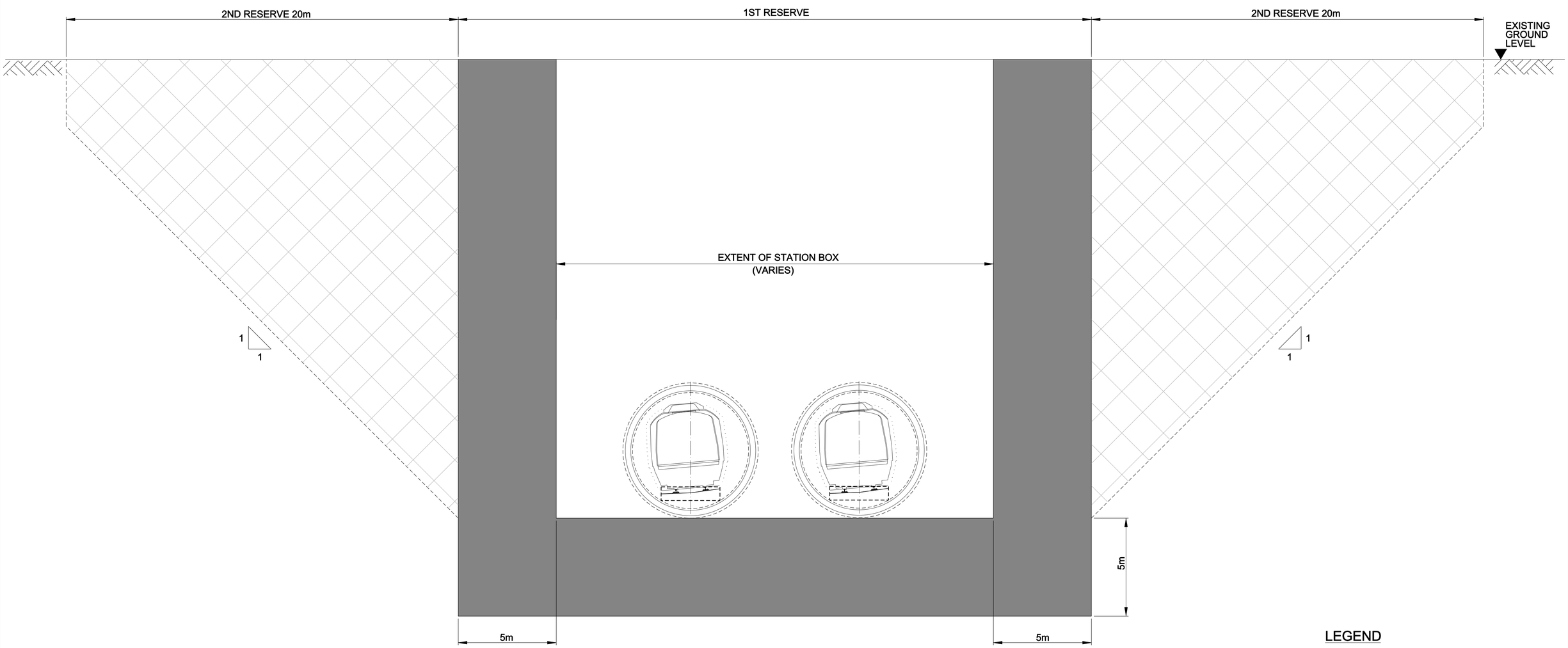
Client: SydneyMetro

Project Title: SYDNEY METRO NETWORK

Drawing Title: CORRIDOR PROTECTION STUDY
RAIL PROTECTION RESERVES
CROSS SECTION - STATION CAVERN
SHEET 2 OF 3

Status	Drg No.	Rev
FOR INFORMATION	SMN-2100-CPS-0000-TU-0121	A

A1



SMN PROTECTION CORRIDOR
CUT AND COVER STRUCTURES

LEGEND

PROTECTION ZONE

ZONE OF INFLUENCE

No.	BY	DATE	DESCRIPTION	APPD
A	PCB	16/03/10	FOR INFORMATION ONLY	RL

Key Plan

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NO WARRANTY IS GIVEN OR IMPLIED AS TO ITS SUITABILITY FOR ANY OTHER PURPOSE

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	PREPARED	CHECKED	PSC APPROVED
DESIGN	RL	AK	
DRAFTING			DATE

Scales: N.T.S

Professional Services Contractor / Technical Advisor: pbach PB | ARUP | COX | HASSELL

Client: SydneyMetro

Project Title: SYDNEY METRO NETWORK

Drawing Title: CORRIDOR PROTECTION STUDY
RAIL PROTECTION RESERVES
CROSS SECTION - RUNNING TUNNELS
SHEET 3 OF 3

Status	Drg No.	Rev
FOR INFORMATION	SMN-2100-CPS-0000-TU-0122	A

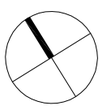
A1

NOTES:

1. REFER TO DRG. CBD-2110-SK-0000-GE-0000 FOR GEOTECHNICAL LEGEND AND NOTES.
2. THIS SECTION IS ON THE DOWN TRACK ALIGNMENT REFER TO DRG. CBD-2110-SK-0000-GE-0025 FOR RELATIVE LOCATION.
3. CHAINAGES BASED ON JUNE 30 2009 ALIGNMENT PROVIDED BY PBACH JOINT VENTURE - SYDNEY METRO ANY SUBSEQUENT ALIGNMENT CHANGES MAY REQUIRE RELATIVE FEATURE POSITIONS TO BE REVIEWED.
4. BOREHOLE POSITIONS CORRECT TO WITHIN ±5m.

No.	BY	DATE	DESCRIPTION	APPD
B	HW	21.08.09	FOR PRE-TENDER INFORMATION	BJR
A	VN	17.07.09	ISSUED FOR REFERENCE DESIGN CONSIDERATION	BJR

Key Plan



APPROVED ORIGINAL OF THIS DRAWING SIGNED & DATED AS INDICATED BELOW

	PREPARED	CHECKED	PSC APPROVED
DESIGN	G McKAY	GBM	
DRAFTING	V NGUYEN	HW	DATE:

Scales 0 10 20 30 40 50m

SCALE 1:1000 AT ORIGINAL SIZE

Professional Services Contractor / Technical Advisor

GHD CLIENTS | PEOPLE | PERFORMANCE
GHD GEOTECHNICS
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E atnmail@ghd.com.au W www.ghd.com.au/ghdgeotechnics

Client: SydneyMetro

Project Title: CBD METRO

Drawing Title: GEOTECHNICAL INTERPRETIVE REPORT
GEOTECHNICAL
TEST LOCATION AND GEOLOGICAL PLAN
CHAINAGE 5 + 580.000 TO 6 + 280.000 / SHEET 10 OF 13

Status	Drg No.	Rev.
PRE-TENDER INFORMATION	CBD-2110-SK-0000-GE-0012	B

Plot Date: 21 August 2009 - 6:15 PM Plotted by: Helen Warr, Sydney (Bond) Cad File No: G:\21\18427\CADD\Drawings\CBD-2110-SK-0000-GE-0002_15-B.dwg

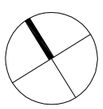
A1

NOTES:

1. REFER TO DRG. CBD-2110-SK-0000-GE-0000 FOR GEOTECHNICAL LEGEND AND NOTES.
2. THIS SECTION IS ON THE DOWN TRACK ALIGNMENT REFER TO DRG. CBD-2110-SK-0000-GE-0026 FOR RELATIVE LOCATION.
3. CHAINAGES BASED ON JUNE 30 2009 ALIGNMENT PROVIDED BY PBACH JOINT VENTURE - SYDNEY METRO ANY SUBSEQUENT ALIGNMENT CHANGES MAY REQUIRE RELATIVE FEATURE POSITIONS TO BE REVIEWED.
4. BOREHOLE POSITIONS CORRECT TO WITHIN ±5m.

No.	BY	DATE	DESCRIPTION	APPD
B	HW	21.08.09	FOR PRE-TENDER INFORMATION	BJR
A	VN	17.07.09	ISSUED FOR REFERENCE DESIGN CONSIDERATION	BJR

Key Plan



APPROVED ORIGINAL OF THIS DRAWING SIGNED & DATED AS INDICATED BELOW

	PREPARED	CHECKED	PSC APPROVED
DESIGN	G McKAY	GBM	
DRAFTING	V NGUYEN	HW	DATE:

Scales 0 10 20 30 40 50m

SCALE 1:1000 AT ORIGINAL SIZE

Professional Services Contractor / Technical Advisor

GHD CLIENTS | PEOPLE | PERFORMANCE

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Client

SydneyMetro

Project Title: CBD METRO

Drawing Title: GEOTECHNICAL INTERPRETIVE REPORT
GEOTECHNICAL
TEST LOCATION AND GEOLOGICAL PLAN
CHAINAGE 6 + 280.000 TO 6 + 690.000 / SHEET 11 OF 13

Status	Drg No.	Rev.
PRE-TENDER INFORMATION	CBD-2110-SK-0000-GE-0013	B

Plot Date: 24 August 2009 - 10:36 AM Plotted by: Helen Warr, Sydney (Bond) Cad File No: G:\21\18427\CADD\Drawings\CBD-2110-SK-0000-GE-0002_15-B.dwg

coffey geotechnics

Borehole No. **BH232**

Engineering Log - Borehole

Sheet 1 of 9

Project No: **GEOTLCOV23558AA**

Client: ***North West Metro Project Team***

Date started: ***29.9.2008***

Principal: ***Transport and Infrastructure Development Corporation***

Date completed: ***2.10.2008***

Project: ***North West Metro, Preliminary Investigation***

Logged by: ***AS***

Borehole Location: ***TA07 Rozelle Station - Hancock St***

Checked by: ***DMH***

drill model and mounting: Hydrapower Truck | Easting: 330750.85 | slope: -60° | R.L. Surface: 40.82m

hole diameter: 100 mm | Northing 6251376.35 | bearing: 050° | datum: AHD

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
ADT				D D D		1			**ASPHALT:** 0.05m. **FILL: SANDY CLAY:** High plasticity, pale grey, brown and orange with some fine to coarse grained sand, trace of fine to coarse grained subangular to angular gravels. **FILL: SANDY CLAY:** High plasticity, orange and pale grey, with some fine to medium grained sand, trace of organic material and coarse grained subangular sandstone gravel.	M			ASPHALT FILL
						2			Borehole BH232 continued as cored hole				
						3							
						4							
						5							
						6							
						7							
						8							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil
C casing

penetration

1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No.	***BH232***
Sheet	2 of 9
Project No:	***GEOTLCOV23558AA***
Client:	***North West Metro Project Team***
Date started:	***29.9.2008***
Principal:	***Transport and Infrastructure Development Corporation***
Date completed:	***2.10.2008***
Project:	***North West Metro, Preliminary Investigation***
Logged by:	***AS***
Borehole Location:	***TA07 Rozelle Station - Hancock St***
Checked by:	***DMH***

drill model & mounting: Hydrapower Truck | Easting: 330750.85 | slope: -60° | R.L. Surface: 40.82m

hole diameter: 100 mm | Drilling fluid: | Northing: 6251376.35 | bearing: 050° | datum: AHD

drilling information | **material substance** | **rock mass defects**

method	core-lift	water	RL	depth metres	graphic log core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength VL L M H VH EH	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm 30 100 300 1000 3000	defect description: type, inclination, planarity, roughness, coating, thickness (particular / general)
				1		Continued from non-cored borehole						
NQ				2		**FILL: CONCRETE**						
						SANDSTONE: Medium grained, pale grey stained orange, yellow and red, distinctly cross bedded at 20°. Trace of carbonaceous laminae.	HW		D 0.23 A 0.26	69		PT, 20°, PL, RO, SN, iron
												PT, 20°, PL, 5mm sandy clay
						NO CORE: 0.2m.						
				3		**SANDSTONE:** Medium grained, dark red, orange, purple, cross bedded at 30°. With some carbonaceous laminae.	XW					
							HW		D 0.16 A 0.2	84		JT, 0°, PL, RO, SN orange
				4			MW					
						SANDSTONE: Medium grained, cross bedded at 30°-40°, with some carbonaceous laminae.	FR		D 0.4 A 0.43			JT, 0°, PL, RO, SN orange
												PT, 30°, PL, RO, SN orange
				5					D 1.35 A 1.42			PT, 30°, PL, RO, VN carbonaceous material & mica
												PT, 30°, PL, 5mm clayey sand
				6					D 0.93 A 1.07			PT, 30°, PL, 5mm clayey sand
										94		
				7					D 0.48 A 1.06			
						INTERLAMINATED SANDSTONE AND SILTSTONE: Medium grained, pale grey, distinctly cross bedded at 15°-						
				8					D A			

PT, 20-30°, PL, RO, SN

PT, 25-35°, PL, RO, CN

method

DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
NMLC	NMLC core
NQ, HQ, PQ	wireline core

core-lift

- casing used
- barrel withdrawn

graphic log/core recovery

- core recovered - graphic symbols indicate material
- no core recovered

water

- 10/1/98 water level on date shown
- water inflow
- partial drill fluid loss
- complete drill fluid loss
- 25 — water pressure test result (lugeons) for depth interval shown

weathering

FR	fresh
SW	slightly weathered
MW	moderately weathered
HW	highly weathered
XW	extremely weathered
DW	distinctly weathered (covers MW and HW)

strength

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type

JT	joint
PT	parting
SM	seam
SZ	sheared zone
SS	sheared surface
CS	crushed seam

planarity

PL	planar
CU	curved
UN	undulating
ST	stepped
IR	irregular

roughness

VR	very rough
RO	rough
SO	smooth
SL	slickensided

coating

CN	clean
SN	stained
VN	veneer
CO	coating

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No.	***BH232***
Sheet	3 of 9
Project No:	***GEOTLCOV23558AA***
Client:	***North West Metro Project Team***
Date started:	***29.9.2008***
Principal:	***Transport and Infrastructure Development Corporation***
Date completed:	***2.10.2008***
Project:	***North West Metro, Preliminary Investigation***
Logged by:	***AS***
Borehole Location:	***TA07 Rozelle Station - Hancock St***
Checked by:	***DMH***

drill model & mounting: Hydrapower Truck | Easting: 330750.85 | slope: -60° | R.L. Surface: 40.82m

hole diameter: 100 mm | Drilling fluid: | Northing: 6251376.35 | bearing: 050° | datum: AHD

drilling information | **material substance** | **rock mass defects**

method	core-lift	water	RL	depth metres	graphic log core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength VL L M H VH EH	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm 30 100 300 1000 3000	defect description: type, inclination, planarity, roughness, coating, thickness (particular / general)
NQ				9		35°sandstone (60%) with dark grey siltstone (40%). **SANDSTONE:** Medium grained, pale grey. Distinctly bedded at 20°. Trace of carbonaceous laminae. **SANDSTONE:** Medium grained, pale grey and dark grey. Distinctly cross bedded at 20°-35°. Trace of carbonaceous laminae.	FR		D 1.24 A 1.31	94		
							HW					PT, 20°, PL, RO, SN orange
				10		**SANDSTONE:** Coarse grained, pale grey, stained orange where weathered with grey laminae, dark grey. Distinctly cross bedded at 20° to 35°.	SW		D 1.22 A 1.3			
							FR		D 0.95 A 1.08	95		
							SW					
				11			MW					
						SANDSTONE: Coarse grained, pale grey, stained orange, distinctly cross bedded at 30°. Trace of siltstone and carbonaceous laminae and subrounded gravels.			D 1.68 A 2.23			SM, 30°, PL, 10mm clay
				12					D 2.44 A 3.19			
							XW-HW					JT, 0°, PL, RO, SN orange JT, 0°, PL, RO, SN orange JT, 10°, PL, RO, SN orange
				13			FR		D 1.32 A 1.27	90		PT, 20-40°, PL, RO, CN
						SANDSTONE: Medium grained, pale grey, distinctly cross bedded at 20° to 30°, with some carbonaceous laminae.						
				14		**SANDSTONE:** Coarse grained, pale grey, distinctly cross bedded at 20° to 30°, with some carbonaceous laminae. Some rounded to subrounded shale clasts.			D 1.4 A 1.35			
				15		**SANDSTONE:** Medium grained, dark grey, distinctly bedded at 30°, with some carbonaceous laminae.				100		JT, 0°, PL, SN, CN
						SANDSTONE: Coarse grained, pale grey, distinctly cross bedded at 5°-15° with trace of carbonaceous laminae.			D 1.46 A 1.9			
				16								

method

DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
NMLC	NMLC core
NQ, HQ, PQ	wireline core

core-lift

- casing used
- barrel withdrawn

graphic log/core recovery

- core recovered - graphic symbols indicate material
- no core recovered

water

- 10/1/98 water level on date shown
- water inflow
- partial drill fluid loss
- complete drill fluid loss
- 25 water pressure test result (lugeons) for depth interval shown

weathering

FR	fresh
SW	slightly weathered
MW	moderately weathered
HW	highly weathered
XW	extremely weathered
DW	distinctly weathered (covers MW and HW)

strength

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type

JT	joint
PT	parting
SM	seam
SZ	sheared zone
SS	sheared surface
CS	crushed seam

planarity

PL	planar
CU	curved
UN	undulating
ST	stepped
IR	irregular

roughness

VR	very rough
RO	rough
SO	smooth
SL	slickensided

coating

CN	clean
SN	stained
VN	veneer
CO	coating

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No. **BH232**

Sheet 4 of 9

Project No: **GEOTLCOV23558AA**

Client: ***North West Metro Project Team***

Date started: ***29.9.2008***

Principal: ***Transport and Infrastructure Development Corporation***

Date completed: ***2.10.2008***

Project: ***North West Metro, Preliminary Investigation***

Logged by: ***AS***

Borehole Location: ***TA07 Rozelle Station - Hancock St***

Checked by: ***DMH***

drill model & mounting: Hydrapower Truck | Easting: 330750.85 | slope: -60° | R.L. Surface: 40.82m

hole diameter: 100 mm | Drilling fluid: | Northing: 6251376.35 | bearing: 050° | datum: AHD

drilling information					material substance						rock mass defects		
method	core-lift	water	RL	depth metres	graphic log core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength VL L M H VH EH	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm (30 100 300 1000 3000)	defect description: type, inclination, planarity, roughness, coating, thickness — particular / general
NQ				17		**SANDSTONE:** Coarse grained, pale grey, distinctly cross bedded at 5°-15° with trace of carbonaceous laminae *(continued)*	FR		D 1.18 A 1.26	100		
				18		**SANDSTONE:** Medium grained, pale grey, with dark grey laminae, distinctly cross-bedded at 40°.			D 1.54 A 1.71 D 1.35 A 1.25			
				19					D 1.54 A 1.26	100		
				20		20.02m-22.55m - Trace of carbonaceous laminae.			D 1.59 A 1.79			
				21					D 1.31 A 1.08			
				22					D 0.74 A 0.99	95		SM, 30°, PL, 30mm clayey sand PT, 10°, PL-IR, RO, CN
				23		**SANDSTONE:** Medium grained, pale grey with dark grey beds, disturbed bedding.			D 1.33 A 1.59			PT, 20-40°, PL, RO, CN
				24					D A	100		

method

DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
NMLC	NMLC core
NQ, HQ, PQ	wireline core

core-lift

- casing used
- barrel withdrawn

graphic log/core recovery

- core recovered - graphic symbols indicate material
- no core recovered

water

- 10/1/98 water level on date shown
- water inflow
- partial drill fluid loss
- complete drill fluid loss
- 25 — water pressure test result (lugeons) for depth interval shown

weathering

FR	fresh
SW	slightly weathered
MW	moderately weathered
HW	highly weathered
XW	extremely weathered
DW	distinctly weathered (covers MW and HW)

strength

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type

JT	joint
PT	parting
SM	seam
SZ	sheared zone
SS	sheared surface
CS	crushed seam

planarity

PL	planar
CU	curved
UN	undulating
ST	stepped
IR	irregular

roughness

VR	very rough
RO	rough
SO	smooth
SL	slickensided

coating

CN	clean
SN	stained
VN	veneer
CO	coating

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No.	***BH232***
Sheet	5 of 9
Project No:	***GEOTLCOV23558AA***
Client:	***North West Metro Project Team***
Date started:	***29.9.2008***
Principal:	***Transport and Infrastructure Development Corporation***
Date completed:	***2.10.2008***
Project:	***North West Metro, Preliminary Investigation***
Logged by:	***AS***
Borehole Location:	***TA07 Rozelle Station - Hancock St***
Checked by:	***DMH***

drill model & mounting: Hydrapower Truck | Easting: 330750.85 | slope: -60° | R.L. Surface: 40.82m

hole diameter: 100 mm | Drilling fluid: | Northing: 6251376.35 | bearing: 050° | datum: AHD

drilling information | **material substance** | **rock mass defects**

method	core-lift	water	RL	depth metres	graphic log core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength (VL L M H VH EH)	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm (30 100 300 1000 3000)	defect description: type, inclination, planarity, roughness, coating, thickness — particular / general
NQ				25		**SANDSTONE:** Medium grained, pale grey, with dark grey beds, distinctly bedded at 45°. Trace of dark grey flecks.	FR		1.15 1.19 D A 1.69 1.69	100		
				26		**INTERLAMINATED SANDSTONE AND SILTSTONE:** Fine grained, dark grey, distinctly cross-bedded at 30°, sandstone (70%) with black siltstone. **SANDSTONE:** Medium grained, pale grey, with dark grey laminae, distinctly cross-bedded at 40°. Trace of carbonaceous laminae.			D A 1.32 1.6	100		PT, 25°, PL, SO-RO, VN silty clay PT, 30°, PL, SO, VN carbonaceous material PT, 10-35°, IR, SO-RO, CN
				27		**SANDSTONE:** Medium grained, pale grey, massive.			D A 0.71 0.76			PT, 30°, PL, SO, VN Silty clay
				28		**SANDSTONE:** Medium grained, pale grey with dark grey laminae, distinctly cross-bedded at 40° with trace disturbed beds.			D A 1.36 1.65			
				29		**SANDSTONE:** Coarse grained, pale grey, dark grey laminae, distinctly cross-bedded at 40°-45°. Trace of fine to medium gravel bands up to 15mm thick.			D A 1.74 1.39	100		PT, 45°, PL, SO, VN Silty clay
				30		**SANDSTONE:** Medium grained, pale grey, distinctly cross bedded at 35°.			D A 1.77 1.87			PT, 35°, PL, SO, VN Silty clay
				31					D A 1.99 2.48	100		
				32					D A			

method
DT diatube; AS auger screwing; AD auger drilling; RR roller/tricone; CB claw or blade bit; NMLC NMLC core; NQ, HQ, PQ wireline core

core-lift
casing used; barrel withdrawn

graphic log/core recovery
core recovered - graphic symbols indicate material; no core recovered

water
10/1/98 water level on date shown; water inflow; partial drill fluid loss; complete drill fluid loss; water pressure test result (lugeons) for depth interval shown (25)

weathering
FR fresh; SW slightly weathered; MW moderately weathered; HW highly weathered; XW extremely weathered; DW distinctly weathered (covers MW and HW)

strength
VL very low; L low; M medium; H high; VH very high; EH extremely high

defect type
JT joint; PT parting; SM seam; SZ sheared zone; SS sheared surface; CS crushed seam

planarity
PL planar; CU curved; UN undulating; ST stepped; IR irregular

roughness
VR very rough; RO rough; SO smooth; SL slickensided

coating
CN clean; SN stained; VN veneer; CO coating

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No. **BH232**

Sheet 6 of 9

Project No: **GEOTLCOV23558AA**

Client: ***North West Metro Project Team***

Date started: ***29.9.2008***

Principal: ***Transport and Infrastructure Development Corporation***

Date completed: ***2.10.2008***

Project: ***North West Metro, Preliminary Investigation***

Logged by: ***AS***

Borehole Location: ***TA07 Rozelle Station - Hancock St***

Checked by: ***DMH***

drill model & mounting: Hydrapower Truck | Easting: 330750.85 | slope: -60° | R.L. Surface: 40.82m

hole diameter: 100 mm | Drilling fluid: | Northing: 6251376.35 | bearing: 050° | datum: AHD

drilling information					material substance						rock mass defects		
method	core-lift	water	RL	depth metres	graphic log core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength VL L M H VH EH	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm 30 100 300 1000 3000	defect description: type, inclination, planarity, roughness, coating, thickness — particular	general
NQ				33		**SANDSTONE:** Medium grained, pale grey, distinctly cross bedded at 35° *(continued)*	FR		D 1.97 A 1.97			PT, 35°, PL, SO-RO, VN Silty clay	
												PT, 35°, PL, SO-RO, VN Silty clay	
						Trace of coarse grained sandstone bands.			D 1.83 A 1.88	100			
				34		**SANDSTONE:** Coarse grained, pale grey, cross bedded at 25°-30°. Trace of fine grained quartz gravel.							
						Trace of carbonaceous laminae.			D 2.02 A 1.75				
				35					D 2.31 A 2.48				
						SANDSTONE: Medium to coarse grained, pale grey, distinctly cross-bedded at 30°. 35.65m-35.75m - Band of fine grained quartz gravel.							
				36						100		PT, 30°, PL, RO, VN of carbonaceous laminae	
									D 1.68 A 2.17				
				37					D 2.29 A 2.1				
						SANDSTONE: Medium grained, pale grey, indistinctly cross-bedded at 15°-30°. Trace of coarse grained bands.							
				38					D 1.6 A 1.72				
										100			
				39		**SANDSTONE:** Coarse grained, pale grey, indistinctly cross-bedded at 20°-30°.			D 2.2 A 2.04				
				40					D A				

PT, 30-40°, PL, SO-RO, VN, silty clay

method

DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
NMLC	NMLC core
NQ, HQ, PQ	wireline core

core-lift

- casing used
- barrel withdrawn

graphic log/core recovery

- core recovered - graphic symbols indicate material
- no core recovered

water

- 10/1/98 water level on date shown
- water inflow
- partial drill fluid loss
- complete drill fluid loss
- 25 water pressure test result (lugeons) for depth interval shown

weathering

FR	fresh
SW	slightly weathered
MW	moderately weathered
HW	highly weathered
XW	extremely weathered
DW	distinctly weathered (covers MW and HW)

strength

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type

JT	joint
PT	parting
SM	seam
SZ	sheared zone
SS	sheared surface
CS	crushed seam

planarity

PL	planar
CU	curved
UN	undulating
ST	stepped
IR	irregular

roughness

VR	very rough
RO	rough
SO	smooth
SL	slickensided

coating

CN	clean
SN	stained
VN	veneer
CO	coating

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No. **BH232**

Sheet 7 of 9

Project No: **GEOTLCOV23558AA**

Client: ***North West Metro Project Team***

Date started: ***29.9.2008***

Principal: ***Transport and Infrastructure Development Corporation***

Date completed: ***2.10.2008***

Project: ***North West Metro, Preliminary Investigation***

Logged by: ***AS***

Borehole Location: ***TA07 Rozelle Station - Hancock St***

Checked by: ***DMH***

drill model & mounting: Hydrapower Truck | Easting: 330750.85 | slope: -60° | R.L. Surface: 40.82m

hole diameter: 100 mm | Drilling fluid: | Northing: 6251376.35 | bearing: 050° | datum: AHD

drilling information | **material substance** | **rock mass defects**

method	core-lift	water	RL	depth metres	graphic log core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength (VL L M H VH EH)	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm (30 100 300 1000 3000)	defect description: type, inclination, planarity, roughness, coating, thickness (particular / general)
NQ						**SANDSTONE:** Medium grained, pale grey with dark grey beds, cross-bedded at 35°, with some carbonaceous laminae and trace bands of coarse grained sandstone bands.	FR		D 1.95 A 1.74	100		
				41		**SANDSTONE:** Medium grained, pale grey, indistinctly bedded at 30° with some dark grey flecks.			D 1.21 A 1.37			
				42		**SANDSTONE:** Medium grained, grey, cross bedded at 30°-35°.	MW		D 1.53 A 2.13			PT, 60°, PL, CO, silty clay
						SANDSTONE: Fine grained, brown, indistinctly bedded, trace of carbonaceous laminae, with some coarse grained crystalisation.	FR					
				43		**SANDSTONE:** Medium grained, pale grey, distinctly cross bedded at 35°-55°, with trace of carbonaceous laminae.			D 1.32 A 1.6	99		PT, 30-40°, PL, SO-RO, VN, silty clay
				44					D 1.15 A 1.34			
				45		**SANDSTONE:** Medium grained, pale grey with grey laminae, distinctly cross-bedded at 40°.			D 1.37 A 1.28			PT, 40°, PL, SO, VN
						SANDSTONE: Medium grained, pale grey, indistinctly cross-bedded at 50°, trace of carbonaceous laminae.						SM, 40°, PL, 35mm gravelly clay
				46		**SANDSTONE:** Medium grained, pale grey with grey laminae, distinctly cross-bedded at 35°, with some carbonaceous laminae.			D 1.5 A 1.24			PT, 35°, PL, SO, CN
						SANDSTONE: Coarse grained, pale grey, indistinctly cross-bedded at 35°, with a trace subangular shale clasts up to 40mm.						PT, 35°, PL, RO, CN PT, 25°, PL, RO, CN PT, 45°, PL, RO, CN
				47					D 1.7 A 1.64	95		
						SANDSTONE: Medium grained, pale grey with grey laminae, distinctly cross bedded at 45°, with a trace of carbonaceous laminae.						SM, 35°, silty clay, 5mm
				48					D A			

method

DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
NMLC	NMLC core
NQ, HQ, PQ	wireline core

core-lift

- casing used
- barrel withdrawn

graphic log/core recovery

- core recovered - graphic symbols indicate material
- no core recovered

water

- 10/1/98 water level on date shown
- water inflow
- partial drill fluid loss
- complete drill fluid loss
- 25 — water pressure test result (lugeons) for depth interval shown

weathering

FR	fresh
SW	slightly weathered
MW	moderately weathered
HW	highly weathered
XW	extremely weathered
DW	distinctly weathered (covers MW and HW)

strength

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type

JT	joint
PT	parting
SM	seam
SZ	sheared zone
SS	sheared surface
CS	crushed seam

planarity

PL	planar
CU	curved
UN	undulating
ST	stepped
IR	irregular

roughness

VR	very rough
RO	rough
SO	smooth
SL	slickensided

coating

CN	clean
SN	stained
VN	veneer
CO	coating

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No. **BH232**

Sheet 8 of 9

Project No: **GEOTLCOV23558AA**

Client: ***North West Metro Project Team***

Date started: ***29.9.2008***

Principal: ***Transport and Infrastructure Development Corporation***

Date completed: ***2.10.2008***

Project: ***North West Metro, Preliminary Investigation***

Logged by: ***AS***

Borehole Location: ***TA07 Rozelle Station - Hancock St***

Checked by: ***DMH***

drill model & mounting: Hydrapower Truck | Easting: 330750.85 | slope: -60° | R.L. Surface: 40.82m

hole diameter: 100 mm | Drilling fluid: | Northing: 6251376.35 | bearing: 050° | datum: AHD

drilling information | **material substance** | **rock mass defects**

method	core-lift	water	RL	depth metres	graphic log core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength (VL L M H VH EH)	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm (30 100 300 1000 3000)	defect description: type, inclination, planarity, roughness, coating, thickness (particular / general)
NQ						**SANDSTONE:** Medium grained, pale grey with grey laminae, distinctly cross bedded at 45°, with a trace of carbonaceous laminae. *(continued)*	FR		D 0.86 A 1.43	95		PT, 35°, PL, RO, CN JT, 10°, PL, cemented JT, 35°, PL, RO, CN PT, 35°, PL, RO, CN SM, 45°, IR, 60mm clayey sandy gravel
						NO CORE: 0.4m.						
				49		**SANDSTONE:** Medium grained, pale grey, massive.	FR					JT, 50°, PL, RO, CN
						NO CORE: 0.2m.						
						SANDSTONE: Medium grained, pale grey, massive, trace of dark grey flecks.	FR					JT, 25°, PL, closed SM, 35°, PL, 5mm sandy clay JT, 22°, PL, RO, CO sandy clay JT, 20°, IR, RO, CO sandy clay JT, 80°-90°, PL, closed (50.30 - 50.40m)
				50					D 0.7 A 0.86	71		SM, 30°, PL, 5-10mm sandy clay JT, 80°, PL, closed (50.63 - 50.79m) JT, 45°, PL, RO, CN
				51					D 1.05 A 1.24 D 0.9 A 1.13			JT, 35-40°, PL-RO, CO sandy clay
				52					D 1.18 A 1.42			
				53					D 1.32 A 1.6			
				54		**SANDSTONE:** Medium grained, pale grey with dark grey laminae, distinctly cross-bedded at 20°-30°.			D 0.96 A 1.04	90		SM, 20°, PL, 45mm sandy clay PT, 20°, PL, SO, CO silty clay PT, 20°, PL, SO, CO silty clay JT, 0°, PL, RO, CN
				55		**SANDSTONE:** Medium grained, pale grey, distinctly cross-bedded at 40°.						CS, 30°, PL, 1-3mm sandy clay JT, 5°, PL, CO silty clay PT, 30°, PL, RO silty clay JT, 10°, PL, RO, CO silty clay PT, 30°, PL, SO-RO, CO silty clay JT, 30°, PL, SO, CN JT, 30°, PL, SO, CN PT, 45°, PL, RO, CN
				56		With a trace of carbonaceous laminae up to				67		PT, 45°, PL, RO, VN carbonaceous

method

DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
NMLC	NMLC core
NQ, HQ, PQ	wireline core

core-lift

- casing used
- barrel withdrawn

graphic log/core recovery

- core recovered - graphic symbols indicate material
- no core recovered

water

- 10/1/98 water level on date shown
- water inflow
- partial drill fluid loss
- complete drill fluid loss
- 25 — water pressure test result (lugeons) for depth interval shown

weathering

FR	fresh
SW	slightly weathered
MW	moderately weathered
HW	highly weathered
XW	extremely weathered
DW	distinctly weathered (covers MW and HW)

strength

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type

JT	joint
PT	parting
SM	seam
SZ	sheared zone
SS	sheared surface
CS	crushed seam

roughness

VR	very rough
RO	rough
SO	smooth
SL	slickensided

planarity

PL	planar
CU	curved
UN	undulating
ST	stepped
IR	irregular

coating

CN	clean
SN	stained
VN	veneer
CO	coating

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No. **BH232**
Sheet 9 of 9
Project No: **GEOTLCOV23558AA**

Client: ***North West Metro Project Team***
Date started: ***29.9.2008***
Principal: ***Transport and Infrastructure Development Corporation***
Date completed: ***2.10.2008***
Project: ***North West Metro, Preliminary Investigation***
Logged by: ***AS***
Borehole Location: ***TA07 Rozelle Station - Hancock St***
Checked by: ***DMH***

drill model & mounting: Hydrapower Truck | Easting: 330750.85 | slope: -60° | R.L. Surface: 40.82m
hole diameter: 100 mm | Drilling fluid: | Northing: 6251376.35 | bearing: 050° | datum: AHD

drilling information | **material substance** | **rock mass defects**

method	core-lift	water	RL	depth metres	graphic log core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength VL L M H VH EH	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm 30 100 300 1000 3000	defect description: type, inclination, planarity, roughness, coating, thickness — particular	general
NQ				57		2mm thick.	FR			67		PT, 45°, PL, RO, VN carbonaceous	
						INTERBEDDED SILTSTONE AND SANDSTONE: Dark grey, indistinctly bedded at 10°-15°, siltstone (85%) with thin, medium grained, pale grey sandstone interbeds. Bedding disturbance and sandstone bed thickness increases with depth.						JT, 25°, PL, RO, CO clayey sand SM, 35°, PL, 5mm sandy clay JT, 60°, PL, 6mm clayey gravel SM, 10°, PL, 20mm gravelly clay JT, 40°, IR, SO, CN JT, 25°, PL, SO, CN JT, 40°, PL, closed PT, 15°, PL, SO, CN PT, 15°, PL, SO, CN PT, 25°, PL, RO, CN JT, 80°, PL, RO, CN PT, 30°, PL, RO, CN PT, 30°, PL, RO, CN	
						SANDSTONE: Medium and coarse grained, pale grey, massive.			D 0.25 A 0.42				
						SILTSTONE: Dark grey, distinctly bedded at 30°.							
				58		**SANDSTONE:** Medium grained, pale grey, distinctly cross-bedded at 25°, trace of siltstone clasts and trace of carbonaceous laminae.			D 1.44 A 1.74				
						SANDSTONE: Medium grained, pale grey, massive with some siltstone clasts up to 40mm.						PT, 45°, PL, SO PT, 45°, PL, SO, VN silty clay	
						Siltstone band, 140mm thick dark grey, distinctly bedded at 45°.							
				59		**SILTSTONE:** Dark grey, convulute bedding.			D 1.05 A 0.62				
						SANDSTONE: Medium grained, pale grey, massive with some siltstone clasts up to 40mm.						PT, 25°, PL, 3mm silty clay SM, 30°, PL 10mm sandy clay	
				60		**SANDSTONE:** Medium grained, pale grey, cross bedded at 30°.						SM, 10°, PL, 2mm silty clay SM, 30°, PL, 2-5mm sandy clay	
						BH232 terminated at 60m						PT, 30°, PL, RO, CN PT, 30°, PL, RO, CN	
				61									
				62									
				63									
				64									

method
DT diatube; AS auger screwing; AD auger drilling; RR roller/tricone; CB claw or blade bit; NMLC NMLC core; NQ, HQ, PQ wireline core

core-lift
casing used
barrel withdrawn

graphic log/core recovery
core recovered - graphic symbols indicate material
no core recovered

water
10/1/98 water level on date shown
water inflow
partial drill fluid loss
complete drill fluid loss
25 water pressure test result (lugeons) for depth interval shown

weathering
FR fresh; SW slightly weathered; MW moderately weathered; HW highly weathered; XW extremely weathered; DW distinctly weathered (covers MW and HW)

strength
VL very low; L low; M medium; H high; VH very high; EH extremely high

defect type
JT joint; PT parting; SM seam; SZ sheared zone; SS sheared surface; CS crushed seam

planarity
PL planar; CU curved; UN undulating; ST stepped; IR irregular

roughness
VR very rough; RO rough; SO smooth; SL slickensided

coating
CN clean; SN stained; VN veneer; CO coating

CORED BOREHOLE GEOTLCOV23558AA - ORIGINAL.GPJ COFFEY.GDT 2.25.09

Form GEO 5.5 Issue 3 Rev. 3


coffey
geotechnics
Project: NORTH WEST METRO
Project No: GEOTLCOV23558AA
Borehole No: 232
Date: 30.09.08
Depth: 1.80m - 11.00m
BH232 GEOTLCOV23558AA START CORING AT 1.8m
NO CORE 02
2
3
4
5
6
7
8
9
10


coffey
geotechnics
Project: NORTH WEST METRO
Project No: GEOTLCOV23558AA
Borehole No: 232
Date: 30.09.08
Depth: 11.00m - 21.00m
11
12
13
14
15
16
17
18
19
20


coffey
geotechnics
Project: NORTH WEST METRO
Project No: GEOTLCOV23558AA
Borehole No: 232
Date: 01.10.08
Depth: 21.00-31.00m
21
22
23
24
25
26
27
28
29
30


coffey
geotechnics
Project: NORTH WEST METRO
Project No: GEOTLCOV23558AA
Borehole No: 232
Date: 01.10.08
Depth: 31.00-41.00m
31
32
33
34
35
36
37
38
39
40


coffey
geotechnics
Project: NORTH WEST METRO
Project No: GEOTLCOV23558AA
Borehole No: 232
Date: 02.10.08
Depth: 41.00 - 51.00
41
42
43
44
45
46
47
48
49
50
NO CORE 0.4m
NO CORE 0.2m


coffey
geotechnics
Project: NORTH WEST METRO
Project No: GEOTLCOV23558AA
Borehole No: 232
Date: 02.10.08
Depth: 51.00 - 60.00m
51
52
53
54
55
56
57
58
59
E.O.H 60.00m

coffey geotechnics

Engineering Log - Borehole

Borehole No.	***BH210***
Sheet	1 of 7
Project No:	***GEOTLCOV23558AA***
Client:	***North West Metro Project Team***
Date started:	***13.10.2008***
Principal:	***Transport and Infrastructure Development Corporation***
Date completed:	***17.10.2008***
Project:	***North West Metro, Preliminary Investigation***
Logged by:	***RF***
Borehole Location:	***TA07 Rozelle Station - Victoria Rd corner of Darling St***
Checked by:	***DMH***

drill model and mounting:	E50 Truck		Easting:	330701.59	slope:	-90°	R.L. Surface: 40.09
hole diameter:	100 mm		Northing	6251474.61	bearing:		datum: AHD

drilling information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
ADV					40				**TOPSOIL: SILT:** Dark brown with some sand, trace of clay and gravel with some plant roots and organic matter.	M			TOPSOIL
								CL	**CLAY:** Medium plasticity, yellow with some silt and with some fine grained sand.		St		RESIDUAL SOIL
								SM	**CLAYEY SILTY SAND:** Fine to medium grained, pale yellow, pale grey, white.				
				SPT 10,14/120mm N*=R	39	1					H		
									SANDSTONE: Fine to medium grained, pale grey, pale yellow, extremely weathered, very low strength.				WEATHERED BEDROCK
					38	2							
									Borehole BH210 continued as cored hole				
					37	3							
					36	4							
					35	5							
					34	6							
					33	7							
						8							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit
*bit shown by suffix e.g.	ADT

support

M mud N nil
C casing

penetration

1 2 3 4 no resistance ranging to refusal

water

10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No.	***BH210***
Sheet	2 of 7
Project No:	***GEOTLCOV23558AA***
Client:	***North West Metro Project Team***
Date started:	***13.10.2008***
Principal:	***Transport and Infrastructure Development Corporation***
Date completed:	***17.10.2008***
Project:	***North West Metro, Preliminary Investigation***
Logged by:	***RF***
Borehole Location:	***TA07 Rozelle Station - Victoria Rd corner of Darling St***
Checked by:	***DMH***

drill model & mounting: E50 Truck | Easting: 330701.59 | slope: -90° | R.L. Surface: 40.09

hole diameter: 100 mm | Drilling fluid: | Northing: 6251474.61 | bearing: | datum: AHD

drilling information | **material substance** | **rock mass defects**

method	core-lift	water	RL	depth metres	graphic log core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength VL L M H VH EH	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm 30 100 300 1000 3000	defect description: type, inclination, planarity, roughness, coating, thickness — particular / general
			40									
				1								
			39									
				2								
			38			Continued from non-cored borehole						
						NO CORE: 0.35m						
				3		**SANDSTONE:** Fine to medium grained, orange and pale grey, distinctly bedded at 0°-10°.	HW		D 0.15 A 0.22	66		
			37			**NO CORE:** 0.1m						
				4		**SANDSTONE:** Fine to medium grained, orange brown and pale grey, indistinctly bedded at 0°-10°.	HW					
							MW		D 0.11 A 0.14	88		
			36									
				5								PT, 5°, PL, 3mm clay PT, 0°, PL, 3mm clay
			35			**NO CORE:** 0.1m			D 0.37 A 0.46			
				6		**SANDSTONE:** Fine to medium grained, orange and pale grey, indistinctly bedded at 0°-10°.						
			34			**NO CORE:** 0.21m						
						SANDSTONE: Fine to medium grained, orange and pale grey, indistinctly bedded at 0°-10°.	MW		D 0.35 A 0.28	61		SM, 0°,PL, 80mm sandy clay SM, 0°,PL, 80mm clay
				7		**SANDSTONE:** Fine to medium grained, pale grey and pale yellow, distinct wavy bedded at 0°-5°.	SW					SM, 0°, PL, 20mm SM, 0°, PL, 40mm
			33						D 0.12 A 0.33			
						NO CORE: 0.2m						SM, 0°, PL, 20mm clay
				8		**SANDSTONE:** Fine to medium grained,	FR					

method

DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
NMLC	NMLC core
NQ, HQ, PQ	wireline core

core-lift

- casing used
- barrel withdrawn

graphic log/core recovery

- core recovered - graphic symbols indicate material
- no core recovered

water

- 10/1/98 water level on date shown
- water inflow
- partial drill fluid loss
- complete drill fluid loss
- 25 water pressure test result (lugeons) for depth interval shown

weathering

FR	fresh
SW	slightly weathered
MW	moderately weathered
HW	highly weathered
XW	extremely weathered
DW	distinctly weathered (covers MW and HW)

strength

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type

JT	joint
PT	parting
SM	seam
SZ	sheared zone
SS	sheared surface
CS	crushed seam

planarity

PL	planar
CU	curved
UN	undulating
ST	stepped
IR	irregular

roughness

VR	very rough
RO	rough
SO	smooth
SL	slickensided

coating

CN	clean
SN	stained
VN	veneer
CO	coating

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No.	**BH210**
Sheet	3 of 7
Project No:	**GEOTLCOV23558AA**
Client:	***North West Metro Project Team***
Date started:	***13.10.2008***
Principal:	***Transport and Infrastructure Development Corporation***
Date completed:	***17.10.2008***
Project:	***North West Metro, Preliminary Investigation***
Logged by:	***RF***
Borehole Location:	***TA07 Rozelle Station - Victoria Rd corner of Darling St***
Checked by:	***DMH***

drill model & mounting: E50 Truck | Easting: 330701.59 | slope: -90° | R.L. Surface: 40.09

hole diameter: 100 mm | Drilling fluid: | Northing: 6251474.61 | bearing: | datum: AHD

drilling information | **material substance** | **rock mass defects**

method	core-lift	water	RL	depth metres	graphic log core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength VL L M H VH EH	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm 30 100 300 1000 3000	defect description: type, inclination, planarity, roughness, coating, thickness (particular / general)
			32			pale grey and pale yellow, distinctly wavy bedded at 0°- 5°.	FR					
						NO CORE: 0.16m *(continued)*						
						SANDSTONE: Medium grained, pale grey indistinctly to distinctly bedded at 0°-20°, with trace of carbonaceous laminations. 80mm band of interlaminated siltstone and sandstone.			D A 0.83 0.92	92		PT, 5°, PL, RO, CN PT, 0°, PL, RO, SN, orange
			31	9								
									D A 0.58 0.68	100		PT, 5°, PL, SO, CO, clay 1mm
			30	10								
						SANDSTONE: Fine grained, grey and dark grey, distinctly laminated at 0°- 5°, with some black carbonaceous laminations.	SW		D A 0.25 0.4	100		JT, 60°, PL, RO, CN JT, 60°,PL, RO, CN
			29	11								
						120mm dark grey shale band.				85		SM, 0°, PL, 10mm clay SM, 0°, PL, 30mm clay
						SANDSTONE: Medium grained, pale grey, stained orange brown, indistinctly bedded at 0°-20°.			D A 0.24 0.36			PT, 0°- 5°, IR, SN, orange-brown PT, 0°- 5°, IR, 2mm clay PT, PL, 5°, 2mm clay JT, 10°, PL, SN, orange brown PT, 0°, PL, 2mm, clay
			28	12								
									D A 0.85 0.93			PT, PL, 20°, RO, CN
						NO CORE: 0.6m	FR					SM, 0°, PL, 20mm clay
						SANDSTONE: Medium grained, pale grey, indistinctly cross bedded at 0°-20° with trace of shale and carbonaceous laminations.						SM, 5°, PL, 10mm sand
			27	13								PT, 5°, PL, 5mm clay PT, 0°, PL, CO, clay PT, 0°, PL, 2mm clay
									D A 1.03 1.19	97		JT, 30°, PL, RO, CO, clay JT, 30°, PL, RO, CO, clay PT, 5°, PL, 2mm clay
				14								PT, 5°-10°, IR, 2mm clay
			26									SM, 0°, PL, 10mm
									D A 0.71 0.75			JT, 10°-30°, IR, RO, CN
				15								
			25							100		
						15.22m: 40mm shale clast.			D A 1.19 1.33			PT, 0°-20°, IR, RO, CO, 1mm, clay
						SANDSTONE: Fine to medium grained, pale grey, stained pale yellow, massive.				93		
						15.66m: 25mm shale clast						PT, 10°, PL, CO, clay JT, 30°, PL, 5mm, clay
				16		15.87m: Carbonaceous material 2mm-3mm						

method

DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
NMLC	NMLC core
NQ, HQ, PQ	wireline core

core-lift

- casing used
- barrel withdrawn

graphic log/core recovery

- core recovered - graphic symbols indicate material
- no core recovered

water

- 10/1/98 water level on date shown
- water inflow
- partial drill fluid loss
- complete drill fluid loss
- water pressure test result (lugeons) for depth interval shown (25)

weathering

FR	fresh
SW	slightly weathered
MW	moderately weathered
HW	highly weathered
XW	extremely weathered
DW	distinctly weathered (covers MW and HW)

strength

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type

JT	joint
PT	parting
SM	seam
SZ	sheared zone
SS	sheared surface
CS	crushed seam

planarity

PL	planar
CU	curved
UN	undulating
ST	stepped
IR	irregular

roughness

VR	very rough
RO	rough
SO	smooth
SL	slickensided

coating

CN	clean
SN	stained
VN	veneer
CO	coating

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No.	***BH210***
Sheet	4 of 7
Project No:	***GEOTLCOV23558AA***
Client:	***North West Metro Project Team***
Date started:	***13.10.2008***
Principal:	***Transport and Infrastructure Development Corporation***
Date completed:	***17.10.2008***
Project:	***North West Metro, Preliminary Investigation***
Logged by:	***RF***
Borehole Location:	***TA07 Rozelle Station - Victoria Rd corner of Darling St***
Checked by:	***DMH***

drill model & mounting: E50 Truck | Easting: 330701.59 | slope: -90° | R.L. Surface: 40.09

hole diameter: 100 mm | Drilling fluid: | Northing: 6251474.61 | bearing: | datum: AHD

drilling information | **material substance** | **rock mass defects**

method	core-lift	water	RL	depth metres	graphic log core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength (VL L M H VH EH)	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm (30 100 300 1000 3000)	defect description: type, inclination, planarity, roughness, coating, thickness (particular / general)
			24			**SANDSTONE:** Fine to medium grained, pale grey, pale yellow, indistinctly bedded at 0°-10° with some medium to coarse grained bands. *(continued)*	FR		D 1.22 A 1.49			
			23	17		**SANDSTONE:** Fine to medium grained, pale grey, distinctly cross-bedded at 0°-10°. Dark grey shale laminations spaced at 1-50mm.			D 0.86 A 1.29	93		PT, 20°, PL, CO, clay PT, 10°, IR, CO clay PT, 10°, IR, CO clay PT, 0°, PL, RO, CO clay PT, 5°, IR, RO, CN
			22	18		**SANDSTONE:** Medium grained, pale grey, indistinctly bedded at 20°.						PT, 0°, PL, RO, CO clay
						SANDSTONE: Fine to medium grained, pale grey, distinctly bedded at 0°, dark grey shale laminations spaced at 2-10mm. Carbonaceous laminations between 18.58m to 18.82m.			D 1.19 A 1.26			
			21	19					D 1 A 1.51			PT, 0°, PL, RO, CO clay
						SANDSTONE: Medium grained, pale grey, indistinctly cross bedded at 0°-20° with some shale laminations.						
			20	20					D 1.53 A 1.64	100		SM, 0°, PL, 30mm clayey sand
			19	21					D 1.19 A 1.07			PT, 0°, PL, RO, CO clay JT, 70°-90°, IR, RO, CO clay (21.71m-21.80m) SM, 20°-30°, IR, 30mm clayey sand
			18	22		**NO CORE:** 0.49m.						SM, 0°, PL, 10mm clay
						SANDSTONE: Fine grained, grey, distinctly bedded at 0°-10°, shale and carbonaceous dark grey laminations.	FR		D 0.79 A 1.05	60		PT, 5°, PL, RO, CO clay JT, 45°, PL, RO, VN clay JT, 20°, PL, closed
			17	23					D 0.94 A 0.75			PT, 0°-5°, PL, RO, VN clay
				24		**SANDSTONE:** Fine grained, pale grey, cross-bedded at 10°-20°, with some coarse grained bands.						JT, 20°, PL, closed JT, 20°, PL, RO, VN clay JT, 20°, PL, closed

method

DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
NMLC	NMLC core
NQ, HQ, PQ	wireline core

core-lift

- casing used
- barrel withdrawn

graphic log/core recovery

- core recovered - graphic symbols indicate material
- no core recovered

water

- 10/1/98 water level on date shown
- water inflow
- partial drill fluid loss
- complete drill fluid loss
- 25 water pressure test result (lugeons) for depth interval shown

weathering

FR	fresh
SW	slightly weathered
MW	moderately weathered
HW	highly weathered
XW	extremely weathered
DW	distinctly weathered (covers MW and HW)

strength

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type

JT	joint
PT	parting
SM	seam
SZ	sheared zone
SS	sheared surface
CS	crushed seam

planarity

PL	planar
CU	curved
UN	undulating
ST	stepped
IR	irregular

roughness

VR	very rough
RO	rough
SO	smooth
SL	slickensided

coating

CN	clean
SN	stained
VN	veneer
CO	coating

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No.	***BH210***
Sheet	5 of 7
Project No:	***GEOTLCOV23558AA***
Client:	***North West Metro Project Team***
Date started:	***13.10.2008***
Principal:	***Transport and Infrastructure Development Corporation***
Date completed:	***17.10.2008***
Project:	***North West Metro, Preliminary Investigation***
Logged by:	***RF***
Borehole Location:	***TA07 Rozelle Station - Victoria Rd corner of Darling St***
Checked by:	***DMH***

drill model & mounting: E50 Truck | Easting: 330701.59 | slope: -90° | R.L. Surface: 40.09

hole diameter: 100 mm | Drilling fluid: | Northing: 6251474.61 | bearing: | datum: AHD

drilling information | **material substance** | **rock mass defects**

method	core-lift	water	RL	depth metres	graphic log core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength (VL L M H VH EH)	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm (30 100 300 1000 3000)	defect description: type, inclination, planarity, roughness, coating, thickness (particular / general)
			16			**NO CORE:** 0.12m.	FR					SM, 20°, PL, 40mm, clay
						SANDSTONE: Fine grained, grey to pale grey, distinctly cross-bedded at 10°-20°, dark grey shale and carbonaceous laminations.						SM, 0°, PL, 30mm, gravelly clay JT, 30°, PL, closed JT, 45°, PL, closed JT, 5°-10°, IR, RO, CO clay JT, 60°-90°, IR, RO, CN (24.53m - 24.64m) Shear zone between 24.95m and 25.77m
			15	25					D A 0.83 0.79	89		SM, 0°, PL, 20mm CS, 20°, IR, 50mm gravelly clay SM, 10°-20°, IR, 40mm clay, pp=360kPa
						25.57m - 25.60m: Interlaminated fine grained sandstone and black shale band.			D A 0.49 0.44			JT, 40°, PL, RO, CO clay JT, 60°-90°, IR, closed (25.19m - 25.85m)
			14	26					D A 0.2 0.25	40		JT, 80°, PL, RO, closed PT, 5°, PL, 3mm clay JT, 45°, PL, RO, CO clay SM, 0°, PL, 20mm, clay, pp=120kPa 2X JT, 45°, PL, RO, CO clay JT, 30°, PL, closed SM, 10°, IR, 40mm, clayey sand PT, 0°, PL, CO clay 3 x JT, 20°, PL, closed 2 x JT, 60°, PL, closed JT, 80°, PL, RO, CN SM, 0°, PL, 10mm clay
			13	27		**SANDSTONE:** Fine to medium grained, orange, distinctly bedded at 0°-10° with some grey shale and carbonaceous laminations.	SW		D A 1.26 1.41			
							FR					2 x PT, 5°, PL, RO, CO, clay PT, 5°, PL, RO, CO, clay
			12	28						98		
						SANDSTONE: Medium grained, orange, red, indistinctly bedded at 0°-10°.	MW		D A 1.12 1.39			
			11	29								JT, 60°, PL, RO, CN 29.40m - 29.45m - No core
									D A 1.35 1.32			
			10	30						98		
						SANDSTONE: Medium grained, pale grey, pale orange, indistinctly bedded at 0°-10° to massive with rare carbonaceous flecks.	FR		D A 0.98 1.02			
			9	31								
						NO CORE: 0.07m	SW			96		
				32					D A 1.46 2.05			

method
DT diatube; AS auger screwing; AD auger drilling; RR roller/tricone; CB claw or blade bit; NMLC NMLC core; NQ, HQ, PQ wireline core

core-lift
casing used; barrel withdrawn

graphic log/core recovery
core recovered - graphic symbols indicate material; no core recovered

water
10/1/98 water level on date shown; water inflow; partial drill fluid loss; complete drill fluid loss; water pressure test result (lugeons) for depth interval shown (25)

weathering
FR fresh; SW slightly weathered; MW moderately weathered; HW highly weathered; XW extremely weathered; DW distinctly weathered (covers MW and HW)

strength
VL very low; L low; M medium; H high; VH very high; EH extremely high

defect type
JT joint; PT parting; SM seam; SZ sheared zone; SS sheared surface; CS crushed seam

planarity
PL planar; CU curved; UN undulating; ST stepped; IR irregular

roughness
VR very rough; RO rough; SO smooth; SL slickensided

coating
CN clean; SN stained; VN veneer; CO coating

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No.	***BH210***
Sheet	6 of 7
Project No:	***GEOTLCOV23558AA***
Client:	***North West Metro Project Team***
Date started:	***13.10.2008***
Principal:	***Transport and Infrastructure Development Corporation***
Date completed:	***17.10.2008***
Project:	***North West Metro, Preliminary Investigation***
Logged by:	***RF***
Borehole Location:	***TA07 Rozelle Station - Victoria Rd corner of Darling St***
Checked by:	***DMH***

drill model & mounting: E50 Truck | Easting: 330701.59 | slope: -90° | R.L. Surface: 40.09

hole diameter: 100 mm | Drilling fluid: | Northing: 6251474.61 | bearing: | datum: AHD

drilling information | **material substance** | **rock mass defects**

method	core-lift	water	RL	depth metres	graphic log core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength (VL L M H VH EH)	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm (30 100 300 1000 3000)	defect description: type, inclination, planarity, roughness, coating, thickness — particular / general
			8	33		**SANDSTONE:** Medium grained, pale yellow, orange, massive to indistinctly bedded at 0°-10°. Trace of sideite grains and coarse quartz grains *(continued)*	SW		D 1.36 A 1.76	96		
			7						D 1.22 A 1.33			
				34								
			6						D 1.6 A 1.35			
				35		**SANDSTONE:** Medium grained, pale grey, indistinctly bedded at 0°-20°, with some coarse grained bands and grey shale and carbonaceous laminations.	FR			100		
			5						D 1.27 A 1.05			
							SW					
				36		**SANDSTONE:** Fine to coarse grained, pale grey, distinctly bedded at 0°- 5°, with grey laminations.	FR		D 1.51 A 1.79			
			4							99		
				37		**SANDSTONE:** Medium grained, pale grey, indistinctly corss bedded at 0°- 20°, with grey shale and black carbonaceous wavy laminations.			D 1.15 A 1.25			SM, 0°, PL, 10mm
			3									
				38						98		
			2									
									D 1.93 A 1.55			SM, 0°, PL, 10mm clay PT, 0°, PL, 5mm clay JT, 30°, PL, RO, CO clay
				39					D 1.97 A 2.17			
			1			**SANDSTONE:** Medium to coarse grained, pale grey, indistinctly bedded at 0°-10°.						
				40								

method
DT diatube; AS auger screwing; AD auger drilling; RR roller/tricone; CB claw or blade bit; NMLC NMLC core; NQ, HQ, PQ wireline core

core-lift
casing used; barrel withdrawn

graphic log/core recovery
core recovered - graphic symbols indicate material; no core recovered

water
10/1/98 water level on date shown; water inflow; partial drill fluid loss; complete drill fluid loss; water pressure test result (lugeons) for depth interval shown (25)

weathering
FR fresh; SW slightly weathered; MW moderately weathered; HW highly weathered; XW extremely weathered; DW distinctly weathered (covers MW and HW)

strength
VL very low; L low; M medium; H high; VH very high; EH extremely high

defect type
JT joint; PT parting; SM seam; SZ sheared zone; SS sheared surface; CS crushed seam

planarity
PL planar; CU curved; UN undulating; ST stepped; IR irregular

roughness
VR very rough; RO rough; SO smooth; SL slickensided

coating
CN clean; SN stained; VN veneer; CO coating

coffey geotechnics

Engineering Log - Cored Borehole

Borehole No. **BH210**

Sheet 7 of 7

Project No: **GEOTLCOV23558AA**

Client: ***North West Metro Project Team***

Date started: ***13.10.2008***

Principal: ***Transport and Infrastructure Development Corporation***

Date completed: ***17.10.2008***

Project: ***North West Metro, Preliminary Investigation***

Logged by: ***RF***

Borehole Location: ***TA07 Rozelle Station - Victoria Rd corner of Darling St***

Checked by: ***DMH***

drill model & mounting: E50 Truck | Easting: 330701.59 | slope: -90° | R.L. Surface: 40.09

hole diameter: 100 mm | Drilling fluid: | Northing: 6251474.61 | bearing: | datum: AHD

drilling information | **material substance** | **rock mass defects**

method	core-lift	water	RL	depth metres	graphic log / core recovery	material: rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength (VL L M H VH EH)	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	defect spacing mm (30 100 300 1000 3000)	defect description: type, inclination, planarity, roughness, coating, thickness (particular / general)
			0			**SANDSTONE:** Medium to coarse grained, pale grey, indistinctly bedded at 0°-10°. *(continued)*	FR		D 1.77 A 2			
			-1	41		**SANDSTONE:** Fine to medium grained, pale grey, distinctly cross-bedded at 0°-15°, with grey shale laminations.			D 1.2 A 1.05	98		PT, 0°, PL, 5mm clayey sand
			-2	42					D 1.96 A 1.93			
			-3	43		Extremely weathered siltstone clast 30mm			D 1.92 A 2.29	97		JT, 25°, IR, RO, CN
			-4	44		Trace of quartz and siltstone clasts up to 2mm Dark grey siltstone band between 44.06m to 44.11m Trace of carbonaceous flecks and laminae			D 1.93 A 1.55			PT, 0°, PL, SO, CN PT, 0°, PL, SO, CN
			-5	45		BH210 terminated at 45m						
			-6	46								
			-7	47								
				48								

method

DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
NMLC	NMLC core
NQ, HQ, PQ	wireline core

core-lift

- casing used
- barrel withdrawn

graphic log/core recovery

- core recovered - graphic symbols indicate material
- no core recovered

water

- 10/1/98 water level on date shown
- water inflow
- partial drill fluid loss
- complete drill fluid loss
- 25 water pressure test result (lugeons) for depth interval shown

weathering

FR	fresh
SW	slightly weathered
MW	moderately weathered
HW	highly weathered
XW	extremely weathered
DW	distinctly weathered (covers MW and HW)

strength

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type

JT	joint
PT	parting
SM	seam
SZ	sheared zone
SS	sheared surface
CS	crushed seam

planarity

PL	planar
CU	curved
UN	undulating
ST	stepped
IR	irregular

roughness

VR	very rough
RO	rough
SO	smooth
SL	slickensided

coating

CN	clean
SN	stained
VN	veneer
CO	coating


coffey
geotechnics
Project: NORTH WEST METRO
Project No: GEOTLCOV23558AA
Borehole No: BH210
Date: 14 OCT 2008
Depth: 2.5 – 14.0m
GEOTLCOV23558AA BH210 START CORE@2.5m
NO CORE
NO CORE
NO CORE
NO CORE
NO CORE
NO CORE
3
4
5
6
7
8
9
10
11
12
13


coffey
geotechnics
Project: NORTH WEST METRO
Project No: GEOTLCOV23558AA
Borehole No: BH210
Date: 15 OCT 2008
Depth: 14.0 – 26.0m
NO CORE
NO CORE
NO CORE
NO CORE
14
15
16
17
18
19
20
21
22
23
24
25


coffey
geotechnics
Project: NORTH WEST METRO
Project No: GEOTLCOV23558AA
Borehole No: BH210
Date: 16 OCT 2008
Depth: 26.0-38.0m
26
27
28
29
30
31
32
33
34
35
36
37
NO CORE


coffey
geotechnics
Project: NORTH WEST METRO
Project No: GEOTLCOV23558AA
Borehole No: 210
Date: 05/11/08
Depth: 38.00m - 44.00m
38
39
40
41
42
43


coffey
geotechnics
Project: NORTH WEST METRO
Project No: GEOTLCOV23558AA
Borehole No: BH210
Date: 17/10/08
Depth: 43.00m - 45.00m
43
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