396 Lane Cove Road Macquarie Park, Geotechnical desktop study report

September 2010

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Document Path:				
Approval	**Name**	**Position**	**Signed / Approved**	**Date**
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Reviewer	Paul Hewitt	Technical Executive - Geotechnical		26/08/10
Project Manager	Reuben Lamack	Principal Engineer		26/08/10

Revision	Details	Date	Amended By
A	Issue for comments	26/08/10	P.Hewitt and R. Lamack
B	Issue	14/09/10	P.Hewitt and R. Lamack

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1. Introduction

1.1 Background

This report presents the results of a geotechnical desktop study carried out by Parsons Brinckerhoff (PB) for the proposed commercial development at 396 Lane Cove Road and 1 Giffnock Avenue, Macquarie Park. The study was commissioned by Winten Property Group & Australand under a Professional Services Agreement dated 22 July 2010.

The development is adjacent to the Epping to Chatswood Line (ECRL) along the north western site boundary on Waterloo Road. Concept drawings of the development indicate up to 15m excavation (to RL 45.2m) is anticipated along the north western (Lane Cove Road) property boundary.

The proposed development consists of four (4) multi storey buildings with 5 levels of basement excavation. The highest building proposed adjacent to the Macquarie Park Station is 17 storeys. The approximate extent of the proposed site is shown in Figure 1-1.

Figure 1-1 396 Lane Cove Road proposed site boundary

The impact of the proposed development on the ECRL infrastructure is addressed in a separate PB report entitled '396 Lane Cove Road, Macquarie Park, Preliminary geotechnical and structural impact assessment on ECRL infrastructure' dated September 2010.

The purpose of this study is to assess the subsurface conditions related to the development and to provide comments with respect to the following:

- regional geology
- site geology (stratigraphy and geological structures)
- hydrogeology
- ground stress
- geotechnical risks
- further investigations

1.2 Previous investigations

As part of the Thiess Hochtief Joint Venture, GHD/ PB previously carried out geotechnical site investigations for both the ECRL running tunnels and the Macquarie Park Station Cavern in the vicinity of the site.

Additional to this site further site investigations were carried out in the vicinity of the proposed site by other consultants:

- Coffey Geotechnics, 271 Lane Cove Road, Macquarie Park (Ref GEOTLCOV2306TAA-AN, Mirvac), Geotechnical investigation for proposed commercial development, November 2007.
- Douglas Partners, Geotechnical investigation at 394 Lane Cove Road south of Macquarie Park Station, June 2000.
- HLA- Environsciences Pty Ltd, Stage I & II Environmental Site Assessment, 396 Lane Cove Road & 1 Giffnock Avenue, Macquarie Park, NSW, June 2006.

The approximate investigation sites and borehole locations are shown in Figure 1-2

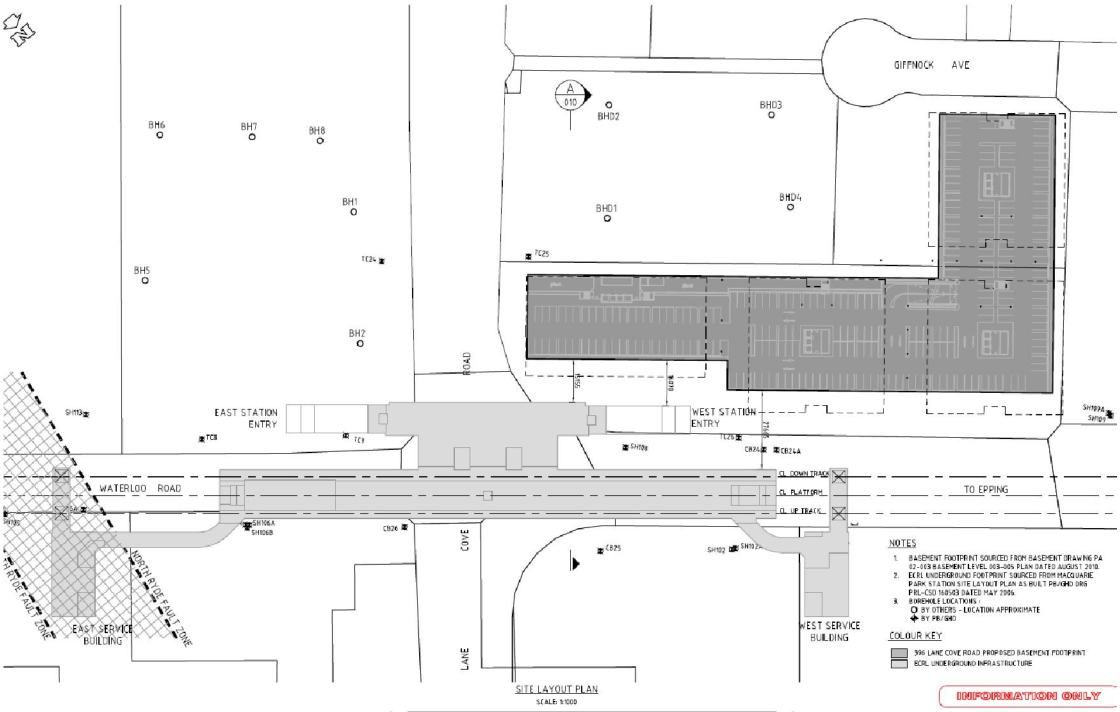


Figure 1-2 396 Lane Cove Road – Borehole locations

1.3 Available information

The following information has been made available for consideration in our assessment:

1. Winten Property Group & Australand – Architectural basement plan (ref no. PA02-001 Basement, scale 1:1000), August 2010.
2. Winten Property Group & Australand – Architectural ground plan (ref no. PA02-00 Ground plan, scale 1:1000), August 2010.
3. Winten Property Group & Australand – Typical level plan (Preferred Scheme), Section AA, Section BB, Section CC and Section DD, August 2010.
4. GHD/PB site investigation and design reports for tunnels and Macquarie Park Station on ECRL.
5. Douglas Partners - Geotechnical investigation report for proposed office building at 394 Lane Cove Road south of Macquarie Park Station dated 30 June 2000.
6. Coffey – Geotechnical investigation report for proposed commercial development at 271 Lane Cove Road, Macquarie Park dated 12 November 2007.
7. PB - Report on assessment of impact of proposed commercial development on Epping to Chatswood rail line at 271 Lane Cove Road, Macquarie Park dated 27 February 2008.
8. HLA Environsciences Pty Ltd -Stage I & II Environmental Site Assessment, 396 Lane Cove Road and 1 Giffnock Avenue Macquarie Park, NSW.

2. Regional geology

Reference to the Sydney 1:100 000 series 9130 geological sheet indicates the site is underlain by Ashfield shale within the Wianamatta Group of Triassic Age. The Ashfield shale is underlain by the Mittagong Formation, and Hawkesbury Sandstone.

The Ashfield Shale (Unit As) is characterised by dark grey to black shale and laminate, which in a weathered condition produces clays of moderate to high reactivity and medium to high plasticity. Minor fine-grained sandstone laminations are present in the shale sequence. Bedding within the Ashfield Shale is usually within a few degrees from horizontal, although some localised warping of up to 30º can occur. Jointing within the Ashfield Shale is generally not persistent over large areas.

The Mittagong Formation (Unit MF) marks the transition between the marine sequence of Ashfield Shale and the fluvial sequence of the Hawkesbury Sandstone. Mittagong Formation deposits are characterised by interbedded and interlaminated siltstone, laminite and fine to medium grained quartz sandstone. The Mittagong Formation is generally less than 10m thick, and absent in some areas. In the vicinity of Macquarie Park Station, the Mittagong Formation is approximately 4m to 5m thick. The lower boundary of the Mittagong Formation is gradational with the Hawkesbury Sandstone.

The Hawkesbury Sandstone (Unit HAW) is a medium to coarse grained quartz sandstone, with occasional fine grained beds and minor shale and laminate lenses. The Hawkesbury Sandstone comprises massive, thickly bedded and cross-bedded strata in near horizontal layers, with some siltstone layers. The major rock defects comprise sub-horizontal and curviplanar bedding planes, bedding plane seams, inclined cross bed partings and steeply dipping to sub-vertical joint sets. The dominant joints strike north-northeast (NNE) with significant horizontal continuity. The vertical continuity of these joints is generally limited with most joint terminating at bedding planes.

The North Ryde Fault Zone, approximately 150m east to the proposed development and runs north-northwest at the eastern end of the Macquarie Park Station.

No other geological structures, such as, faults, dykes were reported in the published papers.

3. Site geology

3.1 Geology/stratigraphy

Based on the investigation conducted in the adjacent sites and the geology exposed during the excavation of station caverns, the geological sequence at this site is expected to be the Ashfield Shale and Mittagong Formation, underlain by Hawkesbury Sandstone.

The subsurface material encountered include fill over residual silty clay, underlain by shale or siltstone of varying weathering degrees. Fill is generally clay, sand or gravelly sand, with varying consistency and relative density. The underlying residual soil is mainly clay, sandy/silty clay, and clayey sand. The bedrock consists of Ashfield Shale of varying strength from very low to medium strength, over Mittagong Formation of medium to high strength, grading into Hawkesbury Sandstone.

Based on studies produced by PB/GHD for Macquarie Park Station as part of the ECRL design, the following profile was identified at the approximate centre of the station:

- residual soil from approximately RL58 to 54m
- Ashfield Shale from approximately RL54 to RL46m
- interbedded/interlaminated siltstone and sandstone (Mittagong Formation) from approximately RL46 to 42m
- Hawkesbury Sandstone from below RL42m

It should be noted that the elevation of these geotechnical units varies across the length of the station caverns as the topography and underlying weathering profile is inclined gently upwards from the SE to the NW.

Six major geotechnical units (from top to bottom as shown in Figure 2) identified and characterised in the station area include:

- residual soil
- class V/IV Shale (weathered ASc)
- class III Shale (moderately weathered ASb)
- class II/I Shale (slightly weathered to fresh ASa)
- class III interbedded/interlaminated siltstone and sandstone (fresh MFa)
- class II/I Sandstone (fresh HAWa)

3.2 Geological structures

Rock mass defects in Ashfield Shale, Mittagong Formation and Hawkesbury Sandstone were documented as below:

- Bedding

Bedding in the Mittagong Formation and the Hawkesbury Sandstone is sub-horizontal, with bedding planes typically spaced at 100-300mm throughout the sandstone units within the Mittagong Formation, ranging to 1.0m or greater, in the siltstone units and in the Hawkesbury Sandstone. Hawkesbury Sandstone is also characterised by cross-beds dipping typically between 15 to 30 degrees, generally towards the north-east.

- Joints

Two main sub-vertical joint sets are identified with general north-north and east-east strikes. These joint sets are interpreted as tectonic features. Most of these main joints sets have limited vertical persistence and are typically confined to single bed thickness in the Hawkesbury Sandstone.

Other moderately dipping joint sets are presented locally in the Ashfield Shale and Mittagong Formation strata. These joints have variable dip and dip directions and are interpreted to be sedimentary origin.

- North Ryde Fault Zone

The North Ryde Fault Zone, was identified some 50m to 60m away from the eastern end of the station and approximately 150m from the proposed development. The fault zone has an approximate NNE strike and has a true width of approximately 30-35m with an expected tunnel intersection length of approximately 40m. The fault zone is interpreted to be sub-vertical with an approximate displacement of 10-15m with the Ashfield Shale and Mittagong Formation downthrown on the western side.

4. Groundwater

With reference to recent geotechnical and environmental investigation work it appears that groundwater is not present within 8-10m from the surface. However, investigation works carried prior to the construction of the ECRL station, indicate that groundwater was present between 6.4m to 7.4m from the surface.

Based on the groundwater summary table (refer Appendix B) it can be concluded that there has been a lowering of the groundwater table on completion of the ECRL station. The station has been designed as a drained structure i.e. groundwater is allowed to seep through the drainage layer behind the lining and collected within drainage systems to reduce the pressure acting on the structural lining. However this design means that the cavern station is similar to a subsurface drain and hence the pore pressures are reduced in the surrounding regions of the cavern. The magnitude of this reduction is dependent on several variables, i.e. distance from the drain source, permeability of the material, fractures and recharging potential.

Measured groundwater levels prior to construction of ECRL are likely associated with localised perched water within the overburden layers and/or discontinuities in siltstone/sandstone (Hewitt 2005 Ref 1. The basement excavation is likely to encounter Mittagong Formation, which is a unit often water-charged.

5. Ground stress

The adjacent basement excavation may cause the change and redistribution of local ground stress. It is anticipated that the excavation will cause stress relief with the surrounding ground and this relief will cause sub surface ground movements. These movements could result in the existing ECRL cavern and tunnel supports systems being subjected to stresses that could exceed design allowances of the support systems.

The ground stress relief impact is addressed in the impact assessment report (Ref 2).

6. Geotechnical risks

The likely geotechnical risks related to the proposed development may include:

- ground settlement caused by significant groundwater drawdown during excavation
- shearing movement along joints/bedding planes caused by inadequate rock shoring/earth supporting system.
- stress relief which can result in unacceptable movement along the horizontal bedding and affect the structural integrity of the adjacent ECRL infrastructure
- high ground stress or concentration of ground stress
- wedge failure due to combination of discontinuities in rock during excavation
- unexpected subsurface conditions such as localised fractured zones or weathered rock pockets with low strength and/or low stiffness.

The above geotechnical risks will be managed by a methodological approach of data gathering, analysis and monitoring to ensure that the risks are kept within acceptable limits.

A detailed site investigation will be undertaken to assess the geotechnical parameters to be used for the numerical analyses as part of the design development. A detailed monitoring plan will be developed to monitor the actual movements with the predictive movements. The monitoring plan will have different level of alerts with the appropriate response to each level detailed out. Details of preliminary predictions and numerical analyses methodology are outlined in the impact assessment report (Ref 2).

7. Conclusions and recommendations

Based on available information, the following conclusions and recommendations are made:

- The geological sequence at this site is expected to be the Ashfield Shale and Mittagong Formation, underlain by Hawkesbury Sandstone.
- No major geological structures such as dykes or faults were reported in the proposed site. The North Ryde Fault Zone, was identified some 50m to 60m away from the eastern end of the station and approximately 150m from the proposed development, is unlikely to have impact on the proposed development.
- Groundwater table at 6.4m depth was recorded in a borehole on an adjacent site prior to the construction of the Macquarie Park station. It is concluded that the groundwater table has lowered to below 8-10m post construction of the station.
- The subsurface conditions show that site is generally suitable for the proposed development, if a site specific geotechnical model and control of excavation support is in place to limit effects of displacement on the adjacent ECRL infrastructure.
- The geotechnical related risks during basement excavation up to 15m depth for the proposed development may include: ground settlement due to groundwater drawdown, shearing movement along joints/bedding planes, redistribution of ground stress and localised ground stress concentration, wedge failure due to combination of discontinuities in rock mass during excavation, and unexpected subsurface conditions such as localised fractured zones or weathered rock pockets with low strength or low stiffness.
- The geotechnical risks identified can be managed within the design and analysis process of the commercial development and the monitoring during the construction stage.
- A detailed geotechnical site investigation is recommended to assess the geotechnical parameters for numerical analysis.

8. Further investigations

The previous investigations can provide baseline information for the proposed site development. However, it will be necessary to conduct a site investigation in detailed design stage, to obtain site specific subsurface conditions, and to assist the geotechnical engineer to make recommendations on geotechnical models and parameters, foundation design, basement excavation, supporting system and provide a monitoring plan to address possible effects on the adjacent ECRL infrastructure.

9. Limitations

Reliance on data

In preparing the report, PB has relied upon data, surveys, analyses, designs, plans and other information (which may include geotechnical data collected by others) provided by the client and other individuals and organisations, most of which are referred to in the report (the data). Except as otherwise stated in the report, PB has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report (conclusions) are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. PB will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to PB.

Report for benefit of client

The report has been prepared for the benefit of the client and no other party. PB assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of PB or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

Other limitations

PB will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

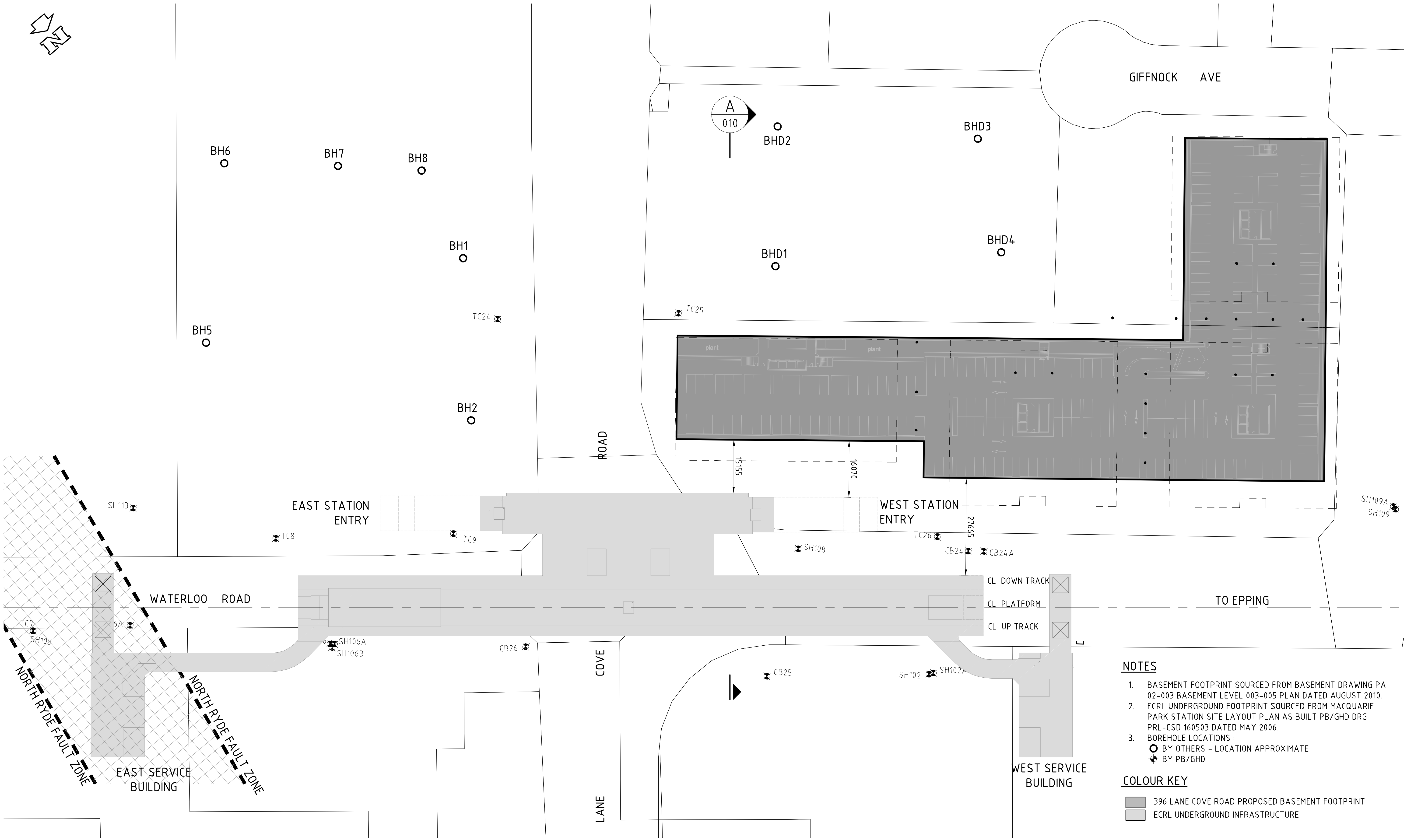
10. References

1. Hewitt P (2005), *Groundwater control for Sydney rock tunnels.*

2. PB, *396 Lane Cove Road, Macquarie Park. Preliminary geotechnical and structural impact assessment on ECRL infrastructure, September 2010.*

Appendix A

Site plan & Inferred geology section



NOTES

1. BASEMENT FOOTPRINT SOURCED FROM BASEMENT DRAWING PA 02-003 BASEMENT LEVEL 003-005 PLAN DATED AUGUST 2010.
2. ECRL UNDERGROUND FOOTPRINT SOURCED FROM MACQUARIE PARK STATION SITE LAYOUT PLAN AS BUILT PB/GHD DRG PRL-CSD 160503 DATED MAY 2006.
3. BOREHOLE LOCATIONS :
   - BY OTHERS - LOCATION APPROXIMATE
   - BY PB/GHD

COLOUR KEY

- 396 LANE COVE ROAD PROPOSED BASEMENT FOOTPRINT
- ECRL UNDERGROUND INFRASTRUCTURE

SITE LAYOUT PLAN

SCALE: 1:1000

INFORMATION ONLY

50mm AT FULL SIZE

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Full Size 1:1000 A3
SCALE (m)

A3 ORIGINAL
DO NOT SCALE THIS DRAWING - USE FIGURED DIMENSIONS ONLY
VERIFY ALL DIMENSIONS ON SITE

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PARSONS BRINCKERHOFF AUSTRALIA PTY LIMITED

SIGNED

DATE

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CLIENT
WINTEN PROPERTY GROUP
AUSTRALAND

PROJECT
396 LANE COVE ROAD MACQUARIE PARK

PROPOSED BASEMENT FOOTPRINT PLAN
SHOWING BOREHOLE LOCATIONS

PROJECT No.	DISCIPLINE	NUMBER	REV.
2108235A	GEO	001	A

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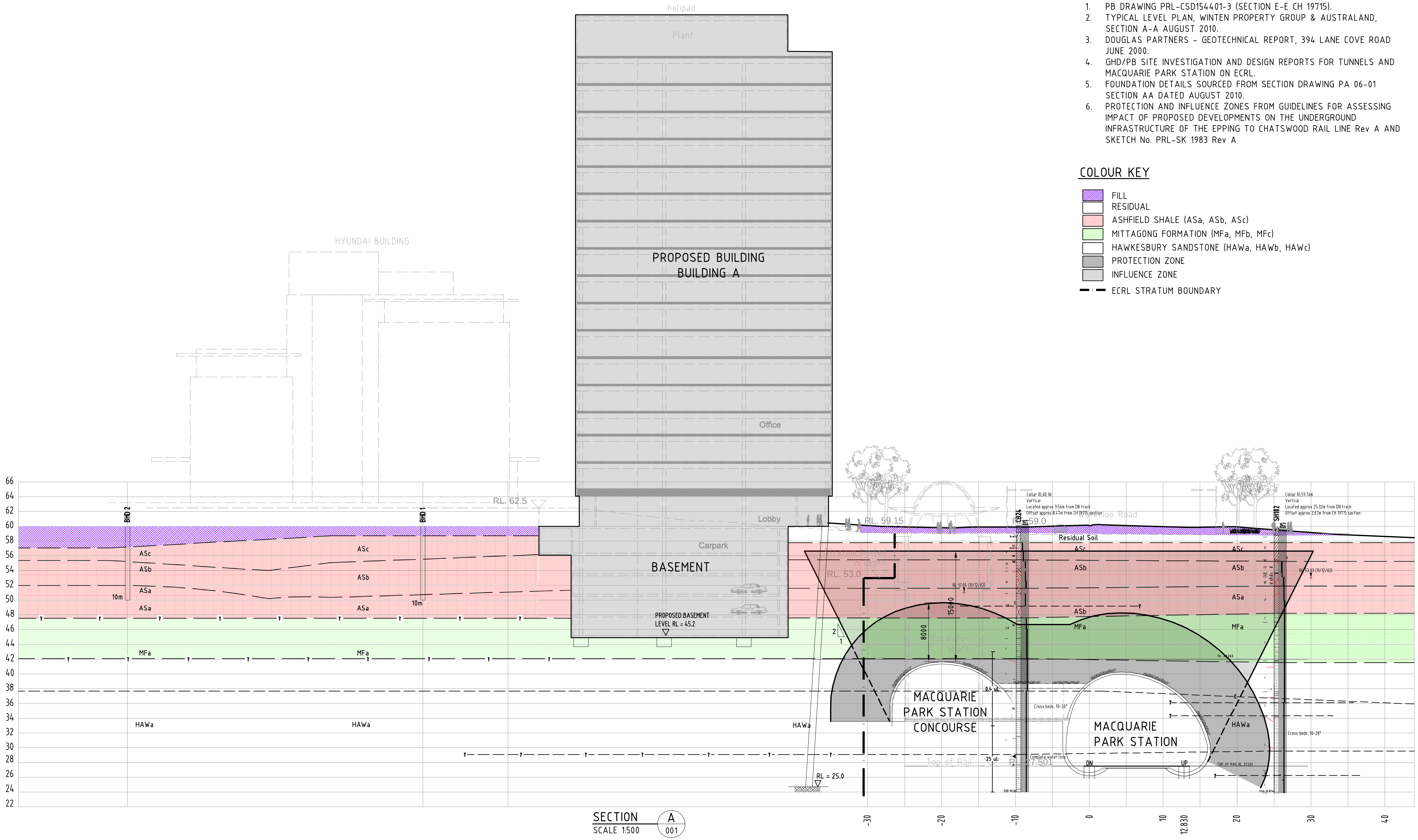
2108235A-GEO-010



SECTION A 001
SCALE 1:500

SOURCE:

1. PB DRAWING PRL-CSD154401-3 (SECTION E-E CH 19715).
2. TYPICAL LEVEL PLAN, WINTEN PROPERTY GROUP & AUSTRALAND, SECTION A-A AUGUST 2010.
3. DOUGLAS PARTNERS - GEOTECHNICAL REPORT, 394 LANE COVE ROAD JUNE 2000.
4. GHD/PB SITE INVESTIGATION AND DESIGN REPORTS FOR TUNNELS AND MACQUARIE PARK STATION ON ECRL.
5. FOUNDATION DETAILS SOURCED FROM SECTION DRAWING PA 06-01 SECTION AA DATED AUGUST 2010.
6. PROTECTION AND INFLUENCE ZONES FROM GUIDELINES FOR ASSESSING IMPACT OF PROPOSED DEVELOPMENTS ON THE UNDERGROUND INFRASTRUCTURE OF THE EPPING TO CHATSWOOD RAIL LINE Rev A AND SKETCH No. PRL-SK 1983 Rev A

COLOUR KEY

- FILL
- RESIDUAL
- ASHFIELD SHALE (ASa, ASb, ASc)
- MITTAGONG FORMATION (MFa, MFb, MFc)
- HAWKESBURY SANDSTONE (HAWa, HAWb, HAWc)
- PROTECTION ZONE
- INFLUENCE ZONE
- ECRL STRATUM BOUNDARY

INFORMATION ONLY

50mm AT FULL SIZE

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DO NOT SCALE THIS DRAWING - USE FIGURED DIMENSIONS ONLY VERIFY ALL DIMENSIONS ON SITE
APPROVED FOR AND ON BEHALF OF PARSONS BRINCKERHOFF AUSTRALIA PTY LIMITED
SIGNED
DATE

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AUSTRALAND

PROJECT
396 LANE COVE ROAD MACQUARIE PARK
GEOTECHNICAL SECTION

PROJECT No.	DISCIPLINE	NUMBER	REV.
2108235A	GEO	010	A

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Appendix B

Groundwater summary table

	Site	Date	Groundwater level m)	Final depth of borehole (m)
		Pre ECRL		
		Douglas Partners – 394 Lane Cove Road		
	BHD1	23/06/2000	N/A	10.0
	BHD2	27/06/2000	N/A	10.0
	BHD3	26/06/2000	N/A	10.0
	BHD4	26/06/2000	N/A	10.0
		GHD - Macquarie Park Station		
	SH102	06/11/2002	4.1	35.87
	SH105	14/11/2002	6.0	43.87 (60˚ angled hole)
	SH106	19/11/2002	N/A	39.12
	SH107	17/11/2002	N/A	41.58
	SH108	19/11/2002	5.2	39.1
	SH109 & SH109A	21/11/2002	N/A	17.9 & 30
	SH113	23/11/2002	7.4	40.06
		GHD – Macquarie Park Station Groundwater Monitoring		
	CB24	11/12/2002	9.07 & 3.86	-
	CB25	11/12/2002	10.72	-
	CB26A	11/12/2002	5.87	-
	TC8	11/12/2002	7.46	-
	SH102	11/12/2002	6.73	-
	SH107	11/12/2002	8.16	-
	SH108	11/12/2002	10.05	-
	SH113	11/12/2002	7.08	-
	SH106	11/12/2002	7.0	-
		Post ECRL		
		Coffey Geotechnics – 271 Lane Cove Road		
	BH1	01/11/2007	N/A	15.05
	BH2	31/10/2007	N/A	15.04
	BH5	27/09/2006	N/A	11.0
	BH6	05/10/2006	N/A	15.17
	BH7	03/10/2006	N/A	15.36
	BH8	05/10/2006	N/A	15.0
		HLA-Envirosciences Pty Limited – 396 Lane Cove Road		
	BH01/MW01	29/05/2006	N/A	2.8
	BH02	29/05/2006	N/A	1.1
	BH03	29/05/2006	N/A	0.5
	BH04	29/05/2006	N/A	3.0
	BH05	29/05/2006	N/A	1.3
	BH06	29/05/2006	N/A	1.1
	BH07	29/05/2006	N/A	0.75
	BH08	29/05/2006	N/A	3.0
	BH09	29/05/2006	N/A	1.3
	BH10	29/05/2006	N/A	0.3
	BH11/MW02	30/05/2006	N/A	5.0
	BH12	30/05/2006	N/A	1.7
	BH13	30/05/2006	N/A	0.6
	BH14/MW03	30/05/2006	N/A	4.0
	BH15	30/05/2006	N/A	1.2
	BH16/MW04	30/05/2006	N/A	3.0
	BH17	30/05/2006	N/A	1.2
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	HA02	29/05/2006	N/A	0.6
	HA03	29/05/2006	N/A	0.5
	HA04	29/05/2006	N/A	0.5
	HA05	29/05/2006	N/A	0.6