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REVISED REPORT
on
GEOTECHNICAL INVESTIGATION

PROPOSED RETAIL REDEVELOPMENT
MARRICKVILLE METRO SHOPPING CENTRE

Prepared for
BOVIS LEND LEASE

Project 71645.01
May 2010

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BOK:lll
Project 71645.01
7 May 2010

REVISED REPORT ON GEOTECHNICAL INVESTIGATION
PROPOSED RETAIL REDEVELOPMENT
MARRICKVILLE METRO SHOPPING CENTRE

1. INTRODUCTION

This report details the results of a geotechnical investigation carried out for proposed redevelopment of the Marrickville Metro Shopping Centre. The work was commissioned by Mr Derrick Burrows of Bovis Lend Lease, project managers on behalf of AMP Capital Investors Ltd (AMPCI), owners of the shopping centre.

AMPCI proposes to upgrade and expand Marrickville Metro Shopping Centre to accommodate additional retail floor space, improved facilities and services, as well as enhance convenience and accessibility for the community.

The proposal has three key elements:

- An extension of retail floor area at first floor level above the existing shopping centre building with further additional roof top parking above;
- Redevelopment of the existing industrial land south of Smidmore Street (13-55 Edinburgh Road) to create a two level retail addition to the shopping centre with car parking above.
- The closure of Smidmore Street between Edinburgh Road and Murray Street in order to create a new pedestrian plaza including a two storey retail link and car parking access.

The additional retail floor area will primarily accommodate a discount department store, supermarket, mini major and specialty retail space. The development will incorporate additional car parking as well as improved vehicle access and loading facilities.

The proposal will create a new urban plaza in Smidmore Street and will be complimentary to an enhanced public space fronting Victoria Road. The proposal will include works to the public domain in order to improve the pedestrian, cycling and public transport connections to and from the site and enhance pedestrian and patron safety.

Geotechnical investigation was carried out to provide information on the subsurface conditions and groundwater levels for planning of site works and the design of foundations and retaining structures.

The geotechnical investigation was carried out in conjunction with contamination assessment of the site which is reported separately in Project Report Number 71645.00.

2. SITE DESCRIPTION AND REGIONAL GEOLOGY

Marrickville Metro Shopping Centre is located at 34 Victoria Road, Marrickville. The existing shopping centre fronts Victoria Road to the north, Murray Street to the east and Smidmore Street to the south and is adjoined by single storey residential dwellings to the west. The shopping centre is predominantly a single level retail building and comprises major tenants being Kmart, Woolworths and Aldi as well as a range of speciality stores. Car parking is located at roof top level with existing vehicle ramp access via Smidmore Street and Murray Street.

The land at 13-55 Edinburgh Road is located to the south of Smidmore Street and is bounded by Edinburgh Road and Murray Street. This site is currently used as a warehouse with associated ground level car parking.

The shopping centre is located within an established residential and industrial precinct surrounded by small lot residential housing to the north and west, and predominantly industrial land comprising larger allotments and larger building scales to the south and east.

Figure 1 – Location Plan

AMP Capital Investors (AMPCI) owns Marrickville Metro Shopping Centre and the land to the immediate south at 13-55 Edinburgh Road, Marrickville.

The local topography slopes very gently to the south, and it appears that current site levels may have been achieved by minor filling across the southern end of the site. A stormwater culvert running generally north-south, probably following an old creek line, bisecting both the shopping centre and the industrial site.

The Soil Landscape Map of Sydney (Scale 1:100,000) prepared by the Soil Conservation Service of NSW, an extract of which is shown in Drawing 1, indicates that the shopping centre and industrial site are located mainly within the Blacktown landscape area which typically consists of highly plastic and relatively impermeable residual soils. The map also suggests that the central portion of the site may be underlain by deep podzolic alluvial soils.

The Geological Map of Sydney (Scale 1:100,000) published by the Department of Mineral Resources indicates the residual soils of the site are underlain by the Ashfield Shale Formation of Triassic Age from the Wianamatta Group, generally comprising black to dark grey shale and laminite. The south-western corner of the shopping centre site and southern half of the industrial site are both shown to be underlain by Quarternary Age alluvial and estuarine sediments.

3. FIELD WORK METHODS

The field work comprised nine bores (BH1 – BH9) drilled with a combination of track and truck mounted rotary drilling and soil sampling rigs. The bores were initially advanced using spiral flight augers and rotary methods in the soils and highly weathered rock. Five of the nine bores were cased and drilling continued in the less weathered rock using NMLC diamond coring equipment to recover 50 mm diameter samples of the bedrock strata.

Whilst drilling in the near surface soils, Standard penetration tests were conducted at regular depth intervals to provide information on the engineering properties of the strata and to obtain partially disturbed samples to assist in the soil classification. The bores were drilled to total depths ranging from 9.4 – 14.8 m.

The locations of these 9 test bores are given on Drawing 2, in Appendix A. The surface level for Bores 4, 6 and 7 were measured using optical survey equipment relative to a local benchmark. The surface levels for the remaining bores were interpolated from a survey drawing by William L Backhouse Pty Ltd (Reference CH4331.001 and CH4331.001).

On completion of the drilling, 50 mm diameter slotted PVC casing was installed in Bores 4, 6 and 7 and the bottom few metres of each hole backfilled with gravel to facilitate ongoing measurement of groundwater levels.

4. FIELD WORK RESULTS

Details of subsurface conditions encountered in the nine bores drilled during the investigation are given on the borehole logs in Appendix B. Appendix B also contains photographs of the core and standard notes defining the terms used to classify the strata.

The bores encountered filling and soil over a deeply weathered rock sequence. Filling and stiff to very stiff clay were initially encountered overlying hard shaly clay, extremely low and very low strength siltstone, low to medium strength laminite and then medium strength laminite. The levels of and depths to the interfaces between the different strata varied. For example, medium strength shale was encountered at RL -4.25 m in BH1 and RL -6.79 m in BH7. Similarly, the level of the surface of extremely low and very low strength shale varied from RL 2.49 m down to RL -6.09 m. The depth of weathering over the site is quite variable, generally increasing with proximity to the line of the culvert which was along a former creek line. The profiles intersected by some of the bores are shown diagrammatically on the cross-section in Drawing 3 in Appendix A.

The results of the test bores with major strata boundaries are summarised in Table 1 below, together with groundwater levels observed on 31 March 2010.

Table 1 – Summary of Previous Borehole Results

Strata Description	Level of Base of Strata (AHD)								
SL	BH 1 8.4	BH 2 6.4	BH 3 5.6	BH 4 5.6	BH 5 5.2	BH 6 4.46	BH 7 4.91	BH8 4.8	BH 9 4.5
Filling and stiff clay	6.4	3.8	1.2	3.2	3.4	2.5	2.1	1.8	1.7
Very stiff clay	3.4	-0.7	-1.5	-0.3	-1.5	-2.0	-4.1	-0.2	-0.5
Hard shaly clay	2.49	-3.5	-3.2	-3.1	-4.9	-4.0	-6.1	-4.5	-2.7
Extremely low or very low strength siltstone	-2.8	-3.7	-5.9				-6.3		-3.5
Very low to low strength laminite	-4.3	-4.6	-6.4				-6.8		-5.9
Medium / medium to high strength laminite Bore Discontinued	-6.1	-7.75	-9.2	-5.4	-5	-5.5	-9.6	-4.6	-7.5
Water Level on 30/3/10				2.6		2.1	1.7		

SL = Surface level (AHD)

On the basis of the results, there appears to be a groundwater gradient in a south westerly direction, although the levels have been observed only once and there are only three locations at which groundwater has been recorded for such a large site.

5. LABORATORY RESULTS

Classification tests comprising Atterberg limits and linear shrinkage tests were carried out on two soil samples from the industrial site. The detailed results are provided in Appendix C and summarised in Table 2. The clays are considered to be of high plasticity with a likely high susceptibility to shrinkage and swelling movements due to changes in soil moisture content.

Table 2 – Results of Plasticity and Moisture Testing

Test Bore	Depth (m)	Material	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)
8	2.7	CLAY – grey + red brown	22.5	62	18	44	19
9	1.2	CLAY – grey + red brown	14.3	44	17	27	14.5

6. PROPOSED DEVELOPMENT

Owing to the scale of the project and the need to undertake the development whilst maintaining a safe and functional retail centre, it is proposed that construction will occur over at least two discrete stages.

Stage 1 will involve the redevelopment of the industrial site at 13-55 Edinburgh Road to accommodate the new two level retail centre including car parking above. This work will also incorporate the creation of the pedestrian plaza and retail extension across Smidmore Street linking the two retail buildings and the refurbishment of the existing shopping centre building fronting the northern side of Smidmore Street.

Stage 2 will involve the first floor level retail extension over the existing shopping centre building with the proposed additional car parking at roof top level.

Preliminary information is available on the estimated design loads on the existing shopping centre pad footings from a letter report dated 10 December 2009 by DW Knox and Partners for the existing shopping centre. The report estimates existing column loads to be in the order of 900 kN to 1600 kN, with additional loading of 850 kN to 1750 kN expected depending on the option chosen for the redevelopment of the existing centre.

The estimated column loads for the new building on the industrial site are between 4500 kN and 5000 kN. Two retail levels and two carparking levels are proposed with the new building constructed predominantly from ground level with excavation mainly for lift pits and footings.

7. COMMENTS

7.1 Soil / Rock Lithology

The investigation indicates that the site is underlain by filling, stiff to very stiff clay and hard shaly clay to depths of about 6 – 10 m below existing site level overlying extremely low and very low strength shale extending to depths of about 10 – 12 m. Below this depth the five cored bores generally encountered medium strength laminite to bore termination at depths of 12 – 14.8 m.

Groundwater levels was observed at depths of 2.4 – 3.2 m (RL 1.71 – 2.60) on 31 March 2010. Groundwater levels fluctuate according to the recent weather conditions, particularly, on sites which are exposed to infiltration from heavy precipitation hence it is therefore expected that the regional groundwater levels would fluctuate.

7.2 Site Preparation

Following demolition of the existing structures, breaking out of existing concrete pavement surface layers and removal of the demolition debris, the site for the new building should be cleared of all trees, stumps and other materials unsuitable for incorporation in the proposed new works. All vegetation and associated silty or organic topsoil within the site should be stripped and either removed off-site or else temporarily stockpiled on-site for potential re-use in landscaping works.

In carrying out any minor excavations required such as for lift pits, it is anticipated that the majority of the material to be removed would comprise filling then stiff to very stiff clays. All of these materials should be readily excavated using conventional earthmoving equipment.

7.3 Excavation Support

It is understood that no major excavation works are proposed; however there may be minor excavations for lift pits at the current industrial site and footing excavations. Some form of excavation support may be necessary in these areas where batters are not feasible.

In areas away from existing structures or roadways it may be feasible to temporarily batter the slopes until retaining walls can be constructed. The maximum temporary and permanent batter slopes for the sub-surface materials present at the site are given in Table 3.

Table 6 – Maximum Recommended Batter Slope Ratios

Material	Temporary Batter Slope Ratio (H:V)	Permanent Batter Slope Ratio (H:V)
Filling	1.5:1	2:1
Stiff to very stiff clays	1.5:1	2:1

All batters should be subject to geotechnical inspection for every 1.5 m of vertical excavation to confirm the adequacy of the slopes indicated above.

Where there is insufficient space for batters, some form of shoring or retention will be required. These are likely to be less than 3 m high and could be constructed using either cantilevered bored piers or shoring systems or boxes. For design of retaining walls, it is suggested that lateral earth pressures be calculated using a bulk unit weight of 20 kN/m^3 and an earth pressure coefficient of 0.40, assuming level backfill and no surcharge loads. Separate account should be taken of water pressures unless adequate provisions are made for drainage of seepage water from behind walls and the base of the excavation.

7.4 Foundations

7.4.1 Shallow Footings

Shallow footings are likely to be unsuitable to support the design loads of around 4500 kN, for the new building as they will be subject to excessive settlements. Bored piles are recommended.

It is understood that the existing shopping centre is founded on pad footings supporting design loads of 900 kN to 1600 kN. Additional loads of 850 kN to 1700 kN are expected from redevelopment. The estimated maximum allowable bearing pressure for footings bearing on the very stiff to hard clays is 200 kPa.

Increasing loads on existing footings is not recommended without detailed assessment of the size and founding conditions of each existing footing. Options to support the additional loads include increasing the sizes of existing spread footings or providing new footings. There needs to be careful consideration of the likely effects of differential and additional settlements resulting from the increased loadings and new footings on finishes and features of the existing shopping centres. Existing footings which will not receive additional loads will be subject to only minimum additional settlement whereas new footings under new loads will settle resulting in greater differential settlements between the old and the new than occurred when the whole building was initially constructed.

7.4.2 Bored Piles

Bored piles founded on the low to medium strength laminite encountered in Bores 1, 2, 3, 7 and 9 below respective levels of -4.25, -4.6, -6.35, -6.79 and -5.9 are considered the most appropriate foundation for the new building. A maximum allowable end bearing pressure of 2500 kPa is recommended in this material with a socket adhesion of 250 kPa.

No socket adhesion is considered appropriate in the filling and very stiff clay soils, however an average of 100 kPa is suggested in hard shaly clay and extremely low to low strength shale/siltstone.

Preliminary calculations indicate a 1.5 m diameter bored pile with 1.3 m socket can support design loads of around 5000 kN.

Groundwater was observed in some bores around RL 2. The bored piles will be relatively large and founded generally below 12 m depth hence seepage into bored pile excavations must be expected. Provision should be made for temporary casing that may be required to stabilise the hole, together with cleaning buckets and pumps. It is recommended that all piles be inspected to ensure founding conditions meet design requirements. Piles should be concreted as soon as possible after drilling, cleaning and inspection to reduce the potential for water softening and side wall collapse.

Continuous flight auger (CFA) piles are an alternative to bored piles that could be considered and are suitable for installation where groundwater inflows are a problem. As CFA piling is a 'blind' construction method monitoring of auger performance and correlation with adjacent bore holes should be carried out to establish and check that piles are founded at or below design levels on siltstone of at least low to medium strength.

7.5 Seismic Site Factor

Based on the sub-surface conditions encountered at the test locations, the site has been assessed in accordance with Section 4 of AS 1170.4 – 2007 (Structural Design Actions: Part 4 - Earthquake Actions in Australia) and has been assessed as site sub-soil Class C_e (shallow soil site).

8. LIMITATIONS

Douglas Partners (DP) has prepared this report for this project at Marrickville Metro Shopping Centre in accordance with DP's proposal dated 19 February 2010 and acceptance received from Mr Derrick Burrows dated 25 February 2010. This report is provided for the exclusive use of the Bovis Lend Lease and AMP Capital Investors Limited for the specific project and purpose as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party.

The results provided in the report are considered to be indicative of the sub-surface conditions on the site only to the depths investigated at the specific sampling and/or testing locations, and only at the time the work was carried out. DP's advice may be based on observations, measurements, tests or derived interpretations. The accuracy of the advice provided by DP in this report is limited by unobserved features and variations in ground conditions across the site in areas between test locations and beyond the site boundaries or by variations with time. The advice may be limited by restrictions in the sampling and testing which was able to be carried out, as well as by the amount of data that could be collected given the project and site constraints. Actual ground conditions and materials behaviour observed or inferred at the test locations may differ from those which may be encountered elsewhere on the site. Should variations in subsurface conditions be encountered, then additional advice should be sought from DP and, if required, amendments made.

This report must be read in conjunction with the attached "Notes Relating to This Report" and any other attached explanatory notes and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions from review by others of this report or test data, which are not otherwise supported by an expressed statement, interpretation, outcome or conclusion stated in this report. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

DOUGLAS PARTNERS PTY LTD

Brendan O'Kane
Geotechnical Engineer

Reviewed by

Dr Terry Wiesner
Principal

APPENDIX A
Drawings 1 to 3

LEGEND

123 = Previous DP Project No. 123

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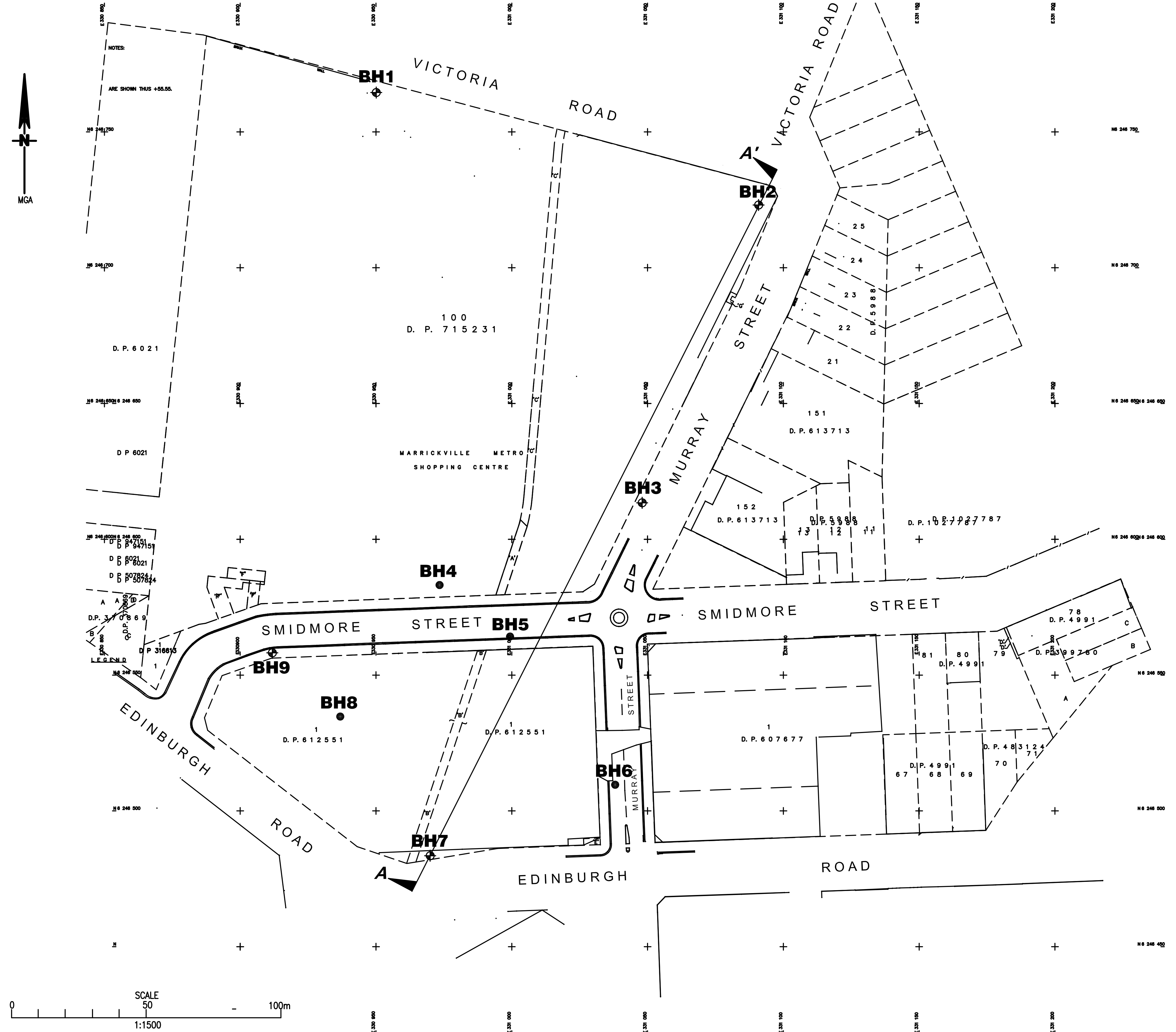
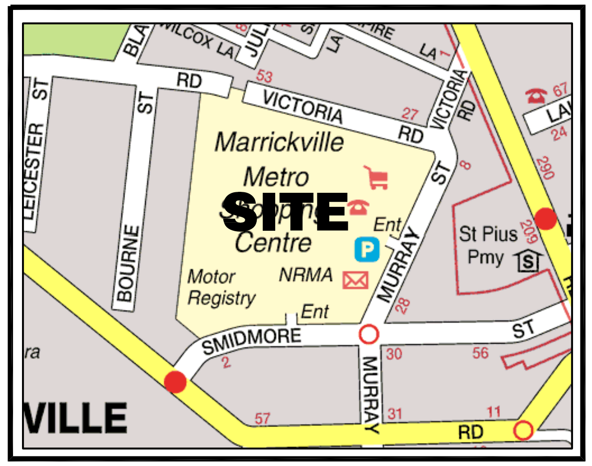
Sydney, Newcastle, Brisbane, Wollongong, Campbelltown
Melbourne, Perth, Wyong, Townsville, Cairns, Darwin

Title **Marrickville Metro Shopping Centre**
Proposed Alterations and Additions
Extract from Geological Map

Client: Bovis Lend Lease			**Office: Sydney**
Drawn by: BOK	**Scale: NTS**	**Project Number: 71645.01**	**Drawing No. 1**
Approved by:		**Date: 24 March 2010**	





LOCALITY PLAN

LEGEND

- CORED BORE
- AUGERED BORE

CLIENT: Bovis Lend Lease			
DRAWN BY: PSCH	SCALE: 1:1500@A3	OFFICE: Sydney	
APPROVED BY:		DATE: 1.4.2010	

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TITLE: **Location of Test Bores**
Proposed Retail Redevelopment
Marrickville Metro Shopping Centre, MARRICKVILLE

PROJECT No: 71645.01
DRAWING No: 2
REVISION: A

A

A'

EXISTING INDUSTRIAL BLOCK

SMIDMORE STREET

EXISTING SHOPPING CENTRE

EDINGURGH ROAD

BH7 Offset - 2.7m

BH5 Offset - 0.4m

BH4 Offset - 33.2m

BH3 Offset - 12.9m

BH2 Offset 4.3m

FILLING

STIFF CLAY

VERY STIFF CLAY

HARD SHALY CLAY

VERY LOW & LOW STRENGTH SILTSTONE

MEDIUM STRENGTH LAMINITE

ELEVATION (AHD)

DISTANCE ALONG PROFILE (m)

Bottom Depth 14.5 m

Bottom Depth 10.2 m

Bottom Depth 11 m

Bottom Depth 14.8 m

Bottom Depth 14.15 m

LEGEND

Concrete
Filling
Silty Clay
Clay
Shaly Clay
Laminite
Siltstone
Bituminous Concrete
Shale

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High

SOIL CONSISTENCY
vs - very soft
s - soft
f - firm
st - stiff
vst - very stiff
h - hard
vl - very loose
l - loose
md - medium dense
d - dense
vd - very dense

TESTS / OTHER
N - Standard penetration test value
- Water level

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CLIENT: Bovis Lend Lease		TITLE: **CROSS SECTION A-A'**	PROJECT No: 71645.01
DRAWN BY: LD	SCALE: 1: 1000 (H)	OFFICE: Sydney	**Proposed Retail Development**	DRAWING No: 3
APPROVED BY:		DATE: 01.04.2010	**Marrickville Metro, Marrickville**	REVISION: 0

APPENDIX B
Notes Relating to this Report
Results of Field Work
Core Photographs

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NOTES RELATING TO THIS REPORT

Introduction

These notes have been provided to amplify the geotechnical report in regard to classification methods, specialist field procedures and certain matters relating to the Discussion and Comments section. Not all, of course, are necessarily relevant to all reports.

Geotechnical reports are based on information gained from limited subsurface test boring and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, Geotechnical Site Investigations Code. In general, descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions.

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (eg. sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	less than 0.002 mm
Silt	0.002 to 0.06 mm
Sand	0.06 to 2.00 mm
Gravel	2.00 to 60.00 mm

Cohesive soils are classified on the basis of strength either by laboratory testing or engineering examination. The strength terms are defined as follows.

Classification	Undrained Shear Strength kPa
Very soft	less than 12
Soft	12—25
Firm	25—50
Stiff	50—100
Very stiff	100—200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer tests (CPT) as below:

Relative Density	SPT "N" Value (blows/300 mm)	CPT Cone Value (q_c — MPa)
Very loose	less than 5	less than 2
Loose	5—10	2—5
Medium dense	10—30	5—15
Dense	30—50	15—25
Very dense	greater than 50	greater than 25

Rock types are classified by their geological names. Where relevant, further information regarding rock classification is given on the following sheet.

Sampling

Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing with a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling are given in the report.

Drilling Methods.

The following is a brief summary of drilling methods currently adopted by the Company and some comments on their use and application.

Test Pits — these are excavated with a backhoe or a tracked excavator, allowing close examination of the in-situ soils if it is safe to descent into the pit. The depth of penetration is limited to about 3 m for a backhoe and up to 6 m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Large Diameter Auger (eg. Pengo) — the hole is advanced by a rotating plate or short spiral auger, generally 300 mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube sampling.

Continuous Sample Drilling — the hole is advanced by pushing a 100 mm diameter socket into the ground and withdrawing it at intervals to extrude the sample. This is the most reliable method of drilling in soils, since moisture content is unchanged and soil structure, strength, etc. is only marginally affected.

Continuous Spiral Flight Augers — the hole is advanced using 90—115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow

sampling or in-situ testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability, due to remoulding, contamination or softening of samples by ground water.

Non-core Rotary Drilling — the hole is advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from 'feel' and rate of penetration.

Rotary Mud Drilling — similar to rotary drilling, but using drilling mud as a circulating fluid. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg. from SPT).

Continuous Core Drilling — a continuous core sample is obtained using a diamond-tipped core barrel, usually 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in very weak rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation.

Standard Penetration Tests

Standard penetration tests (abbreviated as SPT) are used mainly in non-cohesive soils, but occasionally also in cohesive soils as a means of determining density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" — Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of say 4, 6 and 7

  as 4, 6, 7
  N = 13

- In the case where the test is discontinued short of full penetration, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm

  as 15, 30/40 mm.

The results of the tests can be related empirically to the engineering properties of the soil.

Occasionally, the test method is used to obtain samples in 50 mm diameter thin walled sample tubes in clays. In such circumstances, the test results are shown on the borelogs in brackets.

Cone Penetrometer Testing and Interpretation

Cone penetrometer testing (sometimes referred to as Dutch cone — abbreviated as CPT) described in this report has been carried out using an electrical friction cone penetrometer. The test is described in Australian Standard 1289, Test 6.4.1.

In the tests, a 35 mm diameter rod with a cone-tipped end is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separate 130 mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are connected by electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20 mm per second) the information is plotted on a computer screen and at the end of the test is stored on the computer for later plotting of the results.

The information provided on the plotted results comprises: —

- Cone resistance — the actual end bearing force divided by the cross sectional area of the cone — expressed in MPa.
- Sleeve friction — the frictional force on the sleeve divided by the surface area — expressed in kPa.
- Friction ratio — the ratio of sleeve friction to cone resistance, expressed in percent.

There are two scales available for measurement of cone resistance. The lower scale (0—5 MPa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main scale (0—50 MPa) is less sensitive and is shown as a full line.

The ratios of the sleeve friction to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1%—2% are commonly encountered in sands and very soft clays rising to 4%—10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range:—

q_c (MPa) = (0.4 to 0.6) N (blows per 300 mm)

In clays, the relationship between undrained shear strength and cone resistance is commonly in the range:—

q_c = (12 to 18) c_u

Interpretation of CPT values can also be made to allow estimation of modulus or compressibility values to allow calculation of foundation settlements.

Inferred stratification as shown on the attached reports is assessed from the cone and friction traces and from experience and information from nearby boreholes, etc. This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties, and where precise information on

soil classification is required, direct drilling and sampling may be preferable.

Hand Penetrometers

Hand penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 150 mm increments of penetration. Normally, there is a depth limitation of 1.2 m but this may be extended in certain conditions by the use of extension rods.

Two relatively similar tests are used.

- Perth sand penetrometer — a 16 mm diameter flat-ended rod is driven with a 9 kg hammer, dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.
- Cone penetrometer (sometimes known as the Scala Penetrometer) — a 16 mm rod with a 20 mm diameter cone end is driven with a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). The test was developed initially for pavement subgrade investigations, and published correlations of the test results with California bearing ratio have been published by various Road Authorities.

Laboratory Testing

Laboratory testing is carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedure used are given on the individual report forms.

Bore Logs

The bore logs presented herein are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable, or possible to justify on economic grounds. In any case, the boreholes represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes, the frequency of sampling and the possibility of other than 'straight line' variations between the boreholes.

Ground Water

Where ground water levels are measured in boreholes, there are several potential problems;

- In low permeability soils, ground water although present, may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water observations are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Engineering Reports

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. a three storey building), the information and interpretation may not be relevant if the design proposal is changed (eg. to a twenty storey building). If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface condition, discussion of geotechnical aspects and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- unexpected variations in ground conditions — the potential for this will depend partly on bore spacing and sampling frequency
- changes in policy or interpretation of policy by statutory authorities
- the actions of contractors responding to commercial pressures.

If these occur, the Company will be pleased to assist with investigation or advice to resolve the matter.

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

Reproduction of Information for Contractual Purposes

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers,

Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

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DESCRIPTION AND CLASSIFICATION OF ROCKS FOR ENGINEERING PURPOSES

DEGREE OF WEATHERING

Term	Symbol	Definition
Extremely Weathered	EW	Rock substance affected by weathering to the extent that the rock exhibits soil properties - i.e. it can be remoulded and can be classified according to the Unified Classification System, but the texture of the original rock is still evident.
Highly Weathered	HW	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and other signs of chemical or physical decomposition are evident. Porosity and strength may be increased or decreased compared to the fresh rock usually as a result of iron leaching or deposition. The colour and strength of the original fresh rock substance is no longer recognisable.
Moderately Weathered	MW	Rock substance affected by weathering to the extent that staining or discolouration of the rock substance usually by limonite has taken place. The colour of the fresh rock is no longer recognisable.
Slightly Weathered	SW	Rock substance affected by weathering to the extent that partial staining or discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is recognisable.
Fresh Stained	Fs	Rock substance unaffected by weathering, but showing limonite staining along joints.
Fresh	Fr	Rock substance unaffected by weathering.

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index ($I_{S(50)}$) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by Australian Standard 4133.4.1 - 1993.

Term	Symbol	Field Guide*	Point Load Index $I_{S(50)}$ MPa	Approx Unconfined Compressive Strength q_u ** MPa
Extremely low	EL	Easily remoulded by hand to a material with soil properties	<0.03	< 0.6
Very low	VL	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; too hard to cut a triaxial sample by hand. SPT will refuse. Pieces up to 3 cm thick can be broken by finger pressure.	0.03-0.1	0.6-2
Low	L	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150 mm long 40 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.	0.1-0.3	2-6
Medium	M	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.	0.3-1.0	6-20
High	H	Can be slightly scratched with a knife. A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken with pick with a single firm blow, rock rings under hammer.	1 - 3	20-60
Very high	VH	Cannot be scratched with a knife. Hand specimen breaks with pick after more than one blow, rock rings under hammer.	3 - 10	60-200
Extremely high	EH	Specimen requires many blows with geological pick to break through intact material, rock rings under hammer.	>10	> 200

Note that these terms refer to strength of rock material and not to the strength of the rock mass, which may be considerably weaker due to rock defects.

* The field guide assessment of rock strength may be used for preliminary assessment or when point load testing is not able to be done.

** The approximate unconfined compressive strength (q_u) shown in the table is based on an assumed ratio to the point load index of 20:1. This ratio may vary widely.

STRATIFICATION SPACING

Term	Separation of Stratification Planes
Thinly laminated	<6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	>2 m

DEGREE OF FRACTURING

This classification applies to diamond drill cores and refers to the spacing of all types of natural fractures along which the core is discontinuous. These include bedding plane partings, joints and other rock defects, but exclude known artificial fractures such as drilling breaks. The orientation of rock defects is measured as an angle relative to a plane perpendicular to the core axis. Note that where possible, recordings of the actual defect spacing or range of spacings is preferred to the general terms given below.

Term	Description
Fragmented	The core consists mainly of fragments with dimensions less than 20 mm.
Highly Fractured	Core lengths are generally less than 20 mm - 40 mm with occasional fragments.
Fractured	Core lengths are mainly 40 mm - 200 mm with occasional shorter and longer sections.
Slightly Fractured	Core lengths are generally 200 mm - 1000 mm with occasional shorter and longer sections.
Unbroken	The core does not contain any fracture.

ROCK QUALITY DESIGNATION (RQD)

This is defined as the ratio of sound (i.e. low strength or better) core in lengths of greater than 100 mm to the total length of the core, expressed in percent. If the core is broken by handling or by the drilling process (i.e. the fracture surfaces are fresh, irregular breaks rather than joint surfaces) the fresh broken pieces are fitted together and counted as one piece.

SEDIMENTARY ROCK TYPES

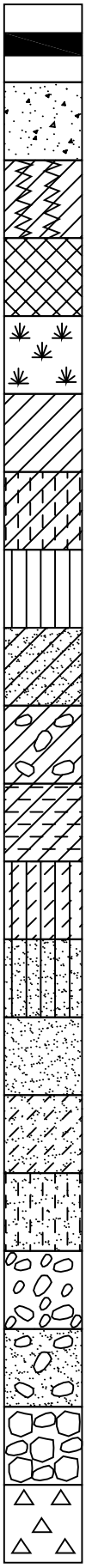
This classification system provides a standardised terminology for the engineering description of sandstone and shales, particularly in the Sydney area, but the terms and definitions may be used elsewhere when applicable.

Rock Type	Definition
Conglomerate	More than 50% of the rock consists of gravel-sized (greater than 2 mm) fragments
Sandstone:	More than 50% of the rock consists of sand-sized (0.06 to 2 mm) grains
Siltstone:	More than 50% of the rock consists of silt-sized (less than 0.06 mm) granular particles and the rock is not laminated.
Claystone:	More than 50% of the rock consists of clay or sericitic material and the rock is not laminated.
Shale:	More than 50% of the rock consists of silt or clay-sized particles and the rock is laminated.

Rocks possessing characteristics of two groups are described by their predominant particle size with reference also to the minor constituents, eg. clayey sandstone, sandy shale.

GRAPHIC SYMBOLS FOR SOIL & ROCK

SOIL



BITUMINOUS CONCRETE

CONCRETE

TOPSOIL

FILLING

PEAT

CLAY

SILTY CLAY

SILT

SANDY CLAY

GRAVELLY CLAY

SHALY CLAY

CLAYEY SILT

SANDY SILT

SAND

CLAYEY SAND

SILTY SAND

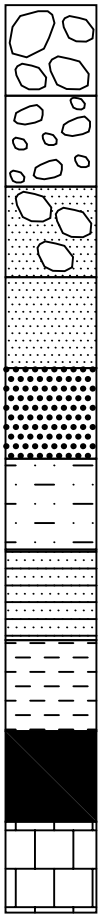
GRAVEL

SANDY GRAVEL

COBBLES/BOULDER

TALUS

SEDIMENTARY ROCK



BOULDER CONGLOMERATE

CONGLOMERATE

CONGLOMERATIC SANDSTONE

SANDSTONE FINE GRAINED

SANDSTONE COARSE GRAINED

SILTSTONE

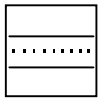
LAMINITE

MUDSTONE, CLAYSTONE, SHALE

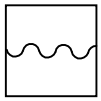
COAL

LIMESTONE

SEAMS

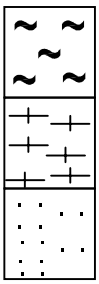


SEAM >10mm



SEAM <10mm

METAMORPHIC ROCK

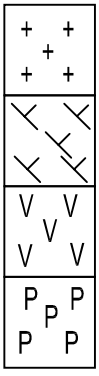


SLATE, PHYLLITE, SCHIST

GNEISS

QUARTZITE

IGNEOUS ROCK



GRANITE

DOLERITE, BASALT

TUFF

PORPHYRY

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BOREHOLE LOG

CLIENT: Bovis Lend Lease
PROJECT: Stage 2 Contamination Assessment
LOCATION: Marrickville Metro, Marrickville

SURFACE LEVEL: 8.4 m AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH1
PROJECT No: 71645
DATE: 12 Mar 10
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
8	0.1	FILLING - brown, sandy silt with some woodchips, rootlets filling							A/E*			PID=3.7ppm
		FILLING - grey brown silt with some fine to medium grained sand and fine grained gravel filling							A/E			PID=2.3ppm
	0.6	SILTY CLAY - dark grey to brown, silty clay, moist (possible filling)										pp = 360kPa
7	1.0	CLAY - stiff, mottled red brown and grey clay with a trace of ironstone gravel, moist							A/E			PID=2.6ppm
									S			2,5,4 N = 9
6	2.0	CLAY - very stiff, mottled red and light grey clay, moist							A/E			PID=2.0ppm
									S			3,7,11 N = 18
5									A/E			PID=2.1ppm
4	3.8	CLAY - very stiff to hard, red brown and light grey clay with ironstone bands, damp							E			PID=2.2ppm
									S			4,15,25/130mm refusal
3	5.0	SHALY CLAY - hard, light grey, shaly clay, damp							S			10,18,25/110mm refusal
2	5.91	SILTSTONE - extremely low then very low strength, dark grey siltstone						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10° and joints	S			25/100mm refusal
1	7.1	SILTSTONE/LAMINITE - extremely low then extremely low to very low strength, extremely to highly weathered, grey siltstone/laminite. Some low strength bands							C	100	0	pp = 310kPa
0	8								C	100	0	pp = 370kPa
-1	9	9.6-10.72m: some fine grained sandstone laminations							C	100	0	

RIG: Bobcat **DRILLER:** SS **LOGGED:** CF/SI **CASING:** HW to 4.0m

TYPE OF BORING: Solid flight auger to 4.0m; Rotary to 7.1m; NMLC-Coring to 14.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *Denotes field replicate sample BD1/12032010 collected. E = Environmental sample

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Bovis Lend Lease
PROJECT: Stage 2 Contamination Assessment
LOCATION: Marrickville Metro, Marrickville

SURFACE LEVEL: 8.4 m AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH1
PROJECT No: 71645
DATE: 12 Mar 10
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Type	Core Rec. %	RQD %	Test Results & Comments
		SILTSTONE/LAMINITE - see previous page	EW HW MW SW FS FR		Ex Low Very Low Low Medium High Very High Ex High		0.01 0.05 0.10 0.50 1.00		C	100	0	pp = 390kPa
-2	10.72							10.72m: CORE LOSS: 480mm	C	52	0	
	11											
	11.2	LAMINITE - very low to low strength, highly weathered, fragmented, light grey to grey laminite with approximately 30% fine grained sandstone laminations						11.2-13.0m: very low to low strength, rock fragmented into 0.01mm intervals	C	100	0	
-3	12											
-4	12.65	LAMINITE - medium strength, slightly weathered, fragmented to fractured, light grey to grey laminite with approximately 30% fine grained sandstone laminations. Very low to low strength bands from 13.33-13.48m										PL(A) = 0.8MPa
	13							13.08m: J20°, rough				
-5	13.5	LAMINITE - medium to high strength, fresh, slightly fractured, light grey to grey laminite with approximately 20% fine grained sandstone laminations						13.08-13.21m: fragmented into 0.01mm intervals 13.21m: J30°, smooth 13.21-13.33m: fragmented in to 0.02mm intervals 13.6m: J35°, rough 13.85m: J65°, ironstained & crushed rock fragments 14.3m: J40°, undulating, rough	C	100	67	PL(A) = 0.9MPa
	14											
-6	14.5	Bore discontinued at 14.5m										PL(A) = 1.5MPa
	15											
-7												
	16											
-8												
	17											
-9												
	18											
-10												
	19											
-11												

RIG: Bobcat **DRILLER:** SS **LOGGED:** CF/SI **CASING:** HW to 4.0m

TYPE OF BORING: Solid flight auger to 4.0m; Rotary to 7.1m; NMLC-Coring to 14.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *Denotes field replicate sample BD1/12032010 collected. E = Environmental sample

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Bovis Lend Lease
PROJECT: Stage 2 Contamination Assessment
LOCATION: Marrickville Metro, Marrickville

SURFACE LEVEL: 6.4 m AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH2
PROJECT No: 71645
DATE: 18 Mar 10
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		CONCRETE										
	0.18	FILLING - grey brown, silty clay and fine grained sand with some concrete gravel filling							A/E			PID=0.5ppm
									A/E*			PID=1.4ppm
	0.6	SILTY CLAY - orange brown to red brown, silty clay with trace of ironstone gravel, moist (possible filling)										
	1.0	CLAY - stiff, mottled orange brown and light grey clay with trace of ironstone gravel, moist							S			4,4,5 N = 9
									A/E			PID=1.4ppm
									E			PID=1.2ppm
	2.65	CLAY - very stiff and hard, mottled red brown and light grey clay with some ironstone gravel, moist							S A/E			3,5,6 N = 11 PID=1.3ppm
									S			5,14,18 N = 32
									S			5,13,16 N = 29
	7.1	SHALY CLAY - very stiff to hard, mottled red brown and grey shaly clay, damp to moist							S			8,13,18 N = 31
									S			8,12,16 N = 28
	9.9											

RIG: DT 100 **DRILLER:** RKE **LOGGED:** CF/SI **CASING:** HW to 2.5m; HQ to 10.1m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 10.1m; NMLC-Coring to 14.15m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *Denotes field duplicate/triplicate sample taken. E = Environmental sample

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

Douglas Partners
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BOREHOLE LOG

CLIENT: Bovis Lend Lease
PROJECT: Stage 2 Contamination Assessment
LOCATION: Marrickville Metro, Marrickville

SURFACE LEVEL: 6.4 m AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH2
PROJECT No: 71645
DATE: 18 Mar 10
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-4	10.1	SILTSTONE/LAMINITE - very low to low strength, red brown siltstone/laminite with ironstone band *(continued)*						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping at 0°-10° or joints	S			20/100mm refusal
-5	11 11.0	LAMINITE - low strength, highly to moderately and slightly weathered, fractured to slightly fractured, grey brown laminite. Some very low strength bands						10.14-10.33m: (x4) B0°, ironstained 10.58m: B0°- 5°, 15mm clay, ironstained 10.63m: J20°, ironstained, rough 10.65m: B0°, ironstained	C	100	37	PL(A) = 0.2MPa PL(A) = 2.5MPa
-6	12	LAMINITE - high strength, fresh stained, fractured to slightly fractured, light grey to grey laminite with approximately 40% fine grained sandstone laminations. Some very low and very low strength bands						11.0-11.25m: (x4) B0°, 2-3mm clay 11.36-13.06m: (x4) B0°, clay veneer/smear				PL(A) = 1.4MPa PL(A) = 1.3MPa
-7	13								C	100	82	PL(A) = 2.3MPa
-8	14							13.39m: J50°, rough 13.43m: J30°- 50°, curved, ironstained, rough 13.56m: J45°, rough				PL(A) = 2.3MPa
	14.15	Bore discontinued at 14.15m						13.78-13.84m: (x2) B0°, clay smear 13.95m: J35°- 90°, curved, ironstained, rough				
-9	15											
-10	16											
-11	17											
-12	18											
-13	19											

RIG: DT 100 **DRILLER:** RKE **LOGGED:** CF/SI **CASING:** HW to 2.5m; HQ to 10.1m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 10.1m; NMLC-Coring to 14.15m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *Denotes field duplicate/triplicate sample taken. E = Environmental sample

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Bovis Lend Lease
PROJECT: Stage 2 Contamination Assessment
LOCATION: Marrickville Metro, Marrickville

SURFACE LEVEL: 5.6 m AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH3
PROJECT No: 71645
DATE: 23 Mar 10
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	0.3	FILLING - brown, silty sand filling with some roots							E			PID=0.5ppm
		FILLING - light brown, sandy gravel filling (gravel is sandstone fragments 20-40mm)							E			PID=1.0ppm
	0.7	FILLING - brown, gravelly sand filling (gravel is sandstone and basalt 4-20mm)							E*			PID=0.9ppm
	1.3	SILTY CLAY - stiff, red brown mottled grey, silty clay with some fine grained ironstone gravel							S			4,5,8 N = 13
									E			PID=0.7ppm
		- grey from about 2.3m										
									E			PID=0.8ppm
									S			4,5,7 N = 12
		- some dark red brown staining from 3.4m				▼						
	4.4	CLAY - very stiff, grey and red brown, slightly silty clay							S			5,8,14 N = 22
									S			8,11,13 N = 24
	7.1	CLAY - hard, grey clay with ironstone bands							E			PID=1.8ppm
									S			7,12,18 N = 30
	8.8	SILTSTONE - extremely low strength, extremely weathered, grey and yellow brown, siltstone with 10% fine grained grey sandstone laminae						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping at 0°-10° or joints	S			11,30 refusal
	9.3	LAMINITE - see next page						9.5m: J25°, ironstained 9.53-9.83m: (x4) B5°-10°, ironstained	C	100	0	pp = 290kPa

RIG: Multi-Drill **DRILLER:** Traccess **LOGGED:** BOK/SI **CASING:** NW to 9.0m

TYPE OF BORING: 110mm diameter solid flight auger with TC-bit to 9.0m; Rotary to 9.3m; NMLC-Coring to 14.8m

WATER OBSERVATIONS: Free groundwater observed at 4.1m

REMARKS: *Denotes field replicate sample BD(A) collected. E = Environmental sample

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Bovis Lend Lease
PROJECT: Stage 2 Contamination Assessment
LOCATION: Marrickville Metro, Marrickville

SURFACE LEVEL: 5.6 m AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH3
PROJECT No: 71645
DATE: 23 Mar 10
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-5	11	LAMINITE - extremely to very low and very low to low strength, extremely and highly weathered, light grey to grey laminite with approximately 30% fine grained sandstone laminations. Some low strength bands *(continued)*						10.22m: B10°m, ironstained 10.47m: J25°, ironstained 10.58m: B5°, ironstained	C	100	71	pp = 360kPa PL(A) = 0.2MPa
-6	11.95											
-7	12	LAMINITE - medium to high strength, fresh, highly fractured to fractured, light grey to grey laminite with approximately 30% fine grained sandstone laminations						11.43m: J50°, clay smear 11.54m: J55°, clay band 11.65m: J, subvertical 11.76m: J50°, smooth, clay smear 12.18m: J30°, smooth 12.26-12.60m: (x6) J30°- 45°, rough 12.35m: J45°, smooth, slickensided 12.64-13.30m: fragmented into 0.01 to 0.05mm intervals	C	100	8	PL(A) = 0.4MPa PL(A) = 1.1MPa
-8	13	13.0-13.15m: very low strength band										
-9	13.3	LAMINITE - high strength, fresh, slightly fractured, light grey to grey laminite with approximately 20% fine grained sandstone laminations						12.95-13.0m: J, subvertical, rough 13.5m: J85°, rough 13.65-13.95m: (x3) J20°- 25°, rough 14.08m: J, subvertical, undulating, rough 14.21m: B0°, clay smear 14.48-14.70m: (x3) J25°- 35°, rough	C	100	95	PL(A) = 1.2MPa PL(A) = 2.1MPa
-10	14											
-11	14.8	Bore discontinued at 14.8m - limit of investigation										
-12	15											
-13	16											
-14	17											
	18											
	19											

RIG: Multi-Drill **DRILLER:** Traccess **LOGGED:** BOK/SI **CASING:** NW to 9.0m

TYPE OF BORING: 110mm diameter solid flight auger with TC-bit to 9.0m; Rotary to 9.3m; NMLC-Coring to 14.8m

WATER OBSERVATIONS: Free groundwater observed at 4.1m

REMARKS: *Denotes field replicate sample BD(A) collected. E = Environmental sample

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Bovis Lend Lease
PROJECT: Stage 2 Contamination Assessment
LOCATION: Marrickville Metro, Marrickville

SURFACE LEVEL: 5.6 m AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH4
PROJECT No: 71645
DATE: 23 Mar 10
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
5.6	0.16	CONCRETE										
		FILLING - red brown and brown clay with some gravel filling							E			PID=0.5ppm
									E			PID=0.5ppm
5	0.6	FILLING - dark grey to grey slightly silty clay filling							E			BD(A) BD(B) BD(C)
	1.1	CLAY - firm, yellow and red brown clay										
4									S			2,2,4 N = 6
	2								E			PID=1.1ppm
3	2.4	CLAY - very stiff, grey and yellow brown from about 2.8m							E			PID=1.0ppm
	3								S			4,6,10 N = 16
2	3.7	CLAY - very stiff, grey and dark red brown clay with some ironstone gravel							E			PID=1.0ppm
	4								S			5,7,12 N = 19
1	5											
	5.3	CLAY - very stiff to hard, grey clay, some red brown staining							E			PID=0.5ppm
0	6								S			8,12,14 N = 26 (no sample)
-1	7											
									E			PID=0.7ppm
-2	8								S			6,10,15 N = 25
-3	8.7	SILTSTONE - extremely weathered, extremely low strength, light grey and yellow brown siltstone				▼			E			PID=0.6ppm
	9								S			8,19,21 N = 40
-4												

RIG: Multi-Drill **DRILLER:** Traccess **LOGGED:** BOK **CASING:** Uncased

TYPE OF BORING: Diatube to 0.16m; 110mm diameter solid flight auger (TC-bit) to 11.0m

WATER OBSERVATIONS: Free groundwater observed at 8.8m

REMARKS: Piezometer installed to 11.0m; Screened 11.0 to 5.0m; Gravel from 4.5 to 11.0m; Bentonite from 3.5 to 4.5m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Bovis Lend Lease
PROJECT: Stage 2 Contamination Assessment
LOCATION: Marrickville Metro, Marrickville

SURFACE LEVEL: 5.6 m AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH4
PROJECT No: 71645
DATE: 23 Mar 10
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-5		SILTSTONE - extremely weathered, extremely low strength, light grey and yellow brown siltstone *(continued)*							E			PID=0.5ppm
	11 11.0								E			PID=0.6ppm
-6		Bore discontinued at 11.0m - limit of investigation										
	12											
-7												
	13											
-8												
	14											
-9												
	15											
-10												
	16											
-11												
	17											
-12												
	18											
-13												
	19											
-14												

RIG: Multi-Drill **DRILLER:** Traccess **LOGGED:** BOK **CASING:** Uncased

TYPE OF BORING: Diatube to 0.16m; 110mm diameter solid flight auger (TC-bit) to 11.0m

WATER OBSERVATIONS: Free groundwater observed at 8.8m

REMARKS: Piezometer installed to 11.0m; Screened 11.0 to 5.0m; Gravel from 4.5 to 11.0m; Bentonite from 3.5 to 4.5m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Bovis Lend Lease
PROJECT: Stage 2 Contamination Assessment
LOCATION: Marrickville Metro, Marrickville

SURFACE LEVEL: 5.2 m AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH5
PROJECT No: 71645
DATE: 17 Mar 10
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
5	0.05	BITUMINOUS CONCRETE							A			PID=0.6ppm
		FILLING - grey sandy gravel filling (gravel is basalt)							A/E			PID=0.7ppm
	0.8	FILLING - grey, silty clay with trace of fine gravel filling, moist							A/E			PID=0.9ppm
4	1.2	CLAY - stiff, mottled orange, light grey clay with trace of silt and ironstone gravel, damp to moist							S			3,5,8 N = 13
									A/E			PID=1.2ppm
	1.8	CLAY - very stiff, light grey clay with trace of ironstone gravel, damp							A/E			PID=1.2ppm
3	2.7	CLAY - very stiff, red brown and grey clay with ironstone bands, moist							S			6,8,10 N = 18
						▼			A/E			PID=1.8ppm
2									S			10,10,15 N = 25
	5.1	CLAY - very stiff, light grey and red brown clay with some ironstone gravel, moist							S			9,13,15 N = 28
1	6.7	SHALY CLAY - very stiff to hard, light grey shaly clay, moist							S			7,11,22 N = 33
									S			6,9,16 N = 25
0												
-1												
-2												
-3												
-4												

RIG: DT 100 **DRILLER:** RKE/GH **LOGGED:** CF **CASING:** HQ to 4.2m

TYPE OF BORING: Solid flight auger to 4.0m; Rotary to 10.2m

WATER OBSERVATIONS: Free groundwater observed at 3.8m whilst augering

REMARKS: *Denotes field replicate sample BD1/17032010 collected. E = Environmental sample

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Bovis Lend Lease
PROJECT: Stage 2 Contamination Assessment
LOCATION: Marrickville Metro, Marrickville

SURFACE LEVEL: 5.2 m AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH5
PROJECT No: 71645
DATE: 17 Mar 10
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	10.05	SHALE - extremely low to very low strength, light grey and red brown shale with ironstone bands							S			24,10/50mm refusal
-5	10.2	Bore discontinued at 10.2m										
-6	11											
-7	12											
-8	13											
-9	14											
-10	15											
-11	16											
-12	17											
-13	18											
-14	19											

RIG: DT 100 **DRILLER:** RKE/GH **LOGGED:** CF **CASING:** HQ to 4.2m

TYPE OF BORING: Solid flight auger to 4.0m; Rotary to 10.2m

WATER OBSERVATIONS: Free groundwater observed at 3.8m whilst augering

REMARKS: *Denotes field replicate sample BD1/17032010 collected. E = Environmental sample

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Bovis Lend Lease
PROJECT: Stage 2 Contamination Assessment
LOCATION: Marrickville Metro, Marrickville

SURFACE LEVEL: 4.46 m AHD **BORE No:** BH6
EASTING: **PROJECT No:** 71645
NORTHING: **DATE:** 16 Mar 10
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	0.15	BITUMINOUS CONCRETE							A/E			PID=1.7ppm
	0.3	FILLING - grey sandy gravel (roadbase)							A/E*			PID=1.8ppm
	0.4	FILLING - dark grey brown silty clay filling, moist										
	0.8	CLAY - light brown clay with trace of silt, moist							A/E			PID=2.3ppm
	1	CLAY - stiff, mottled orange brown and light grey clay with some ironstone gravel, moist							S			4,4,6 N = 10
	2.0	CLAY - very stiff, mottled orange light grey clay, damp to moist							A/E			PID=2.6ppm
	3								S E			5,7,9 N = 16 PID=2.0ppm
	4.0	CLAY - hard, red brown and light grey clay with some ironstone bands, moist							S			9,11,18 N = 29
	5											
	6								S			12,14,20 N = 34
	6.5	SHALY CLAY - very stiff to hard, light grey mottled orange shaly clay with trace of ironstone gravel, moist										
	7								S			6,13,17 N = 30
	8											
	8.5	SHALE - extremely low strength, light grey and red brown shale with ironstone bands							S			13,24,20/100mm refusal
	9											
	10.0	Bore discontinued at 10.0m										

RIG: Bobcat **DRILLER:** SY/GH **LOGGED:** CF **CASING:** HW to 4.0m

TYPE OF BORING: Solid flight auger to 4.0m; Rotary to 10.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *Denotes field replicate sample BD1/16032010 collected. E = Environmental sample

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Bovis Lend Lease
PROJECT: Stage 2 Contamination Assessment
LOCATION: Marrickville Metro, Marrickville

SURFACE LEVEL: 4.91 m AHD **BORE No:** BH7
EASTING: **PROJECT No:** 71645
NORTHING: **DATE:** 23 Mar 10
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
4	1	FILLING - light grey to grey orange brown, clay filling with some ironstone gravel, shale fragments, moist							A/E			
									A			
									A			
	1.0	FILLING - grey brown, fine to medium grained, clayey sand filling, moist							S			1,2,0 N = 2
3	1.5	FILLING - light grey to grey orange brown, clay filling with some shale fragments and ironstone gravel, moist										
	2											
2	2.8	CLAY - very stiff, mottled orange light grey to grey, clay with some carbonised organic matter and weak ironstone, moist							S			1,1,1 N = 2
	3											
1	4								S			3,7,10 N = 17
	5											
0	6								S			4,10,15 N = 25
	6.0	CLAY - very stiff then very stiff to hard, mottled red brown and grey clay with ironstone bands, moist										
-1	7								S			7,11,17 N = 28
	8											
-2	9								S			10,14,16 N = 30
	9.0	SHALY CLAY - hard, mottled red brown light grey shaly clay with ironstone bands, damp										
-3												
-4												
-5												

RIG: DT 100 **DRILLER:** Steve Y **LOGGED:** SI/CF **CASING:** HW to 4.0m; HQ to 11.6m

TYPE OF BORING: Hand auger to 1.3m; Solid flight auger to 2.5m; Rotary to 11.6m; NMLC-Coring to 14.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: 100% water loss from 4.0m; Standpipe installed to 12.0m
*Denotes field replicate sample BD1/23032010 collected

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Bovis Lend Lease
PROJECT: Stage 2 Contamination Assessment
LOCATION: Marrickville Metro, Marrickville

SURFACE LEVEL: 4.91 m AHD **BORE No:** BH7
EASTING: **PROJECT No:** 71645
NORTHING: **DATE:** 23 Mar 10
DIP/AZIMUTH: 90°/-- **SHEET** 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-6	11	SHALY CLAY - hard, mottled red brown light grey shaly clay with ironstone bands, damp *(continued)*						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping at 0°-10° or joints	S			9,14,20 N = 34
	11.0	SILTSTONE/LAMINITE - very low to low strength, grey brown siltstone/laminite with ironstone bands										
	11.6								S			25/100mm refusal
-7	12	LAMINITE - medium strength, moderately weathered then fresh stained, fragmented to fractured, light grey brown to grey, laminite with approximately 40% fine grained sandstone laminations						11.6-11.82m: fragmented & ironstained 11.66m: J75°, rough 11.82-11.94m: J85°, ironstained, rough 11.94-12.14m: (x4) B0°, ironstained 12.2m: J85°, rough, ironstained 12.34m: J75°, ironstained 12.42m: J70°, rough, ironstained 12.62m: J50°, rough 13.04-13.38m: (x2) J, subvertical, parallel, rough & rock fragmented into 0.05mm intervals 13.44m: J90°, rough, ironstained 13.63m: J70°- 80°, steeped, rough 13.81-14.05m: J, subvertical, ironstained & fragmented into 0.03mm intervals 14.13-14.29m: J75°,-80°, rough, fragmented into 0.02mm intervals 14.29m: J70°, rough	C	100	40	PL(A) = 0.8MPa PL(A) = 0.6MPa PL(A) = 1.3MPa
-8	12.65											
	13	LAMINITE - high then medium strength, fresh, highly fractured to fractured and slightly fractured, light grey to grey, laminite with approximately 30% fine grained sandstone laminations							C	100	40	PL(A) = 1.3MPa PL(A) = 0.5MPa
-9	14											
	14.5	Bore discontinued at 14.5m										
-10	15											
-11	16											
-12	17											
-13	18											
-14	19											
-15												

RIG: DT 100 **DRILLER:** Steve Y **LOGGED:** SI/CF **CASING:** HW to 4.0m; HQ to 11.6m

TYPE OF BORING: Hand auger to 1.3m; Solid flight auger to 2.5m; Rotary to 11.6m; NMLC-Coring to 14.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: 100% water loss from 4.0m; Standpipe installed to 12.0m
*Denotes field replicate sample BD1/23032010 collected

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Bovis Lend Lease
PROJECT: Stage 2 Contamination Assessment
LOCATION: Marrickville Metro, Marrickville

SURFACE LEVEL: 4.91 m AHD **BORE No:** BH7A
EASTING: **PROJECT No:** 71645
NORTHING: **DATE:** 22-24/03/2010
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
4	0.0	FILLING - light grey and orange brown, silty clay with some ironstone gravel filling							A/E			
									A/E			
	1.0								A/E			
3		FILLING - light brown to orange brown, silty sand filling							S			1,2,0 N = 2
	1.4	FILLING - brown clay filling							E			
2												
	2.3	FILLING - crushed sandstone/concrete filling							S			1,1,1 N = 2
2	3.0	Bore discontinued at 3.0m - auger refused on crushed sandstone/concrete							E			
1												
0												
-1												
-2												
-3												
-4												
-5												

RIG: DT 100 **DRILLER:** Steve Y **LOGGED:** SI/CF **CASING:** Uncased

TYPE OF BORING: Hand auger to 1.3m; Solid flight auger to 3.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: E = Environmental sample. No sample/refer to driller's log

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

Douglas Partners
Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: Bovis Lend Lease
PROJECT: Stage 2 Contamination Assessment
LOCATION: Marrickville Metro, Marrickville

SURFACE LEVEL: 4.8 m AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH8
PROJECT No: 71645
DATE: 23-24/03/2010
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
4	0.14	CONCRETE							A/E			
		FILLING - grey sandy gravel filling							A/E			PID=3.0ppm
	0.6	FILLING - dark grey, sandy silty clay with some concrete gravel filling, moist							A/E			PID=2.7ppm
3	1								A/E			
	1.25	SILTY CLAY - firm, light brown silty clay, moist							A/E			PID=2.1ppm
									S			1,2,2 N = 4
2	2.0	CLAY - stiff, grey clay with trace of silt and gravel, moist							E			PID=1.6ppm
									E			
									E			PID=2.3ppm
									E			
									S			4,4,7 N = 11
1	3	CLAY - very stiff, mottled orange brown and light grey clay with some ironstone gravel, moist							E			PID=2.5ppm
	4								S			7,10,11 N = 21
0	5	CLAY - hard, mottled orange grey clay with some ironstone gravel, moist							S			8,13,22 N = 35
-1	6											
	7								S			6,13,20 N = 33
-2	8											
	8.5	CLAYEY GRAVEL - hard, red brown, clayey gravel (ironstone), damp							S			19,25/150mm refusal
-3	9											
	9.4	Bore discontinued at 9.4m - refusal on possible weathered rock										
-4												
-5												

RIG: DT 100 **DRILLER:** Steve Y **LOGGED:** SI/CF **CASING:** HQ to 4.0m

TYPE OF BORING: Diatube to 0.14m; Solid flight auger to 4.0m; Rotary to 9.4m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: E = Environmental sample. *Denotes field replicate sample BD1 collected

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Bovis Lend Lease
PROJECT: Stage 2 Contamination Assessment
LOCATION: Marrickville Metro, Marrickville

SURFACE LEVEL: 4.5 m AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH9
PROJECT No: 71645
DATE: 22 Mar 10
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	0.0	FILLING - grey brown, fine to medium grained sand with some concrete gravel filling							A			
									E			PID=2.4ppm
	0.4	SILTY CLAY - grey brown silty clay with trace of fine grained sand, moist (possible filling)							A/E			PID=3.1ppm
	0.8	SILTY CLAY - stiff, mottled orange brown and light grey silty clay with trace of ironstone gravel, moist							E			PID=1.2ppm
									E			
									A			5,8,7
	1.4	CLAY - stiff, mottled orange brown and light grey clay with some ironstone gravel, moist							S			N = 15
									A/E*			PID=2.4ppm
									E			PID=0.2ppm
									A/E			PID=3.8ppm
	2.8	CLAY - very stiff, red brown and light grey clay with some ironstone bands, moist							S			5,6,7 N = 13
	5.0	SHALY CLAY - hard, light grey shaly clay, damp							S			5,8,13 N = 21
									S			8,15,20 N = 35
	7.2	SILTSTONE/LAMINITE - extremely low to very low strength, light grey siltstone/laminite						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping at 0°-10° or joints	S			12,20,10/50mm refusal
	8.0	LAMINITE - low and low to medium strength, slightly weathered then fresh, fractured and slightly fractured, light grey brown and grey, laminite with approximately 30% fine grained sandstone laminations. Some very low strength bands						8m: CORE LOSS: 70mm 8.11-8.31m: (x3) B0°, ironstained, clay veneer 8.37m: B0°, 15mm crushed rock fragments 8.47m: J35°, 5mm clay, ironstained 8.53m: B0°, ironstained 8.54m: B10°, ironstained 8.61m: J45°, healed, ironstained 8.66m: B0°, 50mm clay band, ironstained	C	93	37	PL(A) = 0.3MPa PL(A) = 0.2MPa PL(A) = 0.3MPa
	9.11											

RIG: DT 100 **DRILLER:** Rhett **LOGGED:** CF/SI **CASING:** HW to 2.6m; HQ to 8.0m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 8.0m; NMLC-Coring to 12.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *Denotes field replicate sample BD1/220300 collected

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

Douglas Partners
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BOREHOLE LOG

CLIENT: Bovis Lend Lease
PROJECT: Stage 2 Contamination Assessment
LOCATION: Marrickville Metro, Marrickville

SURFACE LEVEL: 4.5 m AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH9
PROJECT No: 71645
DATE: 22 Mar 10
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-6	10.4	LAMINITE - see previous page						8.74m: B0°, ironstained 9.04m: J45°, rough 9.11m: CORE LOSS: 70mm 9.36m: J20°, clayey 9.26-9.34m: crushed rock, possible shear zone 9.42m: B10°, clay 9.47m: J30°, healed 9.5m: F35°, micro fault 9.55m: J45°, ironstained 9.66m: J25°, clay smear 9.73m: J45°, rough 10.09 & 10.26m: (x2) B0°, clay smear 10.31-10.34m: (x2) J35°, parallel 10.45-10.65m: (x4) B0°, clay smear 10.85m: J50°, smooth 11.14m: J50°, smooth 11.39-11.96m: (x5) B0°, clay smear				
-7	11	LAMINITE - medium strength, fresh, slightly fractured, light grey to grey laminite with approximately 20% fine grained, sandstone laminations. Some extremely and very low strength bands							C	100	77	PL(A) = 0.4MPa PL(A) = 0.6MPa
-8	12 12.0	Bore discontinued at 12.0m										
-9	13											
-10	14											
-11	15											
-12	16											
-13	17											
-14	18											
-15	19											

RIG: DT 100 **DRILLER:** Rhett **LOGGED:** CF/SI **CASING:** HW to 2.6m; HQ to 8.0m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 8.0m; NMLC-Coring to 12.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *Denotes field replicate sample BD1/220300 collected

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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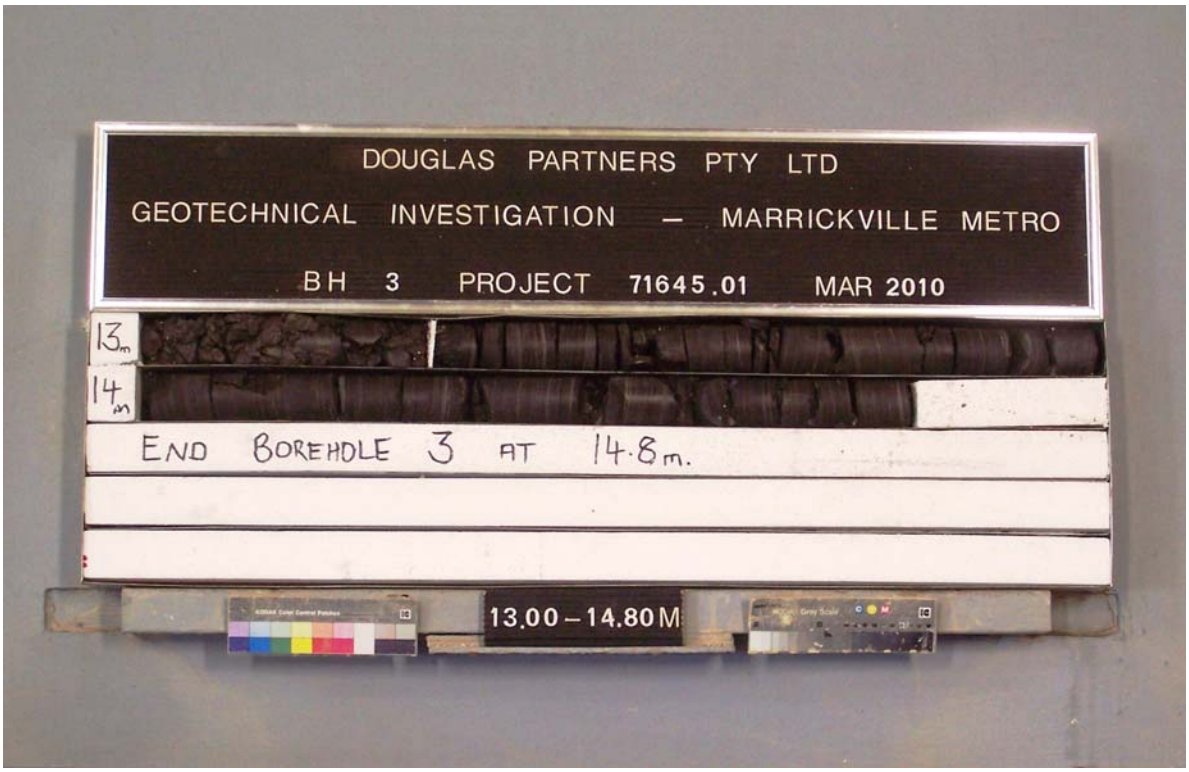
DOUGLAS PARTNERS PTY LTD
GEOTECHNICAL INVESTIGATION – MARRICKVILLE METRO
BH 1 PROJECT 716 45.01 MAR 2010
MERRICKVILLE
716 45.01
BH-1 STARS 7.10
8
9
10
11
7.10 – 12.00M

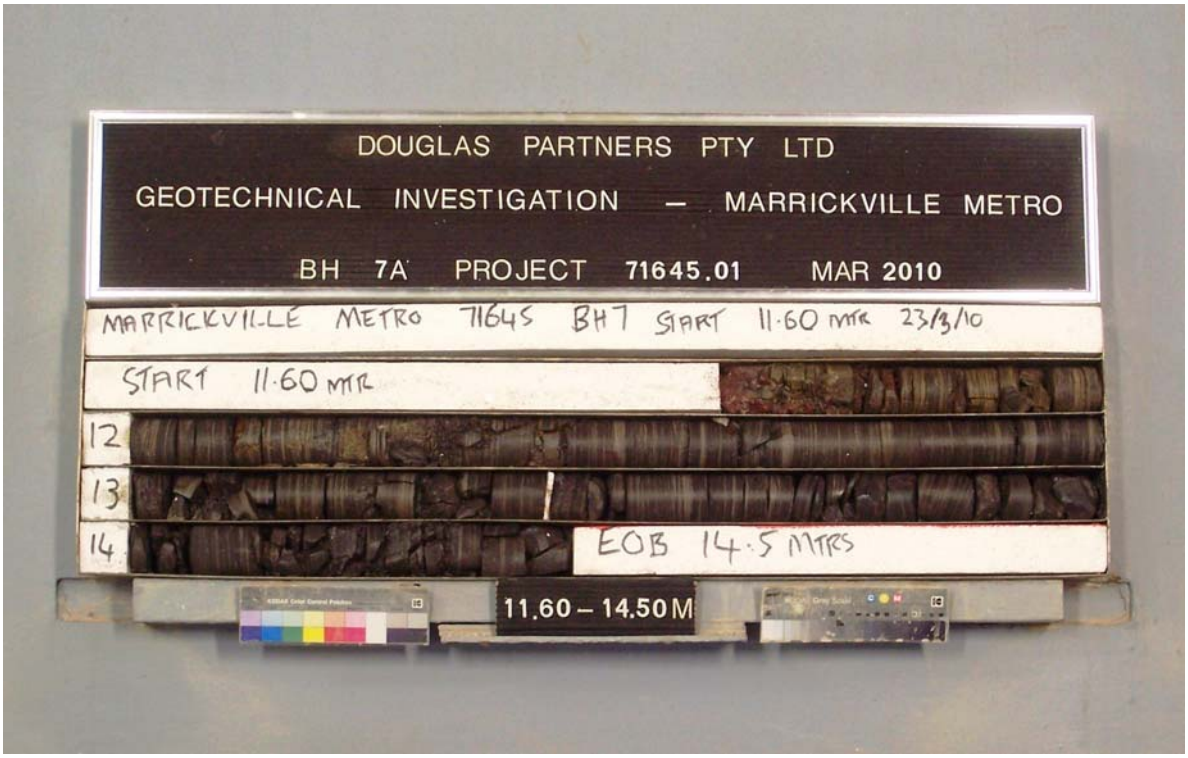

DOUGLAS PARTNERS PTY LTD
GEOTECHNICAL INVESTIGATION – MARRICKVILLE METRO
BH 1 PROJECT 716 45.01 MAR 2010
12
13
14
12.00 – 14.60M


DOUGLAS PARTNERS PTY LTD
GEOTECHNICAL INVESTIGATION – MARRICKVILLE METRO
BH 2 PROJECT 716 45.01 MAR 2010
MARRICKVILLE METRO 71645 BH2 START 10.10M 18/3/10
START 10.1M
11
12
13
10.10– 14.00M


DOUGLAS PARTNERS PTY LTD
GEOTECHNICAL INVESTIGATION – MARRICKVILLE METRO
BH 2 PROJECT 716 45.01 MAR 2010
14
EOB=14.15M
14.00– 14.15M


DOUGLAS PARTNERS PTY LTD
GEOTECHNICAL INVESTIGATION – MARRICKVILLE METRO
BH 3 PROJECT 71645.01 MAR 2010
71645.01 MARRICKVILLE METRO BH3 START CORING 9.3m
9m
10m
11m
12m
9.30 – 13.00 M


DOUGLAS PARTNERS PTY LTD
GEOTECHNICAL INVESTIGATION – MARRICKVILLE METRO
BH 3 PROJECT 71645.01 MAR 2010
13m
14m
END BOREHOLE 3 AT 14.8m.
13.00 – 14.80 M


DOUGLAS PARTNERS PTY LTD
GEOTECHNICAL INVESTIGATION – MARRICKVILLE METRO
BH 7A PROJECT 71645.01 MAR 2010
MARRICKVILLE METRO 71645 BH7 START 11.60 MTR 23/3/10
START 11.60 MTR
12
13
14
EOB 14.5 MTRS
11.60 – 14.50 M


DOUGLAS PARTNERS PTY LTD
GEOTECHNICAL INVESTIGATION – MARRICKVILLE METRO
BH 9 PROJECT 716 45.01 MAR 2010
MARRICKVILLE METRO 71645
BH9 START 8.00m
8
9
10
11
8.00– 12.00M

APPENDIX C
Results of Laboratory Tests

Douglas Partners
Geotechnics · Environment · Groundwater

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RESULTS OF MOISTURE CONTENT, PLASTICITY AND LINEAR SHRINKAGE TESTS

Client: BOVIS LEND LEASE

Project: MARRICKVILLE METRO REDEVELOPMENT

Location: MARRICKVILLE

Project No: 71645.01
Report No: S10-056 A
Report Date: 08/04/10

Date Sampled: 23-24/03/10
Date of Test: 05-06/04/10
Page: 1 of 1

TEST LOCATION	DEPTH (m)	DESCRIPTION	CODE	W_F %	W_L %	W_P %	PI %	*LS %
BH8	2.5-2.95	CLAY – Grey and red brown clay	2,5	-	62	18	44	19
BH9	1.0-1.45	CLAY – Grey and yellow brown clay	2,5	-	44	17	27	14.5

Legend:
W_F Field Moisture Content
W_L Liquid limit
W_P Plastic limit
PI Plasticity index
LS Linear shrinkage from liquid limit condition (Mould length 125mm)

Test Methods:
Moisture Content: AS 1289 2.1.1
Liquid Limit: AS 1289 3.1.2, 3.1.1
Plastic Limit: AS 1289 3.2.1
Plasticity Index: AS 1289 3.3.1
Linear Shrinkage: AS 1289 3.4.1

Code
Sample history for plasticity tests
1. Air dried
2. Low temperature (<50°C) oven dried
3. Oven (105°C) dried
4. Unknown

Method of preparation for plasticity tests
5. Dry sieved
6. Wet sieved
7. Natural

*Specify if sample crumbled CR or curled CU

Sampling Method(s): Sampled by Sydney Engineer

Remarks:

Approved Signatory:

Tested: MH
Checked: NW

Norman Weimann
Laboratory Manager

NATA Accredited Laboratory Number: 828

This Document is issued in accordance with NATA's accreditation requirements.
Accredited for compliance with ISO/IEC 17025

ACCREDITED FOR TECHNICAL COMPETENCE

Douglas Partners
Geotechnics · Environment · Groundwater

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Fax: *(02) 9809 4095*
sydney@douglaspartners.com.au

RESULTS OF MOISTURE CONTENT TEST

Client	BOVIS LEND LEASE	**Project No:**	71645.01
		Report No:	S10-056 B
Project	MARRICKVILLE METRO REDEVELOPMENT	**Report Date:**	08/04/10
		Date Sampled	23-24/03/10
Location	MARRICKVILLE	**Date of Test:**	30-/03/10
		Page:	1 of 1

TEST LOCATION	DEPTH (m)	DESCRIPTION	MOISTURE CONTENT (%)
BH 8	2.5-2.95	CLAY – Grey and red brown clay	22.5
BH 9	1.0-1.45	CLAY – Grey and yellow brown clay	14.3

Test Method(s): AS 1289.2.1.1

Sampling Method(s): Sampled by Sydney Engineer

Remarks:

Approved Signatory:

Tested: LW
Checked: NW

Norman Weimann
Laboratory Manager

NATA Accredited Laboratory Number: 828

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