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STE:lll
Project 45679.01
26 July, 2010

Mirvac
Level 26, 60 Margaret Street
SYDNEY NSW 2000

Attention: Ms Nicole Vince

Dear Sirs

DELIVERABLES FOR PART 3A PROJECT APPLICATION MP09_0154
PROPOSED MIXED-USE DEVELOPMENT
7 RAILWAY STREET, CHATSWOOD

This letter provides a response to the "Deliverables for Part 3A Project Application MP09_0154" provided by Mirvac, dated 10 June 2010. The application relates to the proposed multi-storey residential development at 7 Railway Street, Chatswood.

We have reviewed the following documents which are referenced in the list of deliverables:

- Letter from RailCorp Property titled "*Director General's Requirements",* dated 23 October 2009 and the attached *"Brief for review of geotechnical & structural design for developments adjacent to or above rail corridor for external third party works performed under the NSW State Environment".*
- "*Development Near Rail Corridors and Busy Roads – Interim Guideline"*, prepared by NSW Government Department of Planning (2008).

The site of the proposed development at 7 Railway Street is located on the south-western corner of a major commercial and residential development referred to as "Pacific Place". It is the final development to be completed within the Pacific Place precinct, which now includes several high-rise buildings with deep basements along the eastern and western sides of the North Shore Rail Line. The North Shore Rail Line runs along the eastern boundary of the site. The rail corridor is enclosed within a concrete structure referred to as the Railway Enclosure Structure.

Based on preliminary plans provided by Mirvac Design (SK1001 and SK1002, dated 7 June 2010), it is understood that the proposed development on this site will comprise the construction of one multi-storey mixed-use building with five to seven basement levels. Along the eastern side of the site, adjacent to the rail corridor, the proposed basement level (Basement 5) ramps up towards the north from RL 81.4 m to RL 82.9 m. On the western side of the site and set back approximately 9 – 10 m from the rail corridor, the proposed basement level (Basement 7) steps down to RL 74.5 – 75.8m. The existing track level for the rail line is understood to be approximately RL 99.5 m and therefore the proposed Basement 5 levels will require excavation to depths of approximately 16.5 m to 18.0 m below the track level.

Douglas Partners Pty Ltd (DP) has undertaken detailed geotechnical investigations for the completed buildings within Pacific Place and has also carried out full-time inspections of the bulk excavation and installation of permanent anchors and horizontal ties below the Railway Enclosure Structure during construction of the various basement structures.

As part of the previous works, DP prepared a "*Specification S3 – Supply and Installation of Permanent Rock Anchors and Horizontal Ties"* (Project 28994, July 2002). The rock anchors and horizontal ties below the Railway Enclosure Structure were installed in general accordance with the Specification S3.

At the request of Rail Infrastructure Corporation, DP provided a long term monitoring programme for the permanent horizontal ties and inclined anchors below the Railway Enclosure Structure (Project 28994N, dated 16 February 2006). This document included a summary of the anchor design, long term monitoring requirements, a copy of the Specification S3, and lift-off test results for all ties and anchors below the Railway Enclosure Structure.

The deliverable items relating to geotechnical aspects of the proposed development are listed below together with appropriate comments.

Item 1.6 – SEPP 55 Remediation of Land
DP carried out a waste classification assessment of the in-situ materials on the site in July 2008 (Project 45679) and subsequently inspected the site on 6 July 2010. Reference should be made to the DP waste classification letter dated 26 July 2010 for further details.

Item 1.8 – Department's Interim Guidelines for Development Near Rail Corridors and Busy Roads (2008)
Section 6 of the interim guideline outlines minimum requirements for assessment in relation to excavation, earthworks and other construction related activities. DP has prepared a detailed geotechnical report for the site (Project 45679.01 dated 2 July 2010) which is in general accordance with the interim guidelines. The DP report provides a compilation of the previous investigation data for the site together with a geotechnical model and recommendations on excavation, shoring and foundations. The report includes recommendations on the design of a shoring system to support the excavation adjacent to the North Shore Rail Line.

Item 9.0 – Drainage
Comments on groundwater and drainage are provided in Sections 8.0 and 10.3 of the DP Geotechnical Report (2 July 2010).

Item 28.0 – Geotechnical/Structural Report
A geotechnical report is required in accordance with the "*brief for review of geotechnical & structural design for developments adjacent to or above rail corridor for external third party works performed under the NSW State Environment"*. The brief states that RailCorp is required to review all developments within 25 m of the Rail Corridor with ground penetrations greater than 2 m. The RailCorp design reviewer is to "verify that the developers design consultant has conducted sufficient geotechnical investigation and analysis to determine what subsidence or displacement of rail infrastructure may occur due to the development and whether these movements are within approved limits".

It is noted that some of the comments provided in the brief relate to situations where development will occur above or close to railway tunnels. This development involves excavation below the Railway Enclosure Structure and does not involve construction near a railway tunnel.

The DP Geotechnical Report (July 2010) provides a geotechnical model for the site together with comments on the design and construction of shoring adjacent to the railway corridor (refer to Section 10.2.7 of the report). This report satisfies the general geotechnical requirements of the brief. It is anticipated that further detailed geotechnical input will be provided by DP in consultation with RailCorp.

The shoring system for the other deep excavations within the Pacific Place precinct, adjacent to the rail corridor, have previously been designed by Tierney & Partners Pty Ltd, now Opus International Consultants Pty Ltd (Opus). DP has previously been involved with the design of the horizontal ties and rock anchors for these shoring systems. It is understood that a similar approach will be adopted for this site, with the shoring system below the Railway Enclosure Structure to be designed by Opus in conjunction with an anchor design/review by DP.

Three rows of horizontal ties adjacent to the site have previously been installed and the installation and stressing was inspected by DP. Details of the existing ties are provided in the DP long term monitoring programme (Project 28994N, dated 16 February 2006).

Item 34.0 – Construction Plan
It is understood that DP will be engaged by Mirvac to undertake full-time inspections of excavations adjacent to the railway corridor together with full-time inspections of the installation of permanent inclined rock anchors below the Railway Enclosure Structure. This approach was adopted by Mirvac for the previous developments within Pacific Place and was endorsed by RailCorp.

A detailed methodology and construction monitoring plan will be prepared prior to construction, outlining the methodology and monitoring requirements for the excavation and shoring support adjacent to the rail corridor. General comments on monitoring requirements are provided in the DP Geotechnical Report (July 2010).

Item 41.0 – Geotechnical & Structural report that meets the requirements of the attached brief
See response to Item 28.0 above.

Item 42.0 – Construction Methodology
See response to Item 34.0 above

Item 43.0 – Cross Sectional Drawings
A geotechnical cross-section adjacent to the railway corridor is provided in Drawing 3 in the DP Geotechnical Report (Project 45679.01 dated 2 July 2010).

We trust that the above satisfies your present requirements. Please contact the undersigned if you have any further questions or wish to discuss these issues further.

Yours faithfully
DOUGLAS PARTNERS PTY LTD

Scott Easton
Senior Associate

Reviewed by

for

John Braybrooke
Principal

Douglas Partners
Geotechnics • Environment • Groundwater

Integrated Practical Solutions

UPDATED REPORT
on
GEOTECHNICAL INVESTIGATION

PROPOSED RESIDENTIAL DEVELOPMENT
7 RAILWAY STREET
CHATSWOOD

Prepared for
MIRVAC

Project 45679.01
July 2010

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STE:aj
Project 45679.01
15 July 2010

UPDATED REPORT ON GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
7 RAILWAY STREET, CHATSWOOD

1. INTRODUCTION

This report details the results of a geotechnical investigation carried out for a proposed multi-storey residential development with five to seven basement levels at 7 Railway Street, Chatswood. The current scope of work was requested by Mirvac.

The site of the proposed development at 7 Railway Street (referred to as "the site" in this report) is located on the south-western corner of a major commercial and residential development referred to as "Pacific Place". It is the final development to be completed within the Pacific Place precinct, which now includes several high-rise buildings with deep basements along the eastern and western sides of the North Shore Rail Line. The North Shore Rail Line runs along the eastern boundary of the present site and the railway tracks are is enclosed within a concrete structure referred to as the Railway Enclosure Structure.

Douglas Partners Pty Ltd (DP) has undertaken detailed geotechnical investigations for the completed buildings within Pacific Place and has also carried out full-time inspections of the bulk excavation and installation of permanent anchors and horizontal ties below the Railway Enclosure Structure during construction of the various basement structures.

DP has previously carried out a number of investigations on the site between 1984 and 2008, as summarised in Section 2 of this report. This current scope comprised a review of the proposed development and compilation of the previous investigation data for the site, followed by

preparation of a report with recommendations on excavation, shoring and foundations. In particular, the combined geotechnical data has been used to provide recommendations on the design of a shoring system to support the excavation adjacent to the North Shore Rail Line. This current report supersedes the earlier DP reports for this site.

2. BACKGROUND AND PREVIOUS INVESTIGATIONS

A summary of the relevant geotechnical investigations previously carried by DP on the site are summarised below. The previous test locations are shown on Drawing 1 in Appendix A and the Test Bore Report sheets are included in Appendix B.

August 1984 (DP Reference No. SSI/8540) - preliminary investigation was undertaken on the Pacific Place site, previously referred to as the "Chatswood Connection", and comprised five bores, one of which was located on the site (Bore 1).

April 1988 (DP Reference No. SSI/10,000) - a subsequent, more comprehensive investigation was undertaken on the overall site and comprised twenty-two bores and six Cone Penetration Tests (CPTs). This investigation included six bores on the subject portion of the site (BH7, 8, 9, 11, 12 and 13) which were drilled to reduced levels (RLs) of between RL68 m and RL76 m relative to Australian Height Datum (AHD) and three CPTs (CPTs 7, 11 and 13). Two of the boreholes (BH9 and BH11) were drilled at an inclination of 20 degrees off vertical to intersect known joints sets. This investigation identified five principal geotechnical units in the subsurface profile, namely filling, residual clay, Ashfield Shale, the Mittagong Formation and Hawkesbury Sandstone.

The deeper bores indicated that the Mittagong Formation was underlain by generally massive, slightly fractured to unbroken, medium to high strength Hawkesbury Sandstone. This unit typically occurred below RL71 m to RL73 m.

Geotechnical work undertaken by DP after the above investigations included piling inspections during the construction of the Railway Enclosure Structure and geological face mapping of basement excavations during initial development of the Chatswood Connection site. Piling

inspections included proof-core drilling for a penetration of about 3 m below each pile founding level for the Railway Enclosure Structure.

January 2001 (DP Reference No. 28994A) - a further detailed investigation of the broader site was undertaken to supplement the existing geotechnical data. This investigation included seven bores and also mapping of the partly exposed batter slope along the western side of the rail line (the batter has since been removed). The investigation included one bore (BH507) on the subject portion of the site, which was drilled to a depth of 18 m (RL78.3 m).

March 2002 (DP Reference No. 28994F) - a supplementary geotechnical investigation was undertaken on the subject site area for a previous development proposal at 7 Railway Street. The investigation included two bores (BH508 and BH509) which were drilled to depths of between 13.0 m and 17.5 m (RL81.5 m to RL77.3 m).

April 2002 (DP Reference No. 28994G) - a review of geological data for perimeter shoring design was undertaken on the site for the previous development proposal. The assessment included a review and analysis of geological data obtained from the previous deep basement excavations within the Pacific Place precinct to confirm orientations of major jointing, faulting and sheared zones. This data was compared with nearby sites (Artarmon, Chatswood and St Leonards), where rock wedge failures have been recorded. This information was used to define theoretical rock wedge failure mechanisms to assess the required design anchor loads.

July 2008 (DP Reference No. 45679) - a waste classification assessment of the in-situ materials was undertaken on the subject site. Twelve test pits were excavated to depths of 1.0 m to 3.5 m using a backhoe. Twenty-four samples were collected and tested in a NATA accredited laboratory (Envirolab Services Pty Ltd) for a variety of common contaminants. Reference should be made to the previous report for detailed comments on the waste classification assessment of the soils at the subject development site.

3. SITE DESCRIPTION

The site is an irregular-shaped lot with a plan area of approximately 2,500 m^2, with a 30 m long southern frontage to Help Street and an 85 m long western frontage to Railway Street. The North Shore Rail Line runs along the eastern boundary and the railway tracks are enclosed within a concrete structure referred to as the Railway Enclosure Structure. The Railway Enclosure Structure is supported by 0.9 m diameter reinforced concrete piles with steel casing. An access tunnel runs east to west beneath the railway line, towards the central part of the site.

Present ground surface levels for the site and surrounding area fall towards the south at slopes of around 1° and 2°. The broader site has, however, been extensively modified by earthworks associated with the previous development of Pacific Place. During the most recent investigation in July 2008, the site level typically varied from RL95.0 m to RL96.5 m, and is understood to have remained essentially unchanged.

The site is currently vacant and mostly covered with blue metal gravel. The ground surface along the eastern side of the site is approximately 2 - 3 m lower than the general site level. Bulk excavation was previously carried out along the eastern side of the site to approximately RL93 - 94 m to allow construction of the reinforced shotcrete wall and installation of horizontal ties below the Railway Enclosure Structure. Three rows of horizontal ties have previously been installed through the shotcrete shoring wall along the eastern side of the site.

A high-rise building (Epica) is located on the property directly to the north of the site. It is understood that the building has five levels of basement carparking, with the lowest floor level adjacent to the site at approximately RL81.5 m.

4. GEOLOGY

Reference to the Sydney 1:100 000 Series Geological Sheet indicates the site is underlain by Ashfield Shale and that the areas further to the east and west are underlain by Hawkesbury Sandstone. Ashfield Shale typically comprises black to dark grey shale and laminite (interbedded shale, siltstone and fine grained sandstone) and typically weathers to form clays of

medium to high plasticity. Hawkesbury Sandstone typically comprises medium to coarse grained quartz sandstone with some shale bands or lenses. The geological mapping was confirmed by the previous investigations which identified residual soils then shale overlying interbedded fine grained sandstone and laminite (Mittagong Formation) then sandstone bedrock at depth. The Mittagong Formation is a transitional rock unit often encountered between the Ashfield Shale and Hawkesbury Sandstone.

5. SUMMARY OF PREVIOUS FIELD WORK METHODS

A brief description of the previous investigations undertaken on the site is provided in Section 2. Reference may be made to the previous DP reports for more detailed information. In summary, the previous investigations on the site have included a total of ten bores and three cone penetration tests. The bores were drilled vertically with the exception of BH9 and BH11 which were drilled at an inclination of 20 degrees from vertical.

The bores were drilled using truck-mounted drilling rigs and taken to depths of between 13 m to 31.5 m. The bores were drilled initially to depths of between 1.5 m to 11.5 m with 110 mm diameter continuous spiral flight augers. The bores were then cased and continued into the underlying rock using NMLC diamond core drilling equipment to obtain continuous 50 mm diameter core samples of the bedrock.

Standard Penetration Tests (SPTs) were carried out within the bores. Undisturbed samples of residual clay were collected at some locations using a 50 mm diameter thin walled sampling tube.

The rock cores recovered from the bores were returned to the DP office where they were logged by an engineer/geologist, the cores photographed and Point Load Strength Index (Is_{50}) tests carried out on selected samples of the rock core.

Groundwater observations were made during auger drilling of the bores and the use of water during rock coring precluded further measurement of groundwater levels. A groundwater

monitoring well was, however, installed in BH7 to allow for measurement of groundwater levels (this well cannot be located and was probably destroyed or covered by backfilling).

6. SUMMARY OF PREVIOUS FIELD WORK RESULTS

The detailed results of the previous bores are given in the Test Bore Reports in Appendix B, together with colour photographs of the rock core samples (for BH507, 508 and 509 only) and notes defining classification methods and descriptive terms. The rock strength terminology and classification system used for the earlier bore logs from 1984 and 1988 has been replaced, however, a copy of the earlier notes is also included in Appendix B for reference.

6.1 Stratigraphy

The bores drilled during the various phases of site investigation revealed a relatively uniform stratigraphy of overburden soils and bedrock, with only the upper shale sequence (Ashfield Shale) showing a significant degree of weathering over the upper 5 – 8 m zone. The more recent bores from 2000 and 2002 generally indicated a marginally increased rock strength when compared to the earlier bores from 1984 and 1988, particularly for the deeper medium to high strength rock. For example, shale that was logged as “medium” strength in the 1988 bores was generally logged as “medium to high or high” strength in the nearby 2000 and 2002 bores. The earlier bores were logged on the basis of visual and tactile assessment of the rock core (with limited UCS testing) whereas the more recent bores included regular point load strength testing of the rock core to assess the rock strength. Therefore, the recent bores are considered to be more accurate that the previous bores, which were logged more conservatively based on limited testing.

The general sequence of materials subsurface conditions encountered at the bore locations can be summarised as follows:

- **FILLING**: following previous site earthworks and reference to the most recent investigation in July 2008, the depth of filling is expected to vary from approximately 0.5 - 3 m. The filling

is typically poorly compacted and comprises a mixture of sand, clay and gravel with various inclusions The filling was typically overlying,

- **RESIDUAL SOIL**: comprising clays and silty clays, typically in a stiff to very stiff condition and extending to depths of 2 - 3m below the natural (original) ground surface. Where previous bores were drilled through the rail embankment, the natural clays at first were soft to firm only. The residual clays were typically overlying,
- **ASHFIELD SHALE**: comprising a sequence of laminite, shale and siltstone layers, probably representing the Kellyville Laminite and Rouse Hill Siltstone members. The upper 5 - 8 m of this geological unit was generally extremely low to low strength (i.e. UCS< 5 - 7 MPa), being extremely to moderately weathered. Below this upper weathered zone, the slightly weathered to fresh shale is typically medium to high strength and dark grey to black in colour. The competent medium to high strength Ashfield Shale generally occurs below 10 – 13 m depth below the current surface level. The cores of the Ashfield Shale showed a high incidence of fracturing and bedding defects, though some of the fracturing was almost certainly caused by the core drilling operations. Bedding defects and jointing within the Ashfield Shale is described in greater detail in Section 6.2. In the deeper bores, this unit was underlain by,
- **MITTAGONG FORMATION:** comprising a sequence of fresh, fine grained sandstone, siltstone and laminite, generally of medium to high strength and approximately 4 m thick. The deepest bores from the previous investigation (BHs 7, 11, 8 and 16) indicated that the Mittagong Formation was underlain by,
- **HAWKESBURY SANDSTONE:** fresh, medium and coarse grained sandstone that is typically medium to high strength. The upper surface of the Hawkesbury Sandstone occurs at around RL72 m to RL73 m, being 23 - 24m below the current surface level.

6.2 Rock Mass Defects

Most of the bores intersected subvertical and moderate dipping (30 - 70°) joints within the Ashfield Shale. In particular, the angled bores indicated a high incidence of random jointing, with many of the joints having dip angles of between 30° and 70°. The joint spacing and dip angle varied considerably, with very closely spaced joints in a number of the bores indicating

possible localised faulting. The joint surfaces were often slickensided, and occasionally showed evidence of shearing, consistent with strain (i.e. movement) associated with faulting. The various joint sets are recorded in detail on the Test Bore Reports.

Where the bores sampled the underlying Mittagong Formation and Hawkesbury Sandstone, only a moderate and minor incidence of fracturing or bedding defects were noted, respectively.

A number of significant weaker zones, clay seams and sheared zones associated mainly with the bedding were noted in the rock cores, these being prevalent mainly around the boundaries between the major formations defined above. The clay seams were typically up to 30 – 50mm thick and may either be associated with old erosional deposition boundaries, horizontal shearing or be caused by differential weathering due to stress concentration close to the boundaries of the major depositional beds arising from warping and folding of the rocks.

6.3 Groundwater

At most locations, no free groundwater was encountered during augering in the upper clays and weathered rock, and the use of water as a drilling fluid precluded any observations of groundwater inflow while coring the underlying bedrock. Groundwater seepage was observed during augering in BH8 and BH13 at depths of 6.7 m and 4.6 m, respectively. Groundwater was measured in a groundwater monitoring well installed in BH7 at a depth of 6.3 m (RL92.6).

7. LABORATORY TESTING

Laboratory testing for the 1984 and 1988 investigations comprised shear strength and consolidation testing of the overburden soils, chemical analysis of groundwater for pH, soluble sulphate and chloride content and Unconfined Compressive Strength (UCS) and accelerated weathering testing of typical rock core samples. Of particular relevance are the results of chemical analysis and accelerated weathering tests, which indicated the groundwater was mildly aggressive to unprotected steel, and that the laminite and lower siltstone units of the Ashfield

Shale were moderately and highly susceptible to weathering respectively. Weathering tests undertaken on Mittagong Formation indicated it was relatively resistant to weathering.

For the 2000 and 2002 investigations, Point Load Strength Index (Is_{50}) tests were conducted on selected intact specimens of rock core at depth intervals of 0.5 - 2.0 m. The results indicate Is_{50} values in the range 0.1 MPa to 1.6 MPa. Unconfined Compressive Strengths (UCS) were estimated from these results using an established correlation with Point Load Strength Index which generally uses UCS : Is_{50} ratio in the range of 15 to 20 : 1. A correlation ratio of 20 was adopted for estimation of UCS, which was then used for interpretation of rock classification based on Pells et al. (1998) [Reference 1]. Therefore the range of UCS was between 2 MPa and 32 MPa for the Ashfield Shale (i.e. “very low to high strength”). The results of the Is_{50} tests are shown on the Test Bore Reports at the appropriate depths.

8. GEOTECHNICAL MODEL

The rock encountered in the bores has been classified in accordance with the procedures given in Reference 1. Two geotechnical cross-sections (Sections A-A' and B-B') showing the interpreted subsurface profile between the bores are shown on Drawings 2 and 3 in Appendix A. The sections show interpreted geotechnical divisions of underlying soil and rock together with the current ground surface level and extent of the proposed basement. Reduced Levels (RLs) at the top surface of the various rock classes, at individual bore locations are shown in Table 1.

As described in Section 6.1, the more recent bores from 2000 and 2002 generally indicated a marginally increased rock strength when compared to the earlier bores from 1984 and 1988, particularly for the deeper medium to high strength rock. The recent bores are considered to be more accurate than the previous bores, which were more conservatively logged based on limited laboratory strength testing of the rock cores. In most cases, the classification of the medium to high strength rock has been based on the more recent bore data.

It should be noted that the interpreted boundaries shown on the sections are accurate at the bore locations only and layers shown diagrammatically on these drawings are based on inferred strata boundaries only. Variations should be expected away from the bores.

Zones of higher strength material occurred within the rock mass pertaining to each rock class. These higher strength zones have sometimes been included within a lower rock class due to the degree of fracturing or limited layer thickness of the higher strength rock. In other words, some zones of higher strength rock have been down-rated due to the presence of significant defects observed in the rock cores. Reference should be made to the Test Bore Reports for full details of inferred rock strengths.

Table 1 – Summary of Depths (and Reduced Level) to Top of Various Rock Strata

Bore Location	Surface RL (AHD)	Depth & Reduced Level to Top of Various Rock				
		Class V	Class IV	Class III	Class II	Class II-I
7	98.9	10.0 (88.9)	11.9 (87.0)	14.0 (84.9)	15.0 (83.9)	16.0 (82.9)
8	94.8	4.5 (90.3)	6.3 (88.5)	8.0 (86.8)	11.9 (82.9)	13.0 (81.8)
9 (inclined)	99.2	12.2 (87.8)	-	17.1 (83.1)	18.9* (81.4)	-
11 (inclined)	99.0	8.4 (91.1)	9.5 (90.1)	15.0 (85.0)	16.8* (83.2)	-
12	95.0	0.9 (94.1)	1.5 (93.5)	3.0 (92.0)	11.8 (83.2)	13.0 (82.0)
13	99.3	7.8 (91.5)	9.5 (89.8)	10.0 (89.3)	15.0* (84.3)	-
16	99.6	6.0 (93.6)	6.5 (93.1)	8.6 (91.0)	15.5* (84.1)	-
507	96.3	-	2.2 (94.1)	9.5 (86.8)	12.8 (83.5)	14.6 (81.7)
508		4.0 (90.5)	4.3 (90.2)	-	9.3 (85.2)	11.6 (82.9)
509		2.2 (92.6)	-	4.1 (90.7)	10.2 (84.6)	10.8 (84.0)

Notes: - Rock classification is based on Reference 1
- Bracketed numbers are the Reduced Level (to AHD) for the top of the stratum
* Class II rock in BH9, 11, 12, 13, 16 is possibly Class II-I rock based on reference to more recent bores.

Based on the bore information the rock mass over the proposed depth of excavation is relatively fractured, with numerous joint sets and some sheared zones dipping between 30° and 70° and also subvertically. Table 2 below (from DP Report 28994A, dated 2001) indicates a number of commonly occurring joint sets within the Ashfield Shale, based on mapping of the western batter exposed at the time of the 2001 investigation and also information from sites elsewhere within Ashfield Shale.

Table 2 – Commonly Occurring Joint Sets within the Ashfield Shale

Joint Set	Predominance	Dip Angle (degrees)	Dip Direction (degrees)
i)	Major	80 - 90	180 - 210
ii)	Major	70 - 90	000 - 030
iii)	Major	65 - 90	240 - 280
iv)	Major	55 - 90	040 - 090
v)	Minor	25 - 45	300 - 325
vi)	Minor	15 - 30	340 - 020
vii)	Minor	15 - 40	160 - 200
viii)	Minor	20 - 45	075 - 095

Subsequent mapping undertaken by DP within the deep excavations to the north of the site (within Pacific Place) provided new data which was analysed and presented in the DP Report "Review of Geological Data and Perimeter Shoring" (Reference No. 28994G, dated April 2002). Incorporation of the new data from within Pacific Place and deletion of the minor joint sets and features of less than 5 m lateral persistence confirmed the presence of joint (and fault) sets v) and vii) with an additional joint orientation of 40 - 50/110 - 120 (dip/dip direction), designated joint set ix).

Orientations of known faults and sheared zones on other Chatswood sites within the Ashfield Shale are shown in Table 3.

Table 3 – Summary of Main Joint Set Orientations

Joint Set	Dip Angle (degrees)	Dip Direction (degrees)
iv	50	050
iv	50	090
ix	50	120
vii	60	170
and a group with the range		
iii & v	30 - 55	260-330

With respect to the hydrogeology or groundwater situation of the present site, some groundwater seepage has been noted previously within the less weathered, fractured Ashfield Shale. Also, minor localised perched groundwater is expected within the filling and to a lesser extent within the natural clay soils. Relatively minor seepage flows were encountered in the previous deep excavations within Pacific Place. It is likely that the groundwater seepage condition at the site

has altered to some extent due to the previous deep excavations to the north and east of the site, which effectively act as a sump, thereby dewatering for some distance around the excavation.

9. PROPOSED DEVELOPMENT

Based on preliminary plans provided by Mirvac Design (dated 12 July 2010) it is understood that the proposed development on this site will comprise the construction of one multi-storey residential building with five to seven basement levels.

Along the eastern side of the site, adjacent to the rail line, the proposed basement level (Basement 5) ramps up towards the north from RL 81.4 m to RL 82.9 m and will require excavation to depths of approximately 13 - 15 m below the existing surface levels. On the western side of the site, and set back approximately approximately 9 -10 m from the rail line, the proposed basement level (Basement 7) steps down to RL74.5 – 75.8 m and will require excavation to depths of approximately 20 – 22 m below existing surface levels.

This existing track level for the rail line is understood to be approximately RL 99.5 m and therefore the proposed Basement 5 level, adjacent to the rail corridor, will require excavation to depths of approximately 16.5 m to 18 m below the track level. The proposed lower basement floor levels are indicated on the geotechnical cross-sections presented in Appendix A (Drawings No. 2 and 3).

Specific details of column loadings are not known at this stage, but it is expected that they will be within the range of 5,000 kN to 10,000 kN, based on experience with the previous developments within the Pacific Place precinct.

With regard to the loading from the existing rail line, Tierney and Partners Pty Ltd (T&P) now Opus International Consultants Pty Ltd (Opus), structural engineers for the Railway Enclosure Structure, previously advised a factored uniform loading of 37.5 kPa, or 600kN/m run of track for the situation where two trains pass each other. For the existing 0.9 m diameter piles supporting

the Railway Enclosure Structure, T&P advised an unfactored vertical (Working) loading of approximately 3500 kN per pile and an unfactored lateral (Working) loading of 200 kN per pile.

10. COMMENTS

10.1 Site Earthworks

10.1.1 Excavation Conditions

Based on the inferred geotechnical sections (Drawings 2 and 3), excavation will mainly be within very low to low strength shale grading to medium and high strength shale and siltstone (Class II-I) below about RL81 m to RL84 m. Medium to high strength sandstone and laminite (Class II, Mittagong Formation) is expected in Basement 7 below about RL76 m to RL77 m. The thickness of the filling and clay profile generally increases towards the south-eastern corner of the site. Prior to excavation, it should be confirmed that all temporary anchors installed for the Epica building to the north of the site have been de-tensioned and care should be taken when removing the de-tensioned anchors during the bulk excavation works.

Relatively straightforward excavation conditions are expected for bulk removal of the filling, clays and extremely to very low strength shale (Class V and IV) which should be readily excavated with conventional earthmoving equipment. It is expected that some of the low strength (Class III) shale, over the lower portion of the proposed excavation may require limited ripping by a heavy D9 class, bulldozer or equivalent. Class II Shale may require moderate ripping by a heavy bulldozer (e.g. D10 or D12) and medium to high strength (Class II and Class II-I) Shale and Sandstone/Laminite may require moderate to heavy ripping. Productivity within medium to high strength rock, particularly sandstone, may be low (even with large dozers) and therefore some pre-splitting or rock hammering may be necessary to improve efficiency. The excavation of localised areas or side trimming within Class II-I Shale and Sandstone/Laminite such as for footings or services, will generally require the use of a rotary rock saw, possibly in conjunction with a medium sized hydraulic rock hammer (e.g. Krupp 600 to Krupp 900, or equivalent).

As indicated in previous sections of this report, some localised medium to high strength rock bands may be encountered at some locations within rock units displayed on the cross-section that are normally only associated with low or even very low strength rock.

The excavation rate that can be achieved within the medium to high strength rock varies considerably and is dependent upon the degree of jointing in the rock, the rock strength, the type of machinery being used and the skill of the operator. Some of these factors vary between individual contractors and it is therefore recommended that bulk excavation tenderers be required to make their own assessment of the equipment required to carry out the work.

10.1.2 Disposal of Excavated Material

All excavated materials will need to be disposed of in accordance with the provisions of the current legislation and guidelines including the *Waste Classification Guidelines* (DECC, April 2008). This includes filling and natural materials that will be removed from site. Accordingly, environmental testing will need to be carried out to classify the materials derived from the bulk excavation works. Reference should be made to the DP waste classification report (Reference No. 45679, dated 21 July 2008) for details on the waste classification of the site soils.

10.1.3 Vibrations Arising from Excavation

During excavation, it will be necessary to use appropriate methods and equipment to keep ground vibrations at adjacent buildings and structures within acceptable limits.

The German Standard DIN4150-3 (1999) *"Structural vibration – effects of vibrations on structures"*, recommends that ground vibrations at the foundation level of residential buildings, in good condition bearing on sound rock foundations, be limited to a peak particle velocity in any component direction (PPVi) of 5, 15 and 20 mm/s at vibration frequencies of 10, 50 and 100 Hz (typical of excavation plant), respectively, in order to reduce the potential for structural damage.

Ground vibration can be strongly perceptible to humans at levels above 2.5 mm/s component PPVi. The Australian Standard AS2670.2-1990 *"Evaluation of human exposure to whole-body vibrations – continuous and shock induced vibrations in buildings (1 - 80 Hz)"* indicates an acceptable day time limit of 8 mm/s component PPVi for human comfort.

Based on reference to DIN4150, AS2670 and the experience of DP with rock excavations in Sydney, it is suggested that a provisional maximum PPVi of 8 mm/sec (applicable at the foundation level of existing buildings) be employed at this site to reduce the risk of structural damage to the surrounding buildings and Railway Enclosure Structure. The vibration limit should be reviewed following a structural assessment of the adjacent buildings and structures which may indicate that a lower or higher vibration limit may be appropriate.

DP maintains a database of vibration trial results, generally vector sum peak particle velocity (VSPPV) versus distance, which can provide guidance for the selection of excavation plant unlikely to produce frequent vibration exceedances. The database results are dependent on the individual site conditions and equipment used, hence actual vibration levels on this site may differ from predictions and a specific trial is recommended at the commencement of rock excavation.

The database suggests that buffer distances estimated from Table 4 should be maintained between various types of excavation plant and the foundations of adjacent buildings, in order to reduce the likelihood of vibrations exceeding the provisional allowed vibration Limit.

Table 4 – Approximate Buffer Distances for Excavation Plant

Provisional Allowed Vibration Limit:	8 mm/s PPVi	
Likely equivalent maximum Vector Sum PPV:	11 mm/s VSPPV	
Excavation Plant	**Buffer Distance**	
	(from trial maxima) [1]	(from trial averages)
Rock Saw on Excavator[2]	0.8 m	0.4 m
Ripper on 20t Excavator	2.5 m	0.9 m
Rock Hammer < 500 kg operating weight	5.6 m	2.2 m
Rock Hammer 501 - 1000 kg operating weight	6.3 m	2.6 m
Rock Hammer 1001 - 2000 kg operating weight	9.7 m	4.3 m
Rock Hammer > 2000 kg operating weight	6.2 m	4.3 m

1. Closer distances can often be achieved from individual trials, as indicated by those from trial averages
2. Loading effects from buildings may reduce vibration levels, to enable boundary saw cuts with few exceedances.

10.1.4 Unsupported Temporary Excavation Batters

Depending on the earthworks sequence, it may be appropriate to batter the excavation within the perimeter shoring system. The following batter slopes (Table 5) are suggested for the design of temporary unsupported cuts of up to 4 m height:

Table 5 – Recommended Safe Batter Slopes for Exposed Material

Exposed Material	Maximum Temporary Batter Slope (H : V)
Filling / Residual Clay	1.5 : 1
Class IV / V Shale	1 : 1
Class IV	0.75 : 1
Class III Shale	0.5:1*
Class II Rock, or better	Vertical*

* Subject to jointing assessment by experienced Engineering Geologist

Regular inspections of the excavated faces should be undertaken by an experienced Engineering Geologist or Geotechnical Engineer at the time of excavation to assess whether localised stabilisation (e.g. rock bolting) is required to control any adversely oriented jointing within the face. Based on the significant amount of jointing with moderate and subvertical dips, noted in the rock core and from previous bulk excavation work at the adjacent building sites, it is expected that some dowelling support may be required to prevent the loss of adversely oriented wedges. If such wedges are not supported prior to excavation significant overbreak may result.

10.2 Excavation Support

10.2.1 General

Excavation is proposed up to the Railway Street boundary and also adjacent to the existing North Shore Railway Line. The excavation for Basement 7 will extend approximately 6 – 7 m below the Epica building floor level along the northern side of the site. It is understood that the excavation will be set back approximately 5 m to 10 m from the Help Street boundary. Retaining structures will be required both during the construction phase and as part of the final structure where the excavation adjoins the boundaries of the site. Support of the rail corridor and Railway Enclosure Structure, along the eastern site boundary is addressed separately in Section 10.2.7.

Most of the soil and weathered rocks will stand vertically for various periods of time, with instability developing over time through erosion, drying and shrinkage, or the formation of blocks sliding along adversely oriented fracture planes. Mass instability could also develop due to sliding on low and moderately dipping joints associated with minor thrust faulting, common in Ashfield Shale in the Chatswood area.

Temporary shoring may be designed to be incorporated within the permanent excavation support. Alternatively, the final structure may be used to prop or brace the retaining wall system in the longer term, so that temporary anchors may be released (i.e. untensioned). Shoring support methods will generally require tie-back anchors for stability, particularly where limiting ground movements behind the wall is essential. The legal implications of the use of rock anchors extending onto neighbouring properties and public land will need to be considered. Approval should be sought from Council and adjacent property owners.

The following shoring options may be considered for the support of such excavations:

- **Contiguous Pile Wall** – Consisting of closely spaced, or almost touching, bored (or Continuous Flight Auger) and socketed reinforced concrete piles. The wall may form part of the final structure, sealed by a shotcrete panel facing that is constructed as the bulk excavation progresses. Multiple rows of ground anchors tied into waling beams are generally required.
- **Soldier Pile/Infill Panel Wall System** – Consisting of bored or CFA, rock socketed piles installed on or behind the excavation line, at typical intervals of 2 – 3 m centres. As excavation proceeds, structurally reinforced shotcrete infill panels, or similar, are constructed in between the piles. The piles can often be designed to also provide foundation support for the perimeter of the structure. Piles are normally drilled with a minimum “toe in” design to provide lateral restraint at the base of the excavation based on the passive resistance of the rock in which the pile is socketed. Again, multiple rows of ground anchors are expected for this site.

Soldier piles in conjunction with reinforced shotcrete panels have been used on the other development sites within Pacific Place and are commonly used in Sydney for excavation support in cohesive soils overlying weak rocks. The exposed soil and rock profile in between the soldier piles is expected to be temporarily self-supporting for panel depths of up to about 2 m, until the

ground anchors are installed and the reinforced infill panels are constructed. At no stage should progressive vertical excavation exceed about 2.5 m without infill panel support being constructed. However, a maximum depth increment of 1.0 – 1.5 m is recommended for excavation over the upper 2 – 3 m of the profile. It is possible that adverse jointing may cause localised instability in the exposed material (e.g. unstable wedges) which may require remedial measures prior to shotcreting. Regular inspection of the excavated faces in between soldier piles should be carried out by an experienced Engineering Geologist/Geotechnical Engineer during the course of excavation works to advise further on such stabilisation measures, as well as to record the orientation of the joints and faults. This latter information can be used to refine the final support design.

It is recommended that soldier piles or other perimeter wall piles, are founded a minimum of two pile diameters below the bulk excavation level (or any perimeter drainage trenches), except where required to carry structural loadings from the proposed building. In this instance, longer rock socket lengths will generally be required. Soldier piles may be designed on the basis of the allowable foundation pressures given in Section 10.4.2, to carry structural compression loads associated with the proposed buildings. Alternatively, soldier piles may be terminated above the bulk excavation level in at least Class II rock, with support below this level provided by rock anchors. Soldier piles terminated above the bulk excavation level should be supported by at least two rock anchors with one located close to the pile toe.

Along the northern side of Basement 7, the excavation below the Epica Building floor level should expose Class II-I Shale overlying Class II Sandstone/Laminite at about RL76 m to RL77 m. Support of this excavation may be achieved using pattern bolting (permanent bolts). This option will probably require heavily reinforced shotcrete walls below any nearby footings.

Consideration of two alternative wall loading conditions will generally be required for the design of retaining structures, the first taking into account horizontal pressures due to the soils and weathered rock material and the second taking account of potential sliding along adversely oriented, continuous joints. The following sections present recommendations on the two alternative retaining wall design conditions.

10.2.2 Earth Pressure Design

The design of retaining structures to support earth pressures for conditions such as those encountered on this site is normally a subjective process, based on presumptive values. The design is often a compromise between a solution whereby the reimposition of lateral restraint equal to pressures calculated using a value of earth pressure in-situ or "at-rest" (K_O) is applied and an approach in which a lesser earth pressure value is adopted, recognising that some lateral movement of the restraint system due to stress relief is acceptable.

Excavations braced, anchored or propped, either temporarily or permanently will be subject to earth pressures above the top of the Class III Shale (refer to Drawings 2 to 3).

Design for lateral earth pressures for a multi-anchored wall system may be based on a uniform rectangular earth pressure distribution of 6H, where H is the depth to the top of the Class III Shale. For situations where only minor lateral movements are acceptable, such as the support of sensitive structures or services, an increased (uniform) pressure of 8H should be adopted, depending on the level of restraint required. A uniform pressure of 10 kPa should be adopted for the support of Class III Shale or better quality between soldier piles and/or anchors to account for minor joint wedges that may become mobilised. The additional lateral pressures due to surcharge loading (e.g. pavements and construction related activities) behind the wall must also be considered.

The earth pressure formulation provided above does not include either earthquake loads or hydrostatic pressure due to the build-up of groundwater behind any retaining wall. If drainage behind the wall is not provided it will be appropriate to reduce the density of soil/rock below the water table and allow for full hydrostatic pressure below about 2 m.

Wall support piles may be designed to extend below the base of the excavation and develop passive resistance at the base of the piles. In estimating the minimum "toe-in" length where this approach is adopted, the ultimate passive pressures shown in Table 6 below are suggested for design based on the nature of the founding material.

Table 6 – Ultimate Passive Pressure for Minimum "Toe-In" Design

Material	Ultimate Passive Pressure (kPa)
Class IV Shale	500
Class III Shale	1500
Class II Shale (or better)	5000

It should be noted that the ultimate values shown above may be considered below one pile diameter beneath the bulk excavation level and will need to incorporate a factor of safety. Piles should also found at least two pile diameters below the bulk excavation level (or perimeter drainage trenches), except when required to carry structural loadings from the proposed building, where longer rock sockets will generally be required. Soldier piles supporting structural compression loads should be apportioned based on the allowable foundation pressures given in Section 10.4.2.

Detailed design of shoring should preferably be carried out using WALLAP, FLAC or other accepted computer analysis programs capable of modelling progressive excavation and anchoring and predicting potential lateral movements, stresses and bending moments.

10.2.3 Inclined Joint Design

10.2.3.1 General

In jointed Ashfield Shale such as exists on this site, the possibility of adversely oriented rock wedges bounded by joints "daylighting" on the face or at the base of the cut should be considered. Such an occurrence could result in a major block failure, which may not be adequately resisted by a retaining wall system designed to support the earth pressures defined in Section 10.2.2. "Failure" generally refers to the mobilisation (i.e. slippage) of a rock wedge that is associated with a resultant thrust or pressure on the back of the wall.

The stability of jointed rock masses is essentially dependent on the presence, shear strength, orientation and continuity of joints, bedding planes or fault planes within the rock mass. While it is not possible to determine the overall 'factor of safety' relating to a rock slope, it is possible to determine a factor of safety for a given model or mechanism (e.g. such as a combination of joints) along which a failure may occur.

The stability of a specific wedge can then be assessed, based on known or assumed joint strength properties. However, for any assumed mechanism, there is a probability regarding the likelihood of its occurrence. Thus, for example, it may be possible to postulate a factor of safety of less than 1 for a particular assumed mechanism, but there may be a probability of only one in 10,000 that such a mechanism could occur.

Experience with deep excavations in Ashfield Shale is that through going faulting dipping both at 45° and near the horizontal is not uncommon and a number of slope failures along such faults have occurred at other sites, with some smaller minor wedge failures observed within the Pacific Place precinct. Since the drilling carried out to date has identified numerous 30° to 50° dipping joints and faults and thin horizontal sheared seams, the possibility of continuous sheared zones or other weak interfaces can not be discounted.

10.2.3.2 Assessment of Mobilised Wedge Loads

On the basis of the joint and fault sets measured at this and other nearby sites, three general failure mechanisms have been considered, assuming that these defects were continuous over a sufficient strike length to be significant. Bedding defects were also assumed to be continuous, though flat lying. The three types of theoretical failure mechanisms are summarised as follows:

- **Type 1**: Planar failure on a joint/fault dipping at 45°, striking parallel to and "daylighting" at the toe of the excavation.
- **Type 2**: Wedge failure formed by the intersection of joints/faults dipping at 45° with dip directions of 020°, 110°, 200° and 290°.
- **Type 3**: Wedge failures formed by the intersection of joints dipping in the range 55 - 80°, with dip directions in the range 000 - 280°.

Computer based stability analyses were carried out for each of the above theoretical failure mechanisms assuming the following material and (drained) strength parameters:

- Shear strength at interface: ϕ = 25°, c = 0 kPa.
- Average bulk unit weight of shale wedge (γ) = 21 kN/m^3

It is noted that there are different factors of safety on differently oriented faces. However, for the sake of simplicity the worst case situation for each failure type has been presented in Table 7.

These anchor loads are for an assumed rock wedge only and do include allowance for surcharge loads, which must also be included in the design.

Table 7 – Results of Stability Analyses for Defined Failure Mechanisms

Failure Type	Factor of Safety	Anchor Load (kN/m)	Remarks
1	1.0	$4.2h^2$	- Temporary anchors on perimeter shoring. - Anchors installed at 10° below horizontal.
2	1.0 1.3 1.6	$1.25\ h^2$ $2.4\ h^2$ $3.2\ h^2$	
3a (individual wedges)	1.0	$1.2\ h^2$ to $2.2\ h^2$	- Horizontal loading on to perimeter wall.
3b (over-lapping wedges)	1.0 1.3 1.6	$2.6\ h^2$ $2.9\ h^2$ $3.65\ h^2$	
3c (adjacent wedges)	1.0 1.3 1.6	$1.3\ h^2$ $1.45\ h^2$ $1.83\ h^2$	

Notes: 1. h = height of excavation face in metres
2. Anchor Load = horizontal force in kN applied over a 1m wide strip over depth h.

The above table indicates that in the case of the 45 degree dipping joints/faults, the worst situation (but considered to be the least likely) would result from planar type failure (Type 1). The table also indicates that in the case of the most likely wedge failures (Type 3) the worst situation would result from overlapping of the assumed wedges (Type 3b). A more likely worst case situation based on observation of failures in similar major shale excavations (e.g. brick pits), would result from a series of adjacent individual wedges (Type 3c) along the face of the excavation. In this case the horizontal loads would be half of those required for the overlapping wedges situation.

Although the Type 1 failure mechanism is considered to be extremely unlikely, in view of the sensitivity of the North Shore Rail Line and the Epica Building, it is recommended that the permanent anchor/bolt support along these excavation faces should be designed for this mechanism (i.e. **$4.2h^2$ in kN/m** for the combined anchor load per metre length of wall). A factor of safety of unity (1.0) may be adopted for this design approach given that it assumes an unlikely combination of adverse factors likely to be encountered on the site. In this way, all other failure

mechanisms will be adequately covered. Preliminary design along the Epica Building frontage could assume a 45 degree wedge extending up from the top of Class II Sandstone/Laminite at about RL76 – 77 m. Surcharge loads, particularly concentrated footing loads for the Epica Building must also be included in the design.

For the Railway Street and Help Street perimeter shoring, review and analysis of the available data has identified a theoretical, worst case scenario for an individual wedge (using the joint sets identified on and near the site) which would require a design anchor load of 1.96 h^2 for a factor of safety of 1.0. To account for the possibility of overlapping wedges it is recommended that the anchor design for the Railway Street and Help Street perimeter shoring may be based upon a design anchor load of **2.5 h^2 in kN/m** for the combined anchor load per metre length of wall (for anchors installed at an angle 10° below horizontal).

To assess the required size and number of anchors it is recommended that the anchors be installed at 10° below horizontal wherever possible. This is considered to be the flattest angle that can realistically be used which will allow relatively easy anchor installation and effective grouting.

Should there be a requirement to increase the angle of installation of the anchor then, to keep a similar factor of safety to that designed for, the anchor capacity would need to be increased as shown in Table 8.

Table 8 – Increased Capacity Requirement for Steeper Anchors

Angle of Installation (below horizontal)	Required Percentage Increase in Capacity
10°	0%
15°	5%
20°	14%
25°	22%

Inspection of the cut faces during the excavation phase should be carried out by an experienced Engineering Geologist to ensure the adequacy of design. The mapping of all actual joints and faults will also allow the recalculation of the horizontal force required to restrain the actual joint wedges present for final support design. Obviously this approach to permanent support design will require considerable interaction between the Structural and Geotechnical Engineer.

10.2.4 Ground Anchor Design

Anchoring of wall piles may be accomplished by pre-stressed type anchors. Normally, ground anchors are inclined to the horizontal as steeply as possible, to allow anchoring in at least medium strength shale or sandstone. However, on this site, due to the significant depth of weathering and the significant anchor forces required to support the deeper excavations, flatter anchors that are anchored in generally low strength shale may also be considered.

For the design of anchors restraining shoring at the boundaries, bonding can be developed behind an "active" zone estimated by an imaginary line rising at 45 degrees from the base of the bulk excavation level to intersect the ground surface behind the excavated face. Bond lengths can then be estimated from the adhesion developed on the sides of the anchor calculated in accordance with the ultimate bond stresses given in Table 9.

Table 9 – Ultimate Bond Stresses for Anchor Design

Material	Ultimate Average Bond Stress (kPa)
Class V / IV Shale	100
Class III Shale	400
Class II Shale (or better)	1000

The parameters given above assume that the anchor holes are clean and adequately flushed, with grouting and other installation procedures carried out carefully and in accordance with good engineering practice. Note that these values should be used in conjunction with a reduction factor of 0.5.

It is noted that the above values are necessarily conservative, particularly for the poorer shale classes. This is based on our experience gained from testing ground anchors in these materials, where the drilling process sometimes causes the formation of a smear zone over the wall of the anchor hole. The use of higher bond stress values for anchor design may be possible but would generally necessitate the Contractor demonstrating their nominated design values by a programme of proof load testing.

After anchors have been installed, it is suggested that they be proof loaded to 125% of the nominal design Working Load and then locked-off at no higher than 60 - 80% of the Working Load until the anchors are decommissioned. Periodic checks should be made throughout the construction period to ensure that the load is maintained and is not lost due to creep effects or to other causes.

10.2.5 Excavation Induced Movements

For the relatively major excavation proposed, there is a possibility that there will be slight horizontal movements due to stress relief effects. It is not possible to make a reliable estimate of such movements, but empirical data for major excavations in Hawkesbury Sandstone suggest that they could be in the order of 0.05 -0.1% of vertical excavation height. There is relatively less recorded data on deformation movements for excavations within Ashfield Shale, as present on this site. Based on published literature and recent experience, the lateral deflections in Ashfield Shale could be in the order of 0.1 - 0.2% of the excavation height.

It is unlikely to be practicable to provide restraint for the relatively high in-situ horizontal stresses associated with stress relief mechanisms. Therefore it is recommended that appropriate allowance be made for movements of this order in construction planning and survey arrangements, etc. For example, it may be necessary to repair pavements and public utilities (e.g. buried services). With respect to adjacent structures, including the Railway Enclosure Structure, it is recommended that dilapidation surveys be carried out prior to the commencement of excavation works to allow an appropriate response to potential future damage claims.

10.2.6 Construction of Retention Systems

The construction method adopted for the retaining structures will depend in part on the extent to which it will be incorporated into the permanent structure. Finish requirements, available clearances and cost will all impact the construction method. A temporary wall can be constructed to serve as a permanent wall, with the external anchoring system replaced eventually by propping from the building structure. A satisfactory architectural finish may also be achieved by constructing a separate masonry wall inside the temporary wall.

The materials exposed in the cut face of the excavation will have the capacity to stand unsupported in the short term. For soldier pile wall systems, it will be appropriate to open up excavated faces to depths of about 1.5 m in soil and 2.5 m in shale and utilising the arching

capacity of the materials to span between the soldier piles until the ground anchors are installed and reinforced infill panels are constructed. For the temporary situation, it is considered that infill panels will be required at least down to the level of the Class V - IV Shale, and thereafter the shale could be relied upon to arch between piles provided they are not greater than 3 m apart. However, as the shale will fret with wetting and drying, it will at least require a thin layer of shotcrete to protect it. The investigations to date indicate that adversely oriented jointing and fracturing may be present in the stronger rock, and may require remedial measures and extension of the closed shoring system. It is suggested that the faces of the excavation are regularly inspected by an experienced geotechnical professional during the course of the excavation works to advise further on any additional stabilisation requirements, which cannot be reliably determined at this stage.

It is considered that the final construction of the retaining system should incorporate protection of all excavated faces by sprayed or cast concrete. As indicated by previous laboratory testing, it is likely that the clays and Ashfield Shale units will weather and degrade rapidly with time, giving rise to local instability. If the temporary wall is to be retained as part of the final structure, it may be more economical to perform final shotcreting as the excavation progresses.

Drainage is normally provided behind soldier pile/infill panel wall systems using one of a number of proprietary strip drains combining a filter fabric “sock” and cellular plastic matrix (e.g. Mebra, Nylex). A width of between 100 mm and 300 mm is usually adequate for strip drains, with one or two strip drains installed against the face of each panel (i.e. strip drains spaced at about 2 m).

The drilling of the soldier piles will require the use of a high powered piling rig capable of drilling medium to high strength shale and possibly high strength sandstone, depending on the socket depths required. Prospective piling contractors should be asked to make their own assessment on the type of equipment required to achieve the design requirements and pile depths.

10.2.7 Railway Embankment Retention System

10.2.7.1 General

The major vertical excavation along the existing rail corridor will require support during both the construction phase and for the long term. The supplied plans indicate that excavation will occur directly adjacent to the western side of the 18 m wide Railway Enclosure Structure. Further

geotechnical review of the shoring wall and existing Railway Enclosure Structure piles should be carried out prior to detailed design.

The North Shore Rail Line is a major rail artery and as such it is expected that the excavation face should be treated as sensitive to deflection. As discussed previously, it will generally not be practical to provide lateral restraint for the slight horizontal movements that are caused by stress relief. For the proposed height of excavation, such movements could be in the order 20 - 40 mm. It is recommended that the advice of the rail authority should be sought in relation to acceptable levels of lateral wall movement beneath the rail line.

It is understood that a reinforced shotcrete wall with permanent horizontal ties and inclined rock anchors will be used to support the excavation along the rail line. Generally the reinforced shotcrete panels should be constructed in maximum heights of 2.5 m for excavations in shale and 1.5 m in clay soils. The maximum excavation height should be confirmed during inspection by a geotechnical engineer. Excavation must not proceed below the panel until the reinforced shotcrete panel is constructed and the anchors are stressed. A detailed methodology and construction monitoring plan should be prepared prior to construction outlining the methodology and monitoring requirements for the excavation and shoring support adjacent to the rail corridor.

The shoring system for the other deep excavations within the Pacific Place precinct, adjacent to the rail corridor, have previously been designed by Opus. DP has previously been involved with the design of the horizontal ties and rock anchors for these shoring systems. It is understood that a similar approach will be adopted for this site, with the shoring system below the Railway Enclosure Structure to be designed by Opus in conjunction with an anchor design/review by DP. The three rows of horizontal ties adjacent to the site have previously been installed and the installation and stressing was inspected by DP.

A pier and beam foundation system support the Railway Enclosure Structure, with the piles generally extending down into, or close to the underlying Hawkesbury Sandstone. A preliminary review of the Railway Enclosure Structure piles adjacent to this site indicate that most piles adjacent to the site are socketed within sandstone and founded close to the Basement 7 level, which is located approximately 9 -10 m to the west. However, five of the Railway Enclosure Structure piles are founded in Class II-I shale within 0.8 m to 3 m below the Basement 5 level, which is adjacent to the Railway Enclosure Structure. Further review and detailed design will be

required, however, preliminary analysis by DP indicates that a permanent rock bolt with a working capacity of 200 kN will be required at the toe of Pile 23W.

The live train traffic load will act as a surcharge (advised previously by T&P) and must be included in wall design calculations.

Due to the noise and vibrations associated with the rail line, it is understood that the shoring system must be isolated from the basement walls of the proposed building. As mentioned, permanent horizontal ties and inclined rock anchors will therefore be used to provide lateral support to the shoring system. Permanent anchors require double corrosion protection and full column grouting of the anchor system, which will necessitate careful detailing, specification and construction monitoring.

It is understood that shoring will be constructed by progressive sequence of excavation and construction of the anchored, reinforced shotcrete wall, as was adopted for the previous deep excavations adjacent to the rail corridor at Pacific Place.

10.2.7.2 Design

As per the recommendations for general perimeter excavations (Section 10.2), design of the shoring system to support the rail corridor should consider both horizontal pressures due to the soils and weathered rock material, and also the potential for mobilised wedges of rock acting on the rear of the wall. In order to provide additional stiffness to the shoring system and thereby reduce lateral movement, the maximum rectangular pressure distribution developing in the overburden filling and natural clays should be based on 8H kPa, where H is the overall depth of the combined filling and clay.

With regard to design for potential rock wedge failures, preliminary support design may be based on the loads generated by the Type 1 wedge failure for the temporary shoring situation (i.e. a combined anchor load of $4.2h^2$ in kN/m length of wall).

All forms of analyses should take due account of potential earthquake and surcharge loadings (e.g. rail traffic), or other relevant possible loads. Also, hydrostatic pressures due to the build-up of groundwater behind retaining walls should be included if drainage behind the wall is not

provided. In this case it would generally be appropriate to reduce the density of soil/rock below the water table and allow for full hydrostatic pressure below about 2 m.

Below the level at which Class III Shale is first encountered, a uniform horizontal pressure of 10kPa should be applied to the cut faces of the rail easement. This pressure is necessary to safeguard against localised slope failure induced by combined jointing/faulting and bedding defects in the rock, between rock anchors.

10.2.7.3 Monitoring of Lateral Deflections

Due to the importance of the shoring system supporting the rail line, it is recommended that a comprehensive monitoring regime be carried out during the bulk excavation phase to measure progressive lateral movement. This will generally require the installation of numerous markers for precise surveying to enable movement monitoring to within 1 mm accuracy. Also, it will be necessary to carry out regular proof-load checks for the anchors to ensure that the load is maintained and that there is minimal load loss due to creep or other factors.

10.2.7.4 Induced Electrical Currents

Attention is drawn to the probability of induced currents from the railway lines causing corrosion of steel in permanent anchors installed below track level. Previous discussions with a consultant electrical engineer who specialises in earthing, suggest that the possibility of electrolytic corrosion of steel anchors can not be dismissed. It is recommended that appropriate testing be carried out on a few installed anchors to assess this risk.

10.3 Groundwater

During construction groundwater inflow into the excavation will be experienced in the form of seepage. It is expected that groundwater seepage may be readily handled by normal “sump-and-pump” techniques.

At this stage it would be difficult to reliably estimate the flow rate into the excavation once all construction has been completed and the phreatic surface lowered. It is suggested that observation of groundwater inflow be made during the final stages of the excavation when the water table has been lowered to near the equilibrium condition before finalising design.

Tests previously conducted on groundwater samples from two bores indicate moderately acidic conditions at the site. This could have an adverse effect on buried steel due to corrosion. Corrosion rates are unlikely to affect the strength of steel components during the construction phase, however, the design of permanent steel structural elements should be reviewed in light of the moderately aggressive groundwater. Further tests could be conducted on representative samples of groundwater, possibly taken from seepage water entering the excavation below the surface filling and soil before finalising the design.

It is considered likely that the most suitable permanent dewatering system would comprise a system of subfloor drains and strategically located sumps installed beneath the lowest basement floor slabs for periodic pumping.

Previous experience indicates that the groundwater within Ashfield Shale can have moderate concentrations of dissolved solids including iron. Once groundwater comes into contact with the atmosphere, precipitation of iron oxides is likely to occur and provision should be made for the periodic filtering and/or cleaning of this precipitate from subsoil drains, sumps, pumps and other fittings.

10.4 Foundations

10.4.1 General

It is anticipated that Class II and II-I Shale will be exposed at the proposed bulk excavation level for Basement 5 and Class II Sandstone/Laminite will be exposed at the bulk excavation level of Basement 7, as indicated an Drawings 2 and 3. High level pad footings should be suitable to support the expected columns loads.

10.4.2 Design Parameters

Recommended maximum allowable pressures and modulus values for the range of possible foundation materials encountered in bores at the site are presented in Table 10. Parameters for clay and Class III-V Shale are provided in case design of smaller isolated structures are required beyond the building footprint. These parameters apply to the design of high level foundations, such as pads or strip footings, or for socketed bored piers.

Table 10 – Recommended Design Parameters & Moduli for Foundation Design

Foundation Stratum	Classification[1]	Maximum Allowable Pressure		Field Elastic Modulus (MPa)
		End Bearing (MPa)	Shaft Adhesion[2] (kPa)	
Residual Clay	Not Applicable	0.3	40	15 – 30
Shale, Laminite or Siltstone	V	0.7	60	50
	V / IV	0.8	80	100
	IV	1.0	100	200
	III	3.5	300	500
	II	6.0	500	1000
	II / I	8.0	650	2000
Sandstone	IV	3.0	300	400
	III	5.0	500	1000
	II	8.0	800	2000
	II / I	10.0	1000	2500

Notes:
1. Classification based on Reference 1 (Pells et al. 1998).
2. Shaft adhesion applicable for the design of bored piers, uncased over rock socket length, where adequate sidewall cleanliness and roughness achieved.

The foundation design parameters given in the above table assume that the foundation excavations (e.g. pads or piles) are clean and free of loose debris, with pile sockets free of smear and adequately rough immediately prior to concrete placement.

Foundations proportioned on the basis of the above parameters would be expected to experience total settlements of less than 1% of the footing width (or pile diameter) under the applied Working (i.e. Serviceability) Load, with differential settlements between adjacent columns expected to be less than half of this value.

Where pad (shallow) foundations or pile shafts are above a line extending upwards at an angle of 45 degrees from the base of an excavation, reduction of the allowable bearing pressure or shaft adhesion parameters may be appropriate. Specific advice should be sought where this situation occurs.

All footings should be inspected by an experienced geotechnical professional prior to the placement of steel and concrete. With regard to proving of high level foundations, attention is drawn to the suggested minimum requirements set out in Reference 1. In particular, “spoon”

testing (or proof core drilling) should be undertaken in at least one-third of high level footings proportioned on the basis of an allowable bearing pressure of between 3500 kPa and 6000 kPa. For high level footings proportioned on the basis of an allowable bearing pressure of greater than 6000 kPa, "spoon" testing should be undertaken at all footing locations. The purpose of "spoon" testing is to check that no significant weak seams exist within a depth of 1.5 times the least footing dimension below the foundation level.

10.5 Design for Earthquake Loads

In accordance with AS1170 - 2007 "Structural Design Actions, Part 4 : Earthquake Actions in Australia" a hazard factor (Z) of 0.08 and a site subsoil Class B_e is considered to be appropriate for the site. This assumes that all structural loads are uniformly founded on very low strength or better rock.

11. LIMITATIONS

Douglas Partners (DP) has prepared this report for this project at 7 Railway Street, Chatswood in accordance with DP proposal dated 18 June 2010. This report is provided for the exclusive use of the Mirvac for the specific project and purpose as described in this 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. 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. 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

Reviewed by

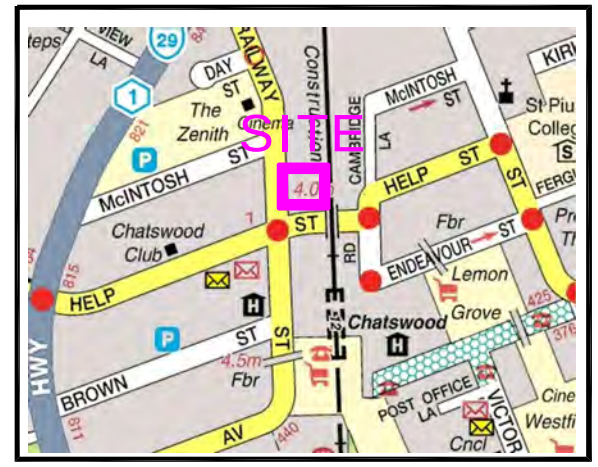
Scott Easton
Senior Associate

Bruce McPherson
Principal

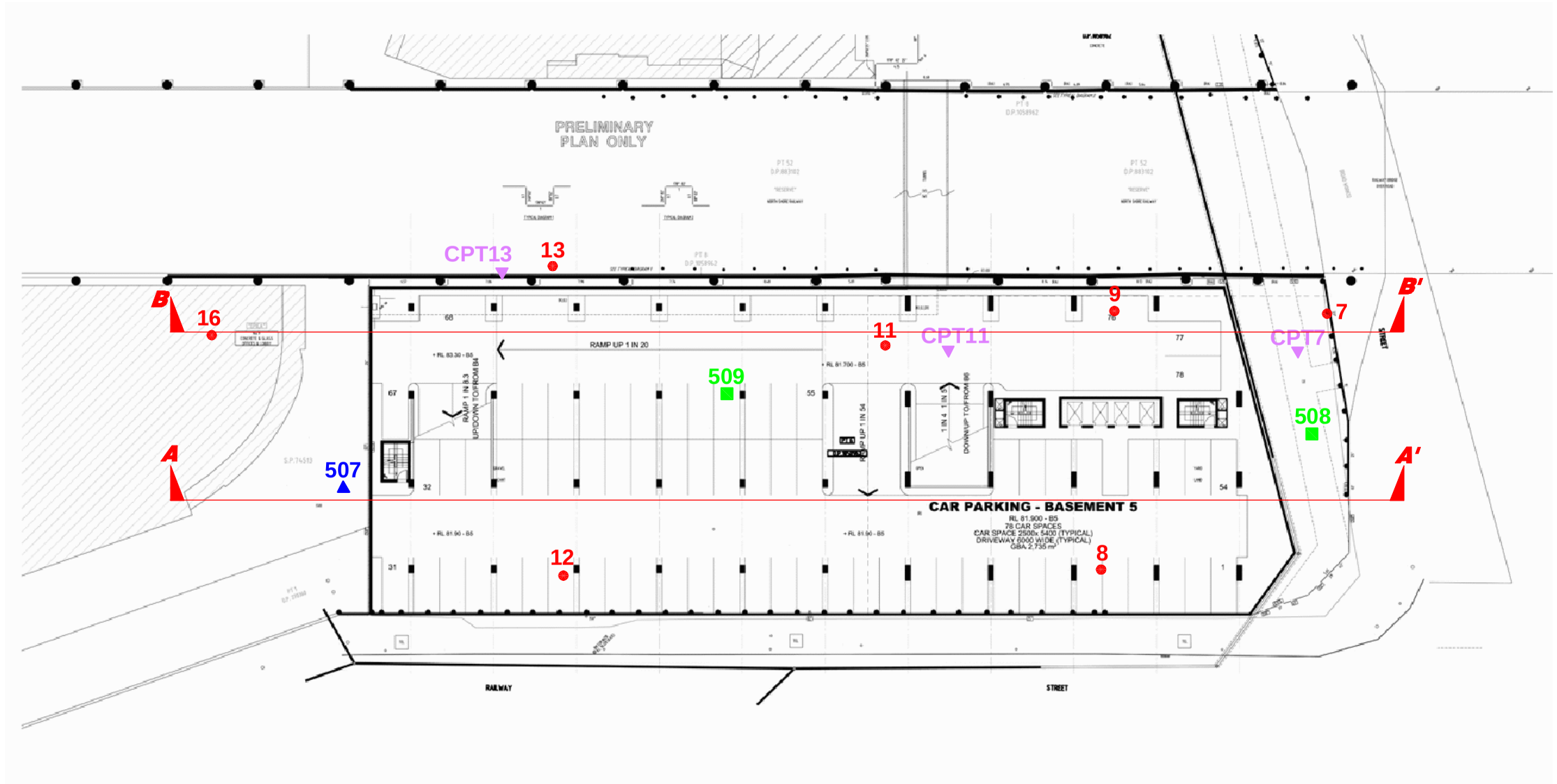
REFERENCES:

1. Pells, P.J., Mostyn, G. and Walker, B.F. *"Foundations on Sandstone and Shale in the Sydney Region".* Australian Geomechanics Journal, Vol. No. 33 Part 3, Dec. 1998.

APPENDIX A
Drawing No. 1 to 3



LOCALITY PLAN



SCALE
0 10 20 30 40 50m
1:500

LEGEND

- PREVIOUS BOREHOLE (April 1988)
- PREVIOUS CONE PENETRATION TEST (April 1988)
- PREVIOUS BOREHOLE (December 2000)
- PREVIOUS BOREHOLE (February 2002)

Douglas Partners Geotechnics · Environment · Groundwater	CLIENT: Mirvac		TITLE: **Location of Tests** **Proposed Residential Development** **7 Railway Street, CHATSWOOD**	PROJECT No: 45679.01
	DRAWN BY: PSCH	SCALE: 1:500 @ A3		DRAWING No: 1
	APPROVED BY: STE	DATE: 29.6.2010		REVISION: A

A

A'

ELEVATION (AHD)

100
95
90
85
80
75
70
65
60

507
12
509
8
508

CURRENT SURFACE (Approx.)

FILLING

CLAY

CLASS V SHALE

CLASS IV SHALE

CLASS III SHALE

CLASS II SHALE

CLASS II-I SHALE

CLASS V
CLASS IV
SHALE
CLASS III
SHALE
EPICA
RL 81.5
CLASS II SHALE
CLASS II-I
SHALE
RL 75.0
BASEMENT 7
RL 75.8
CLASS II
SANDSTONE/LAMINTE
(MITTAGONG)
CLASS II
SANDSTONE/LAMINTE
(MITTAGONG)

Bottom Depth 18 m
Bottom Depth 22 m
Bottom Depth 17.5 m
Bottom Depth 27 m
Bottom Depth 13 m

0 20 40 60 80 100 120 140

DISTANCE ALONG PROFILE (m)

SECTION A-A'

NOTE: Subsurface information is accurate at the borehole locations only. The profile may vary away from the borehole locations.

LEGEND

- CORE LOSS
- Bituminous Concrete
- Clay
- Concrete
- Filling
- Laminite
- Sandstone coarse grained
- Sandstone fine grained
- Shale
- Siltstone

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

TESTS / OTHER
- Water level
- ?— — Interpreted Geotechnical Boundary

ROCK CLASSIFICATION
I CLASS 1
II CLASS 2
III CLASS 3
IV CLASS 4
V CLASS 5
Classification in Accordance with Pells et al. (1998)

Douglas Partners
Geotechnics · Environment · Groundwater

CLIENT: Mirvac		
DRAWN BY: LD	SCALE: 1: 400 (H) 1: 200 (V)	OFFICE:
APPROVED BY: STE		DATE: 29.06.2010

TITLE: **Interpreted Geotechnical Cross Section A-A'**
Proposed Residential Development
7 Railway Street, Chatswood

PROJECT No: 45679.01
DRAWING No: 2
REVISION: 0

P:\45679.01 CHATSWOOD , Building G Pacific Place STE\Drawings\45679.01-2.dwg, 7/15/2010 11:13:55 AM

B

B'

ELEVATION (AHD)

105
100
95
90
85
80
75
70
65

16
13
509
11
9
7

CURRENT SURFACE (Approx.)

FILLING

CLAY

CLASS IV SHALE

CLASS V SHALE

CLASS III SHALE

EPICA RL 81.5

CLASS II POSSIBLY CLASS II-I SHALE

RL 82.9 BASEMENT 5

RL 82.1

CLASS V SHALE

CLASS IV SHALE

CLASS V SHALE

CLASS III SHALE

RL 81.4

CLASS II SHALE POSSIBLY CLASS II-I SHALE

RL 75.0 BASEMENT 7

RL 75.8

CLASS II SANDSTONE/LAMINTE (MITTAGONG)

CLASS II SANDSTONE/LAMINTE (MITTAGONG)

CLASS II-I SANDSTONE (HAWKESBURY)

CLASS II-I SANDSTONE (HAWKESBURY)

Bottom Depth 31.5 m

Bottom Depth 17.5 m

Bottom Depth 26.25 m

Bottom Depth 24.57 m

Bottom Depth 31 m

NOTE: Subsurface information is accurate at the borehole locations only. The profile may vary away from the borehole locations.

SECTION B-B'

0 20 40 60 80 100 120 140

DISTANCE ALONG PROFILE (m)

LEGEND

- CORE LOSS
- Clay
- Filling
- Laminite
- Sandstone coarse grained
- Sandstone fine grained
- Shale
- Shaly Clay
- Siltstone
- Silty Clay
- Topsoil

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

TESTS / OTHER
- Water level
- Interpreted Geotechnical Boundary

ROCK CLASSIFICATION
I CLASS 1
II CLASS 2
III CLASS 3
IV CLASS 4
V CLASS 5
Classification in Accordance with Pells et al. (1998)

Douglas Partners
Geotechnics · Environment · Groundwater

CLIENT: Mirvac			TITLE: Interpreted Geotechnical Cross Section B-B'
DRAWN BY: LD	SCALE: 1: 400 (H) 1: 200 (V)	OFFICE:	Proposed Residential Development
APPROVED BY: STE		DATE: 29.06.2010	7 Railway Street, Chatswood

PROJECT No:	45679.01
DRAWING No:	3
REVISION:	0

P:\45679.01 CHATSWOOD , Building G Pacific Place STE\Drawings\45679.01-3.dwg, 7/15/2010 11:12:56 AM

APPENDIX B
Notes Relating to this Report
Results of Field Work

Douglas Partners
Geotechnics · Environment · Groundwater

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

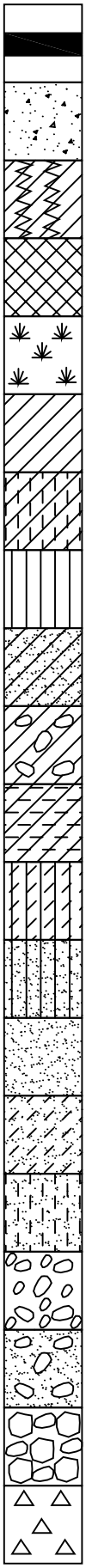
This classification system provides a standardised terminology for the engineering description of sandstone and shales, particularly in the Sydney area, but the terms and definitions may be used elsewhere when applicable.

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.

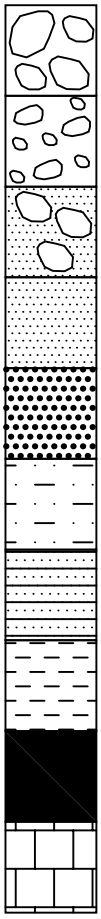
GRAPHIC SYMBOLS FOR SOIL & ROCK

SOIL



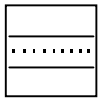
BITUMINOUS CONCRETE
CONCRETE
TOPSOIL
FILLING
PEAT
CLAY
SILTY CLAY
SILT
SANDY CLAY
GRAVELLY CLAY
SHALY CLAY
CLAYEY SILT
SANDY SILT
SAND
CLAYEY SAND
SILTY SAND
GRAVEL
SANDY GRAVEL
COBBLES/BOULDER
TALUS

SEDIMENTARY ROCK

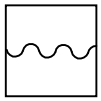


BOULDER CONGLOMERATE
CONGLOMERATE
CONGLOMERATIC SANDSTONE
SANDSTONE FINE GRAINED
SANDSTONE COARSE GRAINED
SILTSTONE
LAMINITE
MUDSTONE, CLAYSTONE, SHALE
COAL
LIMESTONE

SEAMS

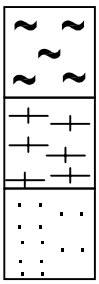


SEAM >10mm



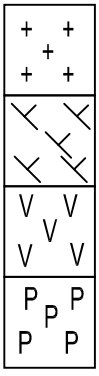
SEAM <10mm

METAMORPHIC ROCK



SLATE, PHYLLITE, SCHIST
GNEISS
QUARTZITE

IGNEOUS ROCK



GRANITE
DOLERITE, BASALT
TUFF
PORPHYRY

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DOUGLAS PARTNERS PTY LTD
PACIFIC PLACE RAILWAY SHORING - CHATSWOOD
BORE 508 PROJECT 28994 F FEBRUARY 2002
28994F BH 508
CHATSWOOD
CORE LOSS 0.100
CORE LOSS 0.700
4.30 - 9.00 M

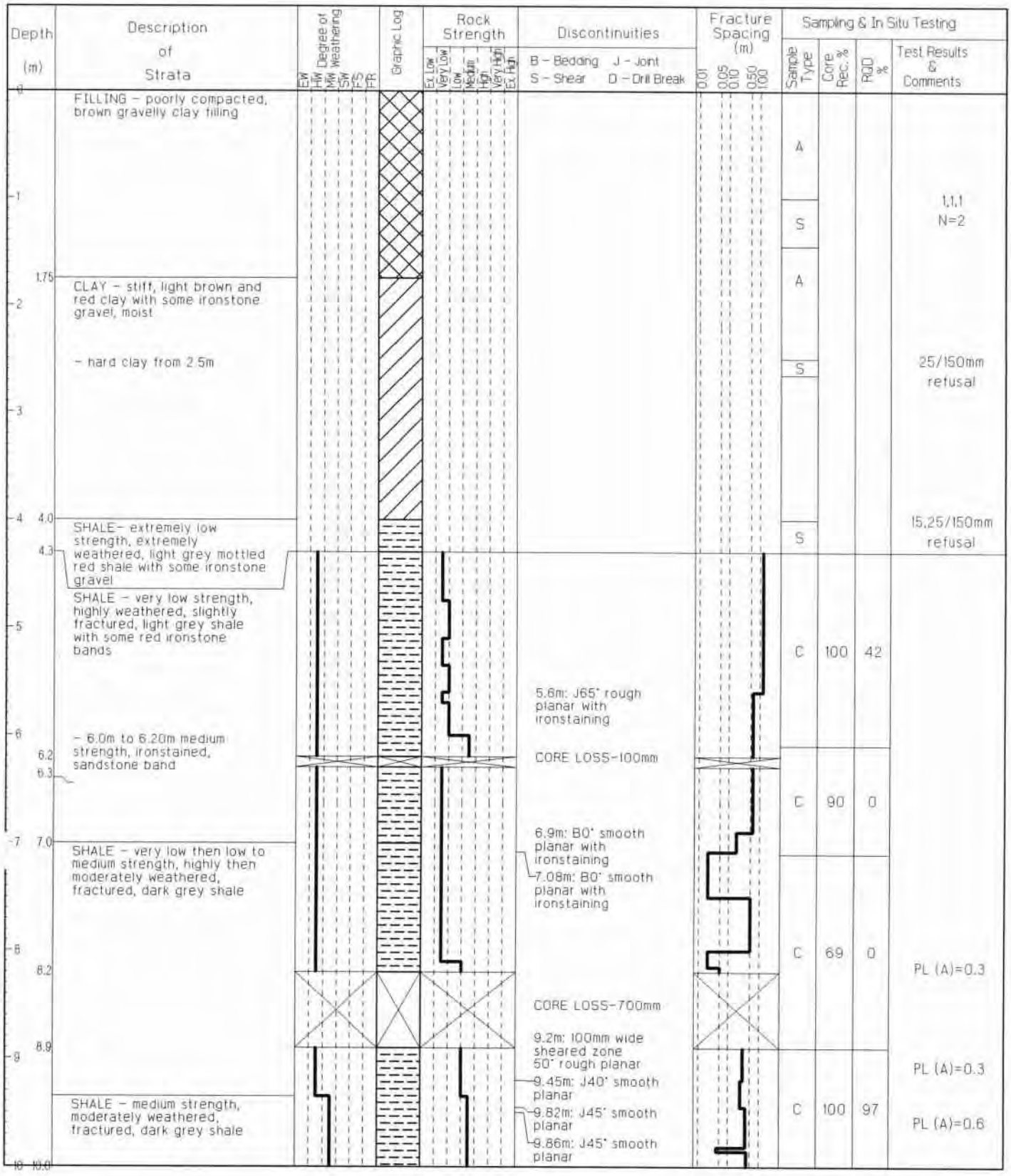
TEST BORE REPORT

BORE No: 508

CLIENT: MIRVAC PROJECTS PTY LTD
PROJECT No: 28994F
DATE: 14 FEBRUARY 02

PROJECT: PACIFIC PLACE – RAILWAY SHORING
SURFACE LEVEL: 94.5 (AHD)
SHEET 1 **OF** 2

LOCATION: RAILWAY STREET, CHATSWOOD
DIP OF HOLE: 90°
AZIMUTH:



RIG: SCOUT **DRILLER:** G COOPER **LOGGED:** WEBSTER **CASING:** GL TO 4.3m

TYPE OF BORING: SPIRAL FLIGHT AUGER TO 4.3m NMLC-CORING TO 13.0m

WATER OBSERVATIONS: FREE GROUNDWATER OBSERVED AT 1.75m

REMARKS:

SAMPLING & IN SITU TESTING LEGEND	
A auger sample	PL point load strength I_S (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp pocket penetrometer (kPa)	V Shear Vane (kPa)

CHECKED:	
Initials:	SE
Date:	27/3/02

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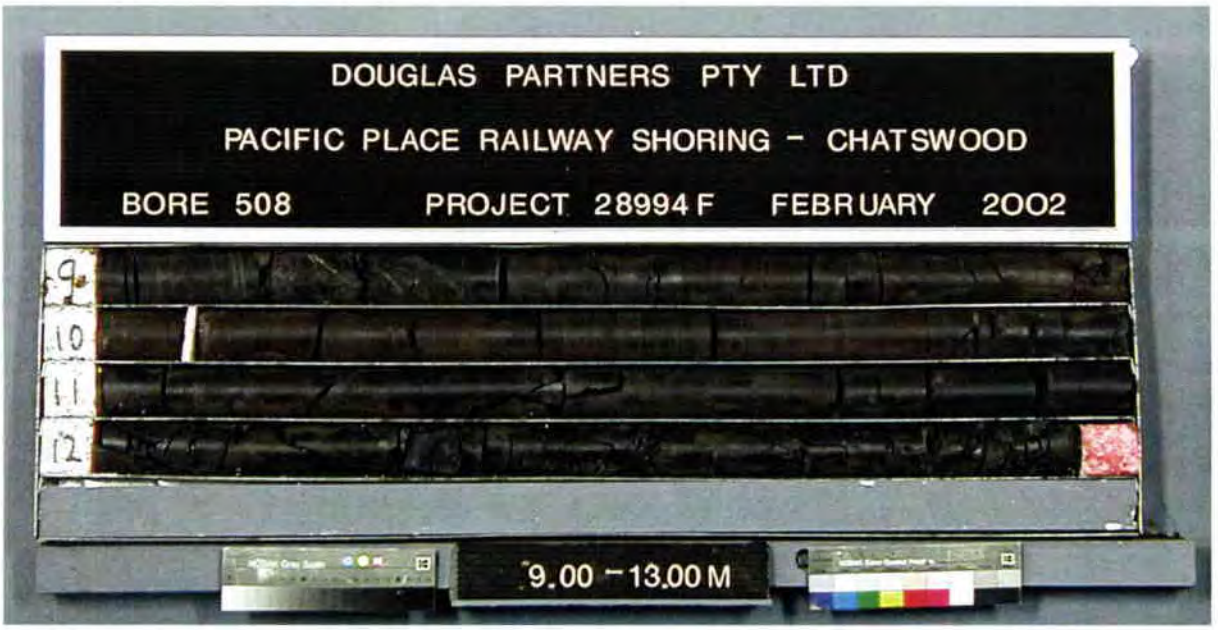
DOUGLAS PARTNERS PTY LTD
PACIFIC PLACE RAILWAY SHORING - CHATSWOOD
BORE 508 PROJECT 28994 F FEBRUARY 2002
9
10
11
12
9.00 - 13.00 M

TEST BORE REPORT

BORE No: 508

CLIENT: MIRVAC PROJECTS PTY LTD
PROJECT No: 28994F
DATE: 14 FEBRUARY 02

PROJECT: PACIFIC PLACE – RAILWAY SHORING
SURFACE LEVEL: 94.5 (AHD)
SHEET 2 **OF** 2

LOCATION: RAILWAY STREET, CHATSWOOD
DIP OF HOLE: 90°
AZIMUTH:

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)	Discontinuities (B – Bedding J – Joint S – Shear D – Drill Break)	Fracture Spacing (m) (0.01 0.05 0.10 0.50 1.00)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Test Results & Comments
10	SHALE – medium strength, moderately weathered, fractured, dark grey shale						C	100	92	PL (A)=0.9
10.9					10.26m: J25° smooth planar 10.3m: J40° rough planar 10.35m: J60° smooth planar 10.83m: J35° smooth planar 10.9m: J35° smooth planar 11.2m: J45° rough planar 11.45m: J75° smooth planar 11.69m: J50° rough planar 12.0m: J85° smooth planar 12.5m: J85° smooth planar 12.85m: Crushed Zone CORE LOSS-80mm		C	97	71	PL (A)=1.3
11	SILTSTONE – medium then high strength, slightly weathered, fractured then highly fractured, dark grey siltstone									
12										
12.92										
13	TEST BORE DISCONTINUED AT 13.0 METRES									
13.0										
14										
15										
16										
17										
18										
19										
20										

RIG: SCOUT **DRILLER:** G COOPER **LOGGED:** WEBSTER **CASING:** GL TO 4.3m

TYPE OF BORING: SPIRAL FLIGHT AUGER TO 4.3m NMLC-CORING TO 13.0m

WATER OBSERVATIONS: FREE GROUNDWATER OBSERVED AT 1.75m

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A auger sample	PL point load strength I_S (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp pocket penetrometer (kPa)	V Shear Vane (kPa)

CHECKED:
Initials: SE
Date: 27/3/02

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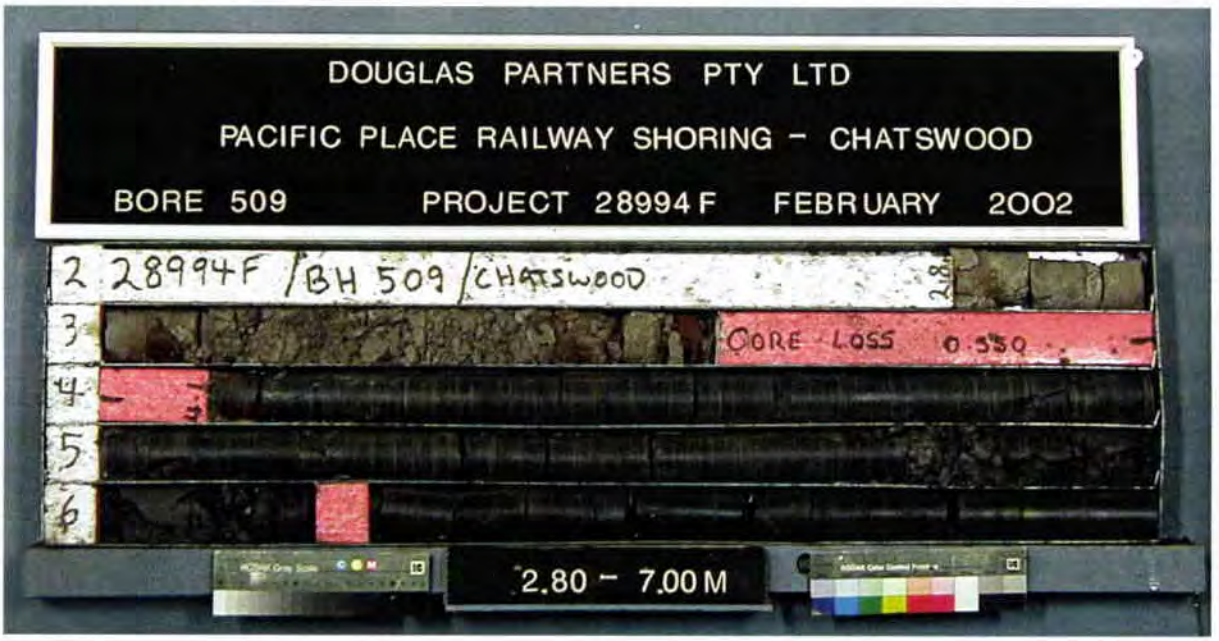
DOUGLAS PARTNERS PTY LTD
PACIFIC PLACE RAILWAY SHORING - CHATSWOOD
BORE 509 PROJECT 28994 F FEBRUARY 2002
2 28994F /BH 509 /CHATSWOOD
CORE LOSS 0.550
2.80 - 7.00 M

TEST BORE REPORT

BORE No: 509

CLIENT: MIRVAC PROJECTS PTY LTD
PROJECT No: 28994F
DATE: 14-15 FEB 02

PROJECT: PACIFIC PLACE – RAILWAY SHORING
SURFACE LEVEL: 94.8 (AHD)
SHEET 1 **OF** 2

LOCATION: RAILWAY STREET, CHATSWOOD
DIP OF HOLE: 90°
AZIMUTH:

Depth (m)	Description of Strata	Degree of weathering (EW HW MW SW FS R)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Discontinuities (B – Bedding J – Joint S – Shear D – Drill Break)	Fracture Spacing (m) (0.01 0.05 0.10 0.50 1.00)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Test Results & Comments
0	FILLING – poorly compacted, brown grey, gravelly sand filling, damp						A			
0.7	FILLING – brown clay filling, damp						A			
1										3,5,7 N=12
1.15	CLAY – stiff, grey mottled red, clay with some ironstone gravel						S			
2	– light grey mottled red clay from 1.8m						A			
2.2	SHALE – extremely low strength, extremely weathered, light grey shale						S			9,25/150mm refusal
2.8	SHALE – very low strength, extremely weathered, fractured then fragmented, light grey shale									
3	– 30mm ironstone band at 3.05m						C	58	0	
3.5					CORE LOSS-550mm					
4										
4.1	LAMINITE – low strength, with very low strength bands, highly weathered, slightly fractured, dark grey siltstone with 20%–30% light grey, fine grained sandstone laminae				4.85m: J80° smooth planar					PL (A)=0.2
5					5.71m: J70° rough planar		C	98	78	PL (A)=0.1
6	– 350mm highly fractured zone at 5.77m									
6.2					CORE LOSS-50mm					
6.25					7.0m: J45° rough planar					PL (A)=0.2
6.65	SHALE – medium then low and very low strength, highly weathered, fractured with highly fractured zones, dark grey shale				7.07m: J45° smooth planar 7.13m: J30° smooth planar 7.17m: J50° smooth planar 7.26m: J70° smooth planar 7.43m: J25° smooth planar 7.61m: J20° smooth planar 7.82m: B5° smooth planar with 10mm clay coating					PL (A)=0.5 PL (A)=0.4
7							C	80	56	
8	– 150mm highly fractured zone at 8.05m									
8.45					CORE LOSS-550mm					
9					9.0m: J80° smooth planar 9.33m: J45° smooth planar 9.4m: J45° rough planar 9.92m: J25° smooth planar					PL (A)=0.1
9.0	– 350mm highly fractured zone at 9.5m						C	87	70	
10 10.0										

RIG: SCOUT **DRILLER:** G COOPER **LOGGED:** WEBSTER **CASING:** GL TO 2.8m

TYPE OF BORING: SPIRAL FLIGHT AUGER TO 2.8m NMLC-CORING TO 17.5m

WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A auger sample	PL point load strength I_S (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia tube
pp pocket penetrometer (kPa)	V Shear Vane (kPa)

CHECKED:
Initials: SE
Date: 27/3/02

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DOUGLAS PARTNERS PTY LTD
PACIFIC PLACE RAILWAY SHORING - CHATSWOOD
BORE 509 PROJECT 28994 F FEBRUARY 2002
CORE LOSS 0.50
CORE LOSS 0.20
7.00 - 13.00 M


DOUGLAS PARTNERS PTY LTD
PACIFIC PLACE RAILWAY SHORING - CHATSWOOD
BORE 509 PROJECT 28994 F FEBRUARY 2002
13.00 - 17.50 M

TEST BORE REPORT

BORE No: 509
DATE: 14-15 FEB 02
SHEET 2 **OF** 2
AZIMUTH:

CLIENT: MIRVAC PROJECTS PTY LTD
PROJECT: PACIFIC PLACE – RAILWAY SHORING
LOCATION: RAILWAY STREET, CHATSWOOD
PROJECT No: 28994F
SURFACE LEVEL: 94.8 (AHD)
DIP OF HOLE: 90°

Depth (m)	Description of Strata	Degree of weathering	Graphic Log	Rock Strength	Discontinuities	Fracture Spacing (m)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Test Results & Comments
10										
10.15	SHALE – low strength, highly weathered, fractured with dark grey shale				10.15m: J40° rough planar					PL (A)=0.7
	SHALE – medium then high strength, moderately then slightly weathered, slightly fractured, dark grey shale				10.40m: J50° rough planar					
11	– 180mm fractured zone at 10.88m				10.88m: J75° smooth planar		C	87	70	
11.4					11.06m: J35° smooth planar					PL (A)=1.1
12	SILTSTONE – high, then medium to high strength, slightly then moderately weathered, fractured then slightly fractured, dark grey siltstone				12.04m: J85° smooth planar					
					12.14m: J45° smooth planar					PL (A)=1.3
					12.18m: J25° smooth planar					PL (A)=1.3
13					12.46m: J55° rough planar					
					12.55m: B5° rough planar with clay veneer		C	100	54	PL (A)=1.5
					12.8m: J75° smooth planar					
14					13.05m: J45° smooth planar					
					13.22m: J85° smooth planar					
					13.5m: 10mm Crushed Zone					PL (A)=1.2
15					13.59m: 10mm Crushed Zone					
					13.7m: J85° smooth undulating with ironstaining					
					14.0m: J85° smooth undulating					
					15.73m: J65° smooth planar					PL (A)=0.9
16					16.11m: Crushed Zone		C	100	96	
										PL (A)=0.8
17										
17.3					17.15m: S 35° slickensided, planar					PL (A)=1.1
17.5	SANDSTONE – medium strength, moderately weathered, slightly fractured, brown, fine grained sandstone									PL (A)=0.9
18	TEST BORE DISCONTINUED AT 17.5 METRES				17.25m: S 30° slickensided, planar					
					17.3m: S 35° slickensided, planar					
19										
20										

RIG: SCOUT **DRILLER:** G COOPER **LOGGED:** WEBSTER **CASING:** GL TO 2.8m

TYPE OF BORING: SPIRAL FLIGHT AUGER TO 2.8m NMLC-CORING TO 17.5m

WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A auger sample	PL point load strength I_S (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia tube
pp pocket penetrometer (kPa)	V Shear Vane (kPa)

CHECKED:
Initials: SE
Date: 27/3/02

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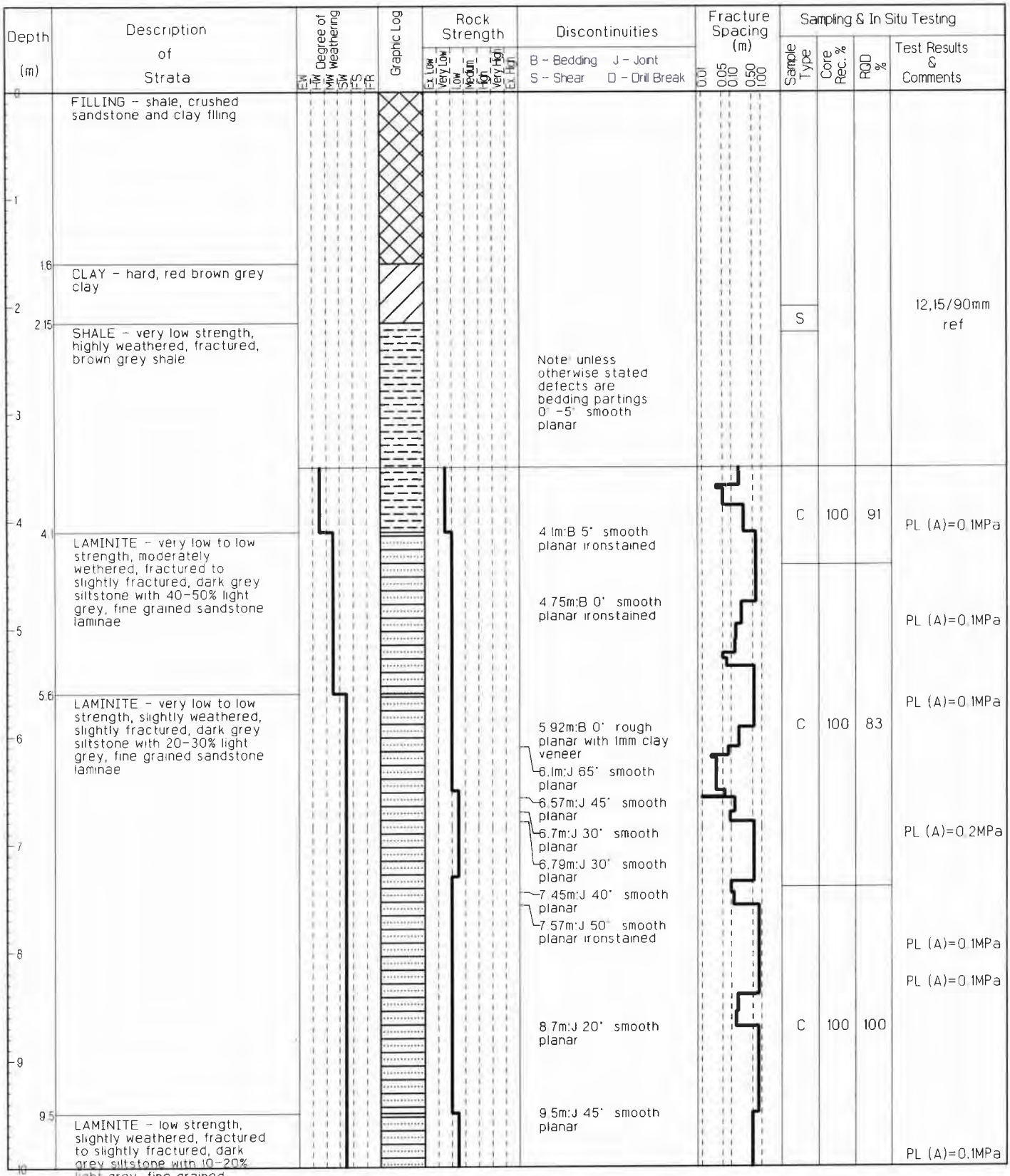
DOUGLAS PARTNERS PTY LTD
PACIFIC PLACE - CHATSWOOD
BORE 507 PROJECT 28994A NOVEMBER 2000
3M
CHATSWOOD BH507 START 3.5
28994A CORE
4M
5M
6M
7M
3.50 - 8.00 M

TEST BORE REPORT

BORE No: 507
DATE: 23/11/00
SHEET 1 **OF** 2
AZIMUTH:

CLIENT: MIRVAC PROJECTS PTY LTD
PROJECT: PACIFIC PLACE
LOCATION: HELP STREET, CHATSWOOD

PROJECT No: 28994A
SURFACE LEVEL: 96.3 AHD
DIP OF HOLE: 90°



RIG: SCOUT **DRILLER:** COOPER **LOGGED:** WEBSTER **CASING:** GL TO 3.5m

TYPE OF BORING: SPIRAL FLIGHT AUGER TO 3.5m, NMLC CORING TO 18.0m

WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED WHILST AUGERING

REMARKS:

SAMPLING & IN SITU TESTING LEGEND	
A auger sample	PL point load strength I_S (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp pocket penetrometer (kPa)	V Shear Vane (kPa)

CHECKED:
Initials: BJM
Date: 6/12/00

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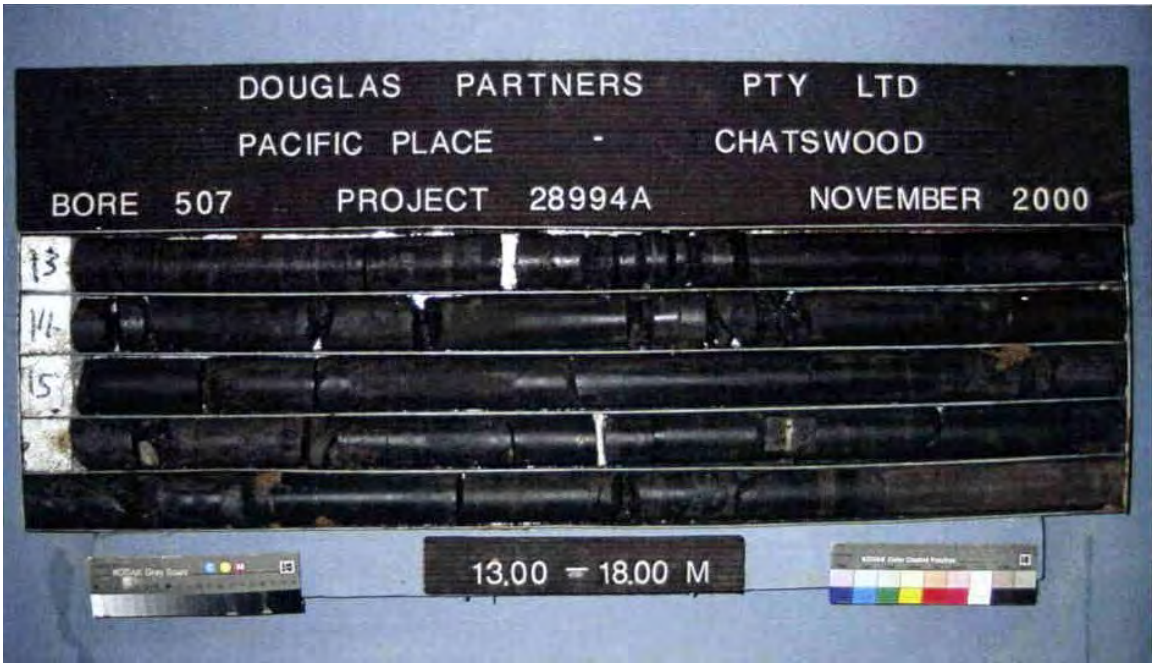
DOUGLAS PARTNERS PTY LTD
PACIFIC PLACE - CHATSWOOD
BORE 507 PROJECT 28994A NOVEMBER 2000
8M
9M
10M
11M
12M
8.00 - 13.00 M

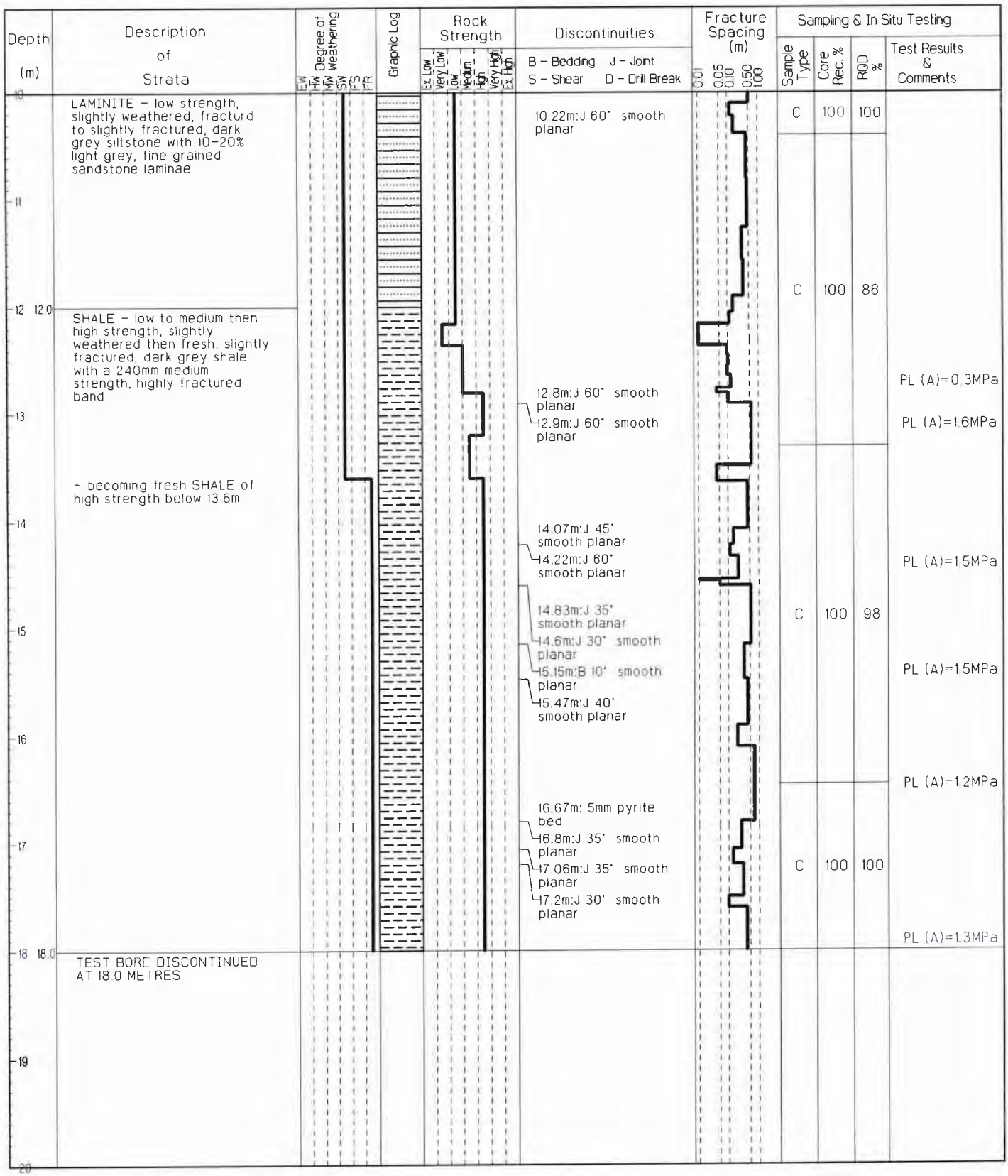

DOUGLAS PARTNERS PTY LTD
PACIFIC PLACE - CHATSWOOD
BORE 507 PROJECT 28994A NOVEMBER 2000
13
14
15
13.00 - 18.00 M

TEST BORE REPORT

BORE No: 507
DATE: 23/11/00
SHEET 2 **OF** 2
AZIMUTH:

CLIENT: MIRVAC PROJECTS PTY LTD
PROJECT: PACIFIC PLACE
LOCATION: HELP STREET, CHATSWOOD

PROJECT No: 28994A
SURFACE LEVEL: 96.3 AHD
DIP OF HOLE: 90°



RIG: SCOUT **DRILLER:** COOPER **LOGGED:** WEBSTER **CASING:** GL TO 3.5m

TYPE OF BORING: SPIRAL FLIGHT AUGER TO 3.5m, NMLC CORING TO 18.0m

WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED WHILST AUGERING

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A auger sample	PL point load strength I_s (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp pocket penetrometer (kPa)	V Shear Vane (kPa)

CHECKED:
Initials: BJM
Date: 6/12/00

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TEST BORE REPORT

CLIENT TIERNEY AND PARTNERS PTY. LTD.
PROJECT THE CHATSWOOD CONNECTION
LOCATION RAILWAY & CAMBRIDGE STREETS., CHATSWOOD

DATE 28/11/86-3/12/86 **BORE No** 7
PROJECT No. SSI/10000 **SHEET** 1 **OF** 4
SURFACE LEVEL 98.9
DIP OF HOLE 90° **AZIMUTH** -

Depth m	Description of Strata	Graphic Log	RL	Discontinuities. B-Bedding J-Joint S-Shear D-Drill Brk	Rock Character: Strength (Soil, Ex. Weak, V. Weak, Weak, M. Strong, Strong, V. Strong, Ex. Strong) / Fract. (Fragment, High Fract, Fractured, Sl. Fract, Unbroken)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Depth	Test Results
1	FILLING - black ash, cinders and gravel					A			0.50	
1.45			97.45						1.00	
						S			1.45	1,0,1 N = 1
2	FILLING - red brown gravelly clay					A			2.00	
2.85			96.05						2.50	
3	FILLING - stiff to very stiff light grey and brown clay with shale fragments					U(70)			2.90	
						A			3.50	
4									4.00	
4.46			94.44							
5.00	FILLING - stiff dark brown silty clay with some iron-stone gravel					U(70)			4.40	
5.40	SILTY CLAY - soft to firm yellow brown silty clay with fine ironstone gravel		93.50			A			5.00	
6									5.50	
6.20			92.70			U(70)			5.90	
						A			6.50	
7	CLAY - stiff to very stiff red brown and grey clay with fine ironstone gravel								7.00	
7.80	grading into		91.10			U(70)			7.40	
8	SHALEY CLAY - very stiff to hard grey shaley clay with red brown iron concretions and bands								8.50	
9	Hard light grey shaley clay from 8.50 m					S			8.80	14,25.
						A				
10									10.00	

RIG Inter B40 DRILLER G. Cooper LOGGED R. Lloyd CASING SL - 11.30 m

TYPE OF BORING Solid Flight auger to 11.50 m then NMLC core drilling

WATER OBSERVATIONS No free ground water observed during augering, standing water level at 6.30 m on 9/3/87

REMARKS

SAMPLING & IN SITU TESTING

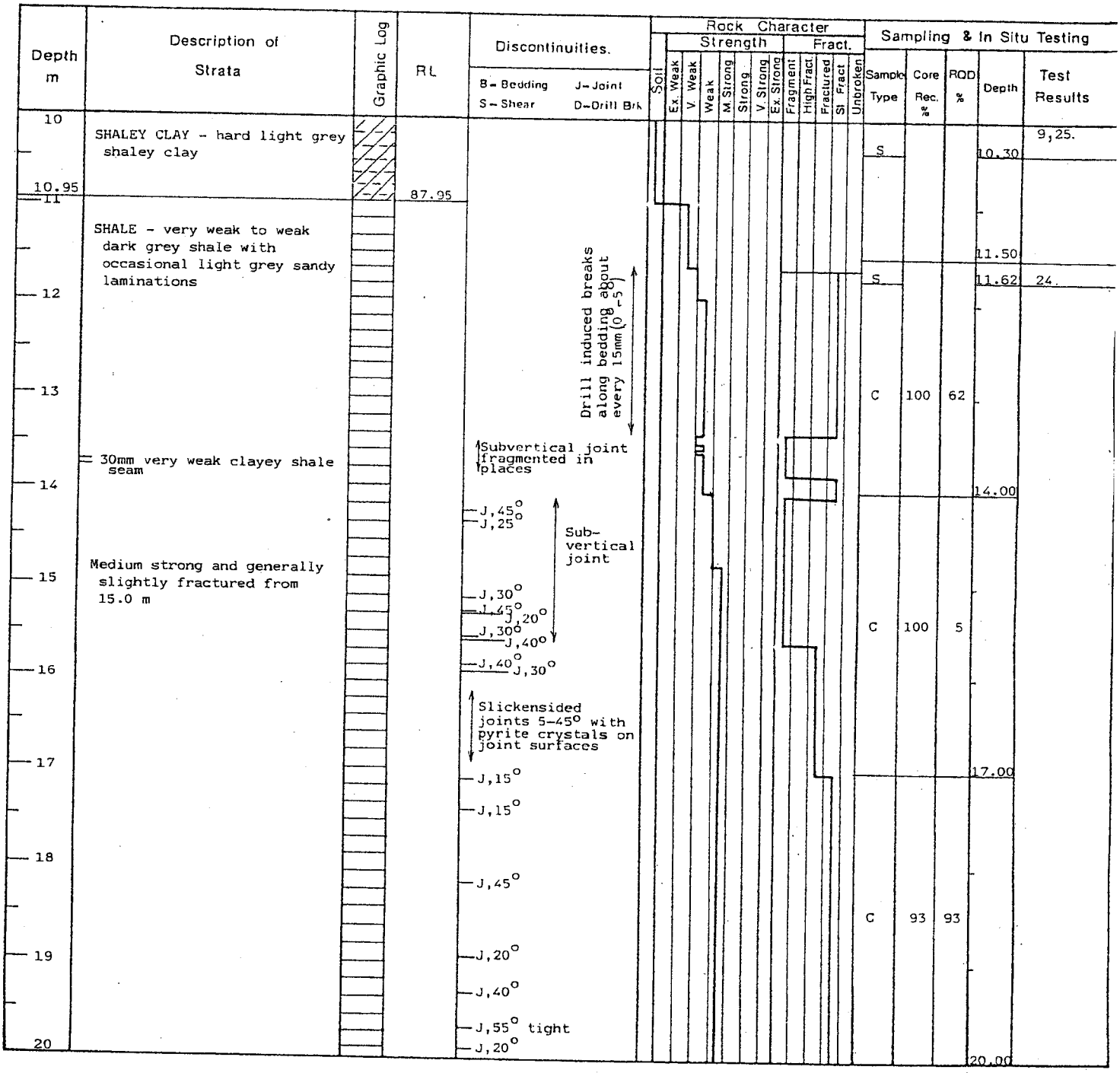
A	auger sample	V	vane shear test
DP	dry plug	P	pressuremeter test
C	diamond core	W	water pressure test
S	standard penetration	PP	pocket penetrometer test
U( )( )mm tube			

D.J. Douglas & Partners

TEST BORE REPORT

CLIENT TIERNEY AND PARTNERS PTY. LTD.
PROJECT THE CHATSWOOD CONNECTION
LOCATION RAILWAY & CAMBRIDGE STREETS., CHATSWOOD

DATE 28/11/86-3/12/86 **BORE No** 7
PROJECT No. SSI/10000 **SHEET** 2 **OF** 4
SURFACE LEVEL 98.9
DIP OF HOLE 90° **AZIMUTH** -



RIG Inter B40 **DRILLER** G. Cooper **LOGGED** R. Lloyd **CASING** SL - 11.30 m

TYPE OF BORING Solid flight auger to 11.50 m then NMLC core drilling

WATER OBSERVATIONS No free ground water observed during augering, standing water level at 6.30 m on 9/3/87

REMARKS

SAMPLING & IN SITU TESTING

A	auger sample	V	vane shear test
DP	dry plug	P	pressuremeter test
C	diamond core	W	water pressure test
S	standard penetration	PP	pocket penetrometer test
U( )( )mm tube			

D.J. Douglas & Partners

TEST BORE REPORT

CLIENT TIERNEY AND PARTNERS PTY. LTD.
PROJECT THE CHATSWOOD CONNECTION
LOCATION RAILWAY & CAMBRIDGE STREETS., CHATSWOOD

DATE 28/11/86-3/12/86 **BORE No** 7
PROJECT No. SSI/10000 **SHEET** 3 **OF** 4
SURFACE LEVEL 98.9
DIP OF HOLE 90° **AZIMUTH** -

Depth m	Description of Strata	RL	Discontinuities (B-Bedding J-Joint S-Shear D-Drill Brk)	Rock Character: Soil / Strength: Ex. Weak, V. Weak, Weak, M. Strong, Strong, V. Strong, Ex. Strong / Fract.: Fragment, High Fract, Fractured, Sl. Fract, Unbroken	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Depth	Test Results
20.20	SHALE (as above)	78.70	J,40° with silicate coating						
21	SILTSTONE - grey siltstone medium strong slightly fractured to unbroken		Occasional drill induced breaks along bedding 0-10°		C	100	100		
22	grading into								
22.20		76.70							
23	SANDSTONE - strong slightly fractured to unbroken grey fine to medium grained sandstone with shale laminations							23.00	
24			J,45°						
24.20		74.70			C	100	91		
25	LAMINITE - strong slightly fractured to unbroken dark grey and light grey laminite with occasional sandstone seams to 50mm.		J,45° J,55°						
26.10		72.80	J,80°					26.00	
27	SANDSTONE - strong unbroken light grey medium to course grained sandstone with silty cross bedding laminations at 25°		Occasional drill induced partings along cross bedding and bedding. Bedding 0°-5°		C	98	98		
28									
29								29.10	
30					C	86	84		

RIG Inter B40 DRILLER G. Cooper LOGGED R. Lloyd CASING SL - 11.30 m

TYPE OF BORING Solid flight auger to 11.50 m then NMLC core drilling

WATER OBSERVATIONS No free ground water observed during augering, standing water level at 6.30 m on 9/3/87

REMARKS

SAMPLING & IN SITU TESTING

A	auger sample	V	vane shear test
DP	dry plug	P	pressuremeter test
C	diamond core	W	water pressure test
S	standard penetration	PP	pocket penetrometer test
U( )( )mm tube			

D.J. Douglas & Partners

TEST BORE REPORT

CLIENT TIERNEY AND PARTNERS PTY. LTD.
PROJECT THE CHATSWOOD CONNECTION
LOCATION RAILWAY & CAMBRIDGE STREETS., CHATSWOOD

DATE 28/11/86-3/12/86 **BORE No** 7
PROJECT No. SSI/10000 **SHEET** 4 **OF** 4
SURFACE LEVEL 98.9
DIP OF HOLE 90° **AZIMUTH** -

Depth m	Description of Strata	Graphic Log	RL	Discontinuities. B - Bedding J - Joint S - Shear D - Drill Brk	Rock Character: Strength (Soil, Ex. Weak, V. Weak, Weak, M. Strong, Strong, V. Strong, Ex. Strong) Fract. (Fragment, High Fract., Fractured, Sl. Fract, Unbroken)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Depth	Test Results
	SANDSTONE - strong unbroken light grey medium to coarse grained sandstone with silty cross bedding laminations					C	86	84		
31.00	= 30mm grey clayey shale seam		67.90						31.00	
	BORE DISCONTINUED AT 31.00 METRES									

RIG Inter B40 DRILLER G. Cooper LOGGED R. Lloyd CASING SL - 11.30 m

TYPE OF BORING Solid flight auger to 11.50 m then NMLC core drilling

WATER OBSERVATIONS No free ground water observed during augering, standing water level at 6.30 m on 9/3/87

REMARKS

SAMPLING & IN SITU TESTING

A	auger sample	V	vane shear test
DP	dry plug	P	pressuremeter test
C	diamond core	W	water pressure test
S	standard penetration	PP	pocket penetrometer test
U( )( )mm tube			

D.J. Douglas & Partners

TEST BORE REPORT

CLIENT	TIERNEY AND PARTNERS PTY. LTD.	**DATE** 12-15/12/86	**BORE No** 8
PROJECT	THE CHATSWOOD CONNECTION	**PROJECT No.** SSI/10000	**SHEET** 1 **OF** 3
LOCATION	RAILWAY & CAMBRIDGE STREETS., CHATSWOOD	**SURFACE LEVEL** 94.8	
		DIP OF HOLE 90°	**AZIMUTH** -

Depth m	Description of Strata	Graphic Log	RL	Discontinuities. B-Bedding J-Joint S-Shear D-Drill Brk	Rock Character: Strength (Soil, Ex. Weak, V. Weak, Weak, M. Strong, Strong, V. Strong, Ex. Strong) / Fract. (Fragment, High Fract, Fractured, Sl Fract, Unbroken)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Depth	Test Results
0.55	BITUMINOUS CONCRETE & FINE CRUSHED DOLERITE		94.25							
0.75	CONCRETE		94.05							
1	FILLING - firm to stiff brown silty clay and gravel					A			0.50	
1.50			93.30			U (50)			1.00	
2	CLAY - stiff to very stiff light grey and red brown clay with ironstone bands					A			1.40	
3						U (50)			2.00	
4									2.50	
4.50			90.30						2.90	
5	CLAYEY LAMINITE - extremely weak to very weak dark grey and light grey laminite								4.00	
6						S			4.12	25 for 120 mm
6.30			88.50						5.50	
7	CLAYEY SHALE - extremely weak to very weak fractured dark grey clayey shale					S			5.75	10,20 for 100mm
8.00			86.80	J, 45°					7.00	
9	SHALE - weak to medium strong fractured dark grey shale			J, 60° J, 80° XJ, 35°, 45° J, 80° J, 30° XJ, 80°, 45°	Numerous drill induced breaks along bedding (0-10°)	S			7.27	10,20 for 120mm
	20mm clay seam					C	100	48	8.50	
10						C	100	21		

RIG Inter B40 DRILLER G. Cooper LOGGED R. Lloyd CASING SL to 7.20 m

TYPE OF BORING Solid flight auger to 7.27 m then NMLC core drilling

WATER OBSERVATIONS Free ground water observed at 6.70 m

REMARKS (U) denotes nil recovery

SAMPLING & IN SITU TESTING

A	auger sample	V	vane shear test
DP	dry plug	P	pressuremeter test
C	diamond core	W	water pressure test
S	standard penetration	PP	pocket penetrometer test
U( )( )mm	tube		

D.J. Douglas & Partner

TEST BORE REPORT

CLIENT	TIERNEY AND PARTNERS PTY. LTD.	**DATE** 12-15/12/86	**BORE No** 8
PROJECT	THE CHATSWOOD CONNECTION	**PROJECT No.** SSI/10000	**SHEET** 2 **OF** 3
LOCATION	RAILWAY & CAMBRIDGE STREETS., CHATSWOOD	**SURFACE LEVEL** 94.8	
		DIP OF HOLE 90°	**AZIMUTH** -

Depth m	Description of Strata	RL	Discontinuities. B-Bedding J-Joint S-Shear D-Drill Brk	Rock Character: Strength (Soil, Ex. Weak, V. Weak, Weak, M. Strong, Strong, V. Strong, Ex. Strong) / Fract. (Fragment, High Fract, Fractured, Sl. Fract, Unbroken)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Depth	Test Results
	SHALE - weak to medium strong fractured dark grey shale		J,80° XJ,45°,50° J,90°					10.38	
11			J,30°		C	100	71		
			J,90°					11.50	
11.90		81.90	J,60°						
12	SHALE - medium strong to strong slightly fractured dark grey shale		XJ,30°,60° J,60° J,30°						
			J,60°						
13			J,30° water J,10° charged XJ,45°,80° XJ,20°,40°		C	100	71		
14								14.50	
			J,30° J,70°						
15			J,90° J,20°						
			XJ,60°,70° J,50° slicken-sided XJ,80,45°						
16			J,55°		C	100	57		
16.25		78.55	J,20° J,20° tight					16.75	
	SILTSTONE - medium strong slightly fractured brown siltstone		J,85-90°						
17									
18									
18.30	extremely weak seam 40mm	76.50			C	100	94		
	SANDSTONE - medium strong slightly fractured fine grained sandstone with occasional grey shale laminations 50mm very weak seam 200mm very weak shale seam 10mm weak shale seam		J,90°						
19			J,70°						
20								19.90	

RIG Inter B40 DRILLER G. Cooper LOGGED R. Lloyd CASING SL to 7.20 m

TYPE OF BORING Solid flight auger to 7.27 m then NMLC core drilling

WATER OBSERVATIONS Free ground water observed at 6.70 m

REMARKS (U) denotes nil recovery

SAMPLING & IN SITU TESTING

A	auger sample	V	vane shear test
DP	dry plug	P	pressuremeter test
C	diamond core	W	water pressure test
S	standard penetration	PP	pocket penetrometer test
U( )( )mm tube			

D.J. Douglas & Partner

TEST BORE REPORT

CLIENT	TIERNEY AND PARTNERS PTY. LTD.	**DATE** 12-15/12/86	**BORE No** 8
PROJECT	THE CHATSWOOD CONNECTION	**PROJECT No.** SSI/10000	**SHEET** 3 **OF** 3
LOCATION	RAILWAY & CAMBRIDGE STREETS., CHATSWOOD	**SURFACE LEVEL** 94.8	
		DIP OF HOLE 90°	**AZIMUTH** -

Depth m	Description of Strata	Graphic Log	RL	Discontinuities. B-Bedding J-Joint S-Shear D-Drill Brk	Rock Character: Strength (Soil, Ex. Weak, V. Weak, Weak, M. Strong, Strong, V. Strong, Ex. Strong) / Fract. (Fragment, High Fract, Fractured, Sl. Fract, Unbroken)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Depth	Test Results
	SANDSTONE - medium strong slightly fractured grey fine grained sandstone with grey shale laminations			50mm weak seam						
21				Occasional drill induced breaks along bedding laminations						
21.25			73.55							
	LAMINITE - medium strong slightly fractured dark and light grey laminite					C	100	86		
21.90			72.90							
22	SANDSTONE - medium strong slightly fractured grey fine grained sandstone with grey shale laminations									
22.40			72.40							
22.70	LAMINITE - weak and medium strong fractured dark grey and grey laminite, sandy in parts		72.10	J,30° J,15°						
23									23.05	
	SANDSTONE - medium strong to strong slightly fractured to unbroken light grey medium to coarse grained sandstone with occasional silty laminations and cross laminations									
24										
						C	100	100		
25				XB,20°						
	40mm weak to medium strong seam									
26									26.05	
	2mm silty seam					C	100	100		
27.00			67.80						27.00	
	DISCONTINUED AT 27.00 METRES									
28										

RIG Inter B40 DRILLER G. Cooper LOGGED R. Lloyd CASINGSL to 7.20 m

TYPE OF BORING Solid flight auger to 7.27 m then NMLC core drilling

WATER OBSERVATIONS Free ground water observed at 6.70m

REMARKS

SAMPLING & IN SITU TESTING

A	auger sample	V	vane shear test
DP	dry plug	P	pressuremeter test
C	diamond core	W	water pressure test
S	standard penetration	PP	pocket penetrometer test
U( )( )mm tube			

D.J. Douglas & Partners

TEST BORE REPORT

CLIENT TIERNEY AND PARTNERS PTY. LTD.
PROJECT THE CHATSWOOD CONNECTION
LOCATION RAILWAY & CAMBRIDGE STREETS., CHATSWOOD

DATE 5-6/1/87
PROJECT No. SSI/10000
SURFACE LEVEL 99.20
DIP OF HOLE 20° FROM VERTICAL
AZIMUTH 110

BORE No 9
SHEET 1 **OF** 3

Depth m	Description of Strata	Graphic Log	RL	Discontinuities. B-Bedding J-Joint S-Shear D-Drill Brk	Rock Character: Soil / Strength: Ex. Weak, V. Weak, Weak, M. Strong, Strong, V. Strong, Ex. Strong / Fract.: Fragment, High Fract., Fractured, Sl. Fract, Unbroken	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Depth	Test Results
1	FILLING - grey ash, gravel filling					A			1.00	
1.75			97.56							
2	FILLING - stiff to very stiff grey and brown clay filling with ironstone and shale fragments									
3						A			2.50	
4										
5						A			4.00	
5.80			93.70						5.00	
6	SILTY CLAY - soft to firm yellow brown silty clay with fine gravel					u(50)			5.32	
7									7.00	
7.90			91.78			u(50)			7.40	
8	CLAY - very stiff to hard light grey and red brown clay with ironstone bands to 250 mm Shaley in parts					A			8.50	
9										
10						A			10.00	

RIG Inter B40 DRILLER G.Cooper LOGGED R.Lloyd CASING SL - 10.40m

TYPE OF BORING Solid flight auger to 10.45 then NLMC core drilling

WATER OBSERVATIONS No free ground water observed during augering

REMARKS

SAMPLING & IN SITU TESTING

A	auger sample	V	vane shear test
DP	dry plug	P	pressuremeter test
C	diamond core	W	water pressure test
S	standard penetration	PP	pocket penetrometer test
U( )( )mm tube			

D.J. Douglas & Partners

TEST BORE REPORT

CLIENT TIERNEY AND PARTNERS PTY. LTD.
PROJECT THE CHATSWOOD CONNECTION
LOCATION RAILWAY & CAMBRIDGE STREETS., CHATSWOOD

DATE 5-6/1/87 **BORE No** 9
PROJECT No. SSI/10000 **SHEET** 2 **OF** 3
SURFACE LEVEL 99.20
DIP OF HOLE 20° FROM VERTICAL **AZIMUTH** 110

Depth m	Description of Strata	Graphic Log	RL	Discontinuities. B-Bedding J-Joint S-Shear D-Drill Brk	Rock Character: Strength (Soil, Ex. Weak, V. Weak, Weak, M. Strong, Strong, V. Strong, Ex. Strong) / Fract. (Fragment, High Fract, Fractured, Sl. Fract, Unbroken)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Depth	Test Results
11	CLAY - very stiff light grey and red brown clay with ironstone bands to 250mm Shaley from 10.60								10.45	
						C	100	–	10.75	
12						C	100	–		
12.15			~87.78	J,75° ironstained					12.00	
13				J,25° ironstained B,20° ironstained J,55° ironstained J,40° ironstained B,20° 3mm movement slickensided		C	77	9		
14	SHALE - extremely weak to very weak fractured to slightly fractured dark grey shale with occasional light grey sandy laminations			Fragmented possibly by drilling Extremely weak rock disguises true fracture character					14.20	
15						C	100	35		
16				Fragmented possibly by drilling					15.60	
17	Weak to medium strong from 17.10			J,80° stepped J,35° with silicate & pyrite coating J,30°		C	100	10	17.20	
18				XJ,50°, 5° J,90° irregular with pyrite coating J,50° pyrite coating B,25°						
	5mm Pyrite band			B,25°						
19	Medium strong from 18.90			J,35° irregular J,30°-50°,50°		C	100	82		
				XJ,60° & 60° pyrite -J,50° coating -J,50° pyrite coating J,50° slickensided J,50°						
20										

RIG Inter B40 **DRILLER** G.Cooper **LOGGED** R.Lloyd **CASING** SL – 10.40m

TYPE OF BORING Solid flight auger to 10.45 then NLMC core drilling

WATER OBSERVATIONS No free ground water observed during augering

REMARKS

SAMPLING & IN SITU TESTING

A	auger sample	V	vane shear test
DP	dry plug	P	pressuremeter test
C	diamond core	W	water pressure test
S	standard penetration	PP	pocket penetrometer test
U( )( )mm tube			

D.J. Douglas & Partner

TEST BORE REPORT

CLIENT TIERNEY AND PARTNERS PTY. LTD.
PROJECT THE CHATSWOOD CONNECTION
LOCATION RAILWAY & CAMBRIDGE STREETS., CHATSWOOD

DATE 5-6/1/87
PROJECT No. SSI/10000
SURFACE LEVEL 99.20
DIP OF HOLE 20° FROM VERTICAL

BORE No 9
SHEET 3 **OF** 3
AZIMUTH 110

Depth m	Description of Strata	Graphic Log	RL	Discontinuities. B-Bedding J-Joint S-Shear D-Drill Brk	Rock Character: Strength (Soil, Ex. Weak, V. Weak, Weak, M. Strong, Strong, V. Strong, Ex. Strong) / Fract. (Fragment, High Fract., Fractured, Sl. Fract, Unbroken)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Depth	Test Results
									20.20	
21	SHALE - medium strong fractured to slightly fractured dark grey shale			J,15°-25° curved B,20° with pyrite crystals J,30° with pyrite		C	100	95		
21.90			78.62	J,30° with pyrite coating B,35° with pyrite coating J,65° irregular					21.67	
22	SILTSTONE - weak to medium strong fractured to slightly fractured dark grey and brown siltstone fossiliferous in parts			J,55° slickensided						
23				B,15°-20° J,45° fragmented		C	97	76		
23.70			77.93							
24	SANDSTONE - weak to medium strong slightly fractured grey fine grained sandstone 60mm very weak to weak slightly clayey									
24.67			76.02						24.67	
25	BORE DISCONTINUED AT 24.67 METRES									

RIG Inter B40 DRILLER G.Cooper LOGGED R.Lloyd CASING SL - 10.40m

TYPE OF BORING Solid flight auger to 10.45 then NLMC core drilling

WATER OBSERVATIONS No free ground water observed during augering

REMARKS

SAMPLING & IN SITU TESTING

A	auger sample	V	vane shear test
DP	dry plug	P	pressuremeter test
C	diamond core	W	water pressure test
S	standard penetration	PP	pocket penetrometer test
U( )( )mm tube			

D.J. Douglas & Partner

TEST BORE REPORT

CLIENT TIERNEY AND PARTNERS PTY. LTD.
PROJECT THE CHATSWOOD CONNECTION
LOCATION RAILWAY & CAMBRIDGE STREETS., CHATSWOOD

DATE 16/12/86 - 19/12/86 **BORE No** 11
PROJECT No. SSI/10000 **SHEET** 1 **OF** 4
SURFACE LEVEL 99.0
DIP OF HOLE 20° FROM VERTICAL **AZIMUTH** 020°

Depth m	Description of Strata	Graphic Log	RL	Discontinuities. B-Bedding J-Joint S-Shear D-Drill Brk	Rock Character: Strength (Soil, Ex. Weak, V. Weak, Weak, M. Strong, Strong, V. Strong, Ex. Strong) / Fract. (Fragment, High Fract., Fractured, Sl Fract, Unbroken)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Depth	Test Results
0.45	FILLING - ash, cinders and gravel		98.57							
1.10	FILLING - stiff brown and red brown silty clay		97.97			A			0.50 1.00	
						U (50)			1.30	
2	FILLING - ash and cinders with some clay and gravel					A			1.50 2.50	
3						S			2.95	1, 2, 1 N=3
3.30			95.90			A			3.50 4.00	
4	FILLING - ash, gravel and clay					S			4.45	2, 2, 2 N=4
5						A			5.00 5.50	
5.65			93.59			U (50)			5.80	
6	TOPSOIL - firm to stiff grey brown clayey silt					A			6.50	
6.30			93.08						7.00	
7.00	SILTY CLAY - firm to stiff yellow brown and red brown silty clay grading into		92.47			S			7.45	6,20,17 N=37
8	CLAY - stiff to very stiff grey brown and red brown clay with ironstone concretions and gravel					A			8.00 8.50	
8.40			91.10			S			8.77	18, 25 for 120mm
9	SHALEY CLAY - hard light grey shaley clay with ironstone bands, sandy in parts									
9.50			90.07							
10	SHALE - very weak and weak fractured dark grey shale									

RIG B20 Pioneer DRILLER M. Crowe LOGGED R. Lloyd CASING SL - 8.50

TYPE OF BORING Solid flight auger to 8.50 m, rotary drilling to 10.00 m then NMLC core drilling

WATER OBSERVATIONS No free ground water observed during augering

REMARKS

SAMPLING & IN SITU TESTING

A	auger sample	V	vane shear test
DP	dry plug	P	pressuremeter test
C	diamond core	W	water pressure test
S	standard penetration	PP	pocket penetrometer test
U( )( )mm tube			

D.J. Douglas & Partner

TEST BORE REPORT

CLIENT	TIERNEY AND PARTNERS PTY. LTD.	**DATE** 16-19/12/86	**BORE No** 11
PROJECT	THE CHATSWOOD CONNECTION	**PROJECT No.** SSI/10000	**SHEET** 2 **OF** 4
LOCATION	RAILWAY & CAMBRIDGE STREETS., CHATSWOOD	**SURFACE LEVEL** 99.0	
		DIP OF HOLE 20° FROM VERTICAL	**AZIMUTH** 020°

Depth m	Description of Strata	Graphic Log	RL	Discontinuities. B-Bedding J-Joint S-Shear D-Drill Brk	Rock Character: Strength (Soil, Ex. Weak, V. Weak, Weak, M. Strong, Strong, V. Strong, Ex. Strong) / Fract. (Fragment, High Fract, Fractured, Si Fract, Unbroken)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Depth	Test Results
11	SHALE – very weak and weak fractured dark grey shale with light grey sandy laminations Bedding 25°			Numerous drill induced breaks along bedding Very weak nature of rock disguises true degree of fracturing J,90°		C	100	50	11.50	
12						C	100	45	13.00	
13										
14				XJ,40° & 25°		C	63	48	14.50	
15				J,45° J,45° XJ,55° & 35°		C	73	41	16.00	
16				Highly fractured to fragmented						
17	Medium strong from 16.80			J,30° J,50° J,90° irregular & pyrite crystals		C	83	0	17.50	
18				J,50° J,20° J,40° & pyrite crystals J,20° XJ,50° & 20° J,20° XJ,20° & 45°		C	100	68	19.00	
19				B,20 J,54° D,0° J,55°						
20						C	100	100		

RIG B20 Pioneer DRILLER M. Crowe LOGGED R. Lloyd CASING SL – 8.50

TYPE OF BORING Solid flight auger to 8.50 m, rotary drilling to 10.00 m then NMLC core drilling

WATER OBSERVATIONS No free ground water observed during augering

REMARKS

SAMPLING & IN SITU TESTING

A	auger sample	V	vane shear test
DP	dry plug	P	pressuremeter test
C	diamond core	W	water pressure test
S	standard penetration	PP	pocket penetrometer test
U( )( )mm tube			

D.J. Douglas & Partner

TEST BORE REPORT

CLIENT	TIERNEY AND PARTNERS PTY. LTD.	**DATE** 16-19/12/86	**BORE No** 11
PROJECT	THE CHATSWOOD CONNECTION	**PROJECT No.** SSI/10000	**SHEET** 3 **OF** 4
LOCATION	RAILWAY & CAMBRIDGE STREETS., CHATSWOOD	**SURFACE LEVEL** 99.0	
		DIP OF HOLE 20° FROM VERTICAL	**AZIMUTH** 020°

Depth m	Description of Strata	RL	Discontinuities. B-Bedding J-Joint S-Shear D-Drill Brk	Rock Character: Soil / Strength: Ex. Weak, V. Weak, Weak, M. Strong, Strong, V. Strong, Ex. Strong / Fract.: Fragment, High Fract., Fractured, Sl Fract, Unbroken	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Depth	Test Results
	SHALE - medium strong slightly fractured dark grey shale		D J,60° J,55° J,43° curved B,20° XJ,17 & 76° slickensided D J,80° with pyrite crystals D J,75°					20.50	
21					C	100	45		
21.70		78.61	Fragmented by drilling					21.75	
22	SILTSTONE - medium strong slightly fractured dark grey and brown siltstone fossiliferous in parts				C	100	91		
	50mm weak sandy seam		B,5°						
23								23.25	
23.10		77.29							
	SANDSTONE - medium strong slightly fractured light grey fine grained sandstone with occasional laminations - weak and silty for top 150mm		B,10° B,10-15°			100	89		
24								24.70	
25			D Occasional drill induced breaks along silty laminations		C	100	92		
	40mm weak clayey seam							26.20	
26									
26.45		74.15							
	LAMINITE - medium strong slightly fractured dark grey and light grey laminite		J,45°						
26.95		73.67	73.67						
27	SANDSTONE - medium strong slightly fractured light grey fine grained sandstone with occasional laminations		40mm weak sandstone seam J,35°		C	100	98		
27.75		72.92						27.70	
28	40mm weak sandstone seam		Occasional drill induced breaks along bedding and cross laminations						
	SANDSTONE - strong slightly fractured to unbroken light grey medium grained sandstone with silty laminations 15- 0°		B,35°		C	100	98		
29			J or B,15° silty					29.25	
30									

RIG B20 Pioneer DRILLER M. Crowe LOGGED R. Lloyd CASING SL - 8.50

TYPE OF BORING Solid flight auger to 8.50 m, rotary drilling to 10.00 m then NMLC core drilling

WATER OBSERVATIONS No free ground water observed during augering

REMARKS

SAMPLING & IN SITU TESTING

A	auger sample	V	vane shear test
DP	dry plug	P	pressuremeter test
C	diamond core	W	water pressure test
S	standard penetration	PP	pocket penetrometer test
U( )( )mm tube			

D.J. Douglas & Partner

TEST BORE REPORT

CLIENT TIERNEY AND PARTNERS PTY. LTD.
PROJECT THE CHATSWOOD CONNECTION
LOCATION RAILWAY & CAMBRIDGE STREETS., CHATSWOOD

DATE 16-19/12/86
PROJECT No. SSI/10000
SURFACE LEVEL 99.0
DIP OF HOLE 20° FROM VERTICAL
AZIMUTH 020°

BORE No 11
SHEET 4 **OF** 4

Depth m	Description of Strata	Graphic Log	RL	Discontinuities. B-Bedding J-Joint S-Shear D-Drill Brk	Rock Character: Strength (Soil, Ex. Weak, V. Weak, Weak, M. Strong, Strong, V. Strong, Ex. Strong) Fract. (Fragment, High Fract, Fractured, Sl. Fract, Unbroken)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Depth	Test Results
	SANDSTONE – strong slightly fractured to unbroken light grey medium grained sandstone with occasional silty laminations					C	100	100	30.75	
31	10mm clayey shale seam			Occasional drill induced breaks along bedding 10-25°		C	100	99	32.15	
32										
33	10mm weak seam					C	100	99	33.60	
33.60			67.43							
34	BORE DISCONTINUED AT 33.60 METRES									

RIG B20 Pioneer DRILLER M. Crowe LOGGED R. Lloyd CASING SL – 8.50

TYPE OF BORING Solid flight auger to 8.50 m, rotary drilling to 10.00 m then NMLC core drilling

WATER OBSERVATIONS No free ground water observed during augering

REMARKS

SAMPLING & IN SITU TESTING

A	auger sample	V	vane shear test
DP	dry plug	P	pressuremeter test
C	diamond core	W	water pressure test
S	standard penetration	PP	pocket penetrometer test
U( )( )mm tube			

D.J. Douglas & Partner

TEST BORE REPORT

CLIENT TIERNEY AND PARTNERS PTY. LTD.
PROJECT THE CHATSWOOD CONNECTION
LOCATION RAILWAY & CAMBRIDGE STREETS., CHATSWOOD

DATE 16/12/86 **BORE No** 12
PROJECT No. SSI/10000 **SHEET** 1 **OF** 3
SURFACE LEVEL 95.0
DIP OF HOLE 90° **AZIMUTH** -

Depth m	Description of Strata	RL
0.25	BITUMINOUS CONCRETE & CONCRETE	94.75
0.85	FILLING - brown and grey clay (possibly natural)	94.15
1	SHALE - weak fractured to slightly fractured light grey and grey shale with medium strong ironstone bands	
2	30mm clay seam 50mm clayey shale seam	
3.00		92.00
4	SHALE - weak to medium strong slightly fractured dark grey shale with light grey sandy laminations	
5		
6		
7		
8		
9		
10		

Graphic Log

Discontinuities.
B - Bedding J - Joint
S - Shear D - Drill Brk

Numerous drill induced breaks along bedding 0-10°
J,90° fragmented
J,30°
J,90°
J,45° & 50° fragmented
J,45°
J,90° irregular
Numerous drill induced breaks along bedding 0-10°
Fragmented
J,50°

Rock Character
Strength: Soil, Ex. Weak, V. Weak, Weak, M. Strong, Strong, V. Strong, Ex. Strong
Fract.: Fragment, High Fract., Fractured, Sl. Fract., Unbroken

Sampling & In Situ Testing

Sample Type	Core Rec. %	RQD %	Depth	Test Results
A			0.50	
			1.00	
U (50)			1.40	
			1.50	
C	77	55	2.80	
C	79	63	5.30	
C	97	70	8.30	
C	76	23		

RIG Inter B40 DRILLER G Cooper LOGGED R Lloyd CASING SL to 1.50 m

TYPE OF BORING Solid flight auger to 1.50 m then NMLC core drilling

WATER OBSERVATIONS No free ground water observed during augering

REMARKS

SAMPLING & IN SITU TESTING

A	auger sample	V	vane shear test
DP	dry plug	P	pressuremeter test
C	diamond core	W	water pressure test
S	standard penetration	PP	pocket penetrometer test
U( )( )mm	tube		

D.J. Douglas & Partner

TEST BORE REPORT

CLIENT	TIERNEY AND PARTNERS PTY. LTD.	**DATE** 16/12/86	**BORE No** 12
PROJECT	THE CHATSWOOD CONNECTION	**PROJECT No.** SSI/10000	**SHEET** 2 **OF**
LOCATION	RAILWAY & CAMBRIDGE STREETS., CHATSWOOD	**SURFACE LEVEL.** 95.0	
		DIP OF HOLE 90°	**AZIMUTH** -

Depth m	Description of Strata	Graphic Log	RL	Discontinuities. B-Bedding J-Joint S-Shear D-Drill Brk	Rock Character: Soil	Strength: Ex. Weak	V. Weak	Weak	M. Strong	Strong	V. Strong	Ex. Strong	Fract.: Fragment	High Fract.	Fractured	Si. Fract	Unbroken	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Depth	Test Results
11	SHALE - weak to medium strong slightly fractured dark grey shale with light grey sandy laminations			Numerous drill induced breaks along bedding 0-10°																		
				Fragmented with J,90° irregular																	11.30	
11.80			83.20																			
12	SHALE - medium strong slightly fractured dark grey shale			J,90° J,65° J,90° J,45° J,60° J,30°																		
13				J,45° irregular J,30-45° irregular with pyrite crystals J,50°														C	83	50		
14				J,25°																	14.30	
15				J,50°																		
16				J,30° slickensided J,45° slickensided J,80°														C	100	86		
16.45			78.55																		17.08	
17	SILTSTONE - medium strong slightly fractured dark grey brown siltstone, fossiliferous in parts																					
17.45			77.55																			
18.00	LAMINITE - medium strong slightly fractured dark grey and light grey laminite		77.00	J,30° J,45°																		
19	SANDSTONE - medium strong slightly fractured to unbroken light grey, brown fine grained sandstone with occasional shale laminations			B,0° B,10°														C	100	92		
20																						

RIG Inter B40 DRILLER G Cooper LOGGED R Lloyd CASING SL to 1.50 m

TYPE OF BORING Solid flight auger to 1.50 m then NMLC core drilling

WATER OBSERVATIONS No free ground water observed during augering

REMARKS

SAMPLING & IN SITU TESTING

A	auger sample	V	vane shear test
DP	dry plug	P	pressuremeter test
C	diamond core	W	water pressure test
S	standard penetration	PP	pocket penetrometer test
U( )( )mm tube			

D.J. Douglas & Partner

TEST BORE REPORT

CLIENT	TIERNEY AND PARTNERS PTY. LTD.	**DATE** 16/12/86	**BORE No** 12
PROJECT	THE CHATSWOOD CONNECTION	**PROJECT No.** SSI/10000	**SHEET** 3 **OF** 3
LOCATION	RAILWAY & CAMBRIDGE STREETS., CHATSWOOD	**SURFACE LEVEL** 95.0	
		DIP OF HOLE 90°	**AZIMUTH** -

Depth m	Description of Strata	Graphic Log	RL	Discontinuities. B-Bedding J-Joint S-Shear D-Drill Brk	Rock Character: Strength (Soil, Ex. Weak, V. Weak, Weak, M. Strong, Strong, V. Strong, Ex. Strong) Fract. (Fragment, High Fract, Fractured, Sl. Fract, Unbroken)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Depth	Test Results
20.20	SANDSTONE (as previously)		74.80						20.23	
20.70	LAMINITE - medium strong slightly fractured to unbroken dark and light grey laminite		74.30	Occasional drill induced breaks along bedding laminations		C	100	99		
21	SANDSTONE - medium strong slightly fractured to unbroken light grey, brown fine grained sandstone with occasional shale laminations									
21.95	SANDSTONE - strong grey medium grained sandstone		73.05	D					22.00	
22.00	DISCONTINUED AT 22.00 METRES		73.00							
23										

RIG Inter B40 DRILLER G Cooper LOGGED R Lloyd CASING SL to 1.50 m

TYPE OF BORING Solid flight auger to 1.50 m then NMLC core drilling

WATER OBSERVATIONS No free ground water observed during augering

REMARKS

SAMPLING & IN SITU TESTING

A	auger sample	V	vane shear test
DP	dry plug	P	pressuremeter test
C	diamond core	W	water pressure test
S	standard penetration	PP	pocket penetrometer test
U( )( )mm tube			

D.J. Douglas & Partner

TEST BORE REPORT

CLIENT TIERNEY AND PARTNERS PTY. LTD.
PROJECT THE CHATSWOOD CONNECTION
LOCATION RAILWAY & CAMBRIDGE STREETS., CHATSWOOD

DATE 3-5/12/86
PROJECT No. SSI/10000
SURFACE LEVEL 99.3
DIP OF HOLE 90°

BORE No 13
SHEET 1 **OF** 3
AZIMUTH -

Depth m	Description of Strata	Graphic Log	RL
0.63	FILLING - ash, cinders and gravel		98.67
4.50	FILLING - red brown and grey shaley clay filling with shale fragments, stiff at top becoming firm to stiff		94.80
5.00	TOPSOIL - firm to stiff dark brown silty clay		94.30
6.00	SILTY CLAY - stiff brown silty clay grading into		93.30
7.75	CLAY - stiff to very stiff grey and red brown clay with iron concretions grading into		91.55
9.20	SHALEY CLAY - very stiff to hard grey shaley clay with red brown iron concretions and ironstone bands		90.10
10	SHALE - extremely weak to very weak dark grey shale with occasional light grey sandy laminations		

Discontinuities: B - Bedding, J - Joint, S - Shear, D - Drill Brk

Rock Character — Strength: Soil, Ex. Weak, V. Weak, Weak, M. Strong, Strong, V. Strong, Ex. Strong; Fract.: Fragment, High Fract, Fractured, Sl. Fract, Unbroken

Sampling & In Situ Testing				
Sample Type	Core Rec. %	RQD %	Depth	Test Results
A			0.50	
U(70)			1.00	
			1.40	
A			2.00	
			2.50	
U(70)			2.90	
A			3.50	
			4.00	
U(70)			4.40	
			5.00	
U(70)			5.40	
			6.50	
U(70)			6.90	
			8.00	
U(70)			8.27	
			9.50	
S			9.62	20.
C				

RIG Inter B40 DRILLER G.Cooper/B.Lamb LOGGED R. Lloyd CASING SL - 9.40 m

TYPE OF BORING Solid flight auger to 9.62 m then NMLC core drilling

WATER OBSERVATIONS Free ground water observed at 4.60 m

REMARKS

SAMPLING & IN SITU TESTING

A	auger sample	V	vane shear test
DP	dry plug	P	pressuremeter test
C	diamond core	W	water pressure test
S	standard penetration	PP	pocket penetrometer test
U( )( )mm tube			

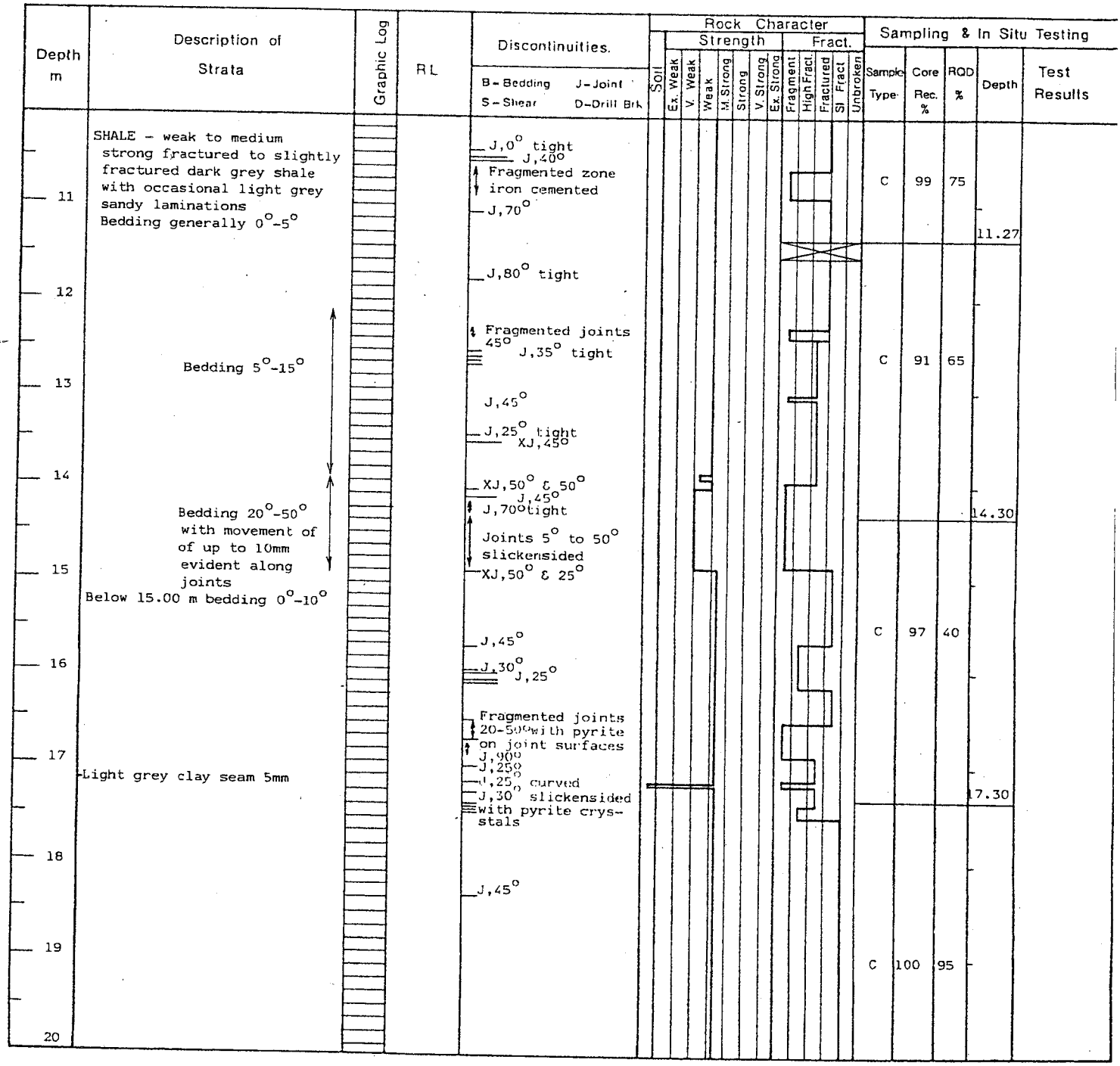
D.J. Douglas & Partners

TEST BORE REPORT

CLIENT TIERNEY AND PARTNERS PTY. LTD.
PROJECT THE CHATSWOOD CONNECTION
LOCATION RAILWAY & CAMBRIDGE STREETS., CHATSWOOD

DATE 3-5/12/86
PROJECT No. SSI/10000
SURFACE LEVEL 99.3
DIP OF HOLE 90°

BORE No 13
SHEET 2 **OF** 3
AZIMUTH -



RIG Inter B40 DRILLER G. Cooper/B. Lamb LOGGED R. Lloyd CASINGSL - 9.40 m

TYPE OF BORING Solid flight auger to 9.62 m then NMLC core drilling

WATER OBSERVATIONS Free ground water observed at 4.60 m

REMARKS

SAMPLING & IN SITU TESTING

A	auger sample	V	vane shear test
DP	dry plug	P	pressuremeter test
C	diamond core	W	water pressure test
S	standard penetration	PP	pocket penetrometer test
U( )( )mm tube			

D.J. Douglas & Partners

TEST BORE REPORT

CLIENT TIERNEY AND PARTNERS PTY. LTD.
PROJECT THE CHATSWOOD CONNECTION
LOCATION RAILWAY & CAMBRIDGE STREETS., CHATSWOOD

DATE 3 - 5/12/86
PROJECT No. SSI/10000
SURFACE LEVEL 99.3
DIP OF HOLE 90°

BORE No 13
SHEET 3 **OF** 3
AZIMUTH -

Depth m	Description of Strata	RL	Discontinuities (B-Bedding J-Joint S-Shear D-Drill Brk)	Rock Character: Strength (Soil, Ex. Weak, V. Weak, Weak, M. Strong, Strong, V. Strong, Ex. Strong) / Fract. (Fragment, High Fract, Fractured, Sl. Fract, Unbroken)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Depth	Test Results
21	SHALE - medium strong fractured to slightly fractured dark grey shale		XJ,45° & 45° J,50° J,35° J,45° J,20-50° slickensided J,50°					20.24	
	silty shale/siltstone below 21.40 m				C	100	66		
22 22.10		77.20	J,20°						
23	SANDSTONE - weak and medium strong slightly fractured grey and brown grey fine grained sandstone with grey shale laminations		Fragmented joints 90° & 20-50° ironstained					23.24	
24			J,45°						
24.85 25	LAMINITE - medium strong slightly fractured dark grey to light grey laminite	74.45			C	100	76		
25.50			J,30° slickensided J,30° slickensided with 2mm clay coating						
26 26.25	SANDSTONE - weak to medium strong, fractured grey and brown grey fine grained sandstone with grey shale laminations	73.80 73.05	J,85° with partings along laminations					26.25	
27	BORE DISCONTINUED AT 26.25 METRES								

RIG Inter B40 DRILLER G. Cooper/B. Lamb LOGGED R. Lloyd CASING SL - 9.40 m

TYPE OF BORING Solid flight auger to 9.62 m then NMLC core drilling

WATER OBSERVATIONS Free ground water observed at 4.60 m

REMARKS

SAMPLING & IN SITU TESTING

A	auger sample	V	vane shear test
DP	dry plug	P	pressuremeter test
C	diamond core	W	water pressure test
S	standard penetration	PP	pocket penetrometer test
U( )( )mm tube			

D.J. Douglas & Partners

TEST BORE REPORT

CLIENT	TIERNEY AND PARTNERS PTY. LTD.	**DATE** 5-8/12/86	**BORE No** 16
PROJECT	THE CHATSWOOD CONNECTION	**PROJECT No.** SSI/10000	**SHEET** 1 **OF** 4
LOCATION	RAILWAY & CAMBRIDGE STREETS., CHATSWOOD	**SURFACE LEVEL** 99.6	
		DIP OF HOLE 90°	**AZIMUTH** -

Depth m	Description of Strata	Graphic Log	RL	Discontinuities. B-Bedding J-Joint S-Shear D-Drill Brk	Rock Character: Strength (Soil, Ex. Weak, V. Weak, Weak, M. Strong, Strong, V. Strong, Ex. Strong) / Fract. (Fragment, High Fract, Fractured, Sl Fract, Unbroken)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Depth	Test Results
1	FILLING - cinders, ash, gravel and concrete					A			0.50	
									1.00	
						S			1.45	1,1,1 N = 2
2										
2.30			97.30			S			2.45	1,1,2 N = 3
3	FILLING - firm to stiff brown clayey silt, silty clay and clay with some organic matter									
4.00			95.60						3.50	
						S			2.95	1,1,2 N = 3
4.50	SILTY CLAY - firm to stiff brown silty clay with fine ironstone gravel		95.10							
5	CLAY - stiff to very stiff grey and red brown clay with iron concretions								5.00	
						U(50)			5.39	
6.00	grading into		93.60						6.20	
6.50	SHALEY CLAY - very stiff to hard light grey shaley clay with ironstone bands		93.10	J,55°		S			6.50	12,24.
7	CLAYEY SHALE - very weak highly fractured light grey shale sandy in parts with ironstone bands			J,45° and 50° clay coated						
				J,30°-40° iron cemented		C	100	53		
8	20mm shaley clay seam			J,30° iron cemented						
8.60			91.00	Joints 20°-50° iron cemented					8.43	
9	LAMINITE - weak to medium strong highly fractured dark grey and light grey laminite Bedding 5°-10°			J,90° irregular and iron stained in places	Drill induced breaks along bedding	C	100	30		
10										

RIG Inter B40 DRILLER B.Lamb/G.Cooper LOGGED R.Lloyd CASING SL - 7.00 m

TYPE OF BORING Solid flight auger to 6.50 m then NMLC core drilling

WATER OBSERVATIONS

REMARKS

SAMPLING & IN SITU TESTING

A	auger sample	V	vane shear test
DP	dry plug	P	pressuremeter test
C	diamond core	W	water pressure test
S	standard penetration	PP	pocket penetrometer test
U( )( )mm tube			

D.J. Douglas & Partners

TEST BORE REPORT

CLIENT TIERNEY AND PARTNERS PTY. LTD.
PROJECT THE CHATSWOOD CONNECTION
LOCATION RAILWAY & CAMBRIDGE STREETS., CHATSWOOD

DATE 5-8/12/86 **BORE No** 16
PROJECT No. SSI/10000 **SHEET** 2 **OF** 4
SURFACE LEVEL 99.6
DIP OF HOLE 90° **AZIMUTH** -

Depth m	Description of Strata	RL	Discontinuities (B-Bedding J-Joint S-Shear D-Drill Brk)	Rock Character: Strength (Soil, Ex. Weak, V. Weak, Weak, M. Strong, Strong, V. Strong, Ex. Strong) / Fract. (Fragment, High Fract., Fractured, Sl. Fract., Unbroken)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Depth	Test Results
11.10	LAMINITE - weak to medium strong slightly fractured dark grey and light grey laminite	88.50	J,90° irregular J,30° J,90° fragmented Numerous drill induced breaks along bedding					11.05	
12	SHALE - weak to medium strong slightly fractured dark grey shale with occasional light grey sandy laminations		J,55° J,90°		C	95	70		
13			J,70° XJ,50° XJ,50°						
14			J,30° J,30° XJ,45° and 45°					14.20	
15			J,30° with pyrite crystals J,45° J,30° Numerous drill induced breaks along bedding						
16	Medium strong to strong from 15.50 m		J,30° J,90° J,50°		C	96	87		
17			J,90° Open 1mm J,10°-40° fragmented					17.00	
18			J,15° J,20°		C	100	88		
19			J,15° J,20° J,20°						
20			J,20°					20.00	

RIG Inter B40 DRILLER B.Lamb/G.Cooper LOGGED R.Lloyd CASING SL - 7.00 m

TYPE OF BORING Solid flight auger to 6.50 m then NMLC core drilling

WATER OBSERVATIONS

REMARKS

SAMPLING & IN SITU TESTING

A	auger sample	V	vane shear test
DP	dry plug	P	pressuremeter test
C	diamond core	W	water pressure test
S	standard penetration	PP	pocket penetrometer test
U( )( )mm tube			

D.J. Douglas & Partners

TEST BORE REPORT

CLIENT	TIERNEY AND PARTNERS PTY. LTD.	**DATE** 5-8/12/86	**BORE No** 16
PROJECT	THE CHATSWOOD CONNECTION	**PROJECT No.** SSI/10000	**SHEET** 3 **OF** 4
LOCATION	RAILWAY & CAMBRIDGE STREETS., CHATSWOOD	**SURFACE LEVEL** 99.6	
		DIP OF HOLE 90°	**AZIMUTH** -

Depth m	Description of Strata	RL	Discontinuities. B-Bedding J-Joint S-Shear D-Drill Brk	Rock Character: Strength (Soil, Ex. Weak, V. Weak, Weak, M. Strong, Strong, V. Strong, Ex. Strong) / Fract. (Fragment, High Fract, Fractured, Sl Fract, Unbroken)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Depth	Test Results
20.70	SHALE - medium strong to strong slightly fractured dark grey shale	78.90	J,80°-90° fragmented with pyrite crystals, water charged						
21	SILTSTONE - medium strong to strong slightly fractured dark grey and brown siltstone		J,15°		C	100	81		
			J,5°						
22	5mm weak seam		J,0°						
22.30		77.30							
	SANDSTONE - medium strong to strong slightly fractured grey fine grained sandstone with occasional shale laminations		J,80°-90°						
23	22.30 - 22.50 weak to medium strong laminite		J,10°					23.15	
	23.15 - 23.30 weak clayey sandstone laminated		J,5°						
24	40mm laminated clayey sandstone		J,0°		D	100	90		
25			B,10°						
	Dark grey and light grey laminite								
26								26.30	
27									
27.30	3mm clay seam	72.30	J,45° sandy						
	SANDSTONE - strong slightly fractured to unbroken grey medium grained sandstone				C	100	97		
28									
29	40mm weak laminite seam							29.40	
30									

RIG Inter B40 DRILLER B.Lamb/G.Cooper LOGGED R.Lloyd CASING SL - 7.00 m

TYPE OF BORING Solid flight auger to 6.50 m then NMLC core drilling

WATER OBSERVATIONS

REMARKS

SAMPLING & IN SITU TESTING

A	auger sample	V	vane shear test
DP	dry plug	P	pressuremeter test
C	diamond core	W	water pressure test
S	standard penetration	PP	pocket penetrometer test
U( )( )mm tube			

D.J. Douglas & Partners

TEST BORE REPORT

CLIENT TIERNEY AND PARTNERS PTY. LTD.
PROJECT THE CHATSWOOD CONNECTION
LOCATION RAILWAY & CAMBRIDGE STREETS., CHATSWOOD

DATE 5-8/12/86 **BORE No** 16
PROJECT No. SSI/10000 **SHEET** 4 **OF** 4
SURFACE LEVEL 99.6
DIP OF HOLE 90° **AZIMUTH** -

Depth m	Description of Strata	Graphic Log	RL	Discontinuities. B-Bedding J-Joint S-Shear D-Drill Brk	Rock Character: Strength (Soil, Ex. Weak, V. Weak, Weak, M. Strong, Strong, V. Strong, Ex. Strong)	Rock Character: Fract. (Fragment, High Fract, Fractured, Sl Fract, Unbroken)	Sampling & In Situ Testing: Sample Type	Core Rec. %	RQD %	Depth	Test Results
31	SANDSTONE - strong slightly fractured to unbroken medium grained light grey sandstone 30.25 - 30.80 light grey cross laminations 25° 2mm sandy clay seam			J,0°	Strong	Unbroken	C	100	100		
31.50			68.10							31.50	
	BORE DISCONTINUED AT 31.50 METRES										

RIG Inter B40 DRILLER B.Lamb/G.Cooper LOGGED R.Lloyd CASING SL - 7.00 m

TYPE OF BORING Solid flight auger to 6.50 m then NMLC core drilling

WATER OBSERVATIONS

REMARKS

SAMPLING & IN SITU TESTING

A	auger sample	V	vane shear test
DP	dry plug	P	pressuremeter test
C	diamond core	W	water pressure test
S	standard penetration	PP	pocket penetrometer test
U( )( )mm tube			

D.J. Douglas & Partner

Superseded Classification
- for reference with 1984 logs

AN ENGINEERING CLASSIFICATION OF SEDIMENTARY ROCKS IN THE SYDNEY AREA

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

Under this system rocks are classified by Rock Type, Degree of Weathering, Strength, Stratification Spacing, and Degree of Fracturing. These terms do not cover the full range of engineering properties. Descriptions of rock may also need to refer to other properties (e.g. durability, abrasiveness, etc.) where these are relevant.

ROCK TYPE DEFINITIONS

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 (.06 to 2 mm) grains.
Siltstone:	More than 50% of the rock consists of silt-sized (less than .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, e.g., clayey sandstone, sandy shale.

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 extends throughout the whole of the rock substance and the original 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	Fr	Rock substance unaffected by weathering.

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	>2m

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index (Is 50) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by the International Society of Rock Mechanics (Reference).

Term	Is(50) MPa	Field Guide	Approx. qu MPa*
Extremely Weak :	0.03	Easily remoulded by hand to a material with soil properties.	0.7
Very Weak:	0.1	May be crumbled in the hand. Sandstone is "sugary" and friable.	2.4
Weak :	0.3	A piece of core 150 mm long x 50 mm dia. may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.	7
Medium Strong:	1	A piece of core 150 mm long x 50 mm dia. can be broken by hand with considerable difficulty. Readily scored with knife.	24
Strong:	3	A piece of core 150 mm long x 50 mm dia. core cannot be broken by unaided hands, can be slightly scratched or scored with knife.	70
Very Strong:	10	A piece of core 150 mm long x 50 mm dia. may be broken readily with hand held hammer. Cannot be scratched with pen knife.	240
Extremely Strong:		A piece of core 150 mm long x 50 mm dia. is difficult to break with hand held hammer. Rings when struck with a hammer.	

*The approximate unconfined compressive strength (qu) shown in the table is based on an assumed ratio to the point load index of 24:1. This ratio may vary widely.

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.

Term	Description
Fragmented:	The core is comprised primarily of fragments of length less than 20 mm, and mostly of width less than the core diameter.
Highly Fractured:	Core lengths are generally less than 20 mm — 40 mm with occasional fragments.
Fractured:	Core lengths are mainly 30 mm — 100 mm with occasional shorter and longer section.
Slightly Fractured:	Core lengths are generally 300 mm –1000 mm with occasional longer sections and occasional sections of 100 mm — 300 mm.
Unbroken:	The core does not contain any fracture.

REFERENCE

— International Society of Rock Mechanics, Commission on Standardisation of Laboratory and Field Tests, Suggested Methods for Determining the Uniaxial Compressive Strength of Rock Materials and the Point Load Strength Index, Committee on Laboratory Tests Document No. 1. Final Draft October 1972.

Prepared by the Sydney Group of the Australian Geomechanics Society, January, 1975.

Douglas Partners
Geotechnics · Environment · Groundwater

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26 July 2010
STE:ste

Mirvac
Level 26,
60 Margaret Street
SYDNEY NSW 2000

Attention : Nicole Vince

WASTE CLASSIFICATION ASSESMENT
PROPOSED MIXED-USE DEVELOPMENT
7 RAILWAY STREET, CHATSWOOD

Douglas Partners Pty Ltd (DP) previously carried out a waste classification assessment of the *in situ* materials on the site in July 2008 (Project 45679, dated 21 July 2008). The previous report is attached.

A site inspection was carried out by DP on 6 July, 2010, and this confirmed that the site is vacant and mostly covered with gravel. The current site status appears similar to that observed by DP in 2008 and is consistent with the advice from Mirvac that the site has remained unchanged since that time.

Based on the above, it is considered that the previous waste classification assessment is still relevant and valid for the site.

DP has carried out a number of investigations on the site since 2002 but has not performed a full Phase 2 investigation; however, the data obtained to date has not identified any significant contamination issues. In support of this, the adjacent site (identified as Epica) with similar conditions, has been successfully constructed. Additionally, the proposed development for the current site will have five to seven basement levels which will result in most or all of the filling on the site being excavated and disposed off site. Therefore, based on the data to date, experience with the adjacent site and the proposed basement excavation, DP considers that the site can be made suitable for the proposed mixed-use development.

We trust the above satisfies your present requirements.

Yours faithfully
DOUGLAS PARTNERS PTY LTD

Scott Easton
Senior Associate

Attached : DP Report (Project 45679, dated July 2008).

Douglas Partners
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DW:jlb
Project 45679
21 July 2008

Mirvac Constructions Pty Ltd
Level 26
60 Margaret Street
SYDNEY NSW 2000

Attention: Mr Zac Hart

By email: zac_hart@mirvac.com.au

Dear Sirs

WASTE CLASSIFICATION ASSESSMENT
BUILDING G SITE - 7 RAILWAY STREET, CHATSWOOD

1. INTRODUCTION

This letter report provides details of the methodology and findings of a waste classification of *in situ* materials located at the above site. The work was conducted by Douglas Partners (DP) Pty Ltd at the request of Mirvac Constructions Pty Ltd.

It is understood that the proposed excavation works for a basement will require all filling materials to be disposed off-site.

Field investigations were conducted on 30 June 2008 and 3 July 2008.

DP previously conducted a waste classification on soil at the site in June 2002. The letter report titled *Waste Classification, "Pacific Place" Railway Street, Chatswood* (reference No. 28994I) was produced for a larger area, part of which was the current Building G Site. Soil samples were collected from 18 drilling locations from the Building G Site. The filling encountered in June 2002 generally comprised orange brown, sandy clay filling to a depth of 1.2 m with the exception of two locations which comprised filling up to 5.1 m. Concrete fragments were generally encountered in the filling at shallow depths along the south-western boundary of the site. The underlying natural material comprised grey red clay and grey shale. From the results of laboratory analysis, the filling was considered to be *Inert Waste* according to the then current NSW EPA Environmental Guidelines: *Assessment, Classification and Management of Liquid and Non-Liquid Wastes (1999).* The underlying natural material was considered to be Virgin Excavated Natural Material (VENM).

It is understood that activities at the site since 2002 have included some minor cut and fill works. For this reason and as considerable time has lapsed since the previous DP investigation, and that the report was prepared for a site larger than Building G, the 2002 results have not been included as part of the current waste classification assessment.

Also note that the 1999 Environmental Guidelines have now been superseded by the current DECC *Waste Classification Guidelines* (2008). There is no equivalent to the "Inert Waste" classification in the current guidelines.

2. SITE INFORMATION

The site was a vacant lot at the time of investigation. The site is rectangular in shape and has approximate dimensions of 30m (east to west) by 90 m (south to north). Adjacent the east of the site is the Railway Enclosure Structure (RES). Help Street is located to the south and Railway Street to the west of the site. A high rise building is located in the neighbouring property to the north.

The majority of the site was covered in blue metal gravel. There was a fill batter at the east of the site which slopes down to the RES. The height of the batter slope varies and is approximately 3 m at its maximum. Storage sheds were located at the northern end of the site.

A site and locality plan is shown on Drawing No. 1 attached.

3. FIELD METHODOLOGY AND OBSERVATIONS

On 30 June 2008 twelve test pits were excavated to variable depths using a backhoe with a 450 mm bucket. Soil samples were generally collected at nominal depths or changes in strata. However, in six of the twelve sampling locations (Test Pits 2, 3, 4, 5, 10, and 11), machine refusal was encountered on buried concrete. Also, at Test Pit 9, filling was encountered to the limit of reach of the backhoe a depth of approximately 2.7 m below the surface. Drawing 1 attached shows the location of the test pits.

On 3 July 2008, an excavator with hammer attachment was used to break through some of the buried concrete previously encountered. The excavator was then used to collect soil samples from below the removed concrete. Due to the greater limit of reach compared to the Backhoe, the excavator was able to excavate into natural soils at Test Pit 9.

At Test Pit 2, excavator refusal was encountered at a depth of 2.2 m on concrete. The concrete slab was not penetrated. The test pit also had two side walls of concrete from a depth of 1.2 m to 2.2 m.

At Test Pit 5, the pit was discontinued in concrete at a depth of 1 m, due to the (not anticipated) thickness of the concrete (more than 0.3 m).

Apart from Test Pits 2 and 5, natural soil was encountered in each of the test pits.

Filling materials were encountered at depths ranging from 0.7 m to 2.7 m below the surface. The top layer of filling at each location was 20 mm blue metal gravel. As various filling materials were encountered beneath this top layer, reference should be made to the attached Test Pit Log sheets for soil descriptions at each location. The following should be noted:

- Asphaltic concrete (probably a buried road surface) was encountered at six locations (Test Pits 1, 2, 3, 4, 5, 6, and 9);
- The filling at Test Pit 9 depth 1.9 m to 2.7 m, described as mottled light grey and red-brown clay filling, with some ironstone gravel was probably reworked (local) natural material;
- Buried concrete was encountered in numerous locations;
- Some filling soils were identified to contain small proportions of anthropogenic materials including metal, wire, geofabric, plastic, concrete pieces, glass, asphalt, brick, terracotta, tiles, and timber;
- Some sand was encountered at the south-west corner of Test Pit 4, 0.7 m to 1.1 m may indicate a service line.

Natural soils encountered included:

- light grey silty clay with trace ironstone gravel;
- orange brown silty clay;
- mottled grey and orange brown silty clay with trace ironstone boulders; and
- mottled red and grey silty clay with trace ironstone gravel.

Free groundwater was not encountered at any of the sampling locations except at Test Pit 2, where water seepage was observed at 1.2 m to 2.2 m below the surface. This groundwater is assumed to be perched on top of buried concrete.

No odours in the soil and filling were encountered during fieldwork.

A photograph of Test Pit 3 and Test Pit 12 is attached showing layers of filling (including asphaltic concrete and concrete) as well as natural soils.

4 FIELD TESTING

Replicate samples were screened for the presence of volatile compounds using a Photo-ionisation Detector (PID). PID results are provided in the attached test pit logs. The results are low and typical of background levels.

5. LABORATORY ANALYSIS AND RESULTS

A total of 24 soil samples (including 2 replicate samples) were collected and sent for analysis at a NATA accredited laboratory (Envirolab Services Pty Ltd) for a variety of common contaminants including:

- Heavy Metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc);
- Total Petroleum Hydrocarbons (TPH);
- Benzene, Toluene, Ethyl Benzene and Xylenes (BTEX);
- Polycyclic Aromatic Hydrocarbons (PAH);
- Polychlorinated Biphenyls (PCB);
- Organochlorine Pesticides (OCP);

- Phenols; and
- Asbestos.

Based on site observations, tests for putrescible waste were not required as the material consisted of non-putrescible soil and rock.

Table 1 summarises the results of laboratory analysis on filling samples. Results are compared to the contaminant threshold values for classifying waste by chemical assessment without the leaching (TCLP) test according to Part 1 of the DECC NSW *Waste Classification Guidelines* (2008).

TCLP analysis (the leaching test) for lead was undertaken on sample 6/0.6-1.2 as this sample had a (specific contaminant) concentration of lead above the contaminant threshold values for classifying waste by chemical assessment without the leaching test. The leaching test result is shown in Table 2. The specific contaminant concentration and leaching concentration are compared to the maximum values for the leachable concentration and the specific contaminant concentration when used together according to the guideline.

Table 3 shows the results of analysis on the natural soil sample 12/2.0-2.5. Results are compared to the Background Levels adopted from:

- NEPC (1999). National Environmental Protection (Assessment of Site Contamination) Measure Schedule B(1) Guidelines on the Investigation Levels for Soil and Groundwater, Background Ranges; and
- Australian and New Zealand Environment and Conservation Council/National Health and Medical Research Council (ANZECC/NHMRC): Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (1992), Environmental Soil Quality Guidelines Background A [ANZECC A];

Results of laboratory analysis are provided in the attached laboratory reports.

Table 1 - Results of Analysis for Filling Soils (All results in mg/kg unless otherwise stated)

Sample ID (Test Pit No. /Depth)	Heavy Metals								PAH		TPH		Benzene	Toluene	Ethylbenzene	Total Xylene	Phenols	Asbestos	OCP	PCB
	As	Cd	Cr~	Cu	Pb	Hg	Ni	Zn	B(a)P	Total +ve PAH	C6-C9	C10-C36								
1/0.0-0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ND	-	-
1/0.1-0.5	<4	<1	23	23	58	<0.1	23	42	0.07	0.27	<25	<PQL	<0.5	<0.5	<1	<PQL	-	-	-	-
1/0.8-1.5	<4	<1	8.9	7.4	24	<0.1	5.8	26	0.3	3	<25	<PQL	<0.5	<0.5	<1	<PQL	<5	ND	<PQL	<PQL
2/0.1-1.0	6	<1	18	22	26	<0.1	20	52	0.08	0.08	<25	<PQL	<0.5	<0.5	<1	<PQL	-	ND	-	-
2/1.3-2.2	<4	<1	9.2	13	43	<0.1	4.2	50	0.2	2.2	<25	<PQL	<0.5	<0.5	<1	<PQL	<5	ND	<PQL	<PQL
3/0.1-0.4	<4	<1	19	22	21	<0.1	16	44	0.07	0.17	<25	<PQL	<0.5	<0.5	<1	<PQL	<5	ND	<PQL	<PQL
BD1-300608	<4	<1	16	17	22	<0.1	16	58	<0.05	<PQL	<25	<PQL	<0.5	<0.5	<1	<PQL	-	-	-	-
4/0.1-0.4	<4	<1	20	20	22	<0.1	22	49	0.2	2.2	<25	<PQL	<0.5	<0.5	<1	<PQL	-	-	-	-
5/0.1-0.5	8.9	<1	21	34	38	<0.1	27	58	0.1	1.5	<25	<PQL	<0.5	<0.5	<1	<PQL	<5	ND	<PQL	<PQL
6/0.1-0.5	5	<1	5.7	6.4	12	<0.1	3.5	7.4	<0.05	<PQL	<25	<PQL	<0.5	<0.5	<1	<PQL	<5	ND	<PQL	<PQL
6/0.6-1.2	84	<1	9.6	16	**110**	0.18	3.4	73	0.3	3.4	<25	<PQL	<0.5	<0.5	<1	<PQL	-	-	-	-
BD2-300608	11	<1	11	12	59	<0.1	3.3	78	0.4	6.4	<25	<PQL	<0.5	<0.5	<1	<PQL	-	-	-	-
7/0.4-1.4	7.3	<1	33	17	27	<0.1	4.7	11	<0.05	<PQL	<25	<PQL	<0.5	<0.5	<1	<PQL	<5	ND	<PQL	<PQL
8/0.1-1.0	18	<1	10	35	42	<0.1	7.9	120	0.3	3.8	<25	<PQL	<0.5	<0.5	<1	<PQL	<5	ND	<PQL	<PQL
8/1.0-1.7	11	<1	11	31	30	<0.1	15	97	<0.05	<PQL	<25	<PQL	<0.5	<0.5	<1	<PQL	-	-	-	-
9/0.6-1.1	20	<1	14	29	49	<0.1	6.5	58	0.08	0.68	<25	<PQL	<0.5	<0.5	<1	<PQL	<5	ND	<PQL	<PQL
9/1.1-1.9	<4	<1	6.5	9.4	10	<0.1	2.1	16	<0.05	0.2	<25	<PQL	<0.5	<0.5	<1	<PQL	<5	ND	<PQL	<PQL
9/1.9-2.7	<4	<1	4.2	17	11	<0.1	1.4	6	<0.05	<PQL	<25	<PQL	<0.5	<0.5	<1	<PQL	-	-	-	-
10/0.0-0.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ND	-	-
10/0.2-1.5	19	<1	10	33	60	<0.1	6.2	49	0.1	1.4	<25	<PQL	<0.5	<0.5	<1	<PQL	<5	ND	<PQL	<PQL
11/0.3-0.9	12	<1	29	24	29	<0.1	11	35	<0.05	<PQL	<25	<PQL	<0.5	<0.5	<1	<PQL	<5	ND	<PQL	<PQL
11/1.0-2.0	7.4	<1	7.9	58	42	<0.1	23	120	0.5	6.3	<25	<PQL	<0.5	<0.5	<1	<PQL	-	-	-	-
12/1.0-1.7	<4	<1	13	25	27	<0.1	15	28	0.05	0.35	<25	<PQL	<0.5	<0.5	<1	<PQL	<5	ND	<PQL	<PQL
General Solid Waste^^	100	20	-	-	100	4	40	-	0.8	200	650	10000	10	288	600	1000	288	ND	60^	50

Notes:
- ~ All Chromium are assumed to exist in the stable Cr(III) oxidation state, as Cr(VI) will be too reactive and unstable under the normal environment
- PQL Practical Quantitation Limit
- ND Not Detected
- D Detected
- ^ Value for Endosulfan only
- ^^ Maximum values for General solid waste for classification without TCLP
- **BOLD** Exceeds General Solid Waste criteria (without TCLP analysis)
- BD1-300608 is a blind replicate sample of 3/0.1-0.4
- BD2-300608 is a blind replicate sample of 6/0.6-1.2

Table 2 - Results of Analysis for Filling Samples including TCLP analysis (All results in mg/kg unless otherwise stated)

Sample ID (Test Pit No./Depth)	Pb	
	Specific Contaminant Concentration (mg/kg)	(TCLP) Leachable Concentration (mg/L)
6/0.6-1.2	110	1
General Solid Waste^	1500	5

Note: ^ Maximum values for General solid waste when using specific contaminant concentrations and leachable concentrations together

Table 3 – Results of Analysis on Natural Soil

Sample ID (Test Pit No. /Depth)	Heavy Metals								PAH		TPH		Benzene	Toluene	Ethylbenzene	Total Xylene
	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn	B(a)P	Total +ve PAH	C6-C9	C10-C36				
12/2.0-2.5	<4	<1	7.5	<1	18	<0.1	<1	<1	<0.05	<PQL	<25	<PQL	<0.5	<0.5	<1	<PQL
Background Levels	1 - 50	1	5 - 1000	2-100	2-100	0.03	5 - 500	10 - 300	-	0.95 - 5	-	-	0.05 - 1	0.1-1	-	-

6. DISCUSSION AND CONCLUSION

6.1 Filling Materials

Concentrations of heavy metals in filling materials were generally low (or not detected) and were within the General Solid Waste criteria without the leaching test, except for the concentration of lead (110 mg/kg) which was marginally above the criteria of 100 mg/kg. TCLP analysis for lead was undertaken on this sample. The total and leachable concentrations of lead for sample 6/0.6-1.2 were within the General Solid Waste maximum values when combining the specific contaminant concentration with the leachable concentration.

Concentrations of PAH (including Benzo(a)pyrene) in filling materials were generally low or not detected and were within the General Solid Waste criteria without doing the leaching test.

Concentrations of TPH, BTEX, Phenols, OCP and PCB in filling materials were not detected.

Asbestos was not detected in any of the analysed samples.

Obvious signs of contamination, such as odours or fibre cement fragments, were not observed during fieldwork.

Based on fieldwork observations and analytical results the bulk of filling materials at the site are considered to be **General Solid Waste (non-putrescible)**. It is considered that the filling material is suitable for disposal to a landfill licensed by NSW DECC to accept General Solid Waste, provided the material is not cross-contaminated/ mixed with other non-reported material. The following should also be noted:

- If buried concrete can be segregated from soil filling materials, the concrete is considered to *Building and Demolition Waste,* which is pre-classified as General Solid Waste (non-putrescible);
- If buried asphalt or asphaltic concrete can be segregated from soil filling materials, the asphalt or asphaltic concrete is considered to be *Asphalt Waste,* which pre-classified as General Solid Waste (non-putrescible);

Even though asbestos was not detected in any of the samples, heterogeneous materials including building rubble were noted in some of the Test Pits. Asbestos-containing materials can be associated with building rubble in filling. During excavation works, if materials that are suspected to contain asbestos are encountered, then this material should be segregated for separate waste classification. Similarly, if materials are observed to contain other obvious signs of contamination such as odours, this material should be segregated for separate waste classification.

6.2 Natural Soil

Concentrations of heavy metals were low or not detected in the natural soil sample (12/2.0-2.5) and were at levels comparable to background levels.

Concentrations of PAH (including Benzo(a)pyrene), TPH and BTEX were not detected in the natural soil samples.

It is therefore considered that the natural soil materials described in the Test Bore Logs (and in Section 3 of this report) are considered to be **Virgin Excavated Natural Material (VENM)** as defined in Department of Environment and Climate Change (DECC) *Waste Classification Guidelines* April 2008, provided the material is not cross-contaminated/ mixed with other non-VENM material. Any material exhibiting obvious signs of contamination or odours would not be classifiable as VENM and should be stockpiled and assessed separately.

6.3 Approximate Volume of Filling Material

The approximate volume filling would appear to the order of 5000 m^3. This volume includes buried concrete slabs and buried asphaltic concrete. However, the following should be considered:

- Natural soil was not encountered in Test Pits 2 and 5 due to buried concrete obstructions. The depths of fill are unknown at these two locations;
- According to DP's 2002 report, filling to depths of 5.1 m were encountered in the vicinity of Test Pit 8, just to the south of the tunnel entrance. However, filling at Test Pit 8 was noted to be to a depth of only 1.7 m. It can not be discounted that a pocket of deeper filling may exist in the vicinity of Test Pit 8, just to the south of the tunnel entrance.

It should be noted that significant volumes of buried concrete were encountered whilst test pitting and, from discussions with the client, have also been noted in recent service location works at the south of the site. The proportion of filling material that is buried concrete is not known.

The volume of fill material will vary with depth and the depth of fill has not been investigated at all locations across the site. The approximate volume of filling material provided above should thus be considered as a rough guide, rather than a qualified estimate for the volume of material that needs to be disposed off site.

6.4 QA/QC

Two replicate intra-laboratory samples were analysed for heavy metals and PAH. A measure of the consistency of results is derived by the calculation of relative percentage differences (RPDs) for replicate samples, calculated as the difference in analyte concentrations between primary and replicate samples, divided by the average of the two results and expressed as a percentage. An RPD of $\pm$ 30 (for inorganic analytes) and 50% (or organic analytes) is considered acceptable in AS 4482.1:2006. The calculated RPDs for the soil duplicates and the respective primary sample are reported in detail in Table 4.

Table 4 – RPD results

Sample	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn	B(a)P	Total +ve PAH
3/0.1-0.4	<4	<1	19	22	21	<0.1	16	44	0.07	0.17
BD1-300608	<4	<1	16	17	22	<0.1	16	58	<0.05	<PQL
RPD (%)	**0**	**0**	**17**	**26**	**5**	**0**	**0**	**27**	**95**	**51**
6/0.6-1.2	84	<1	9.6	16	110	0.18	3.4	73	0.3	3.4
BD2-300608	11	<1	11	12	59	<0.1	3.3	78	0.4	6.4
RPD (%)	**153**	**0**	**14**	**29**	**60**	**94**	**3**	**5**	**29**	**61**

Some of the RPDs were outside the accepted range (of ±30 percent). However, it is considered that the recorded RPD exceedances do not compromise the analytical results obtained given the following:

- The replicate soil sample and the original sample were obtained from filling material, which was noted to be heterogeneous;
- Replicate soil samples were obtained rather than duplicate samples, therefore further decreasing the homogeneity of the samples taken; and
- The concentrations are low, which may give a high RPD value even though the actual difference between the replicate and parent sample is small.

It is therefore considered that the precision and accuracy of the laboratory analyses were acceptable.

The laboratory undergoes its own QA/QC procedures which are provided in the attached laboratory reports.

7. LIMITATIONS

The scope of the material classification and consulting services undertaken by DP were limited to those outlined in the DP proposal dated 13 June 2008.

DP's assessment is necessarily based on the result of limited site investigations and sample testing. Neither DP, nor any other reputable consultant, can provide unqualified warranties nor does DP assume any liability for site conditions not observed, or accessible during the time of the investigations.

Despite all reasonable care and diligence, the materials encountered and concentrations of contaminants measured may not be representative of conditions between the locations sampled and investigated. In addition, site characteristics may change at any time in response to variations in natural conditions, chemical reactions and other events, e.g. groundwater movement and or spillages of contaminating substances. These changes may occur subsequent to DP's investigations and assessment.

This report and associated documentation and the information herein have been prepared solely for the use of Mirvac Constructions Pty Ltd and interested parties at the time and is valid (for the purposes of transport of material) for a period of twelve months only from the date of issue. Any other reliance assumed by third parties on this report shall be at such parties' own

risk. Any ensuing liability resulting from use of the report by third parties cannot be transferred to DP.

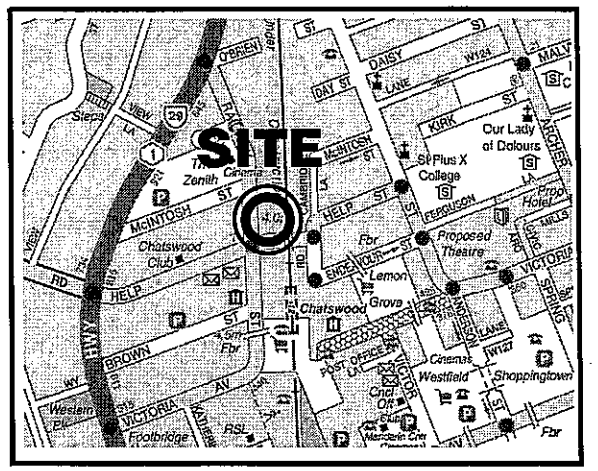
Please note that Part 5.6, Section 143 of the Protection of the Environment Operations (POEO) Act 1997 states that is an offence for waste to be transported to a place that cannot lawfully be used as a facility to accept that waste. It is the duty of the owner and transporter of the waste to ensure that the waste is disposed of appropriately. DP accept no liability for the unlawful disposal of waste materials from any site. DP accepts no responsibility for the material tracking, loading, management, transport or disposal of waste from the site. Before disposal of the material to a licensed landfill is undertaken, the waste producer will be required to obtain prior consent from the landfill.

Yours faithfully
DOUGLAS PARTNER PTY LTD Reviewed by:

David Walker
Environmental Engineer

Lindsay Rockett
Senior Associate

Attachments: *Site Drawing*
Photographs of Test Pits
Test Pit Logs and Notes Relating to this Report
Laboratory Reports



LOCALITY PLAN

RAILWAY ENCLOSURE | TUNNEL | STRUCTURE

HELP STREET

RAILWAY STREET

LEGEND

TEST PIT LOCATION

SCALE

0 10 20 30m

1:400

Douglas Partners *Geotechnics · Environment · Groundwater*	CLIENT: Mirvac Constructions Pty Ltd		OFFICE: SYDNEY	TITLE: **Location of Test Pits Waste Classification Building G Site, Railway Street CHATSWOOD**
	PROJECT No: 45679		DRAWN BY: PSCH	
	DATE: 7.7.2008	SCALE: As shown	APPROVED BY:	

DRAWING No: 1

P:\45679 CHATSWOOD, Waste Classification LR\Drawings\45679-1.dwg, 7/17/2008 12:00:51 PM

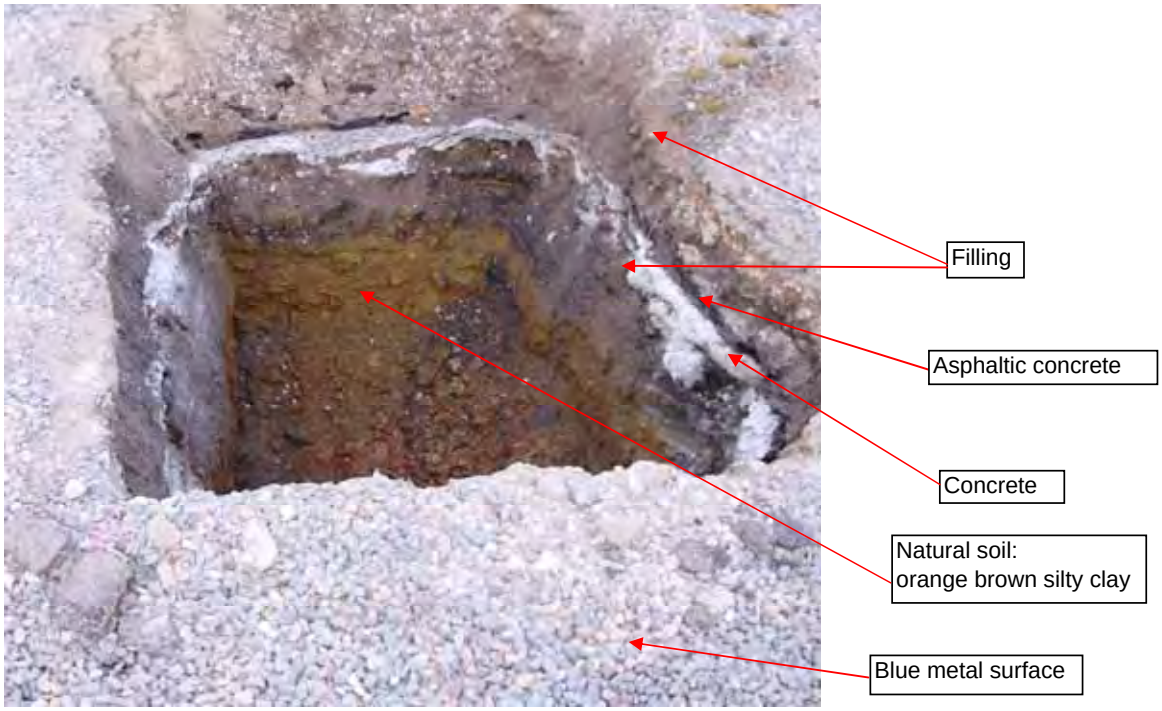


Photo 1: Test Pit 3

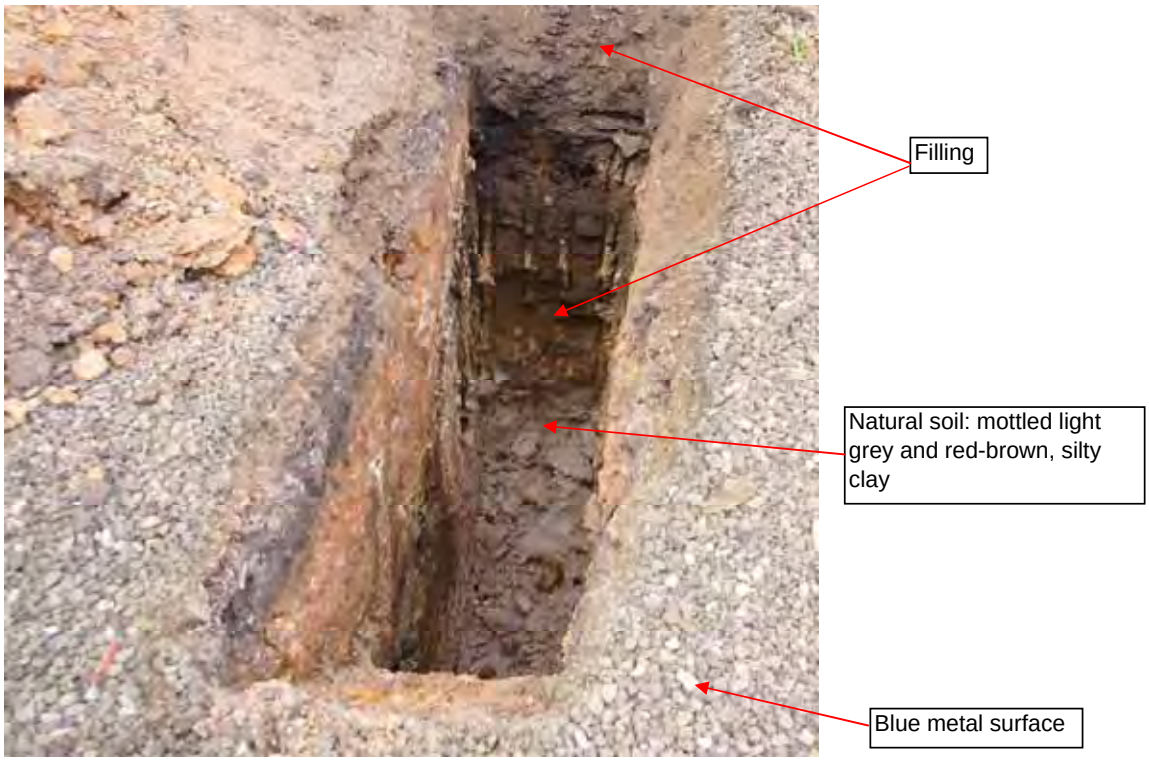
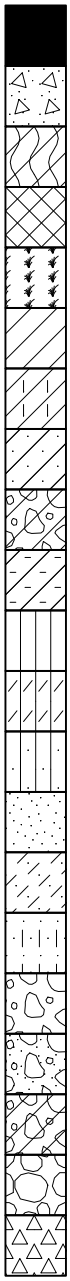


Photo 2: Test Pit 12

GRAPHIC SYMBOLS FOR SOIL & ROCK

SOIL



BITUMINOUS CONCRETE

CONCRETE

TOPSOIL

FILLING

PEAT

CLAY

SILTY CLAY

SANDY CLAY

GRAVELLY CLAY

SHALY CLAY

SILT

CLAYEY SILT

SANDY SILT

SAND

CLAYEY SAND

SILTY SAND

GRAVEL

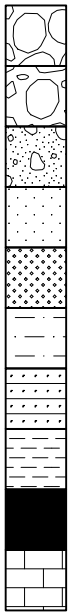
SANDY GRAVEL

CLAYEY GRAVEL

COBBLES/BOULDERS

TALUS

SEDIMENTARY ROCK



BOULDER CONGLOMERATE

CONGLOMERATE

CONGLOMERATIC SANDSTONE

SANDSTONE FINE GRAINED

SANDSTONE COARSE GRAINED

SILTSTONE

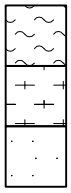
LAMINITE

MUDSTONE, CLAYSTONE, SHALE

COAL

LIMESTONE

METAMORPHIC ROCK

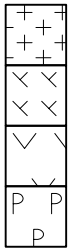


SLATE, PHYLITTE, SCHIST

GNEISS

QUARTZITE

IGNEOUS ROCK



GRANITE

DOLERITE, BASALT

TUFF

PORPHYRY

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TEST PIT LOG

CLIENT: Mirvac Constructions Pty Ltd
PROJECT: Waste Classification
LOCATION: Building G Site - 7 Railway Street, Chatswood

SURFACE LEVEL: 96.5 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: 1
PROJECT No: 45679
DATE: 30 Jun 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.1	FILLING - grey gravel filling (20mm diameter blue metal)		D	0.0 0.1		PID<1ppm PID=2ppm		
		FILLING - brown gravelly sand filling with trace clay		D					
96	0.5	ASPHALTIC CONCRETE			0.5				
	0.6	FILLING - yellow brown, clayey sand filling with some sandstone boulders			0.8		PID=1ppm		
	1			D					1
95					1.5				
	1.8	SILTY CLAY - light grey, silty clay with trace ironstone gravel			1.9		PID=2ppm		
	2			D					2
	2.2	Pit discontinued at 2.2m - target depth reached			2.2				
94									
	3								3
93									
	4								4
92									

RIG: Backhoe - JCB3CX, 6.5t, 450mm bucket

LOGGED: DW

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

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,	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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TEST PIT LOG

CLIENT: Mirvac Constructions Pty Ltd
PROJECT: Waste Classification
LOCATION: Building G Site - 7 Railway Street, Chatswood

SURFACE LEVEL: 95.9 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: 2
PROJECT No: 45679
DATE: 30/6 & 3/7/08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
95	0.05	FILLING - grey gravel filling (20mm diameter blue metal)			0.1		PID<1ppm		
		FILLING - brown and grey, gravel filling with some ballast, trace of sand, silt, clay, wire, geofabric and plastic		D					
	1				1.0				1
	1.15	ASPHALTIC CONCRETE					Concrete side walls from 1.2m to 2.2m on north side and east side PID<1ppm		
	1.2	CONCRETE			1.3				
94		FILLING - brown clayey gravel filling		D				▽	
	2								2
	2.2	- some boulders and concrete at 2.1m to 2.2m			2.2				
		Pit discontinued at 2.2m - refusal on concrete							
93	3								3
92	4								4
91									

RIG: Backhoe - JCB3CX, 6.5t, 450mm bucket & Excavator-Kobelco, 7t **LOGGED:** DW

WATER OBSERVATIONS: Water seepage at 1.7m to 2.2m

REMARKS: Concrete broken with excavator hammer (3/7/08)

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

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,	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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TEST PIT LOG

CLIENT: Mirvac Constructions Pty Ltd
PROJECT: Waste Classification
LOCATION: Building G Site - 7 Railway Street, Chatswood

SURFACE LEVEL: 95.1 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: 3
PROJECT No: 45679
DATE: 30/6 & 3/7/08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
95	0.04	FILLING - grey gravel filling (20mm diameter blue metal)							
		FILLING - brown gravel filling, with some sand and trace of clay		D*	0.1		PID<1ppm		
	0.45				0.4				
	0.5	ASPHALTIC CONCRETE							
		CONCRETE							
	0.68	FILLING - grey clayey sand filling, with trace of gravel		D	0.7		PID=1ppm		
	0.8	SILTY CLAY - orange brown silty clay			0.8				
94	1				1.0		PID<1ppm		1
				D					
	1.5	Pit discontinued at 1.5m - target depth reached			1.5				
93	2								2
92	3								3
91	4								4

RIG: Backhoe - JCB3CX, 6.5t, 450mm bucket & Excavator-Kobelco, 7t **LOGGED:** DW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Denotes BD1-300608 blind replicate sample of 3/0.1-0.4m
Concrete broken with excavator hammer (3/7/08)

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

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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TEST PIT LOG

CLIENT: Mirvac Constructions Pty Ltd
PROJECT: Waste Classification
LOCATION: Building G Site - 7 Railway Street, Chatswood

SURFACE LEVEL: 95.1 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: 4
PROJECT No: 45679
DATE: 30/6 & 3/7/08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
95	0.06	FILLING - grey gravel filling (20mm diameter blue metal)		D	0.0		PID=2ppm		
					0.05		PID<1ppm		
		FILLING - grey brown, gravel filling with some sand, trace clay and concrete pieces		D	0.1				
	0.45				0.4				
	0.5	ASPHALTIC CONCRETE							
		CONCRETE							
	0.65								
	0.7	FILLING - grey gravelly sand filling					Some sand at south west corner of test pit 0.7m to 1.1m, probable service line PID<1ppm		
		SILTY CLAY - orange brown silty clay		D	0.8				
94	1								1
	1.1	Pit discontinued at 1.1m - target depth reached			1.1				
93	2								2
92	3								3
91	4								4

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Backhoe - JCB3CX, 6.5t, 450mm bucket & Excavator-Kobelco, 7t **LOGGED:** DW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Concrete broken with excavator hammer (3/7/08)

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

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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TEST PIT LOG

CLIENT: Mirvac Constructions Pty Ltd
PROJECT: Waste Classification
LOCATION: Building G Site - 7 Railway Street, Chatswood

SURFACE LEVEL: 95.3 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: 5
PROJECT No: 45679
DATE: 30/6 & 3/7/08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
95	0.08	FILLING - grey gravel filling (20mm diameter blue metal)							
		FILLING - grey brown, gravel filling with some sand, trace of clay and plastic		D	0.1		PID=3ppm		
	0.6				0.5				
	0.68	ASPHALTIC CONCRETE							
		CONCRETE							
	1.0	Pit discontinued at 1.0m - in concrete							

RIG: Backhoe - JCB3CX, 6.5t, 450mm bucket & Excavator-Kobelco, 7t **LOGGED:** DW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Concrete broken with hammer (3/7/08)

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

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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TEST PIT LOG

CLIENT: Mirvac Constructions Pty Ltd
PROJECT: Waste Classification
LOCATION: Building G Site - 7 Railway Street, Chatswood

SURFACE LEVEL: 95.3 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: 6
PROJECT No: 45679
DATE: 30 Jun 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
95	0.1	FILLING - grey gravel filling (20mm diameter blue metal)			0.1		PID<1ppm		
		FILLING - brown and grey, gravelly clay filling with some sand, trace of brick, metal and plastic		D					
	0.5				0.5				
	0.55	ASPHALTIC CONCRETE			0.6		PID=2ppm		
		FILLING - brown and grey, clay filling with trace gravel and silt		D*					
94	1								1
					1.2		PID=4ppm		
	1.4	SILTY CLAY - orange brown silty clay							
					1.5		PID=3ppm		
				D					
	2								2
93	2.0	Pit discontinued at 2.0m - target depth reached			2.0				
	3								3
92									
	4								4
91									

RIG: Backhoe - JCB3CX, 6.5t, 450mm bucket

LOGGED: DW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Denotes BD2-300608 blind replicate sample of 6/0.6-1.2m

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

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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TEST PIT LOG

CLIENT: Mirvac Constructions Pty Ltd
PROJECT: Waste Classification
LOCATION: Building G Site - 7 Railway Street, Chatswood

SURFACE LEVEL: 95.3 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: 7
PROJECT No: 45679
DATE: 30 Jun 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
95	0.1	FILLING - grey gravel filling (20mm diameter blue metal)			0.1		PID=2ppm		
		FILLING - grey gravelly clay filling, with trace of silt		D					
	0.3	FILLING - mottled orange brown and grey, silty clay filling with trace ironstone gravel			0.3				
					0.4		PID<1ppm		
94	1			D					1
					1.4				
	1.7	SILTY CLAY - orange brown silty clay			1.8		PID=2ppm		
93	2			D*					2
					2.2				
	2.4	Pit discontinued at 2.4m - target depth reached							
92	3								3
91	4								4

RIG: Backhoe - JCB3CX, 6.5t, 450mm bucket
LOGGED: DW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Denotes BD3-300608 blind replicate sample of 7/1.8-2.2m

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

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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TEST PIT LOG

CLIENT: Mirvac Constructions Pty Ltd
PROJECT: Waste Classification
LOCATION: Building G Site - 7 Railway Street, Chatswood

SURFACE LEVEL: 95.2 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: 8
PROJECT No: 45679
DATE: 30 Jun 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
95	0.05	FILLING - grey gravel filling (20mm diameter blue metal)							
	0.17	FILLING - brown gravelly clay filling							
		FILLING - yellow sand filling							
	0.4	FILLING - brown and grey, clay filling with some gravel and trace of timber, concrete, ballast, geofabric, glass and asphalt		D	0.1		PID<1ppm		
94	1			D*	1.0		PID=2ppm		1
	1.7	SILTY CLAY - orange brown silty clay		D	1.7		PID<1ppm		2
93	2.2	Pit discontinued at 2.2m - target depth reached			2.2				3
92	3								4
91	4								

5 10 15 20

RIG: Backhoe - JCB3CX, 6.5t, 450mm bucket

LOGGED: DW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Denotes BD4-300608 blind replicate sample of 8/1.0-1.7m

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

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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TEST PIT LOG

CLIENT: Mirvac Constructions Pty Ltd
PROJECT: Waste Classification
LOCATION: Building G Site - 7 Railway Street, Chatswood

SURFACE LEVEL: 95.1 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: 9
PROJECT No: 45679
DATE: 30 Jun 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
95	0.07	FILLING - grey gravel filling (20mm diameter blue metal)			0.1		PID=2ppm		
		FILLING - brown grey, sandy gravel filling with some clay		D					
	0.45				0.4				
	0.52	ASPHALTIC CONCRETE							
		FILLING - mottled light grey and orange brown, clay filling with some gravel and trace of concrete and ballast			0.6		PID=2ppm		
	1			D					1
94	1.1	FILLING - yellow and white, sand filling with some sandstone boulders			1.1		PID=1ppm		
				D					
	1.9	FILLING - mottled light grey and red-brown clay, with some ironstone gravel			1.9		PID=2ppm		
	2			D					2
93	2.7	SILTY CLAY - mottled grey and orange brown, silty clay with trace ironstone gravel and ironstone boulders			2.7				
	3				3.0		PID<1ppm		3
92				D					
	3.5	Pit discontinued at 3.5m - target depth reached			3.5				
	4								4
91									

RIG: Backhoe - JCB3CX, 6.5t, 450mm bucket & Excavator-Kobelco, 7t **LOGGED:** DW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Backhoe limit of reach 2.7m; Excavator to 3.5m

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

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,	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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TEST PIT LOG

CLIENT: Mirvac Constructions Pty Ltd
PROJECT: Waste Classification
LOCATION: Building G Site - 7 Railway Street, Chatswood

SURFACE LEVEL: 95.7 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: 10
PROJECT No: 45679
DATE: 30/6 & 3/7/08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.05	FILLING - grey gravel filling (20mm diameter blue metal)		D	0.0		PID<1ppm		
	0.15				0.15				
	0.2	FILLING - brown gravel filling, with some sand and clay			0.2		PID<1ppm		
		CONCRETE							
95		FILLING - brown gravelly clay filling with some sand, trace of metal, plastic, terracotta, concrete		D					
	1	- some ballast at 1.0m to 1.2m							1
					1.5				
94	1.9	SILTY CLAY - mottled red and grey silty clay							
	2			D	2.0		PID=2ppm		2
	2.5	Pit discontinued at 2.5m - target depth reached			2.5				
93	3								3
92	4								4
91									

RIG: Backhoe - JCB3CX, 6.5t, 450mm bucket & Excavator-Kobelco, 7t **LOGGED:** DW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Concrete broken with excavator hammer (3/7/08)

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

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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TEST PIT LOG

CLIENT: Mirvac Constructions Pty Ltd
PROJECT: Waste Classification
LOCATION: Building G Site - 7 Railway Street, Chatswood

SURFACE LEVEL: 96.4 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: 11
PROJECT No: 45679
DATE: 30/6 & 3/7/08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.05	FILLING - grey gravel filling (20mm diameter blue metal)		D	0.0		PID=2ppm		
	0.2	FILLING - brown sandy gravel filling, with some clay and trace rootlets			0.2				
	0.25	CONCRETE			0.3		PID<1ppm		
96		FILLING - brown gravelly clay filling with trace of sand, concrete, tiles and glass		D					
	0.9	FILLING - yellow-grey sand filling, with some sandstone and ironstone boulders and trace gravel			0.9				
1		- some dark grey ballast at 1.3m to 1.5m			1.0		PID=2ppm		1
95				D					
2					2.0				2
	2.2	SILTY CLAY - red brown silty clay			2.3		PID<1ppm		
94	2.4	SILTY CLAY - light grey mottled red, silty clay with trace ironstone gravel		D	2.5				
	2.9	Pit discontinued at 2.9m - target depth reached							
3									3
93									
4									4
92									

RIG: Backhoe - JCB3CX, 6.5t, 450mm bucket & Excavator-Kobelco, 7t **LOGGED:** DW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Concrete broken with excavator hammer (3/7/08)

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

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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TEST PIT LOG

CLIENT: Mirvac Constructions Pty Ltd
PROJECT: Waste Classification
LOCATION: Building G Site - 7 Railway Street, Chatswood

SURFACE LEVEL: 96.5 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: 12
PROJECT No: 45679
DATE: 30 Jun 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.05	FILLING - grey gravel filling (20mm diameter blue metal)			0.1		PID<1ppm		
		FILLING - grey gravelly clay filling							
	0.35	FILLING - mottled orange brown and grey, clay filling with some ironstone, boulders, trace of gravel, sand, bricks and timber		D*					
96	1				1.0		PID=2ppm		1
				D					
95		- some gravel with trace coal pieces at 1.4m to 1.5m - some sand at 1.5m to 1.7m			1.7				
	1.8	SILTY CLAY - mottled light grey and red-brown, silty clay							
	2				2.0		PID=3ppm		2
				D					
94	2.5	Pit discontinued at 2.5m - target depth reached			2.5				
	3								3
93									
	4								4
92									

RIG: Backhoe - JCB3CX, 6.5t, 450mm bucket & Excavator-Kobelco, 7t **LOGGED:** DW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Denotes BD5-0300608 blind replicate sample of 12/0.1-1.0m

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

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,	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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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.

Envirolab Services Pty Ltd
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CERTIFICATE OF ANALYSIS 20728

Client:
Douglas Partners
96 Hermitage Rd
West Ryde
NSW 2114

Attention: David Walker

Sample log in details:

Your Reference:	**45679, Chatswood**
No. of samples:	24 Soils
Date samples received:	04/07/08
Date completed instructions received:	04/07/08

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by:	11/07/08
Date of Preliminary Report:	Not Issued
Issue Date:	11/07/08

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Accredited for compliance with ISO/IEC 17025.
Tests not covered by NATA are denoted with *.

Results Approved By:

Jacinta Hurst
Operations Manager

Joshua Lim
Chemist

vTPH & BTEX in Soil Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-1 1/0.1-0.5 Soil	20728-2 1/0.8-1.5 Soil	20728-3 2/0.1-1.0 Soil	20728-4 2/1.3-2.2 Soil	20728-5 3/0.1-0.4 Soil
Date extracted	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Date analysed	-	8/07/2008	8/07/2008	8/07/2008	8/07/2008	8/07/2008
vTPH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
m+p-xylene	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0
o-Xylene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Surrogate aaa-Trifluorotoluene	%	119	105	99	112	111

vTPH & BTEX in Soil Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-6 4/0.1-0.4 Soil	20728-7 5/0.1-0.5 Soil	20728-8 6/0.1-0.5 Soil	20728-9 6/0.6-1.2 Soil	20728-10 7/0.4-1.4 Soil
Date extracted	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Date analysed	-	8/07/2008	8/07/2008	8/07/2008	8/07/2008	8/07/2008
vTPH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
m+p-xylene	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0
o-Xylene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Surrogate aaa-Trifluorotoluene	%	108	105	105	98	101

vTPH & BTEX in Soil Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-11 8/0.1-1.0 Soil	20728-12 8/1.0-1.7 Soil	20728-13 9/0.6-1.1 Soil	20728-14 9/1.1-1.9 Soil	20728-15 9/1.9-2.7 Soil
Date extracted	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Date analysed	-	8/07/2008	8/07/2008	8/07/2008	8/07/2008	8/07/2008
vTPH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
m+p-xylene	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0
o-Xylene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Surrogate aaa-Trifluorotoluene	%	109	104	99	104	104

vTPH & BTEX in Soil Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-16 10/0.2-1.5 Soil	20728-17 11/0.3-0.9 Soil	20728-18 11/1.0-2.0 Soil	20728-19 12/1.0-1.7 Soil	20728-20 12/2.0-2.5 Soil
Date extracted	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Date analysed	-	8/07/2008	8/07/2008	8/07/2008	8/07/2008	8/07/2008
vTPH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
m+p-xylene	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0
o-Xylene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Surrogate aaa-Trifluorotoluene	%	102	98	114	91	112

vTPH & BTEX in Soil Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-21 BD1-300608 Soil	20728-22 BD2-300608 Soil
Date extracted	-	7/07/2008	7/07/2008
Date analysed	-	8/07/2008	8/07/2008
vTPH C_6 - C_9	mg/kg	<25	<25
Benzene	mg/kg	<0.5	<0.5
Toluene	mg/kg	<0.5	<0.5
Ethylbenzene	mg/kg	<1.0	<1.0
m+p-xylene	mg/kg	<2.0	<2.0
o-Xylene	mg/kg	<1.0	<1.0
Surrogate aaa-Trifluorotoluene	%	95	113

sTPH in Soil (C10-C36)						
Our Reference:	UNITS	20728-1	20728-2	20728-3	20728-4	20728-5
Your Reference	----------	1/0.1-0.5	1/0.8-1.5	2/0.1-1.0	2/1.3-2.2	3/0.1-0.4
Type of sample	----------	Soil	Soil	Soil	Soil	Soil
Date extracted	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Date analysed	-	7/07/2008	7/07/2008	8/07/2008	8/07/2008	8/07/2008
TPH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TPH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TPH C_{29} - C_{36}	mg/kg	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	90	81	82	83	80

sTPH in Soil (C10-C36)						
Our Reference:	UNITS	20728-6	20728-7	20728-8	20728-9	20728-10
Your Reference	----------	4/0.1-0.4	5/0.1-0.5	6/0.1-0.5	6/0.6-1.2	7/0.4-1.4
Type of sample	----------	Soil	Soil	Soil	Soil	Soil
Date extracted	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Date analysed	-	8/07/2008	8/07/2008	8/07/2008	8/07/2008	8/07/2008
TPH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TPH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TPH C_{29} - C_{36}	mg/kg	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	83	84	81	83	86

sTPH in Soil (C10-C36)						
Our Reference:	UNITS	20728-11	20728-12	20728-13	20728-14	20728-15
Your Reference	----------	8/0.1-1.0	8/1.0-1.7	9/0.6-1.1	9/1.1-1.9	9/1.9-2.7
Type of sample	----------	Soil	Soil	Soil	Soil	Soil
Date extracted	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Date analysed	-	8/07/2008	8/07/2008	8/07/2008	8/07/2008	8/07/2008
TPH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TPH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TPH C_{29} - C_{36}	mg/kg	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	82	82	82	83	81

sTPH in Soil (C10-C36)						
Our Reference:	UNITS	20728-16	20728-17	20728-18	20728-19	20728-20
Your Reference	----------	10/0.2-1.5	11/0.3-0.9	11/1.0-2.0	12/1.0-1.7	12/2.0-2.5
Type of sample	----------	Soil	Soil	Soil	Soil	Soil
Date extracted	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Date analysed	-	8/07/2008	8/07/2008	8/07/2008	8/07/2008	8/07/2008
TPH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TPH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TPH C_{29} - C_{36}	mg/kg	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	85	79	83	80	81

sTPH in Soil (C10-C36) Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-21 BD1-300608 Soil	20728-22 BD2-300608 Soil
Date extracted	-	7/07/2008	7/07/2008
Date analysed	-	8/07/2008	8/07/2008
TPH C_{10} - C_{14}	mg/kg	<50	<50
TPH C_{15} - C_{28}	mg/kg	<100	<100
TPH C_{29} - C_{36}	mg/kg	<100	<100
Surrogate o-Terphenyl	%	86	80

PAHs in Soil Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-1 1/0.1-0.5 Soil	20728-2 1/0.8-1.5 Soil	20728-3 2/0.1-1.0 Soil	20728-4 2/1.3-2.2 Soil	20728-5 3/0.1-0.4 Soil
Date extracted	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Date analysed	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	0.2	<0.1	0.2	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.1	0.5	<0.1	0.4	<0.1
Pyrene	mg/kg	0.1	0.5	<0.1	0.4	0.1
Benzo(a)anthracene	mg/kg	<0.1	0.3	<0.1	0.2	<0.1
Chrysene	mg/kg	<0.1	0.3	<0.1	0.2	<0.1
Benzo(b+k)fluoranthene	mg/kg	<0.2	0.5	<0.2	0.4	<0.2
Benzo(a)pyrene	mg/kg	0.07	0.3	0.08	0.2	0.07
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	0.2	<0.1	0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	0.2	<0.1	0.1	<0.1
Surrogate p-Terphenyl-d14	%	124	119	128	119	115

PAHs in Soil Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-6 4/0.1-0.4 Soil	20728-7 5/0.1-0.5 Soil	20728-8 6/0.1-0.5 Soil	20728-9 6/0.6-1.2 Soil	20728-10 7/0.4-1.4 Soil
Date extracted	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Date analysed	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.3	0.2	<0.1	0.7	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.4	0.2	<0.1	0.6	<0.1
Pyrene	mg/kg	0.4	0.3	<0.1	0.6	<0.1
Benzo(a)anthracene	mg/kg	0.2	0.1	<0.1	0.3	<0.1
Chrysene	mg/kg	0.2	0.2	<0.1	0.3	<0.1
Benzo(b+k)fluoranthene	mg/kg	0.3	0.2	<0.2	0.4	<0.2
Benzo(a)pyrene	mg/kg	0.2	0.1	<0.05	0.3	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	0.1	<0.1	0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	0.1	0.1	<0.1	0.1	<0.1
Surrogate p-Terphenyl-d14	%	119	118	112	117	115

PAHs in Soil Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-11 8/0.1-1.0 Soil	20728-12 8/1.0-1.7 Soil	20728-13 9/0.6-1.1 Soil	20728-14 9/1.1-1.9 Soil	20728-15 9/1.9-2.7 Soil
Date extracted	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Date analysed	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.4	<0.1	0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.8	<0.1	0.2	0.1	<0.1
Pyrene	mg/kg	0.8	<0.1	0.2	0.1	<0.1
Benzo(a)anthracene	mg/kg	0.3	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	0.4	<0.1	0.1	<0.1	<0.1
Benzo(b+k)fluoranthene	mg/kg	0.5	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	0.3	<0.05	0.08	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	0.2	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1
Surrogate p-Terphenyl-d14	%	115	115	125	113	115

PAHs in Soil Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-16 10/0.2-1.5 Soil	20728-17 11/0.3-0.9 Soil	20728-18 11/1.0-2.0 Soil	20728-19 12/1.0-1.7 Soil	20728-20 12/2.0-2.5 Soil
Date extracted	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Date analysed	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.2	<0.1	0.7	0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.3	<0.1	1.3	0.1	<0.1
Pyrene	mg/kg	0.3	<0.1	1.2	0.1	<0.1
Benzo(a)anthracene	mg/kg	0.1	<0.1	0.5	<0.1	<0.1
Chrysene	mg/kg	0.2	<0.1	0.6	<0.1	<0.1
Benzo(b+k)fluoranthene	mg/kg	0.2	<0.2	0.8	<0.2	<0.2
Benzo(a)pyrene	mg/kg	0.1	<0.05	0.5	0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	0.3	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	0.3	<0.1	<0.1
Surrogate p-Terphenyl-d14	%	115	115	113	115	114

PAHs in Soil Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-21 BD1-300608 Soil	20728-22 BD2-300608 Soil
Date extracted	-	7/07/2008	7/07/2008
Date analysed	-	7/07/2008	7/07/2008
Naphthalene	mg/kg	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	1.1
Anthracene	mg/kg	<0.1	0.2
Fluoranthene	mg/kg	<0.1	1.2
Pyrene	mg/kg	<0.1	1.2
Benzo(a)anthracene	mg/kg	<0.1	0.5
Chrysene	mg/kg	<0.1	0.6
Benzo(b+k)fluoranthene	mg/kg	<0.2	0.8
Benzo(a)pyrene	mg/kg	<0.05	0.4
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	0.2
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	0.2
Surrogate p-Terphenyl-d_{14}	%	112	116

Organochlorine Pesticides in soil Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-2 1/0.8-1.5 Soil	20728-4 2/1.3-2.2 Soil	20728-5 3/0.1-0.4 Soil	20728-7 5/0.1-0.5 Soil	20728-8 6/0.1-0.5 Soil
Date extracted	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Date analysed	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	99	97	96	99	95

Organochlorine Pesticides in soil Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-10 7/0.4-1.4 Soil	20728-11 8/0.1-1.0 Soil	20728-13 9/0.6-1.1 Soil	20728-14 9/1.1-1.9 Soil	20728-16 10/0.2-1.5 Soil
Date extracted	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Date analysed	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	93	95	100	96	93

Organochlorine Pesticides in soil Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-17 11/0.3-0.9 Soil	20728-19 12/1.0-1.7 Soil
Date extracted	-	7/07/2008	7/07/2008
Date analysed	-	7/07/2008	7/07/2008
HCB	mg/kg	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1
Surrogate TCLMX	%	89	92

PCBs in Soil Our Reference: Your Reference Type of sample	UNITS --- ---	20728-2 1/0.8-1.5 Soil	20728-4 2/1.3-2.2 Soil	20728-5 3/0.1-0.4 Soil	20728-7 5/0.1-0.5 Soil	20728-8 6/0.1-0.5 Soil
Date extracted	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Date analysed	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Arochlor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	99	97	96	99	95

PCBs in Soil Our Reference: Your Reference Type of sample	UNITS --- ---	20728-10 7/0.4-1.4 Soil	20728-11 8/0.1-1.0 Soil	20728-13 9/0.6-1.1 Soil	20728-14 9/1.1-1.9 Soil	20728-16 10/0.2-1.5 Soil
Date extracted	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Date analysed	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Arochlor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	93	95	100	96	93

PCBs in Soil Our Reference: Your Reference Type of sample	UNITS --- ---	20728-17 11/0.3-0.9 Soil	20728-19 12/1.0-1.7 Soil
Date extracted	-	7/07/2008	7/07/2008
Date analysed	-	7/07/2008	7/07/2008
Arochlor 1016	mg/kg	<0.1	<0.1
Arochlor 1232	mg/kg	<0.1	<0.1
Arochlor 1242	mg/kg	<0.1	<0.1
Arochlor 1248	mg/kg	<0.1	<0.1
Arochlor 1254	mg/kg	<0.1	<0.1
Arochlor 1260	mg/kg	<0.1	<0.1
Surrogate TCLMX	%	89	92

Total Phenolics in Soil						
Our Reference:	UNITS	20728-2	20728-4	20728-5	20728-7	20728-8
Your Reference	----------	1/0.8-1.5	2/1.3-2.2	3/0.1-0.4	5/0.1-0.5	6/0.1-0.5
Type of sample	----------	Soil	Soil	Soil	Soil	Soil
Date extracted	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Date analysed	-	9/07/2008	9/07/2008	9/07/2008	9/07/2008	9/07/2008
Total Phenolics (as Phenol)	mg/kg	<5.0	<5.0	<5.0	<5.0	<5.0

Total Phenolics in Soil						
Our Reference:	UNITS	20728-10	20728-11	20728-13	20728-14	20728-16
Your Reference	----------	7/0.4-1.4	8/0.1-1.0	9/0.6-1.1	9/1.1-1.9	10/0.2-1.5
Type of sample	----------	Soil	Soil	Soil	Soil	Soil
Date extracted	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Date analysed	-	9/07/2008	9/07/2008	9/07/2008	9/07/2008	9/07/2008
Total Phenolics (as Phenol)	mg/kg	<5.0	<5.0	<5.0	<5.0	<5.0

Total Phenolics in Soil			
Our Reference:	UNITS	20728-17	20728-19
Your Reference	----------	11/0.3-0.9	12/1.0-1.7
Type of sample	----------	Soil	Soil
Date extracted	-	7/07/2008	7/07/2008
Date analysed	-	9/07/2008	9/07/2008
Total Phenolics (as Phenol)	mg/kg	<5.0	<5.0

Acid Extractable metals in soil Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-1 1/0.1-0.5 Soil	20728-2 1/0.8-1.5 Soil	20728-3 2/0.1-1.0 Soil	20728-4 2/1.3-2.2 Soil	20728-5 3/0.1-0.4 Soil
Date digested	-	8/07/2008	8/07/2008	8/07/2008	8/07/2008	8/07/2008
Date analysed	-	8/07/2008	8/07/2008	8/07/2008	8/07/2008	8/07/2008
Arsenic	mg/kg	<4.0	<4.0	6.0	<4.0	<4.0
Cadmium	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Chromium	mg/kg	23	8.9	18	9.2	19
Copper	mg/kg	23	7.4	22	13	22
Lead	mg/kg	58	24	26	43	21
Mercury	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10
Nickel	mg/kg	23	5.8	20	4.2	16
Zinc	mg/kg	42	26	52	50	44

Acid Extractable metals in soil Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-6 4/0.1-0.4 Soil	20728-7 5/0.1-0.5 Soil	20728-8 6/0.1-0.5 Soil	20728-9 6/0.6-1.2 Soil	20728-10 7/0.4-1.4 Soil
Date digested	-	8/07/2008	8/07/2008	8/07/2008	8/07/2008	8/07/2008
Date analysed	-	8/07/2008	8/07/2008	8/07/2008	8/07/2008	8/07/2008
Arsenic	mg/kg	<4.0	8.9	5.0	84	7.3
Cadmium	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Chromium	mg/kg	20	21	5.7	9.6	33
Copper	mg/kg	20	34	6.4	16	17
Lead	mg/kg	22	38	12	110	27
Mercury	mg/kg	<0.10	<0.10	<0.10	0.18	<0.10
Nickel	mg/kg	22	27	3.5	3.4	4.7
Zinc	mg/kg	49	58	7.4	73	11

Acid Extractable metals in soil Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-11 8/0.1-1.0 Soil	20728-12 8/1.0-1.7 Soil	20728-13 9/0.6-1.1 Soil	20728-14 9/1.1-1.9 Soil	20728-15 9/1.9-2.7 Soil
Date digested	-	8/07/2008	8/07/2008	8/07/2008	8/07/2008	8/07/2008
Date analysed	-	8/07/2008	8/07/2008	8/07/2008	8/07/2008	8/07/2008
Arsenic	mg/kg	18	11	20	<4.0	<4.0
Cadmium	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Chromium	mg/kg	10	11	14	6.5	4.2
Copper	mg/kg	35	31	29	9.4	17
Lead	mg/kg	42	30	49	10	11
Mercury	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10
Nickel	mg/kg	7.9	15	6.5	2.1	1.4
Zinc	mg/kg	120	97	58	16	6.0

Acid Extractable metals in soil Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-16 10/0.2-1.5 Soil	20728-17 11/0.3-0.9 Soil	20728-18 11/1.0-2.0 Soil	20728-19 12/1.0-1.7 Soil	20728-20 12/2.0-2.5 Soil
Date digested	-	8/07/2008	8/07/2008	8/07/2008	8/07/2008	8/07/2008
Date analysed	-	8/07/2008	8/07/2008	8/07/2008	8/07/2008	8/07/2008
Arsenic	mg/kg	19	12	7.4	<4.0	<4.0
Cadmium	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Chromium	mg/kg	10	29	7.9	13	7.5
Copper	mg/kg	33	24	58	25	<1.0
Lead	mg/kg	60	29	42	27	18
Mercury	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10
Nickel	mg/kg	6.2	11	23	15	<1.0
Zinc	mg/kg	49	35	120	28	<1.0

Acid Extractable metals in soil Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-21 BD1-300608 Soil	20728-22 BD2-300608 Soil
Date digested	-	8/07/2008	8/07/2008
Date analysed	-	8/07/2008	8/07/2008
Arsenic	mg/kg	<4.0	11
Cadmium	mg/kg	<1.0	<1.0
Chromium	mg/kg	16	11
Copper	mg/kg	17	12
Lead	mg/kg	22	59
Mercury	mg/kg	<0.10	<0.10
Nickel	mg/kg	16	3.3
Zinc	mg/kg	58	78

Moisture Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-1 1/0.1-0.5 Soil	20728-2 1/0.8-1.5 Soil	20728-3 2/0.1-1.0 Soil	20728-4 2/1.3-2.2 Soil	20728-5 3/0.1-0.4 Soil
Date prepared	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Date analysed	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Moisture	%	9.4	9.3	11	20	16

Moisture Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-6 4/0.1-0.4 Soil	20728-7 5/0.1-0.5 Soil	20728-8 6/0.1-0.5 Soil	20728-9 6/0.6-1.2 Soil	20728-10 7/0.4-1.4 Soil
Date prepared	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Date analysed	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Moisture	%	6.9	7.0	15	19	26

Moisture Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-11 8/0.1-1.0 Soil	20728-12 8/1.0-1.7 Soil	20728-13 9/0.6-1.1 Soil	20728-14 9/1.1-1.9 Soil	20728-15 9/1.9-2.7 Soil
Date prepared	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Date analysed	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Moisture	%	16	18	17	9.7	16

Moisture Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-16 10/0.2-1.5 Soil	20728-17 11/0.3-0.9 Soil	20728-18 11/1.0-2.0 Soil	20728-19 12/1.0-1.7 Soil	20728-20 12/2.0-2.5 Soil
Date prepared	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Date analysed	-	7/07/2008	7/07/2008	7/07/2008	7/07/2008	7/07/2008
Moisture	%	14	22	8.1	20	14

Moisture Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-21 BD1-300608 Soil	20728-22 BD2-300608 Soil
Date prepared	-	7/07/2008	7/07/2008
Date analysed	-	7/07/2008	7/07/2008
Moisture	%	10	13

Asbestos ID - soils						
Our Reference:	UNITS	20728-2	20728-3	20728-4	20728-5	20728-7
Your Reference	----------	1/0.8-1.5	2/0.1-1.0	2/1.3-2.2	3/0.1-0.4	5/0.1-0.5
Type of sample	----------	Soil	Soil	Soil	Soil	Soil
Date analysed	-	8/07/2008	8/07/2008	8/07/2008	8/07/2008	8/07/2008
Sample Description	-	30g soil & rocks	30g soil & rocks	30g soil & rocks	30g soil & rocks	30g soil & rocks
Asbestos ID in soil	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected
Trace Analysis	-	Respirable fibres not detected	Respirable fibres not detected	Respirable fibres not detected	Respirable fibres not detected	Respirable fibres not detected

Asbestos ID - soils						
Our Reference:	UNITS	20728-8	20728-10	20728-11	20728-13	20728-14
Your Reference	----------	6/0.1-0.5	7/0.4-1.4	8/0.1-1.0	9/0.6-1.1	9/1.1-1.9
Type of sample	----------	Soil	Soil	Soil	Soil	Soil
Date analysed	-	8/07/2008	8/07/2008	8/07/2008	8/07/2008	8/07/2008
Sample Description	-	30g soil & rocks	30g soil & rocks	30g soil & rocks	30g soil & rocks	30g soil & rocks
Asbestos ID in soil	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected
Trace Analysis	-	Respirable fibres not detected	Respirable fibres not detected	Respirable fibres not detected	Respirable fibres not detected	Respirable fibres not detected

Asbestos ID - soils						
Our Reference:	UNITS	20728-16	20728-17	20728-19	20728-23	20728-24
Your Reference	----------	10/0.2-1.5	11/0.3-0.9	12/1.0-1.7	1/0.0-0.1	10/0.0-0.15
Type of sample	----------	Soil	Soil	Soil	Soil	Soil
Date analysed	-	8/07/2008	8/07/2008	8/07/2008	8/07/2008	8/07/2008
Sample Description	-	30g soil & rocks	30g soil & rocks	30g soil & rocks	30g soil & rocks	30g soil & rocks
Asbestos ID in soil	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected
Trace Analysis	-	Respirable fibres not detected	Respirable fibres not detected	Respirable fibres not detected	Respirable fibres not detected	Respirable fibres not detected

Method ID	Methodology Summary
GC.16	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS.
GC.3	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID.
GC.12 subset	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.
GC-5	Soil samples are extracted with hexane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
GC-6	Soil samples are extracted with hexane/acetone and waters with dichloromethane and analysed by GC-ECD.
LAB.30	Total Phenolics - determined colorimetrically following disitillation.
Metals.20 ICP-AES	Determination of various metals by ICP-AES.
Metals.21 CV-AAS	Determination of Mercury by Cold Vapour AAS.
LAB.8	Moisture content determined by heating at 105 deg C for a minimum of 4 hours.
AS4964-2004	Qualitative identification of asbestos type fibres in bulk using Polarised Light Microscopy and Dispersion Staining Techniques.

QUALITY CONTROL vTPH & BTEX in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			07/07/2008	20728-1	7/07/2008 || 7/07/2008	LCS-9	07/07/2008 %
Date analysed	-			08/07/2008	20728-1	8/07/2008 || 8/07/2008	LCS-9	08/07/2008 %
vTPH C_6 - C_9	mg/kg	25	GC.16	<25	20728-1	<25 || <25	LCS-9	117%
Benzene	mg/kg	0.5	GC.16	<0.5	20728-1	<0.5 || <0.5	LCS-9	73%
Toluene	mg/kg	0.5	GC.16	<0.5	20728-1	<0.5 || <0.5	LCS-9	105%
Ethylbenzene	mg/kg	1	GC.16	<1.0	20728-1	<1.0 || <1.0	LCS-9	128%
m+p-xylene	mg/kg	2	GC.16	<2.0	20728-1	<2.0 || <2.0	LCS-9	140%
o-Xylene	mg/kg	1	GC.16	<1.0	20728-1	<1.0 || <1.0	LCS-9	140%
Surrogate aaa-Trifluorotoluene	%		GC.16	111	20728-1	119 || 117 || RPD: 2	LCS-9	109%

QUALITY CONTROL sTPH in Soil (C10-C36)	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			7/07/2008	20728-2	7/07/2008 || 7/07/2008	LCS-9	7/07/2008%
Date analysed	-			7/07/2008	20728-2	7/07/2008 || 7/07/2008	LCS-9	7/07/2008%
TPH C_{10} - C_{14}	mg/kg	50	GC.3	<50	20728-2	<50 || <50	LCS-9	68%
TPH C_{15} - C_{28}	mg/kg	100	GC.3	<100	20728-2	<100 || <100	LCS-9	75%
TPH C_{29} - C_{36}	mg/kg	100	GC.3	<100	20728-2	<100 || <100	LCS-9	75%
Surrogate o-Terphenyl	%		GC.3	81	20728-2	81 || 83 || RPD: 2	LCS-9	83%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			7/7/08	20728-2	7/07/2008 || 7/07/2008	LCS-6	7/7/08%
Date analysed	-			7/7/08	20728-2	7/07/2008 || 7/07/2008	LCS-6	7/7/08%
Naphthalene	mg/kg	0.1	GC.12 subset	<0.1	20728-2	<0.1 || <0.1	LCS-6	128%
Acenaphthylene	mg/kg	0.1	GC.12 subset	<0.1	20728-2	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	0.1	GC.12 subset	<0.1	20728-2	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	0.1	GC.12 subset	<0.1	20728-2	<0.1 || <0.1	LCS-6	99%
Phenanthrene	mg/kg	0.1	GC.12 subset	<0.1	20728-2	0.2 || 0.4 || RPD: 67	LCS-6	106%
Anthracene	mg/kg	0.1	GC.12 subset	<0.1	20728-2	<0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	0.1	GC.12 subset	<0.1	20728-2	0.5 || 0.8 || RPD: 46	LCS-6	102%
Pyrene	mg/kg	0.1	GC.12 subset	<0.1	20728-2	0.5 || 0.7 || RPD: 33	LCS-6	107%
Benzo(a)anthracene	mg/kg	0.1	GC.12 subset	<0.1	20728-2	0.3 || 0.4 || RPD: 29	[NR]	[NR]

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Chrysene	mg/kg	0.1	GC.12 subset	<0.1	20728-2	0.3 || 0.4 || RPD: 29	LCS-6	123%
Benzo(b+k)fluoranthene	mg/kg	0.2	GC.12 subset	<0.2	20728-2	0.5 || 0.6 || RPD: 18	[NR]	[NR]
Benzo(a)pyrene	mg/kg	0.05	GC.12 subset	<0.05	20728-2	0.3 || 0.3 || RPD: 0	LCS-6	88%
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	GC.12 subset	<0.1	20728-2	0.2 || 0.2 || RPD: 0	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	0.1	GC.12 subset	<0.1	20728-2	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	0.1	GC.12 subset	<0.1	20728-2	0.2 || 0.2 || RPD: 0	[NR]	[NR]
Surrogate p-Terphenyl-d_{14}	%		GC.12 subset	118	20728-2	119 || 121 || RPD: 2	LCS-6	119%
QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			07/07/2008	20728-2	7/07/2008 || 7/07/2008	LCS-9	07/07/2008 %
Date analysed	-			07/07/2008	20728-2	7/07/2008 || 7/07/2008	LCS-9	07/07/2008 %
HCB	mg/kg	0.1	GC-5	<0.1	20728-2	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	0.1	GC-5	<0.1	20728-2	<0.1 || <0.1	LCS-9	93%
gamma-BHC	mg/kg	0.1	GC-5	<0.1	20728-2	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	0.1	GC-5	<0.1	20728-2	<0.1 || <0.1	LCS-9	98%
Heptachlor	mg/kg	0.1	GC-5	<0.1	20728-2	<0.1 || <0.1	LCS-9	68%
delta-BHC	mg/kg	0.1	GC-5	<0.1	20728-2	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	0.1	GC-5	<0.1	20728-2	<0.1 || <0.1	LCS-9	97%
Heptachlor Epoxide	mg/kg	0.1	GC-5	<0.1	20728-2	<0.1 || <0.1	LCS-9	78%
gamma-Chlordane	mg/kg	0.1	GC-5	<0.1	20728-2	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	0.1	GC-5	<0.1	20728-2	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	0.1	GC-5	<0.1	20728-2	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	0.1	GC-5	<0.1	20728-2	<0.1 || <0.1	LCS-9	120%
Dieldrin	mg/kg	0.1	GC-5	<0.1	20728-2	<0.1 || <0.1	LCS-9	105%
Endrin	mg/kg	0.1	GC-5	<0.1	20728-2	<0.1 || <0.1	LCS-9	108%
pp-DDD	mg/kg	0.1	GC-5	<0.1	20728-2	<0.1 || <0.1	LCS-9	92%
Endosulfan II	mg/kg	0.1	GC-5	<0.1	20728-2	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	0.1	GC-5	<0.1	20728-2	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	0.1	GC-5	<0.1	20728-2	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	0.1	GC-5	<0.1	20728-2	<0.1 || <0.1	LCS-9	85%
Methoxychlor	mg/kg	0.1	GC-5	<0.1	20728-2	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%		GC-5	97	20728-2	99 || 100 || RPD: 1	LCS-9	92%

QUALITY CONTROL PCBs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			07/07/2008	20728-2	7/07/2008 || 7/07/2008	LCS-9	07/07/2008 %
Date analysed	-			07/07/2008	20728-2	7/07/2008 || 7/07/2008	LCS-9	07/07/2008 %
Arochlor 1016	mg/kg	0.1	GC-6	<0.1	20728-2	<0.1 || <0.1	[NR]	[NR]
Arochlor 1232	mg/kg	0.1	GC-6	<0.1	20728-2	<0.1 || <0.1	[NR]	[NR]
Arochlor 1242	mg/kg	0.1	GC-6	<0.1	20728-2	<0.1 || <0.1	[NR]	[NR]
Arochlor 1248	mg/kg	0.1	GC-6	<0.1	20728-2	<0.1 || <0.1	[NR]	[NR]
Arochlor 1254	mg/kg	0.1	GC-6	<0.1	20728-2	<0.1 || <0.1	LCS-9	97%
Arochlor 1260	mg/kg	0.1	GC-6	<0.1	20728-2	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%		GC-6	97	20728-2	99 || 100 || RPD: 1	LCS-9	111%
QUALITY CONTROL Total Phenolics in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			7/7/08	20728-10	7/07/2008 || 7/07/2008	LCS-1	7/7/08%
Date analysed	-			9/7/08	20728-10	9/07/2008 || 9/07/2008	LCS-1	9/7/08%
Total Phenolics (as Phenol)	mg/kg	5	LAB.30	<5.0	20728-10	<5.0 || <5.0	LCS-1	92%
QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date digested	-			08/07/08	20728-1	8/07/2008 || 8/07/2008	LCS-2	08/07/08%
Date analysed	-			08/07/08	20728-1	8/07/2008 || 8/07/2008	LCS-2	08/07/08%
Arsenic	mg/kg	4	Metals.20 ICP-AES	<4.0	20728-1	<4.0 || <4.0	LCS-2	105%
Cadmium	mg/kg	1	Metals.20 ICP-AES	<1.0	20728-1	<1.0 || <1.0	LCS-2	107%
Chromium	mg/kg	1	Metals.20 ICP-AES	<1.0	20728-1	23 || 21 || RPD: 9	LCS-2	109%
Copper	mg/kg	1	Metals.20 ICP-AES	<1.0	20728-1	23 || 15 || RPD: 42	LCS-2	111%
Lead	mg/kg	1	Metals.20 ICP-AES	<1.0	20728-1	58 || 71 || RPD: 20	LCS-2	105%
Mercury	mg/kg	0.1	Metals.21 CV-AAS	<0.10	20728-1	<0.10 || <0.10	LCS-2	116%
Nickel	mg/kg	1	Metals.20 ICP-AES	<1.0	20728-1	23 || 22 || RPD: 4	LCS-2	108%
Zinc	mg/kg	1	Metals.20 ICP-AES	<1.0	20728-1	42 || 44 || RPD: 5	LCS-2	108%

QUALITY CONTROL **Moisture**	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD
Date prepared	-			[NT]	20728-1	7/07/2008 || 7/07/2008
Date analysed	-			[NT]	20728-1	7/07/2008 || 7/07/2008
Moisture	%	0.1	LAB.8	<0.10	20728-1	9.4 || 9.4 || RPD: 0

QUALITY CONTROL Asbestos ID - soils	UNITS	PQL	METHOD	Blank
Date analysed	-			[NT]

QUALITY CONTROL vTPH & BTEX in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	20728-13	7/07/2008 || 7/07/2008	20728-2	07/07/2008%
Date analysed	-	20728-13	8/07/2008 || 8/07/2008	20728-2	08/07/2008%
vTPH C_6 - C_9	mg/kg	20728-13	<25 || <25	20728-2	117%
Benzene	mg/kg	20728-13	<0.5 || <0.5	20728-2	111%
Toluene	mg/kg	20728-13	<0.5 || <0.5	20728-2	131%
Ethylbenzene	mg/kg	20728-13	<1.0 || <1.0	20728-2	93%
m+p-xylene	mg/kg	20728-13	<2.0 || <2.0	20728-2	126%
o-Xylene	mg/kg	20728-13	<1.0 || <1.0	20728-2	126%
Surrogate aaa-Trifluorotoluene	%	20728-13	99 || 96 || RPD: 3	20728-2	120%

QUALITY CONTROL sTPH in Soil (C10-C36)	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	20728-13	7/07/2008 || 7/07/2008	20728-4	7/07/2008%
Date analysed	-	20728-13	8/07/2008 || 8/07/2008	20728-4	7/07/2008%
TPH C_{10} - C_{14}	mg/kg	20728-13	<50 || <50	20728-4	71%
TPH C_{15} - C_{28}	mg/kg	20728-13	<100 || <100	20728-4	80%
TPH C_{29} - C_{36}	mg/kg	20728-13	<100 || <100	20728-4	81%
Surrogate o-Terphenyl	%	20728-13	82 || 81 || RPD: 1	20728-4	83%

QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	20728-13	7/07/2008 || 7/07/2008	20728-4	7/7/08%
Date analysed	-	20728-13	7/07/2008 || 7/07/2008	20728-4	7/7/08%
Naphthalene	mg/kg	20728-13	<0.1 || <0.1	20728-4	107%
Acenaphthylene	mg/kg	20728-13	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	20728-13	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	20728-13	<0.1 || <0.1	20728-4	97%
Phenanthrene	mg/kg	20728-13	0.1 || 0.2 || RPD: 67	20728-4	104%
Anthracene	mg/kg	20728-13	<0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	20728-13	0.2 || 0.2 || RPD: 0	20728-4	107%
Pyrene	mg/kg	20728-13	0.2 || 0.2 || RPD: 0	20728-4	111%
Benzo(a)anthracene	mg/kg	20728-13	<0.1 || 0.1	[NR]	[NR]

QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Chrysene	mg/kg	20728-13	0.1 || 0.2 || RPD: 67	20728-4	118%
Benzo(b+k)fluoranthene	mg/kg	20728-13	<0.2 || <0.2	[NR]	[NR]
Benzo(a)pyrene	mg/kg	20728-13	0.08 || 0.09 || RPD: 12	20728-4	98%
Indeno(1,2,3-c,d)pyrene	mg/kg	20728-13	<0.1 || <0.1	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	20728-13	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	20728-13	<0.1 || <0.1	[NR]	[NR]
Surrogate p-Terphenyl-d_{14}	%	20728-13	125 || 118 || RPD: 6	20728-4	115%
QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	20728-13	7/07/2008 || 7/07/2008	20728-4	07/07/2008%
Date analysed	-	20728-13	7/07/2008 || 7/07/2008	20728-4	07/07/2008%
HCB	mg/kg	20728-13	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	20728-13	<0.1 || <0.1	20728-4	92%
gamma-BHC	mg/kg	20728-13	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	20728-13	<0.1 || <0.1	20728-4	96%
Heptachlor	mg/kg	20728-13	<0.1 || <0.1	20728-4	65%
delta-BHC	mg/kg	20728-13	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	20728-13	<0.1 || <0.1	20728-4	94%
Heptachlor Epoxide	mg/kg	20728-13	<0.1 || <0.1	20728-4	76%
gamma-Chlordane	mg/kg	20728-13	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	20728-13	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	20728-13	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	20728-13	<0.1 || <0.1	20728-4	118%
Dieldrin	mg/kg	20728-13	<0.1 || <0.1	20728-4	104%
Endrin	mg/kg	20728-13	<0.1 || <0.1	20728-4	109%
pp-DDD	mg/kg	20728-13	<0.1 || <0.1	20728-4	91%
Endosulfan II	mg/kg	20728-13	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	20728-13	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	20728-13	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	20728-13	<0.1 || <0.1	20728-4	86%
Methoxychlor	mg/kg	20728-13	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%	20728-13	100 || 95 || RPD: 5	20728-4	93%

QUALITY CONTROL PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	20728-13	7/07/2008 || 7/07/2008	20728-4	07/07/2008%
Date analysed	-	20728-13	7/07/2008 || 7/07/2008	20728-4	07/07/2008%
Arochlor 1016	mg/kg	20728-13	<0.1 || <0.1	[NR]	[NR]
Arochlor 1232	mg/kg	20728-13	<0.1 || <0.1	[NR]	[NR]
Arochlor 1242	mg/kg	20728-13	<0.1 || <0.1	[NR]	[NR]
Arochlor 1248	mg/kg	20728-13	<0.1 || <0.1	[NR]	[NR]
Arochlor 1254	mg/kg	20728-13	<0.1 || <0.1	20728-4	96%
Arochlor 1260	mg/kg	20728-13	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%	20728-13	100 || 95 || RPD: 5	20728-4	124%
QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date digested	-	20728-11	8/07/2008 || 8/07/2008	20728-2	08/07/08%
Date analysed	-	20728-11	8/07/2008 || 8/07/2008	20728-2	08/07/08%
Arsenic	mg/kg	20728-11	18 || 24 || RPD: 29	20728-2	101%
Cadmium	mg/kg	20728-11	<1.0 || <1.0	20728-2	100%
Chromium	mg/kg	20728-11	10 || 13 || RPD: 26	20728-2	104%
Copper	mg/kg	20728-11	35 || 52 || RPD: 39	20728-2	107%
Lead	mg/kg	20728-11	42 || 63 || RPD: 40	20728-2	96%
Mercury	mg/kg	20728-11	<0.10 || <0.10	20728-2	117%
Nickel	mg/kg	20728-11	7.9 || 9.0 || RPD: 13	20728-2	102%
Zinc	mg/kg	20728-11	120 || 96 || RPD: 22	20728-2	98%
QUALITY CONTROL Moisture	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD		
Date prepared	-	20728-2	7/07/2008 || 7/07/2008		
Date analysed	-	20728-2	7/07/2008 || 7/07/2008		
Moisture	%	20728-2	9.3 || 9.3 || RPD: 0		
QUALITY CONTROL Moisture	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD		
Date prepared	-	20728-11	7/07/2008 || 7/07/2008		
Date analysed	-	20728-11	7/07/2008 || 7/07/2008		
Moisture	%	20728-11	16 || 16 || RPD: 0		
QUALITY CONTROL Moisture	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD		
Date prepared	-	20728-13	7/07/2008 || 7/07/2008		
Date analysed	-	20728-13	7/07/2008 || 7/07/2008		
Moisture	%	20728-13	17 || 17 || RPD: 0		

Report Comments:

Asbestos was analysed by Approved Identifier: Joshua Lim

INS: Insufficient sample for this test	NT: Not tested	PQL: Practical Quantitation Limit
RPD: Relative Percent Difference	NA: Test not required	LCS: Laboratory Control Sample
NR: Not requested	<: Less than	>: Greater than

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Douglas Partners
Geotechnics · Environment · Groundwater

CHAIN OF CUSTODY

Project Name: Waste Classification - Chatswood
Project No: 45679 Sampler: David Walker
Project Mgr: LR Mob. Phone: 0409 242 497
Email: david.walker@douglaspartners.com.au
Date Required: Standard T/A Lab Quote No.

To: Envirolab Services
12 Ashley Street, Chatswood NSW 2068
Attn: Tania Notaras
Phone: 02 9910 6200 Fax: 02 9910 6201
Email: tnotaras@envirolabservices.com.au

DOUGLAS PARTNE...
11 6 JUL 2008

Sample ID	Sample Depth	Lab ID	Sampling Date	Sample Type S - soil W - water	Container type	Analytes: As	Cd	Cr	Cu	Pb	Hg	Ni	Zn	BTEX/ TPH	OCPs/ [redacted]	PCBs	PAH	Phenols	VOCs	~~Other~~ Asbestos	Notes
1/0.1-0.5		1				✓	✓	✓	✓	✓	✓	✓	✓	✓			✓				3
1/0.8-1.5		2													✓	✓		✓		✓	7a
2/0.1-1.0		3																		✓	3a
2/1.3-2.2		4													✓	✓		✓		✓	7a
3/0.1-0.4		5													✓	✓		✓		✓	7a
4/0.1-0.4		6																			3
5/0.1-0.5		7													✓	✓		✓		✓	7a
6/0.1-0.5		8													✓	✓		✓		✓	7a
6/0.6-1.2		9																			3
7/0.4-1.4		10													✓	✓		✓		✓	7a
8/0.1-1.0		11													✓	✓		✓		✓	7a
8/1.0-1.7		12				✓	✓	✓	✓	✓	✓	✓	✓	✓			✓				3

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: 9910 6200

Job No: 20728
Date received: 4/7/18
Time received: 11
Received by: S C
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Lab Report No.
Send Results to: Douglas Partners Address: 96 Hermitage Road, West Ryde 2114
Phone: (02) 9809 0666
Fax: (02) 9809 4095

Relinquished by: D.W	Signed:	Date & Time: 4/7/08 9am	Received By: Simon S	Date & Time: 4/7/18 11
Relinquished by:	Signed:	Date & Time:	Received By:	Date & Time:

Douglas Partners
Geotechnics · Environment · Groundwater

CHAIN OF CUSTODY

Project Name: Waste Classification - Chatswood
Project No: 45679 Sampler: David Walker
Project Mgr: LR Mob. Phone: 0409 242 497
Email: david.walker@douglaspartners.com.au
Date Required: Standard T/A Lab Quote No.

To: Envirolab Services
12 Ashley Street, Chatswood NSW 2068
Attn: Tania Notaras
Phone: 02 9910 6200 Fax: 02 9910 6201
Email: tnotaras@envirolabservices.com.au

Sample ID	Sample Depth	Lab ID	Sampling Date	Sample Type S - soil W - water	Container type	Analytes: As	Cd	Cr	Cu	Pb	Hg	Ni	Zn	BTEX/ TPH	OCPs/ [redacted]	PCBs	PAH	Phenols	VOCs	Other Asbestos	Notes
9	0.6-1.1	13				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	7a
9	1.1-1.9	14				↓	↓	↓	↓	↓	↓	↓	↓	↓	✓	✓	↓	✓		✓	7a
9	1.9-2.7	15				↓	↓	↓	↓	↓	↓	↓	↓	↓			↓	↓			3.
10	0.2-1.5	16				↓	↓	↓	↓	↓	↓	↓	↓	↓	✓	✓	↓	✓		✓	7a
11	0.3-0.9	17				↓	↓	↓	↓	↓	↓	↓	↓	↓	✓	✓	↓	✓		✓	7a
11	1.0-1.2	18				↓	↓	↓	↓	↓	↓	↓	↓	↓			↓	↓			3.
12	1.0-1.7	19				↓	↓	↓	↓	↓	↓	↓	↓	↓	✓	✓	↓	✓		✓	7a
12	2.0-2.5	20				↓	↓	↓	↓	↓	↓	↓	↓	↓			↓	↓			3.
BD1-300608		21				↓	↓	↓	↓	↓	↓	↓	↓	↓			↓	↓			3
BD2-300608		22				✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	↓			3.
1	0.0-0.1	23																		✓	
10	0.0-0.15	24																		✓	

Lab Report No.
Send Results to: Douglas Partners Address: 96 Hermitage Road, West Ryde 2114 Phone: (02) 9809 0666 Fax: (02) 9809 4095

Relinquished by: D.W	Signed:	Date & Time: 4/7/08 9am	Received By:	Date & Time:	
Relinquished by:	Signed:	Date & Time:	Received By:	Date & Time:	

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

CERTIFICATE OF ANALYSIS 20728-A

Client:
Douglas Partners
96 Hermitage Rd
West Ryde
NSW 2114

Attention: David Walker

Sample log in details:

Your Reference:	**45679, Chatswood**
No. of samples:	Additional Testing on 1 Soil
Date samples received:	04/07/08
Date completed instructions received:	11/07/08

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by:	18/07/08
Date of Preliminary Report:	Not Issued
Issue Date:	16/07/08

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Accredited for compliance with ISO/IEC 17025.
Tests not covered by NATA are denoted with *.

Results Approved By:

Jacinta Hurst
Operations Manager

Metals in TCLP Our Reference: Your Reference Type of sample	UNITS ---------- ----------	20728-A-9 6/0.6-1.2 Soil
Date extracted	-	14/07/2008
Date analysed	-	16/07/2008
pH of soil for fluid# determ.	pH units	7.80
pH of soil for fluid # determ. (acid)	pH units	1.40
Extraction fluid used	-	1
pH of final Leachate	pH units	5.00
Lead in TCLP	mg/L	0.1

Method ID	Methodology Summary
EXTRACT.7	Toxicity Characteristic Leaching Procedure (TCLP).
Metals.20 ICP-AES	Determination of various metals by ICP-AES.

QUALITY CONTROL Metals in TCLP	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			14/7/08	[NT]	[NT]	LCS-W1	14/7/08%
Date analysed	-			16/07/08	[NT]	[NT]	LCS-W1	16/07/08%
Lead in TCLP	mg/L	0.03	Metals.20 ICP-AES	<0.03	[NT]	[NT]	LCS-W1	100%

Report Comments:

Asbestos was analysed by Approved Identifier: Not applicable for this job

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