Douglas Partners
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Report on
Preliminary Geotechnical Investigation of Ivanhoe Estate

Proposed Residential Development
Ivanhoe Estate, Macquarie Park

Prepared for
Frasers Property Ivanhoe Pty Ltd

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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Revised Report on Preliminary Geotechnical Investigation of Ivanhoe Estate
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1. Introduction

This revised report presents the results of a geotechnical investigation undertaken by Douglas Partners Pty Ltd (DP) for a proposed residential development at Ivanhoe Estate, Macquarie Park. The assessment was commissioned by Frasers Property Ivanhoe Pty Ltd under the Consultancy Services Deed for Ivanhoe Estate dated 15 November 2017.

This report provides preliminary geotechnical information on the greater area of the Ivanhoe Estate, and follows after a desktop geotechnical assessment, DP Report 86043.00.R.001.Rev1 dated November 2017, produced to support the Concept Development Application.

This revised report has been prepared including a correction to Table 1 and updated groundwater levels following a 6 month period of groundwater monitoring at the site.

As part of this work package, covered by the Consultancy Services Deed, separate reports have been prepared for:

- Preliminary geotechnical investigation of Ivanhoe Estate (this report)
- Geotechnical investigation of the Stage 1 Area (DP Report 86043.01.R.002, issued separately)
- Summary results of geotechnical investigation at 2-4 Lyonpark Road (DP Report 86043.01.R.003, issued separately); and,
- Preliminary waste classification at Ivanhoe Estate (DP Report 86043.01.R.004, issued separately)
- Results of groundwater monitoring (DP Report 86043.01.R.005, issued separately).

It is understood that the development of the site will include the demolition of existing structures at the site followed by the construction of new high-rise buildings, largely for residential purposes. Basements of two to six levels are proposed to provide suitable parking for the development, together with the construction of a new bridge across Shrimptons Creek and connecting road to Lyonpark Road. Significant excavation is anticipated across the greater site area in order to obtain the proposed site levels and for the basement excavations.

The aim of this investigation is to provide information on subsurface soil and groundwater conditions at Ivanhoe Estate in order to 'ground truth' the previous desktop assessment, and to provide preliminary information on:

- Shallow geotechnical conditions across the greater site area to support general earthworks and excavation planning, and likely subgrade conditions for new pavements;
- Geotechnical conditions in the vicinity of the proposed bridge at Shrimptons Creek, for planning and preliminary design purposes;

- Additional deeper bores to provide information on deeper ground conditions for preliminary assessment of excavation conditions along the proposed main road (for services) and towards Shrimptons Creek (for preliminary assessment of basement excavation and design); and,
- Groundwater conditions.

The investigation included:

- 13 cored boreholes within the Ivanhoe Estate area, including 4 boreholes near Shrimptons Creek, and 7 boreholes in the Stage 1 development area.
- 1 cored borehole at 2-4 Lyonpark Road, near the proposed south-eastern bridge abutment;
- 17 shallow boreholes in accessible areas across the greater Ivanhoe Estate area; and,
- 6 standpipes, including datalogger installation for groundwater monitoring

2. Background

2.1 Proposed Development

In September 2015 the Ivanhoe Estate was rezoned by the Department of Planning and Environment as part of the Macquarie University Station (Herring Road) Priority Precinct, to transform the area into a vibrant centre that benefits from the available transport infrastructure and the precinct's proximity to jobs, retail and education opportunities within the Macquarie Park corridor.

The Ivanhoe Estate is currently owned by NSW Land and Housing Corporation and comprises 259 social housing dwellings. The redevelopment of the Ivanhoe Estate is part of the NSW Government Communities Plus program, which seeks to deliver new communities where social housing blends with private and affordable housing, with good access to transport, employment, improved community facilities and open space.

The Communities Plus program seeks to leverage the expertise and capacity of the private and non-government sectors. As part of this program, Aspire Consortium, comprising Frasers Property Australia, Citta Property Group and Mission Australia Housing, was selected as the successful proponent to develop the site in July 2017.

2.2 Previous Assessment

A previous, desktop geotechnical assessment (DP Report 86043.00.R.001.Rev0) was undertaken for Ivanhoe Estate for the Masterplan DA stage. This report includes the relevant results of that assessment, together with the information obtained from the recent investigation. This report should therefore be taken to supersede the previous (desktop) assessment.

Historic boreholes were identified from 2-4 Lyonpark Road, from prior to the development of the commercial building at the site. The approximate plan locations of those bores (Bores A1 to A5) is shown in Drawing 1 in Appendix B, and borehole logs reproduced in Appendix E. It is noted that ground conditions may have changed during the subsequent site development.

3. Site Description

The Ivanhoe Estate site is located in Macquarie Park near the corner of Epping Road and Herring Road within the Ryde Local Government Area (LGA). The site is approximately 8.2 hectares and currently accommodates 259 social housing dwellings, comprising a mix of townhouse and four storey apartment buildings set around a cul-de-sac street layout. An aerial photo of the site is provided in Figure 1.

Figure 1: Ivanhoe Estate site

Immediately to the north of the site are a series of four storey residential apartment buildings. On the north-western boundary, the site fronts Herring Road and a lot which is currently occupied by four former student accommodation buildings and is likely to be subject to redevelopment. Epping Road runs along the south-western boundary of the site and Shrimptons Creek, an area of public open space, runs along the south-eastern boundary. Vehicle access to the site is via Herring Road.

The site is comprised of 17 individual lots and a part lot and are owned and managed by Land and Housing Corporation. The Masterplan site also incorporates an extension of this land, being a portion

of Shrimptons Creek and part of the commercial site at 2-4 Lyonpark Road. The extended land is included to facilitate a bridge crossing and road connection to Lyonpark Road.

Ground levels in the Ivanhoe Estate site slope down from approximately RL 71 towards the Herring Road/Epping Road intersection towards the east and south-east, to RL 42 at Shrimptons Creek, at the south-eastern site boundary.

3.1 Site Observations

A walkover of the site was undertaken by an experienced geotechnical engineer on 3 July 2017, and the following conditions noted:

- The existing two to four-storey structures, were generally in poor to reasonable conditions, with some cracks present in the brickwork of buildings and retaining walls, possibly indicating differential movement of foundations;
- Existing pavements were generally in poor to reasonable condition, with potholes, alligator cracking and rutting variously present at the site.
- A sandstone outcrop and bedrock exposed in cuttings were observed during the site walkover, with the locations shown in Drawing 1, in Appendix C. These included:
    - A medium strength sandstone outcrop at the southern corner of the site, near Shrimptons Creek.
    - Exposed rock cuttings were visible in several locations at the rear of residences west of Ivanhoe Place. The rock faces were generally not accessible for close inspection, but appeared to generally comprise sandstone, sometimes thinly bedded. Shale and siltstone were also considered to be present, particularly towards the upper (north–western) end of the site, based on the apparent bedding thickness and weathering of the rock, although this may also be due to the presence of weaker sandstone. A photograph of a cut rock face exposed at the rear of 10 Ivanhoe Place is included in Figure 2, below.

Figure 2: Exposed rock face at rear of 10 Ivanhoe Place.

- Gravelly clay, clayey sand and sand filling was also exposed in the faces of some batters at the site, likely due to past construction works for building platforms and road embankments.
- At Shrimptons Creek, the banks were gently to moderately sloping, and were generally vegetated or comprised exposed filling. Numerous sandstone boulders were present in the banks and creek bed. Signage at Shrimptons Creek indicates that the creek is subject to flooding.
- Groundwater seepage was not observed at cuts or creek banks, although mossy growth was observed between pavers and on walls, suggesting that the existing shallow soils are poorly grained.

Site observations during the recent field work were consistent with those noted above.

3.2 Regional Mapping

Reference to the Sydney Soils Landscape Series Sheet (see Figure 3) indicates that the site is largely underlain by the residual Lucas Heights soil landscape, though partly underlain by the erosional Glenorie soils towards Herring Road, over the upper (north-western) third of the site.

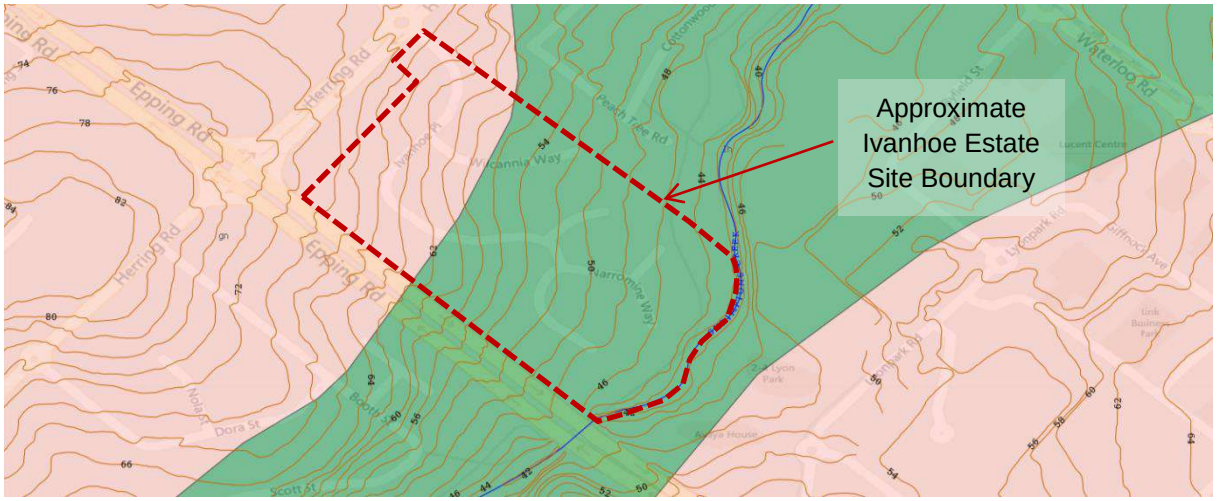


Figure 3: Extract of Soils Landscape Series Mapping (pink = Glenorie; green = Lucas Heights)

The results of the field work indicated that filling is present across much of the site, with natural soils present between the filling and bedrock at few locations.

Reference to the Sydney Geology Series Sheet, shown in Figure 4, suggests that the site is underlain by Ashfield Shale towards Herring Road (typically comprising shale and laminite); and by Hawkesbury Sandstone in the lower half of the site (typically comprising medium to coarse grained sandstone with very minor shale and laminite lenses). The Ashfield Shale, where present, would be underlain by Hawkesbury Sandstone, possibly with a transitional Mittagong Formation (interbedded shale, laminite and sandstone) between the two layers.

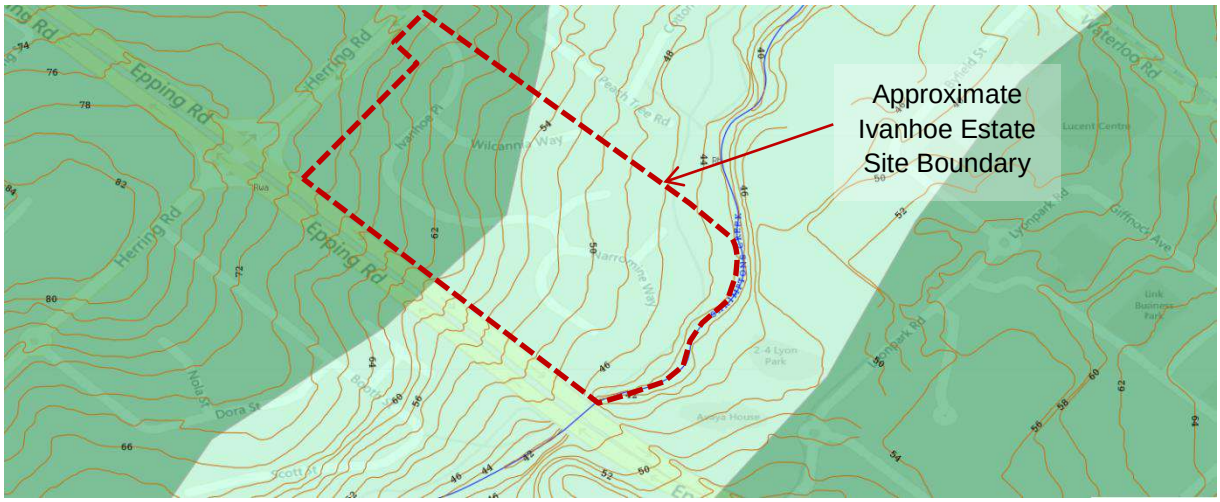


Figure 4: Edited Extract of Geological Series Mapping (dark green = Ashfield Shale, light green = Hawkesbury Sandstone)

The results from the current investigation are considered to be relatively consistent with the published mapping, with the presence of interbedded shales, laminate and sandstone (Mittagong Formation) underlain by Hawkesbury Sandstone in a small area in the upper part of the site towards Herring Road, and Hawkesbury Sandstone present from top of rock across the lower parts of the site.

A broader view of the geological mapping, as shown in Figure 5, indicates that a dyke has been identified approximately 2 km north-west of the site, oriented parallel to and near Epping Road. Dykes are often long, linear (in plan) features in the Sydney area, and, while not yet mapped at the subject site, may potentially extend to or near it.

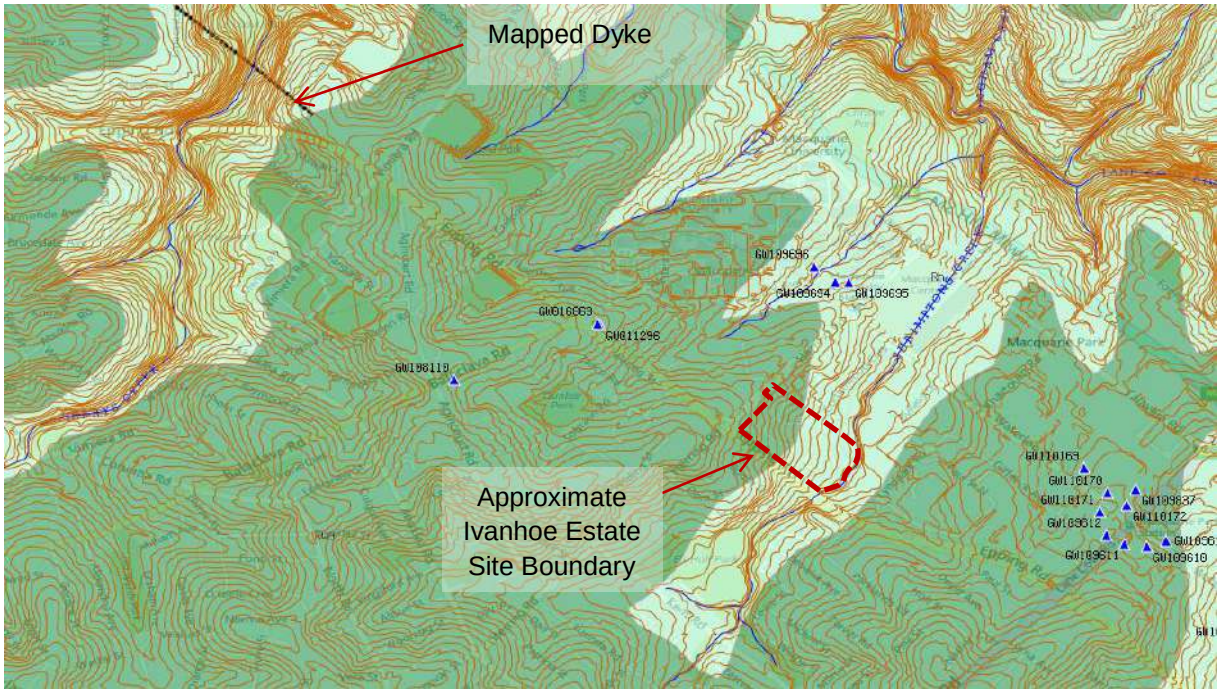


Figure 5: Registered Groundwater Bores (blue triangles) and Geological Series Mapping – Note diagonal black line at top left corner (mapped dyke)

Further discussion of dykes is included in Section 7.1.

Groundwater bores in the vicinity of the subject site on the NSW Office of Water register (2010) - shown as blue triangles in Figure 5 - are relatively distant from the subject site, but indicate groundwater at depths of 4 m to 18 m below ground level, within bedrock. This is broadly consistent with the results of the current investigation.

3.3 Salinity and Acid Sulfate Soils

The site is in an area of no known risk of coastal Acid Sulfate Soil, and is at an elevation above those associated with coastal Acid Sulfate Soils.

The site is outside of the Salinity Potential in Western Sydney mapping, and is not in an area generally associated with saline soils. Some layers within the Glenorie soil landscape are associated with localised salinity, but are not considered likely to be present in significant volumes on this site.

The results of laboratory testing are consistent with the absence of saline or acid sulphate soils.

4. Field Work

4.1 Field Work Methods

The field work comprised:

- 14 deep, small-diameter boreholes (Bores 01 to 13, and LP1), drilled with a geotechnical drilling rig under the supervision of a geotechnical engineer. The boreholes were drilled using auger or rotary drilling methods to bedrock, then continued by NMLC (50 mm diameter) diamond core drilling methods into the underlying bedrock. Sampling and identification of strata was undertaken from the cuttings returned by the auger blade, supplemented by disturbed sampling of soils by Standard Penetration Tests, and by logging of the retrieved rock core. The bores were taken to depths of between 5.1 m and 23.5 m, with the deeper bores in the area of the proposed Stage 1 development (as shown in Drawing 1, in Appendix B).
- 17 shallow, augered boreholes (Bores 31 to 47), drilled with an, excavator-mounted 300 mm diameter auger or auger drilling with a geotechnical drilling rig. The bores were taken down into bedrock, generally to material consistent with refusal for the excavator-mounted augers. The following exceptions are noted:
    - At Bore 36, services were known to be present in the area but were not detectable with the services scanning equipment. The bore was therefore hand-augered, but encountered effective refusal and discontinued in filling at shallow depth due to sandstone gravel within a hard clay filling matrix. (A supplementary large diameter bore was subsequently undertaken at Bore 05, to obtain a bulk soil sample for laboratory testing from the vicinity of Bore 36).
    - At Bore 33 the bore was discontinued in filling at 1.2 m due to contact with a possible concrete boulder or service at the side of the hole.

  - At Bore 37, due to auger refusal on a concrete boulder within the filling; and,
  - At Bore 47, due to the depth of soil exceeding the maximum reach of the excavator-mounted augers.
- Dynamic cone penetrometer (DCP) tests were undertaken at most test locations, except where precluded by ground surface conditions or by potential services. The tests were undertaken to provide information on the general consistency of near-surface soils.
- Standpipes were installed at 6 of the borehole locations (Bore 01, 05, 07, 10, 12 and 13) to the full depth of the bores, to allow for the measurement of groundwater levels. The wells were installed with screen lengths within the bedrock, backfilled with a gravel back, bentonite seal then spoil, with a gatic cover installed in concrete at the ground surface. The bentonite seal is intended to isolate surface water inflow and shallow 'perched' groundwater flows from any groundwater flows within the rock. At three locations (Bore 05 and Bore 07 and Bore 13), the formation of a gravel 'bridge' around the standpipe during backfilling resulted in a higher-than-intended gravel pack, and bentonite was subsequently placed above the top of bedrock. At Bore 05, the bentonite seal is within the filling, with the standpipe potentially indicating 'perched' levels within the filling. At Bore 07 and 13 the bentonite is within the natural clay, and would be less impacted by any 'perched' groundwater levels. The standpipes were bailed to remove drilling fluid, and dataloggers installed for the monitoring of groundwater levels in November 2017.

At the completion of drilling, the ground surface was reinstated with spoil at all bore locations, except at standpipe locations (gatic cover at surface).

Further details on the methods and procedures employed in the investigation are presented in the notes in Appendix A of this report.

Access to the test locations towards Shrimptons Creek was arranged with Ryde Council, who manage the existing open park area and the secured chain for vehicle access.

Test locations and ground surface levels at test locations were determined relative to Australian Height Datum (AHD) by high precision HDGPS equipment.

The locations of the bores are shown in Drawing 1, in Appendix B. The test locations were necessarily limited by the existing structures and vegetation, site topography, below ground services, and the need to limit disruption to residents in the community.

4.2 Field Work Results

The detailed results of the field work are given in Appendix C of this report, together with relevant notes on classification terms, symbols and abbreviations.

The results of the field work may be broadly summarised as follows:

- **Filling –** variable filling materials, including clay, sandy clay and gravelly sand, with roadbase, sandstone and concrete gravel, of variable compaction to depths of 0.2 m to 2.1 m, though more typically between 0.4 m and 1.4 m deep; underlain by,

- **Clay** – generally stiff to hard, medium plasticity red brown, orange brown and brown clay, with ironstone gravel, with some clayey silt and silty clay, including some soft and firm layers towards Shrimptons Creek (at Bores 10 and 11) and some silty sand (Bore 10), absent in approximately half of the bores, but typically to depths of 1 m to 3 m where encountered; underlain by,
- **Interbedded shale, laminite and sandstone** – variable strength, with interbedded extremely low to low strength rock with medium and high strength, iron-cemented bands, generally becoming medium strength below approximately 3.5 m depth, only present in the upper boreholes (Bores 01, 02 and 03), towards Herring Road; underlain by,
- **Sandstone** – extremely low to low strength, then variable, with medium and high strength iron-cemented bands to depths of 2.5 m to 5 m below ground level, then typically medium strength, then high strength below depths of 4 m to 6.5 m below ground level. Some significant very low and very high strength bands were noted within the otherwise medium and high strength rock.

No groundwater was observed whilst augering at the borehole locations. The following groundwater observations were made from discrete measurements at standpipe locations:

Table 1: Discrete Groundwater Measurements

Groundwater	Date	Bore 01	Bore 05	Bore 07	Bore 10	Bore 12	Bore 13
Depth (m)	12/12/17	17.7	12.7	13.5	4.5	4.1	4.9
RL (m AHD)	12/12/17	49.8	46.5	45.6	40.7	41.1	41.9

The results of groundwater monitoring during the monitoring period 15/11/17 to 22/06/18 are provided in Appendix D.

Groundwater level fluctuations in the order of 0.5 m to 1.0 m were observed at the bores during the monitoring period 15/11/17 to 22/06/18.

The interpreted geotechnical model developed from the test results, mapping, nearby experience and site topography is described in Section 7.1.

5. Laboratory Testing

Laboratory testing was undertaken on selected soil samples in order to provide information on soil classification, soil compaction, field moisture content, California bearing ratio (CBR), aggressivity and dispersion potential.

The detailed results of laboratory testing are provided in Appendix E, and summarised in the following sections.

5.1 Soil Classification

Atterberg Limit tests were undertaken on selected soil samples across the site, to provide information on the soil behaviour and the results are summarised in Table 2.

Table 2: Summary of Results of Atterberg Limit Test Results

Bore	Depth (m)	Material	Liquid Limit	Plastic Limit	Plasticity Index	Comment
02	1.0-1.45	Filling - Clay	46	22	24	Medium plasticity
LP1	1.3-1.45	Clay	37	16	21	Medium plasticity
34	0.5-0.6	Sandstone	24	18	6	Low plasticity
38	0.4-0.5	Sandstone	38	19	19	Medium plasticity
40	1.3-1.5	Clay	42	23	19	Medium plasticity
41	0.9-1.0	Sandstone	32	18	14	Low plasticity
46	0.5-0.6	Filling - Sandy clay	21	15	6	Low plasticity
47	0.4-0.5	Filling - Clay	22	15	7	Low plasticity

The above results indicate that the filling, natural clay and weathered sandstone on the site are generally of low and medium plasticity.

Particle size distribution tests were undertaken on selected soil samples near the proposed bridge over Shrimptons Creek. The results are summarised in Table 3.

Table 3: Summary of Results of Particle Size Distribution Tests

Bore	Depth (m)	Material type	D_{15}	D_{50}	D_{85}	Comment
LP1	0.9	Filling – Clayey silt and sand	0.002	0.1	0.35	
11	0.9-1.0	Clayey silt	<0.002	0.025	0.3	
11	2.5-2.8	Gravelly Silty Clay	0.002	0.8	15	Possibly affected by gravel from underlying fragmented lateritic sandstone

The hydrometer results indicate variable soil composition near Shrimptons Creek.

5.2 Soil Compaction, Field Moisture Content and California Bearing Ratio (CBR)

Bulk soil samples were obtained from large diameter augered bores for the purpose of undertaking laboratory testing of the California bearing ratio (CBR), to assist with future pavement design. The compaction properties of the samples were determined, and each sample was then prepared in CBR moulds at approximately 100% of the Standard Maximum Dry Density (SMDD) and within 2% of the Standard Optimum Moisture Content (SOMC). Once prepared, the samples were immersed in a water tank with a 4.5 kg surcharge for a 4 day period. The results of the laboratory compaction and

the CBR tests are summarised in Table 4, below, together with results of field moisture content tests from additional samples.

Table 4: Summary of Results of Soil Compaction, Field Moisture Content and CBR Tests

Bore	Sample Depth (m)	Material	Field Moisture Content (%)	SOMC (%)	SMDD (t/m^3)	CBR – 4 day soak (%)	Swell (%)
05	0.6-0.9	Filling – Sandy Clay	6.4	12.0	1.95	16	0
31	0.5-0.7	Filling – Silty Clay	8.8	13.0	1.87	9	0.5
32	0.5-0.7	Sandstone	6.0	10.5	1.95	10	0
33	0.4-0.7	Filling – Sand	7.7	10.5	1.99	20	0.5
35	0.2-0.7	Filling – Clay	7.1	11.5	1.97	30	0.5
37	0.5-0.8	Filling – Clayey Sand	8.1	12.0	1.90	16	0
39	0.1-0.5	Clayey Sand	10.3	10.5	1.96	20	0.5
40	1.3-1.5	Clay	15.7	16.0	1.80	14	0
42	0.6-0.9	Filling – Clayey Sand	5.5	11.5	1.96	16	-0.5
43	0.1-0.4	Filling – Gravelly Sand	7.3	11.0	1.95	45	0
46	0.6-0.8	Filling – Sandy Clay	9.7	12.0	1.96	14	-0.5
47	0.5-1.0	Clay (possible filling)	9.8	13.5	1.91	4.5	-0.5
2	0.9-1.0	Filling – Clay	10	-	-	-	-
3	2.5-2.85	Shale	6.7	-	-	-	-
6	0.9-1.0	Filling – Clay	11	-	-	-	-
8	0.5	Filling – Clay	9.9	-	-	-	-
8	0.9-1.0	Clay	8.6	-	-	-	-
10	0.4-0.5	Filling – Silty Clay	9.5	-	-	-	-
13	0.4-0.5	Filling – Sandy Clay	8.7	-	-	-	-
34	0.1-0.2	Filling – Gravelly Sand	7.7	-	-	-	-
41	0.4-0.5	Clay	14	-	-	-	-

The above results indicate CBR values of 9% to 45% in the filling, reflecting the variability of the filling materials encountered. CBR values of 4.5% and 14% were obtained in the clay soils, and 10% and 20% obtained in extremely weathered sandstone and clayey sand, respectively. Broadly speaking, these results are considered relatively high for low and medium plasticity, clay soils and should be considered with caution. Field moisture contents are generally below optimum moisture content. The swell results are generally consistent with the typically low to medium plasticity soils indicated by the Atterberg Limit test results.

5.3 Aggressivity

Selected soil samples were tested for pH, electrical conductivity, chloride and sulphate ion concentrations. Resistivity values were calculated from the conductivity results. The results of the testing are summarised in Table 5.

Table 5: Summary of Results of Chemical Aggressivity Tests

Bore	Depth (m)	Material	pH	Electrical Conductivity (µS/cm)	Electrical Resistivity (ohm.m)	Chloride (mg/kg)	Sulphate (mg/kg)
01	0.9-1.0	Sandstone	5.1	56	180	20	63
01*	0.9-1.0	Sandstone	5	56	180	20	63
02	0.9-1.0	Filling – Clay	4.9	45	220	10	54
03	0.9-1.0	Filling – Sandy Clay	8.2	83	120	<10	10
03	2.5-2.85	Shale	5.7	33	300	10	37
05	0.9-1.0	Filling – Gravelly Clay	4.9	41	240	<10	58
05*	0.9-1.0	Filling – Gravelly Clay	5	46	220	10	66
06	0.9-1.0	Filling – Clay	7.9	75	130	<10	20
08	0.9-1.0	Clay	6.4	75	130	<10	120
08	2.4-2.5	Sandstone	5.1	61	160	20	81
10	0.4-0.5	Filling – Silty Clay	8.1	85	120	10	48
10	1.0-1.45	Sandy Clay	5.3	44	230	<10	57
11	1.5	Silty Clay	5	30	330	10	28
13	0.4-0.5	Filling – Sandy Clay	5.7	53	190	20	69
LP1	2.5-2.55	Sandstone	5.3	26	380	<10	34
31	2.1-2.2	Shale	4.6	77	130	50	53
34	0.9-1.0	Sandstone	4.6	66	150	26	70
38	0.9-1.0	Sandstone	4.6	46	220	10	58
39	0.4-0.5	Clayey Sand	6.7	16	630	<10	20
41	0.4-0.5	Clay	7.7	55	180	10	<10
42	2.0-2.1	Sandstone	5.3	34	290	<10	47
43	0.5-0.6	Sandstone	8.1	56	180	<10	<10

*Replicate tests

Noting that groundwater was not observed within the soil column at test locations, the results in Table 5 are considered to be generally consistent with the expected absence of acid sulphate soils at the site.

5.4 Soil Dispersion Potential

Emerson Crumb dispersion tests were undertaken on several soil samples across the site. The results are summarised in Table 6.

Table 6: Summary of Results of Emerson Crumb Class Tests

Bore	Depth	Material type	Emerson Crumb Class	Comment
01	0.4-0.5	Filling – Silty Clay	6	
07	0.9-1.0	Clay	6	
11	0.9-1.0	Clayey Silt and Sand	6	
11	2.5-2.8	Gravelly Silty Clay	6	
12	1.4-1.5	Sandy Clay	6	
LP1	0.9	Filling – Clayey silt and sand	6	
34	0.5-0.6	Sandstone	4*	*Carbonate present
37	0.4-0.5	Filling – Clayey Sand	7	
47	0.4-0.5	Filling - Clay	2	Some dispersion

6. Proposed Development

6.1 Overview of Proposed Development

The proposed Masterplan is currently at Concept DA stage. The Concept DA sets out the concept proposal for the development of the site, to establish the planning and development framework, which will form the basis for the detailed design of the future buildings and against which the future detailed DAs will be assessed.

The Masterplan DA seeks approval for the maximum building envelopes for future stages of development, the maximum gross floor area (GFA) and land uses for the development. Specifically:

- A mixed use development involving a maximum of GFA of 281,905m2, including residential flat buildings comprising private, social and affordable housing; seniors housing comprising residential care facilities and self-contained dwellings; a new high school; child care centres; minor retail development; and community uses;
- maximum building heights and GFA for each development block;

- public domain landscape concept, including parks, streets and pedestrian connections;
- provision of the Ivanhoe Estate Design Guidelines to guide the detailed design of the future buildings; and
- vehicular and intersection upgrades.

An image of the Masterplan DA is provided at Figure 6 below.

Figure 6: Ivanhoe Estate Masterplan, with Main Road highlighted in yellow

6.2 Expected Works

The proposed development at the site will include the demolition of the existing buildings, followed by re-contouring of the existing site levels to the grades and levels required by the proposed developments, subdivision of the site into new lots and the construction of new roads and key infrastructure (e.g. electricity and sewer main). Key infrastructure is expected to be located along the Main Road of the Masterplan, shown highlighted in Figure 7.

At Shrimptons Creek, at the eastern corner of the site, a bridge is proposed to extend the Main Road over the creek, and connecting to Lyonpark Road. The location of the bridge abutments, extent of approach embankments and location of bridge foundations is not yet known. The final design is expected to include an access path under the Main Road or bridge for the cycleway along Shrimptons Creek.

Deep basement excavations and new, multi-storey building foundations will be required for the proposed buildings, with basement levels of 2 to 4 storeys generally anticipated.

7. Comments

7.1 Geotechnical and Hydrogeological Model

7.1.1 Geotechnical Model

An interpreted geotechnical model has been developed for the site, based on the background information together with the results of testing within the site. The model is summarised in Table 7.

Table 7: Geotechnical Model

Unit	Summary	Sub unit	Summary Description	General Description
1	Filling		Variable	Variably compacted, clay, sandy clay, sand, gravelly sand filling. Broadly present across the site, to typical depths of 0.4 m to 1.5 m but likely to be very shallow in areas of past cuts (generally inaccessible for the current investigation), and deeper around services or in areas of past filling, with depths of up to 2.1 m observed at some test locations.
2	Natural Clay		Stiff to Hard	Typically stiff to hard, medium plasticity residual soils, with some to trace ironstone gravel, includes some clayey silt, clayey sand, sandy clay and silty sand layers, and possible alluvial, soft to firm clay layers towards Shrimptons Creek (eg. Bores 10 and11) Present below the filling at only some locations. To typical depths of 1 m to 3 m, where encountered.
3	Interbedded shale / laminite / siltstone / sandstone	3a	Extremely low to low strength	Typically extremely low to low strength, but includes some medium to high strength, iron-cemented bands, typically highly fractured or fragmented Only present in the upper part of the site towards Herring Road (Bores 01, 02, 03, 31 and 32), to depths of up to 3 m.
		3b	Variable	Very low to low, medium and high strength beds, includes thick beds of medium and high strength, some highly fractured or fragmented beds. Only present in the upper part of the site towards Herring Road (Bores 01 and 02), to depths of up to 3.5 m to 4 m.
		3c	Low to Medium strength	Generally consistently low to medium or higher strength, with some extremely to very low strength bands, fractured. Only present in the upper part of the site towards Herring Road (Bores 01 and 02), to typical depths of up to 4.5 m to 6 m.

Unit	Summary	Sub unit	Summary Description	General Description
4	Sandstone	4a	Extremely low to low strength	Typically extremely low to low strength, but with some medium to high strength, iron-cemented bands, typically fractured. Absent in many locations, typically to depths of 0.5 m to 2.5 m when encountered.
		4b	Variable	Very low to low, medium and high strength beds, includes thick beds of medium and high strength, typically fractured Typically to depths of 2.5 m to 5 m below ground level, but deeper at some locations (e.g. 6.0 m at Bore 07 due to fracturing and thick clay seams).
		4c	Medium strength	Medium and some high strength sandstone, some extremely low, very low and very high strength bands. Typically slightly fractured and unbroken and occurring to depths of 4 m to 6.5 m below ground level.
		4d	High strength	High and very high strength sandstone, some medium and very low strength bands. Typically slightly fractured and unbroken.

The following information, also informs the geotechnical model for the site

- **Dykes** In addition to the dyke noted in Figure 5, a second, unmapped, approximately north south oriented dyke is present to the north-east of the site. If extended, this dyke would be present on the far side of Shrimptons Creek (i.e. east of the subject site), although it is noted that dykes may "step" or fork in plan, and thus may intersect the subject site.

  Dykes in Sydney are typically near-vertical, planar features that may change in thickness, become discontinuous and/or step in plan. Common dyke widths in Sydney range from less than 1 m to approximately 6 m. They are typically completely weathered basalt or dolerite (clay) near surface and are usually weathered and weaker than the surrounding rock to significant depth. The rock adjacent to the dyke can also be highly fractured, variable, or abnormally high strength due to the heat and pressure effects of the intrusion. Higher permeability and greater water seepage is also often observed within and on either side of the dyke material.

  Such dykes would be expected to be sub-vertical, and would typically only be identified by targeted, inclined bores. Therefore, while not identified by the current investigation, dykes may still be present on the subject site.

- **Thrust Faults** Thrust faulting, often associated with dykes, has been previously identified at a nearby site to the north-west of the subject site. A photograph showing the subsurface profile exposed by bulk excavation at the site to the north-west is included in Figure 7.

  Thrust faults may pass along bedding planes before stepping up through a rock bed, potentially presenting as an extremely weathered band, and so can be challenging to identify from widely spaced boreholes such as those at this site. Based on the boreholes, thrust faults are considered most likely to be present within the upper variable strength bedrock (Units 3a, 3b, 3c, 4a, 4b), although the presence of ironstaining, weathered bedrock and weaker sandstone bands at depth may also be indicative of thrust faulting.

Figure 7: Back thrusts in an excavation wall at a nearby site

In practice, the precise influence and treatment (if required) of dykes and thrust faults are often only determined at construction stage, when their presence, extent and orientation with respect to the works can be more reliably assessed.

7.1.2 Groundwater

Groundwater measurements taken at the site to date indicate that permanent groundwater levels are within the bedrock, from depths of approximately 18 m in the upper slopes, reducing to approximately 3 m to 5 m below ground level towards the banks of Shrimptons Creek, at a similar level to those of the creek. The groundwater monitoring has indicated fluctuations of 0.5 m to 1.0 m in groundwater levels, with most locations exhibiting no significant response to rainfall events except at one location, Bore 12, near the creek.

Temporary 'perched' groundwater levels are expected to occur within the upper filling, and along the top of rock following periods of rainfall or due to human-influences such as watering of garden areas.

Within the bedrock, groundwater flows would be concentrated along defects within the rock, such as joints and bedding planes. Iron-staining of the existing joints are suggestive of past groundwater passage, and greater water ingress would be expected through such joints.

7.1.3 Interpreted Geotechnical Long-Sections

Interpreted geotechnical long-sections have been developed for the site, based on the geotechnical model, simplified model units outlined in Table 7 and discrete groundwater measurements of 12 December 2017. The location and orientation of the long-sections are shown in plan in Drawing 1, in Appendix B, and have been provided in Appendix G.

The interpreted model boundaries on the long-sections are intended to provide a visual aid as to the levels and continuity of the model units across the site, and should be used with caution. For example, in contrast to the levels shown, the level of the top-of-bedrock in sandstone would generally be expected to 'step' down the slope in a series of buried shallow cliff-lines due to the influence of natural defects within the bedrock.

Reference should be made to the borehole logs for further specific information.

7.2 Geotechnical Issues

Anticipated geotechnical concerns for the proposed development at this site include:

- Earthworks – for large scale regrading of the site and the construction of new roads; and,
- Pavements – for new roads.
- Excavation – Excavatability, vibrations, excavation support (and movement), groundwater and seepage
- Foundations – footing type and bearing capacities for new buildings and the proposed bridge;

It is noted that deep excavation and footing conditions for the buildings is only considered broadly in this report, given the relatively wide spacing of deep boreholes. Excavation and foundation conditions in the Stage 1 area is discussed in greater detail in the separate report 86043.01.R.002.Rev0.

7.3 Earthworks and Site Preparation

7.3.1 General

Large scale re-grading of the existing site area is proposed as part of the Masterplan development.

While the existing filling appears to be compacted in some areas, in the absence of control and testing records it should be considered 'uncontrolled', and therefore not suitable for use in its current condition for the support of engineered structures.

It is generally recommended that new filling areas are constructed as engineered, or 'controlled' filling and it is suggested that the following general procedure be adopted:

- Excavate any topsoil, existing filling and any deleterious materials (and natural soil if required to achieve levels) at the site, retaining the excavated material in separate stockpiles for assessment for possible re-use. Based on the laboratory test results, moisture conditioning of excavated material is likely to be required prior to re-use in controlled filling, but depending on weather conditions in the lead up to bulk earthworks and during stockpiling;
- Test-roll the underlying natural site soils to identify any soft or yielding areas which require additional treatment (e.g. replacement), and treat such materials;
- Place filling in uniform layers not exceeding 250 mm (loose) layer thickness and compact to an appropriate density. Appropriate densities and compaction ratios will depend on the filling material adopted, and proposed use of the platform. Material should be placed and compacted beyond any proposed batters, to ensure suitable compaction, with excess material later trimmed from the batter face;
- Undertake inspection and testing of compaction activities at a suitable frequency. Guidance on test frequencies may be sought from AS3798 *Guidelines on Earthworks for Commercial or Residential Developments.*

Appropriate management of compaction efforts should be undertaken to ensure that soil is not compacted on excessively sloping ground, and that compaction is achieved to the edge of final slopes. In practice, this may require that the filling be placed as 'stepped' filling in some areas, to several metres beyond the design edge of the fill platform, and then trimmed back.

From a geotechnical perspective, material reuse is likely to be practicable, noting the following:

- Excavated topsoil is likely to be suitable for re-use in landscaping purposes, only;
- Other than topsoil, excavated (existing) filling and natural soils are likely to be largely suitable for reuse in engineered filling, subject to assessment (including appropriate contamination assessment), removal of oversize and organic materials and probable moisture conditioning;
- Excavated sandstone may also be suitable for reuse in engineered filling, subject to crushing or ripping and sorting of the material to remove oversize rock. (The crushed sandstone is expected to be unsuitable for subbase or base pavement layers). It is noted that space is required to allow for stockpiling, and time and favourable weather conditions are generally required for moisture conditioning of filling. Crushing of medium and high strength rock on site may not be cost-effective, and may present noise and/or dust issues. Other project considerations may make these options unfavourable.

Where pavement construction is required on cuts into bedrock, allowance may need to be made for special drainage provisions (e.g. provision of a drainage blanket or drainage channels at the base of the excavation), to provide for seepage and to prevent excessive moisture developing within the pavement layers.

7.3.2 Shrimptons Creek

The proposed extent and design of the bridge over Shrimptons Creek, and the construction of the approach embankments is currently unknown, but may potentially involve the construction of fill approach embankments, particularly in the vicinity of Bores 10 and 11. The current phase of testing has identified soft and firm clays within the underlying clays, which may have an influence on slope stability of the sideslopes and/or bridge abutments. Management of potential slope stability and settlement arising from the construction of an embankment over soft and firm clays may include:

- Flattening the batter slopes of the embankment and channel (if required) to suit slope stability requirements;
- Assessment of potential settlement to determine whether the settlement (or differential settlement) magnitude is likely to be a concern for the embankment and bridge structure interfaces;
- Removal and replacement of the soft and firm clays to avoid the issue, as part of the earthworks preparation; and/or
- Extend the structural foundations of the bridge to avoid areas of concern by spanning over such areas with an extended, fully-supported bridge deck.

While the existing, borehole-based investigation has identified the presence of soft and firm soils at Bores 10 and 11, the depth and extent of such soils is poorly defined, and may be of limited impact. Investigation by cone penetration tests (CPTs) will allow better assessment of the actual strength and thickness of the relevant layers. The depth and extent of such layers should nonetheless be confirmed if a slope stability or settlement assessment is required. Other information required for the

assessment would include the approach embankment width, proposed fill material, height, proposed sideslope and abutment batters, the design flood level and any design scour depth.

7.3.3 Trafficability and Working Platforms

Once exposed, the existing clays on the site are likely to become boggy if left unprotected under heavy traffic loads, particularly following periods of wet weather. The use of temporary roads, working platforms and/or tracked plant would generally be appropriate.

Working platform assessment is also recommended prior to the use of plant with concentrated loads (e.g. cranes or piling rigs), with the assessment undertaken for the particular plant type, anticipated loading and loading area. Generally, a minimum 300 mm thickness of gravel fill would be required for working platforms, although the assessment may indicate that additional filling is required to limit the risk of plant movement or toppling during operation.

Careful survey of excavations, and appropriate backfill of services or temporary trenches

7.3.4 Erosion Protection

Given the laboratory results outlined in Section 5.4 and the results of logging, and based on the soil types outlined in Section 3.2.7 of the “Blue Book”, the Soil Texture Groups over this site are generally expected to be Type F for the natural soils (fine and non-dispersive), and Type F and Type C for the existing filling. The results at Bore 47 from 0.4 m to 0.6 m suggest that Type D (dispersive) soils may be present within the filling towards Shrimptons Creek.

7.4 Pavements

The results of testing have indicated CBR values of 4.5% to 45% from samples obtained in the various soils and extremely weathered rocks. Past DP experience has indicated that CBR values of 3% to 10% are generally observed in the natural soils developed from the Mittagong Formation and Hawkesbury Sandstone.

Care must be taken in considering the raw CBR results, which may not represent the behaviour of the soil as a whole, particularly when considering fill materials. The following preliminary design CBR values are therefore suggested:

- 6% for natural clay soils and clayey filling at the site (excluding the natural soils below RL 45, towards Shrimptons Creek);
- 4% for natural clay soils below RL 45 (i.e. towards Shrimptons Creek)
- 10% be adopted for granular filling material used to construct engineered fill platforms at the site;
- 10% be adopted as the maximum CBR for filling derived from less weathered (medium strength) sandstone derived from the site, where appropriately graded and placed as engineered filling.

These CBR values assume that the pavement subgrade may be maintained near the equilibrium (or optimum) moisture condition, with appropriate pavement drainage.

It is suggested that the natural soils below RL 45 (i.e. towards Shrimptons Creek) are avoided if practicable, due to the relatively high silt content and potential for difficult compaction properties due to their moisture sensitivity and relatively low CBR values.

The filling considered for re-use should be stockpiled by material type (granular or clayey) and the stockpile subject to geotechnical inspection to confirm suitability. It is also recommended that the above preliminary design CBRs be confirmed by testing from the particular stockpile or material source, once confirmed.

For pavements subject to light traffic loads only (design ESA of less than 10^5) the pavement thickness designs given in Table 8 may be considered:

Table 8: Preliminary Pavement Thickness for Light Traffic Loads (ESA <10^5)

CBR	4%	6%	10%
Asphaltic concrete	40mm*	40mm*	40mm*
Base quality material (CBR ≥ 80%);	100mm	100mm	100mm
Granular subbase (CBR ≥ 30%)	250mm	180mm	100mm

* 40 mm “thin” Asphaltic concrete allows for flexible pavement behaviour. Thicker AC layers may result in unsatisfactory AC performance.

It is noted that the proposed staging suggests that construction will commence in areas near Herring Road, followed by staged development down the slope. As a result, construction traffic for the later stage developments may pass over roads constructed as part of the early stage development. Given that the construction traffic is likely to be a significant load on the pavements, it may be preferable to allow for temporary roads only until most construction work is complete, followed by replacement with the permanent road formation. This would involve accepting more rapid deterioration of the temporary roads, while allowing the permanent roads to be designed for the lower, largely residential, long-term traffic load.

For both temporary and permanent roads, the performance of the pavements is likely to be governed by moisture levels within the subgrade, and therefore by the design of suitable surface and subsurface drainage for the site. Subsoil drainage should be installed to at least 500 mm below subgrade levels along the high side of all pavements and adjacent to lawn and garden areas. It is generally impractical to design roads for flooding conditions due to changes in soil behaviour with increased moisture content. Therefore, the use of rockfill and concrete pavements and approach slabs are common for bridge abutments affected by flooding to high level. Where flooding is short-term only, clay embankments may be considered and constructed with some extra width to allow for water penetration into the outer layers. It is suggested that imported rockfill be assumed at this stage, although further detailed testing of the deeper (less weathered) sandstone could be carried out to assess whether ripped sandstone rock fill may be practical.

7.5 Excavation

Soil, extremely low and very low strength rock, such as those expected in Units 1, 2, 3a and 4a, are likely to be readily excavated using conventional earthmoving equipment (eg. bulldozers and hydraulic excavators, with some rock hammering of stronger bands). Higher strength sandstone, such as in Units 4c and 4d, are likely to require excavation by ripping tynes mounted on large bulldozers, large rock hammers, rock saws and milling heads. Excavation in the variable strength or fractured Model Units 3b, 3c and 4b may also require these heavier excavation methods to maintain productivity, although some limited excavation may be possible using conventional earthmoving equipment depending on the thickness and continuity of iron-cemented layers and rock fracturing.

The excavatability of the medium and high strength bedrock (Units 3c, 4c and 4d) will be governed by the defects within the rock mass. Based on the core from Bore 01, Unit 3c is likely to be relatively fractured, which will aid excavation. Within the medium and high strength sandstone of Units 4c and 4d, the rock is more typically slightly fractured and unbroken. In general, the excavation of high strength sandstone is likely to be difficult and slow with low productivity and high hammer/tyne wear expected.

Significant vibrations are anticipated during excavation within low to high strength bedrock. Excavation methods may therefore be limited by acceptable vibration levels, particularly towards neighbouring sites or services, if occupied, or previously constructed buildings if the works are phased.

Batters or excavation support will be required for excavations through soil and extremely low to very low strength sandstone, and into the upper, higher strength sandstone where significant weak bands or steeply oriented defects are more likely to be present.

Preliminary safe batter slopes are provided in Table 9, for batter slopes no greater than 3 m in height, with horizontal ground beyond the crest and below the toe, no deflection sensitive structures or services above the crest, no surcharges above the crest and no seepage from the face. All batter slopes are subject to inspection by an experienced geotechnical professional, and flatter or steeper slopes may be required, depending on that assessment.

Table 9: Preliminary Safe Batter Slopes for Batter Slopes ≤ 3 m Height

Material	Maximum Temporary Safe Batter Slope (H:V)	Maximum Long-Term Safe Batter Slope (H:V)
Filling (Unit 1)	1.5:1	2:1
Stiff to very stiff clay (Unit 2, except near Shrimptons Creek)	1.5:1	2:1
Extremely low to low strength rock (Units 3a, 4a, possibly 3b, 4b)	1:1	2:1
Very low and medium strength rock (Units 3b, 4b)	0.75:1, but dependent on jointing	1:1, but dependent on jointing
Low and medium strength rock (Unit 3c)	0.5:1, but dependent on jointing	1:1, but dependent on jointing
Medium or High Strength Rock (Units 4c, 4d)	vertical, but dependent on jointing	vertical, but dependent on jointing

Higher or steeper batters, or batters subject to surcharges, adjacent sloping ground, seepage or potentially subject to flooding, would generally require more detailed geotechnical assessment. Similarly, batters in soft and firm soils, such as encountered at Bores 10 and 11 near Shrimptons Creek, would require specific assessment.

Within the consistently medium and high strength sandstone (Units 4c and 4d), the rock is likely to be able to be cut vertically and stand unsupported, even for cut depths greater than 3 m, subject to defect and localised stability assessment.

Notwithstanding the presence of existing, near-vertical cuts, vertical cuts are not recommended within the low to medium strength Unit 3c due to its steep jointing and fractured rock mass and expected susceptibility to accelerated weathering and deterioration. Temporary vertical cuts in these materials would be expected to have a relatively high risk of failure, and may require relatively substantial temporary support measures (eg. rock bolting and shotcrete coverage)

All cuts should be subject to defect assessment to identify if additional local support (e.g. bolts or anchors) and/or shotcrete is required due to adverse jointing.

Long-term batters in soils should be protected against erosion, such as by shotcrete or vegetation. Shotcrete is also likely to be required to protect against weathering of extremely low to low strength rock. For permanent batters protected by vegetation, flatter slopes of 3H:1V are recommended to allow for adequate slope maintenance. Separate scour protection assessment would generally be appropriate for any batters subject to flowing water.

All excavated material to be removed off site, will need to be disposed of in accordance with the provisions of the current legislation and guidelines including the *Waste Classification Guidelines* (EPA,

2014). This includes filling and natural materials that may be removed from the site. Reference should be made to DP's Waste Classification Report 86043.01.R.004 in this regard.

7.6 Excavation Support

Where there is insufficient space to accommodate the above batters, excavation support will be required.

For services trenches and similar, the use of shoring boxes would generally be appropriate within soils and rock above the groundwater table.

For basement excavations, excavation support in the soils (Units 1, 2) and extremely low to variable strength, or fractured rock (Units 3a, 3b, 3c, 4a, 4b) could in most cases be by soldier pile shoring walls taken down to bear on at least medium strength sandstone (Unit 4c or 4d), with infill shotcrete panels. Typical soldier pile spacings at 2 m to 2.5 m are likely to be suitable for the support of natural clay soils and weathered rock above the groundwater table.

As can be seen in Drawing 4 in Appendix F (Geotechnical Long-Section C-C'), the level of at least medium strength sandstone (Unit 4c or 4d) appears to fall below the groundwater table towards the eastern corner of the site. This suggests that soldier pile walls may not be adequate for basement excavations around and north of Bore 11, and towards Shrimptons Creek. Basement shoring walls supporting soils below the groundwater table would be required to serve both as excavation support and as a cut-off wall to limit groundwater short and long-term seepage inflows into the basement excavation.

In cases where significant groundwater inflows are expected, shoring walls may take the form of secant pile "cut-off" walls, extending into bedrock, preferably to below the depth of any closely-spaced, water-bearing joints (ie. generally to Unit 4c). For example, the lateritic sandstone from 2.8 m to 3.8 m depth in Bore 11 is expected to be highly permeable, and would result in significant inflows if not 'cut-off'. A higher risk approach would be to use contiguous shoring piles, with the gaps between piles infilled with grout mortar as excavation proceeds. Contiguous piles may also not be appropriate where deep filling and/or granular soils are present, due to potential collapsing ground conditions, and would provide only limited and potentially ineffective "cut-off" through defects in the underlying rock, likely resulting in higher short and long term seepage inflows to the basement.

Within clay soils and bedrock, bored piles are likely to be suitable for the drilling of shoring piles at this site. Casing may be required where deep or granular filling is present above the groundwater table to reduce the risk of side-wall material falling in to the hole. Contiguous flight auger (CFA) piles may be required (eg. for secant pile walls) if deep filling and/or granular soils are present below the groundwater table.

"Tie-back" (ground) anchor support of shoring will generally be required if movement-sensitive structures (e.g. building foundations) are present behind the walls or, where the excavation is deep (e.g. more than about 3 m). Anchors or bolts may also be required at the toe of soldier piles, if the piles are not socketed below basement level, or if adverse jointing is present within the rock face.

For bored or CFA piles, a high torque drilling rig is likely to be required to obtain significant socket (ie. embedment) into medium and high strength sandstone, as may be present at this site.

Preliminary parameters for the design of shoring/retaining walls within these materials are summarised in Table 10. The parameters are based on 'simply-supported' retaining walls (ie either cantilever or restrained by a single row of anchors/struts), where lateral movement of the wall is permitted, and assuming no significant adverse jointing within the rock and a horizontal ground surface above the wall. A triangular pressure distribution may be assumed in such situations.

Table 10: Preliminary Design Parameters for Shoring Retaining Walls

Material	Unit Weight (kN/m^3)	Earth Pressure Coefficient/Value	
		Active	Passive
Filling (Unit 1)	20	0.4	3
Stiff to Very stiff Clay (Unit 2, except locally towards Shrimptons Creek)	20	0.3	2
Extremely low to low strength rock (Units 3a, 4a)	24	0.25	200 kPa (2)
Extremely low and medium strength rock (Units 3b, 3c, 4b) (1)	24	0.2	400 kPa (2)
Medium or high strength rock (Units 4c, 4d) (1)	24	0	4000 kPa (2)

Note: (1) Additional support may be required due to defects, subject to inspection of faces
(2) Ultimate passive pressure

It is recommended that cantilevered walls not exceed 3 m height.

Where multiple rows of anchors/struts or props are employed, a uniform rectangular pressure distribution may be adopted for preliminary design purposes. For shoring/retaining walls remote from existing structures or utilities, a pressure of 4H (where H is the wall height) may be adopted, whereas for walls close to existing structures/utilities, a pressure of between 6H and 8H should be considered, depending on the sensitivity of the structure and the soil profile to be retained. Higher pressures would be appropriate where batters are present above the wall.

Allowance should be made for the provision of drainage behind retaining walls, or alternatively the walls should be designed for full hydrostatic pressures (ie. water rising to the measured groundwater level plus an allowance for rise).

The presence of dykes or thrust faulting may result in locally poorer rock conditions, which may lead to addition support being required in some areas of the site (or over a short distance). Detailed investigation and/or careful monitoring and inspection of ground conditions during excavation (including for soldier piles) would generally be appropriate to ensure that support is taken down to an appropriate depth in any affected areas. It is not likely to be practical to assess the presence of dykes in advance, unless a dyke location and orientation has been determined during an earlier stage of works.

Survey monitoring of excavation would generally be appropriate to assess movement of any shoring walls during excavation. Where basements are adjacent to RMS roads, then the installation of inclinometers and progressive monitoring of lateral wall/ground movement with excavation depth may also be required by RMS.

In addition to retaining wall movements, major excavations into sandstone bedrock may result in lateral movement of the sandstone faces due to stress relief effects. Release of these stresses may cause horizontal movements along the rock bedding surfaces and defects, with estimated movements of between 0.5 mm to 2 mm per metre depth of excavation at the midpoint of the excavation. It is not practical to provide restraint against these movements, and appropriate allowance should instead be made for such movements in construction and planning.

Detailed design of shoring/retaining walls is nowadays normally undertaken using software that can account for the soil-structure interaction during the progressive excavation and support installation (e.g. Wallap, Flac, Plaxis)

7.7 Groundwater and Dewatering

From an engineering perspective, and assuming basement levels are kept above likely flood levels of Shrimptons Creek, groundwater seepage into basement excavations is likely to be readily managed using 'sump-and-pump' methods. This is consistent with DP experience with excavations near the subject site. Such drainage is expected to include strip drains behind shotcrete faces, connecting to perimeter and sub-floor basement drains directing to a sump, or simply downslope, for basements constructed into the existing slope. Such seepage is likely to be iron-rich and a precipitate (gelatinous 'sludge') may develop within drains over time. Allowance should be made for future maintenance to clear such material from the drainage lines and from pump fixtures.

Depending on ground conditions, (groundwater/seepage) cut-off walls may be required over the lower part of the site if basement levels are taken below the design flood levels within soil, or within jointed or fractured rock (generally Units 4a and 4b). Based on existing information, this is likely to be required for at least part of the basement walls near Shrimptons Creek, around and north of Bore 11.

Groundwater inflow would nonetheless be expected to occur through deeper defects (eg bedding planes and joints) below the groundwater table, and below the depth of cut-off walls and additional measures may be required to reduce water inflows. The location of inflows can be difficult to assess in advance of the works, and allowance may need to be made for post-grouting of joints and bedding planes, where basements extend below the groundwater table.

Water NSW has been increasingly requiring tanked basements to limit the dewatering and disturbance of aquifers. Tanking requirements are unlikely to be appropriate where shallow bedrock is present, as is the case over much of the Ivanhoe Estate, although groundwater modelling may potentially be required by Water NSW to assess the potential impact. A regulatory requirement for tanking is considered more likely to apply if the proposed basement levels are taken below the relevant Shrimptons Creek design flood levels, particularly where ground conditions warrant the use of cut-off walls. Water NSW requirements may also include the need for subsurface drainage for diversion of subsurface water flows around basements, so as to reduce any "damming" effect on the regional groundwater table.

7.8 Foundations

It is generally recommended that all foundations for the new buildings and structures be taken down to uniformly bear on bedrock. Given the proposed basement levels, this is expected to typically involve shallow foundations at basement level. For associated structures, shallow or pile foundations may be required, depending on the proposed filling or excavation for the affected area, and desired founding material. Pile foundations are expected to be required for the proposed bridge abutments.

Maximum allowable bearing pressures for preliminary design of foundations supported within the bedrock likely to be encountered at the site are provided in Table 11.

Table 11: Preliminary Allowable Foundation Design Parameters

General Material Description	Allowable Bearing Pressure[2]	Recommended Minimum Testing/Requirements[1]
Very low strength sandstone or laminite, or higher strength sandstone with significant defects (Unit 3b, Unit 4b)	1 MPa	See Note 1
Low strength laminite or sandstone or higher strength but with significant defects (Unit 3c, local Unit 4c, 4d)	2 MPa	Cored boreholes
Medium strength sandstone, limited defects (typical Unit 4c)	3.5 MPa	Cored boreholes, greater test density
Medium to High strength sandstone (some Unit 4c and typical Unit 4d)	6 MPa	Cored boreholes, greater test density, spoon testing of at least 1/3 of footings

Note: 1 Geotechnical investigation and inspection of footing excavations is recommended in all cases; minimum testing is to provide guidance on additional requirements for investigation and inspection, depending on desired bearing pressures.
2. All bearing pressures may be limited by defects, subject to inspection of the excavation and possible spoon testing, which may require the bearing pressure to be downgraded. Allowable bearing pressures assume that the bedrock is in a confined state, and that no nearby excavations are present below an imaginary 'influence' line drawn at 1H:1V down from the edge of the footing.

Investigation should be undertaken at the precise location of the bridge piles to allow assessment of foundation conditions. At LP1, for example, the presence of a thick very low strength sandstone band below 8.5 m depth would generally result in a reduction of the bearing capacity of the overlying, otherwise high strength sandstone. For example, depending on the proposed foundation depth and type, an allowable end bearing capacity of between 1 MPa and 6 MPa may be applicable within the high strength sandstone in these circumstances.

Higher bearing pressures (up to, say, 10 MPa allowable) may potentially be available, depending on the depth of basement excavation and local site conditions. Such bearing pressures would require a significant test (i.e. borehole) density during the investigation phase and proving footings, and may be associated with a higher risk of inspection 'failures' (i.e. with rock indicating a lower bearing capacity,

or further deepening of foundations required). The use of this bearing pressure is therefore not recommended at this time, but may be appropriate to consider after geotechnical investigation at the site, and subject to further investigation or proving.

If thrust faults or dykes are present within the site, then this is likely to result in lower allowable bearing pressures. The following solutions would generally need to be considered:

- For dykes, the likely foundation solution will involve downgrading the rock strength on either side of the dyke, and structurally bridging foundations across the dyke. As the dyke width and strength of rock on either side is likely to be variable, this would normally be assessed at construction stage;
- For thrust faults, the solution will depend on the area affected, but is more likely to include downgrading of the allowable bearing pressure, or deepening of footings to below the affected zone.

Where pile foundations are required, uncased bored piles are likely to be adequate for most situations, although temporary casing/liner support or continuous flight auger (CFA) piles may be required for the foundation support near Shrimptons Creek (e.g. for bridge abutments). Powerful high-torque rigs may be necessary to form pile sockets in medium and high strength sandstone.

Comparison of the results of testing to Table 6.4.2(C) of AS2159 (2009) indicates that the exposure classification within the soils is 'mild' for concrete piles, and 'non-aggressive' for steel piles, for piles above the groundwater table.

7.9 Further Assessment and Investigation

Geotechnical investigation is recommended to provide site-specific information in relation to the residential buildings and basements, similar to the investigation undertaken in the Stage 1 area (and relevant reporting in DP report 86043.01.R.002.) It is understood that progressive investigation is planned in advance of each proposed development stage.

The investigation to date has identified two areas that may warrant earlier investigation:

- The basement area around and north of Bore 11, where deeper soil, fractured rock and a higher groundwater level is anticipated, and more substantial basement shoring or cut-off walls are therefore likely to be required – this will depend on basement levels, the basement footprint and priorities of the Client.
- The bridge area, where the details of the proposed bridge and abutments are currently unknown, but issues are anticipated with respect to embankment construction and earthworks and also in respect to foundations. Further information on the proposed works would be appropriate to determine a course of investigation.
- The basement areas adjacent to Shrimptons Creek are those most likely to be affected by Water NSW requirements, if the basements are taken below the permanent groundwater table. While water inflow is considered likely to be manageable by the methods outlined above, Water NSW may place additional requirements on these basements. Related discussions, modelling and possible exemptions may potentially require significant time, and early assessment may assist with the project timetable.

- Investigation of pavement conditions at 2-4 Lyonpark Road, and Lyonpark Road, to assess potential treatment and construction requirements for new pavements. A proposal is in the process of being prepared for investigation in these areas, for discussion.

8. Limitations

Douglas Partners (DP) has prepared this report for this project at Ivanhoe Estate, Macquarie Park in accordance with the Consultancy Services Deed between Frasers Property Ivanhoe Pty Ltd and Douglas Partners Pty Ltd dated 15 November 2017. This report is provided for the exclusive use of Frasers Property Ivanhoe Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions observed on the site and inferred from geological and other mapping and nearby DP investigations. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's site work has been completed.

The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site. The advice may also be limited by scope constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached notes and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The scope for work for this report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of filling of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such filling may contain contaminants and hazardous building materials.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of

potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About This Report

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations 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.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report 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 or excavation. 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 and test pits 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 or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole 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; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements 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.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

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

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

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

About this Report

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, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

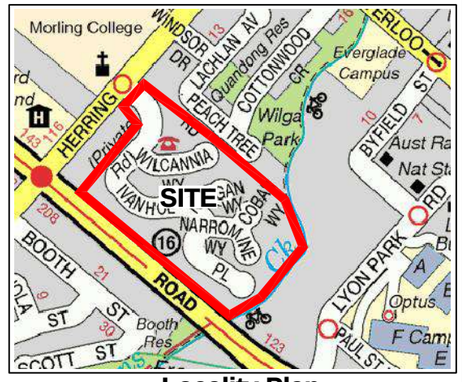
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP 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 and environmental 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.

Appendix B

Drawings – Test Location Plan



Locality Plan

NOTE:
1: Base image from Nearmap.com (Dated 19.10.2017)
2: Test locations are approximate only and are shown with reference to existing features.

LEGEND

- Cored bore location
- Shallow bore location
- Standpipe location
- Previous borehole (August 2000)
- Site boundary
- Stage 1 boundary
- Area to facilitate road extension to Lyonpark Road
- Rock cutting and outcrops
- Geotechnical Cross Section A-A'

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Geotechnics | Environment | Groundwater

CLIENT: Frasers Property Ivanhoe		TITLE: **Test Location Plan** **Proposed Residential Development** **Ivanhoe Estate, MACQUARIE PARK**
OFFICE: Sydney	DRAWN BY: PSCH	
SCALE: 1:2000 @ A3	DATE: 13.12.2017	

PROJECT No:	86043.01
DRAWING No:	1
REVISION:	0

Appendix C

Results of Field Work

Sampling

Sampling is carried out during drilling or test pitting 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 it to obtain 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.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally 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 samples.

Continuous Spiral Flight Augers

The borehole 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 sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud 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 the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils 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 before the full penetration depth, 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 SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. 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 types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Soil Descriptions

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Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726-1993, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Rock Strength

Rock strength is defined by the Point Load Strength Index ($Is_{(50)}$) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 2007. The terms used to describe rock strength are as follows:

Term	Abbreviation	Point Load Index $Is_{(50)}$ MPa	Approximate Unconfined Compressive Strength MPa*
Extremely low	EL	<0.03	<0.6
Very low	VL	0.03 - 0.1	0.6 - 2
Low	L	0.1 - 0.3	2 - 6
Medium	M	0.3 - 1.0	6 - 20
High	H	1 - 3	20 - 60
Very high	VH	3 - 10	60 - 200
Extremely high	EH	>10	>200

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$. It should be noted that the UCS to $Is_{(50)}$ ratio varies significantly for different rock types and specific ratios should be determined for each site.

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Extremely weathered	EW	Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.
Highly weathered	HW	Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable
Moderately weathered	MW	Staining and discolouration of rock substance has taken place
Slightly weathered	SW	Rock substance is slightly discoloured but shows little or no change of strength from fresh rock
Fresh stained	Fs	Rock substance unaffected by weathering but staining visible along defects
Fresh	Fr	No signs of decomposition or staining

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with some fragments
Fractured	Core lengths of 40-200 mm with some shorter and longer sections
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and longer sections
Unbroken	Core lengths mostly > 1000 mm

Rock Descriptions

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq 100 \text{ mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or better. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

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

Symbols & Abbreviations

Douglas Partners

Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	Pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	Lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

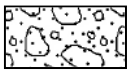
fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

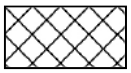
Graphic Symbols for Soil and Rock

General


Asphalt


Road base


Concrete

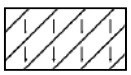

Filling

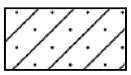
Soils


Topsoil

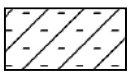

Peat

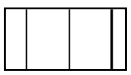

Clay

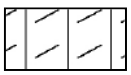

Silty clay

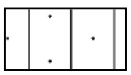

Sandy clay

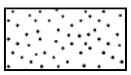

Gravelly clay

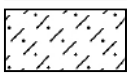

Shaly clay

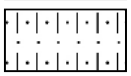

Silt


Clayey silt


Sandy silt

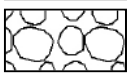

Sand

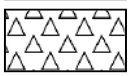

Clayey sand


Silty sand


Gravel


Sandy gravel


Cobbles, boulders

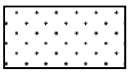

Talus

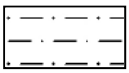
Sedimentary Rocks

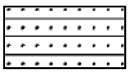

Boulder conglomerate

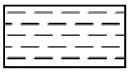

Conglomerate


Conglomeratic sandstone


Sandstone


Siltstone

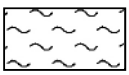

Laminite

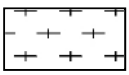

Mudstone, claystone, shale

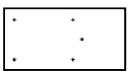

Coal


Limestone

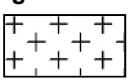
Metamorphic Rocks

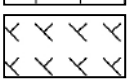

Slate, phyllite, schist

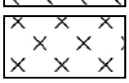

Gneiss

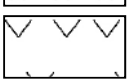

Quartzite

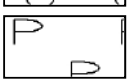
Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 67.5 AHD
EASTING: 325470
NORTHING: 6260569
DIP/AZIMUTH: 90°/--

BORE No: 01
PROJECT No: 86043.01
DATE: 31-10-2017
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Graphic Log	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
67	0.3	FILLING - brown silty sand filling with a trace of clay and roadbase gravel, damp			A/E			
	0.4	- root affected (topsoil) to 0.05m			A/E			
		FILLING - light brown sand filling, slightly clayey, with some roadbase and ironstone gravel, damp			A/E			
66	0.9	FILLING - pale brown silty clay filling with some ironstone gravel and a trace of sand, humid		Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°, some ironstained	A/E S			15,16,6/110mm refusal
	1.75	SANDSTONE - very low strength, orange and red-brown sandstone						
65		SHALE - very low strength, highly weathered, fractured, orange-brown and light grey shale, thinly laminated with some high strength iron-cemented bands		1.8m: B0°, cly, 10mm 1.94m: B0°, cly, 5mm 1.96m: B0°, cly, 10mm 2.11m: B0°, cly, 10mm 2.8m: B0°, cly, 10mm	C	100	0	PL(A) = 1.2 PL(A) = 1.1
64	3.56	LAMINITE - low to medium and medium strength, moderately weathered, fractured laminite, thinly laminated with some iron-cemented beds		3.1m: J60°- 85°, un, ro, cln 3.3-3.79m: B (x12), cly, 5-10mm 3.62-3.89m: Cs, 70mm 3.95m: B0°, cly, 10mm 3.97m: J60°, pl, ro, cly, 2mm 4m: B30°, cly, 4mm 4.03m: J90°, pl, ro, cly, 2mm 4.09m: J85° & 50°, st, ro, fe 4.14-4.27m: B0°, cly, 5-8mm 4.29m: J75°- 85°, un, he, fe 4.55m: J25°, pl, he, fe 4.8-4.94m: B (x2) 0°, cly, 6mm 5.86m: B0°, cly, 2mm, fe	C	100	46	PL(A) = 1.2 PL(A) = 0.87 PL(A) = 0.31
63	5.8	SANDSTONE - high strength, slightly weathered and fresh, slightly fractured and unbroken, grey-brown and grey, medium grained, thinly bedded sandstone 6.4-6.94m: fine grained, thinly laminated		6.51m: B0°, cly, 11mm 6.54-6.59m: Ds, 40mm 6.86-6.92m: B (x3) 0°, fe 7.13-7.3m: B (x4) 0°, fe 8.04m: B0°, fe	C	100	88	PL(A) = 1.4 PL(A) = 1.1 PL(A) = 1.3
58				9.32-9.45m: Ds, 110mm 9.56m: B0°, cly, 7mm	C	100	89	PL(A) = 1.2

RIG: Scout 2 **DRILLER:** Ground Test **LOGGED:** LS/SI **CASING:** HQ to 1.75m

TYPE OF BORING: Solid flight auger (TC-bit) to 1.75m; NMLC-Coring to 23.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering. Water level at 17.7m depth on 12/12/17

REMARKS: Well constructed to 23.5m (blank 0.0-1.0m; screen to 23.5m; backfill 0.0-0.4m; bentonite 0.4-1.4m; sand 1.4-23.5m)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 67.5 AHD
EASTING: 325470
NORTHING: 6260569
DIP/AZIMUTH: 90°/--

BORE No: 01
PROJECT No: 86043.01
DATE: 31-10-2017
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
57		SANDSTONE - high strength, slightly weathered and fresh, slightly fractured and unbroken, grey-brown and grey, medium grained, thinly bedded sandstone *(continued)*										PL(A) = 1.5
								10.3-10.34m: Ds, 40mm				
11												
		11.08-11.8m: fine grained sandstone, indistinct bedding						11.0-11.07m: Ds, 70mm	C	100	89	
56												PL(A) = 1.9
								11.73m: B0°, cly, 3mm 11.75-11.78m: Ds, 20mm 11.86m: B0°, cly, 3mm				
12												
55												PL(A) = 1.4
13												
54									C	100	99	PL(A) = 1.3
14												PL(A) = 1.4
53								14.25-14.28m: B (x2), cly, 3mm				
15												PL(A) = 1.67
52								15.3-15.33m: B (x2), cly, 4mm				
16												
51									C	100	95	PL(A) = 1.3
17								16.65-16.75m: B (x2) 0°, cly				
								17.17-17.87m: B (x5), cly, 2-5mm				
50						12-12-17						PL(A) = 2.1
18								18.04-18.05m: B (x2) 0°, cly, 2mm				PL(A) = 1.2
49												
19									C	100	98	
48	19.7	SANDSTONE - see next page						19.68m: B0°, fe				PL(A) = 2.5

RIG: Scout 2 **DRILLER:** Ground Test **LOGGED:** LS/SI **CASING:** HQ to 1.75m

TYPE OF BORING: Solid flight auger (TC-bit) to 1.75m; NMLC-Coring to 23.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering. Water level at 17.7m depth on 12/12/17

REMARKS: Well constructed to 23.5m (blank 0.0-1.0m; screen to 23.5m; backfill 0.0-0.4m; bentonite 0.4-1.4m; sand 1.4-23.5m)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 67.5 AHD
EASTING: 325470
NORTHING: 6260569
DIP/AZIMUTH: 90°/--

BORE No: 01
PROJECT No: 86043.01
DATE: 31-10-2017
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
47	21	SANDSTONE - high strength, slightly and moderately weathered, slightly fractured, grey, yellow-brown and purple-brown, medium grained sandstone *(continued)*							C	100	98	PL(A) = 2.7
46								20.96m: B0°, cly, 2mm, fe 21.03m: J30°, pl, ro, cly, 1mm, fe				
	22							21.66m: B0°, fe, cly, 1mm				PL(A) = 2.7
45								22.14-22.44m: B (x2) 0°, fe	C	100	100	PL(A) = 3.1
	23											PL(A) = 2.8
44	23.5	Bore discontinued at 23.5m										
43	24											
	25											
42												
	26											
41												
	27											
40												
	28											
39												
	29											
38												

RIG: Scout 2 **DRILLER:** Ground Test **LOGGED:** LS/SI **CASING:** HQ to 1.75m

TYPE OF BORING: Solid flight auger (TC-bit) to 1.75m; NMLC-Coring to 23.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering. Water level at 17.7m depth on 12/12/17

REMARKS: Well constructed to 23.5m (blank 0.0-1.0m; screen to 23.5m; backfill 0.0-0.4m; bentonite 0.4-1.4m; sand 1.4-23.5m)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 01 **PROJECT: MACQUARIE PARK** **OCTOBER 2017**

1.75 – 6.0m

BORE: 01 **PROJECT: MACQUARIE PARK** **OCTOBER 2017**

6.0 – 11.0m

BORE: 01 PROJECT: MACQUARIE PARK OCTOBER 2017

11.0 – 16.0m

BORE: 01 PROJECT: MACQUARIE PARK OCTOBER 2017

16.0 – 21.0m

BORE: 01 **PROJECT: MACQUARIE PARK** **OCTOBER 2017**

21.0 – 23.45m

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 63.1 AHD
EASTING: 325516
NORTHING: 6260564
DIP/AZIMUTH: 90°/--

BORE No: 02
PROJECT No: 86043.01
DATE: 1-11-2017
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
63	0	FILLING - apparently well compacted, brown clay filling with some ironstone gravel							A/E			
		- root affected to 0.01m										
		- some gravel at 0.5m							A/E			
62	1	- possible natural from 1.1m							A/E			
	1.4	SHALE - low to very low strength, brown shale							S			10,9,17 N = 26
61	2							Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
	2.6											
	2.66	SHALE and LAMINITE - low strength with extremely low and high strength beds, highly weathered, fragmented to fractured, orange-brown with some dark grey beds, shale and laminite some iron-cemented beds						2.6m: CORE LOSS: 60mm 2.66-2.82m: fg	C	88	29	PL(A) = 0.18
60	3							3.03-3.11m: B (x5) 0°, cly, 1-3mm, fe 3.2m: B0°, cly , 10mm 3.28-3.33m: Ds, 50mm 3.48-3.77m: B (x5) 0°, cly, 2mm, fe				PL(A) = 3.3
59	4							3.94m: B0°, cly, 1mm 4.1m: B0°, fe 4.17m: B0°, cly, 10mm 4.33-4.37m: Cs, 40mm 4.41-4.48m: Ds, 70mm 4.52m: J45°, pl, ro, cly, 2mm 4.68-4.79m: fragmented	C	100	44	PL(A) = 0.5
	4.83	SANDSTONE - high strength, moderately weathered then fresh, slightly fractured and unbroken, medium grained sandstone, very thinly bedded						5.14m: B0°, fe, mica, cbs 5.38m: B0°, fe, mica 5.54m: B0°, cly, 3mm, cbs				PL(A) = 1.3
58	5											
57	6	6.5-13.7m: indistinct bedding						6.06-6.07m: B (x2) 0°, fe 6.17m: B0°, fe				PL(A) = 1.2
56	7							6.66m: B0°, cly, 10mm				PL(A) = 1.4
									C	100	97	
55	8							>>				PL(A) = 1.4
54	9											PL(A) = 1.5
	10.0								C	100	98	

RIG: Scout 2 **DRILLER:** Ground Test **LOGGED:** LS/SI **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.6m; NMLC-Coring to 19.21m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 63.1 AHD
EASTING: 325516
NORTHING: 6260564
DIP/AZIMUTH: 90°/--

BORE No: 02
PROJECT No: 86043.01
DATE: 1-11-2017
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
53		SANDSTONE - high strength, fresh, slightly fractured and unbroken, medium grained sandstone, very thinly bedded						10.3m: B0°, cly, 5mm				PL(A) = 1.6
52	11								C	100	98	PL(A) = 1.7
51	12											PL(A) = 1.8
50	13							12.74-12.81m: Ds, 70mm				PL(A) = 1.2
49	14							13.67-13.7m: Cs, 30mm 14.17-14.72m: B (x4) 0°, cly, 2-4mm	C	100	97	PL(A) = 2.1
48	15	15.0-16.47m: bedding at 10°										PL(A) = 1.3
47	16							16.0-16.22m: B (x2) 0°, cly, 3mm	C	100	100	PL(A) = 2.1
	16.47	SANDSTONE - high then very high strength, moderately weathered, unbroken, orang-brown and purple-brown, medium to coarse grained sandstone										
46	17											PL(A) = 2.1
45	18								C	100	100	PL(A) = 3
44	19											PL(A) = 3.4
	19.21	Bore discontinued at 19.21m - target depth reached										

RIG: Scout 2 **DRILLER:** Ground Test **LOGGED:** LS/SI **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.6m; NMLC-Coring to 19.21m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BORE: 02 PROJECT: MACQUARIE PARK OCTOBER 2017

2.6 – 7.0m

BORE: 02 PROJECT: MACQUARIE PARK OCTOBER 2017

7.0 – 12.0m

BORE: 02 PROJECT: MACQUARIE PARK OCTOBER 2017

12.0 – 17.0m

BORE: 02 PROJECT: MACQUARIE PARK OCTOBER 2017

17.0 – 19.0m

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 62.3 AHD
EASTING: 325514
NORTHING: 6260536
DIP/AZIMUTH: 90°/--

BORE No: 03
PROJECT No: 86043.01
DATE: 8-11-2017
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
62	0.3	FILLING - dark brown clay filling with some medium to fine sand, roadbase gravel and a trace of slag, MC<PL							A			
		FILLING - light brown sandy clay filling with some ironstone and roadbase gravel and a trace of plastic film, apparently poorly compacted - trace of brick fragments below 1.35m							A/E A/E S A/E			3,2,3 N = 5
60	2.1	SHALE - very low to low strength with some medium strength bands, light brown shale							S			PL(A) = 2.57 4,15,5/50mm refusal
59	2.85	SANDSTONE - medium strength, highly weathered, fractured, light grey and orange-brown, fine grained sandstone, with some very low and high strength bands						2.89-2.95m: B (x2) cly, 10mm 3.1m: CORE LOSS: 110mm 3.31m: B0°, cly, 2mm 3.37-3.59m: Cz, 20mm 3.5-3.66m: Ds, 60mm 3.57m: J85°- 90°, un, he, cly, 2mm 3.6m: J45° & 70°, st, ro, he, cly, 2-9mm 3.7m: B0°, cly, 3mm	C	100	0	
58	4.5	SANDSTONE - medium then high strength, moderately weathered and fresh, slightly fractured and unbroken, thinly and thickly bedded 5.0-5.55m: very thinly bedded at 10°						4.31-4.41m: Cs, 100mm 4.44-4.49m: Cs, 50mm 5.47m: J70°, pl, ro, fe 5.59m: B0°, cly, 5mm	C	97	73	PL(A) = 0.81 PL(A) = 0.62
56									C	100	100	PL(A) = 1.9 PL(A) = 1.2
54		8.2-8.7m: fine grained sandstone, very thinly bedded at 5°						8.21m: B0°, cly, 8mm 8.72m: B0°, cly vn				PL(A) = 1.9
53	10.0								C	100	100	PL(A) = 1.4

RIG: Scout 2 **DRILLER:** Ground Test **LOGGED:** LS **CASING:** HW to 2.85m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.85m; NMLC-Coring to 18.08m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 62.3 AHD
EASTING: 325514
NORTHING: 6260536
DIP/AZIMUTH: 90°/--

BORE No: 03
PROJECT No: 86043.01
DATE: 8-11-2017
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
52		SANDSTONE - high strength, moderately weathered and fresh, slightly fractured and unbroken, thinly and thickly bedded						10.39m: B0°, cly vn				
	11	10.32-10.72m: fine grained sandstone, very thinly bedded cross bedding at 5°- 10°							C	100	100	PL(A) = 1.9
51												PL(A) = 1.7
	12							11.87-12.1m: B (x3) 0°, cbs 12.13m: B0°, cly vn				
50								12.34-12.81m: B (x3) 0°, cly vn, cbs				PL(A) = 1.8
	13											PL(A) = 1.5
49									C	100	100	
	14											PL(A) = 1.2
48												
	15	15.05-15.78m: very thinly bedded at 5°- 10°						15.04m: B0°, fe 15.14m: B0°, cly, 3mm				PL(A) = 1.5
47								15.6m: B0°, fe, cly, 3mm 15.64m: B0°, cly, 3mm 15.7-15.76m: Ds, 60mm				
	16											
46	16.6	SANDSTONE - high strength, moderately weathered, unbroken, purple-brown and orange-brown, coarse grained sandstone, thickly bedded						16.57m: B10°, cly, 1mm	C	100	100	PL(A) = 2.4
	17											
45								17.42m: B0°, cly, 2mm				PL(A) = 2.3
	18											
44	18.08	Bore discontinued at 18.08m										
	19											
43												

RIG: Scout 2 **DRILLER:** Ground Test **LOGGED:** LS **CASING:** HW to 2.85m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.85m; NMLC-Coring to 18.08m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 03 PROJECT: MACQUARIE PARK OCTOBER 2017

2.85 – 7.0m

BORE: 03 PROJECT: MACQUARIE PARK OCTOBER 2017

7.0 – 12.0m

BORE: 03 PROJECT: MACQUARIE PARK OCTOBER 2017

12.0 – 17.0m

BORE: 03 PROJECT: MACQUARIE PARK OCTOBER 2017

17.0 – 20.0m

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 64.6 AHD
EASTING: 325483
NORTHING: 6260455
DIP/AZIMUTH: 90°/--

BORE No: 04
PROJECT No: 86043.01
DATE: 30-10-2017
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing: Type	Core Rec: %	RQD %	Test Results & Comments
			EW HW MW SW FS FR		Ex Low Very Low Low Medium High Very High Ex High		0.01 0.05 0.10 0.50 1.00	B - Bedding J - Joint S - Shear F - Fault				
64	0.2	TOPSOIL - brown, slightly clayey sand with a trace of brick, rootlets and ironstone gravel, humid						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	E			
	0.5	SANDSTONE - low strength, yellow and red-brown sandstone							A			PL(A) = 1.4
63	1 1.0	SANDSTONE - high then very low strength, highly weathered, fractured, red-brown, fine to medium grained sandstone with some medium strength iron-cemented bands						0.75m: CORE LOSS: 250mm 1.0-1.08m: Ds 1.34-1.52m: B's 0°- 5°, cly, fe 1.87-2.2m: Ds	C	88	38	PL(A) = 1.2
62	2 2.2	SANDSTONE - high strength, moderately weathered, fractured, brown, medium grained sandstone with some extremely low and very low strength bands						2.32m: J35°, un, ro, fe 2.6-2.63m: Cs 2.74m: B0°, cly, 1mm 2.9-3.0m: Ds 3.0-3.3m: J80°, pl, ro, cly, 1mm 3.25m: B10°, cly, 10mm 3.45m: B0°, cly, 3mm				PL(A) = 2.2
61	3 4 4.05	SANDSTONE - high strength, moderately then slightly weathered, slightly fractured, light grey and yellow-brown, medium grained sandstone with some siltstone/carbonaceous flakes						3.76m: B5°, fe 3.87, 3.9m: B5°, cly vn, fe 4.04-4.08m: Ds, 40mm 4.9m: B0°, cly, 1mm, fe & J90°, pl, ro, cly vn 5.08, 5.11m: B (x2) 0°, fe	C	100	78	PL(A) = 2.1 PL(A) = 1.8
60	5											PL(A) = 1.6
59	6							6.04m: B, fe				PL(A) = 1.3
58	7							6.71, 6.75m: B (x2) 0°, fe	C	100	90	
57	8	- medium strength from 7.95m						7.31m: B0°, fe 7.49m: B0°, cly, 1mm 7.68-7.7m: Cs, 20mm 7.94m: B0°, fe 8.1m: B0°, fe 8.14m: J20°, pl, ro, fe, cly, 5mm				PL(A) = 1.6 PL(A) = 0.7
56	8.5	SANDSTONE - high strength, fresh, slightly fractured and unbroken, medium grained, thickly bedded, light grey sandstone						8.25m: J25°, pl, ro, fe, cly, 10mm				
55	9	9.0-9.65m: thinly bedded, fine to medium grained sandstone						9.44-9.45m: Ds, 10mm 9.75m: B0°, cly, 4mm	C	100	98	PL(A) = 2.5

RIG: Scout 2 **DRILLER:** Ground Test **LOGGED:** LS/SI **CASING:** HW to 0.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 0.5m; NMLC-Coring to 20.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 64.6 AHD
EASTING: 325483
NORTHING: 6260455
DIP/AZIMUTH: 90°/--

BORE No: 04
PROJECT No: 86043.01
DATE: 30-10-2017
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
54		SANDSTONE - high strength, fresh, slightly fractured and unbroken, medium grained, thickly bedded, light grey sandstone *(continued)*							C	100	98	PL(A) = 1.5
	11											PL(A) = 1.5
53		11.7-12.0m: thinly bedded sandstone						11.7m: irregular bedding with high angle 11.93m: B0°, cly, 1mm				
	12											PL(A) = 1.4
52												
	13							12.93m: B0°, cly, 1mm	C	100	100	
51												PL(A) = 1.6
	14	- thinly cross bedded (5°- 10°) from 14.1m										PL(A) = 1.5
50								14.45, 14.63m: B0°, cly, 1mm				
	15							15.04-15.14m: B (x4) 0°, cbs, cly				
49		15.2-15.6m & 16.25 to 16.6m: fine sandstone										PL(A) = 2.1
	16								C	100	98	
48								16.25m: B5°, cly vn				PL(A) = 1.9
	17											
47								17.45m: B10°, cly co, 3mm				PL(A) = 2.3
	18											
46	18.4	SANDSTONE - high strength, moderately weathered, unbroken, medium to coarse grained sandstone							C	100	100	PL(A) = 2.6
	19											
45	20.0	Bore discontinued at 20.0m										PL(A) = 2.9

RIG: Scout 2 **DRILLER:** Ground Test **LOGGED:** LS/SI **CASING:** HW to 0.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 0.5m; NMLC-Coring to 20.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 04 PROJECT: MACQUARIE PARK OCTOBER 2017

0.5 – 5.0m

BORE: 04 PROJECT: MACQUARIE PARK OCTOBER 2017

5.0 – 10.0m

BORE: 04 PROJECT: MACQUARIE PARK OCTOBER 2017

10.0 – 15.0m

BORE: 04 PROJECT: MACQUARIE PARK OCTOBER 2017

15.0 – 20.0m

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 59.2 AHD
EASTING: 325541
NORTHING: 6260484
DIP/AZIMUTH: 90°/--

BORE No: 05
PROJECT No: 86043.01
DATE: 1-11-2017
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
59	0.3	FILLING - brown medium sand filling with some ironstone gravel and clay, humid - root affected (topsoil) to 0.05m			A/E			
	0.6	FILLING - orange-brown medium sand filling with some ironstone gravel and trace of clay, damp			A/E			
58	1			Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	B			
	1.35	FILLING - brown, gravelly clay filling, ironstone gravel (20-30mm) with a trace of fine sand, MC<PL			A/E			
	1.7	SANDSTONE - extremely low to very low strength, orange-brown and grey sandstone			S			9,10,11 N = 21
57	2			1.8m: B0°, cly, 1mm 1.95m: CORE LOSS: 270mm				PL(A) = 0.28
	2.22	SANDSTONE - extremely low and low strength, extremely to moderately weathered, fractured, light grey and red-brown, medium grained sandstone with some high strength iron-cemented beds			C	78	0	
	2.9	SANDSTONE - high strength, slightly weathered and fresh, slightly fractured and unbroken, light grey, medium grained sandstone		2.6m: B0°, cly, 1mm 2.66-2.74m: Cs, 60mm 2.802.89m: B (x5) 0°, cly, 1-3mm, fe 2.95m: B0°, cly, 3mm				PL(A) = 2.2
56	3							PL(A) = 1.1
				3.67-3.21m: B0°, fe				
55	4							PL(A) = 1.4
					C	100	85	
54	5			5.24m: B15°, fe				
				5.56-5.89m: B (x6) 0°, fe				PL(A) = 1.2
	6			5.9-5.95m: Ds, 50mm 6.09-6.11m: B (x2) 0°, fe				
53								PL(A) = 1
				6.57m: B0°, cly, 2mm 6.68m: J65°, he, fe 6.8m: B0°, cly, 2mm				
52	7			7.3-7.32m: B (x2) 20°, cly, 2mm				
					C	100	91	PL(A) = 1.4
51	8							
				8.78m: B0°, cly, 10mm				PL(A) = 2.1
	9			9.1-9.15m: B (x2) 0°, cly, 1-8mm				
50					C	100	95	PL(A) = 1.3

RIG: Scout 2 **DRILLER:** Ground Test **LOGGED:** LS/SI **CASING:** HW to 1.7m

TYPE OF BORING: Solid flight auger (TC-bit) to 1.7m; NMLC-Coring to 18.27m

WATER OBSERVATIONS: No free groundwater observed whilst augering. Water level at 12.68m depth on 12/12/17

REMARKS: Well constructed to 18.27m (blank to 0.5m; screen 0.5-18.27m; bentonite 0.1-0.8m; sand 0.8-18.27m). MC= Moisture content; PL=Plastic limit; bulk sample obtained by excavator-mounted large diameter auger on 9/11/2017

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 59.2 AHD
EASTING: 325541
NORTHING: 6260484
DIP/AZIMUTH: 90°/--

BORE No: 05
PROJECT No: 86043.01
DATE: 1-11-2017
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec: %	RQD %	Test Results & Comments
49		SANDSTONE - high strength, slightly weathered and fresh, slightly fractured and unbroken, light grey, medium grained sandstone *(continued)*										
								10.63m: B0°,, cly, 4mm 10.67-10.7m: Ds, 30mm				PL(A) = 1.5
48	11								C	100	95	
												PL(A) = 1.3
47	12											
								12.42m: B0°, cly, 10mm, fe				PL(A) = 0.89
46	13					12-12-17						
								13.68m: B0°, cly, 3mm	C	100	97	PL(A) = 2.4
45	14											
								14.55m: B0°, cly, 3mm				PL(A) = 2.4
44	14.8 15	SANDSTONE - high strength, slightly weathered, unbroken, light brown, medium and medium to coarse grained sandstone										
												PL(A) = 2.7
43	16							16.26m: B0°, fe				
									C	100	100	PL(A) = 2.6
42	17											
												PL(A) = 2.6
41	18											
	18.27	Bore discontinued at 18.27m										PL(A) = 2.7
40	19											

RIG: Scout 2 **DRILLER:** Ground Test **LOGGED:** LS/SI **CASING:** HW to 1.7m

TYPE OF BORING: Solid flight auger (TC-bit) to 1.7m; NMLC-Coring to 18.27m

WATER OBSERVATIONS: No free groundwater observed whilst augering. Water level at 12.68m depth on 12/12/17

REMARKS: Well constructed to 18.27m (blank to 0.5m; screen 0.5-18.27m; bentonite 0.1-0.8m; sand 0.8-18.27m). MC= Moisture content; PL=Plastic limit; bulk sample obtained by excavator-mounted large diameter auger on 9/11/2017

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 05 **PROJECT: MACQUARIE PARK** **OCTOBER 2017**

1.7 – 6.0m

BORE: 05 **PROJECT: MACQUARIE PARK** **OCTOBER 2017**

6.0 – 11.0m

BORE: 05 PROJECT: MACQUARIE PARK OCTOBER 2017

11.0 – 16.0m

BORE: 05 PROJECT: MACQUARIE PARK OCTOBER 2017

16.0 – 18.27m

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 54.1 AHD
EASTING: 325597
NORTHING: 6260464
DIP/AZIMUTH: 90°/--

BORE No: 06
PROJECT No: 86043.01
DATE: 10-11-2017
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
54	0	FILLING - apparently compacted, dark brown clay filling, slightly sandy with some silt, MC<PL - top 0.05m affected by rootlets - top 0.2m with some ironstone gravel							A/E			
									A/E			
53	1	FILLING - apparently compacted, brown mottled orange-brown, clay filling with some fine sand, silt and a trace of ironstone gravel, MC<PL						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	A/E S A/E			4,7,4 N = 11
52	2	SANDSTONE - medium strength, moderately and slightly weathered, slightly fractured, red-brown with light grey bands, medium grained sandstone						2.4m: J35°, pl, ro, cly vn, fe 2.46m: B0°, cly, 3mm 2.64m: B0°, fe 2.7-2.78m: Ds, 80mm 3.02-3.14m: Ds, 30mm 3.06-3.14m: Cs, 80mm 3.24m: B0°, cly, 1mm 3.58m: B0°, cly, 4mm 3.9-4.0m: Ds, 100mm 4.05m: B0°, cly, 3mm	C	100	79	PL(A) = 1.3 PL(A) = 0.44
51	3											
50	4											
49	5	SANDSTONE - medium then high strength, slightly weathered to fresh, slightly fractured, light grey with some orange-brown bands, fine and medium grained sandstone						4.3m: B5°, fe 4.34m: J5°- 50°, un, ro, fe, cly, 1mm 4.6m: B0°, cly, 3mm 4.9m: B0°, fe, cly, 3mm 5.05-5.3m: B (x2) 0°, cly, 3mm, fe 5.58-6.04m: B (x2) 0°, cly, 2-4mm 6.76-6.77m: Ds, 10mm	C	100	100	PL(A) = 0.64 PL(A) = 2 PL(A) = 1.4
48	6											
47	7											
46	8							7.64m: B0°, cly, 3mm 8.38-8.56m: B (x2) 0°-5°, cly, 1-4mm	C	100	98	PL(A) = 1.5 PL(A) = 0.96
45	9							9.6-9.65m: Cs, 50mm				PL(A) = 1.2
	10.0											

RIG: Bobcat **DRILLER:** Ground Test **LOGGED:** LS **CASING:** HW to 2.1m

TYPE OF BORING: Solid flight auger to 2.2m; NMLC-Coring to 17.25m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 54.1 AHD
EASTING: 325597
NORTHING: 6260464
DIP/AZIMUTH: 90°/--

BORE No: 06
PROJECT No: 86043.01
DATE: 10-11-2017
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
44		SANDSTONE - high strength, slightly weathered to fresh, slightly fractured, light grey with some orange-brown bands, fine and medium grained sandstone						10.36-10.48m: B (x2) 0°, fe 10.77m: B5°, cbs				PL(A) = 1.2
43	11								C	100	100	PL(A) = 1.3
42	12							11.77m: B5°, cbs				PL(A) = 1.5
41	13											PL(A) = 2.3
40	14											
39	15	- slightly weathered below 15.0m						14.64m: B0°, cly, 2mm	C	100	100	PL(A) = 2
38	16											PL(A) = 2.4
37	17							16.6m: J30°, pl, ro, cbs, fe	C	100	100	PL(A) = 2.5
	17.25	Bore discontinued at 17.25m										
36	18											
35	19											

RIG: Bobcat **DRILLER:** Ground Test **LOGGED:** LS **CASING:** HW to 2.1m

TYPE OF BORING: Solid flight auger to 2.2m; NMLC-Coring to 17.25m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 06 PROJECT: MACQUARIE PARK OCTOBER 2017

2.2 – 7.0m

BORE: 06 PROJECT: MACQUARIE PARK OCTOBER 2017

7.0 – 12.0m

BORE: 06 PROJECT: MACQUARIE PARK OCTOBER 2017

12.0 – 17.0m

BORE: 06 PROJECT: MACQUARIE PARK OCTOBER 2017

17.0 – 17.25m

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 59.1 AHD
EASTING: 325545
NORTHING: 6260402
DIP/AZIMUTH: 90°/--

BORE No: 07
PROJECT No: 86043.01
DATE: 7-11-2017
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Graphic Log	Type	Core Rec. %	RQD %	Test Results & Comments
59	0.05	BRICK PAVERS		A/E			
	0.1	FILLING - light brown then dark brown, fine then coarse sand filling with some roadbase gravel, moist		A/E			
	0.6	FILLING - brown silty clay filling with some fine sand, with a trace of ironstone gravel, humid		A/E			
58	1			S			6,8,20 N = 28
	1.3	CLAY - stiff to very stiff, orange-brown, slightly silty clay with a trace of fine sand, MC<PL					
	1.5	SANDSTONE - very low strength, light grey and orange-brown sandstone		C	100	93	PL(A) = 0.9
57	2	SANDSTONE - medium to high strength, highly weathered, slightly fractured, light grey and orange-brown, medium grained sandstone					PL(A) = 1
56	3						
	3.6	SANDSTONE - medium strength, slightly weathered, fractured, light grey fine grained sandstone, thinly bedded with some siltstone laminations		C	100	77	PL(A) = 0.32
55	4						
54	5						PL(A) = 0.94
	6.0	SANDSTONE - high strength, fresh, unbroken, light grey, medium grained sandstone, thinly and thickly bedded with some siltstone laminations					PL(A) = 1
53	6						
52	7						PL(A) = 1.6
51	8			C	100	100	PL(A) = 1.4
50	9						PL(A) = 1.5
							PL(A) = 1.7

Degree of Weathering: EW, HW, MW, SW, FS, FR
Rock Strength: Ex Low, Very Low, Low, Medium, High, Very High, Ex High
Water
Fracture Spacing (m): 0.01, 0.05, 0.10, 0.50, 1.00

Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)

1.5-1.56m: fg
1.56-1.59m: Cs, 30mm
2.2m: B5°, cly, 8mm
3.28-3.34m: Cs, 60mm
3.4-3.6m: Cs, 200mm
3.69m: B0°, cly, 3mm
3.84-3.86m: fg, 20mm
3.86m: J0° & 90°, st, ro, cln
3.91-3.94m: fg, 30mm
4.17m: B0°, he, cly, 2mm
4.2-4.24m: Cs, 40mm
4.28-4.41m: B (x3) 0°, he, cly, 3mm
4.57-4.74m: B (x4) 0°, fe
4.82-4.94m: B (x4) 0°, he, cly, 2mm
5.21-5.28m: Cs, 70mm
5.57-5.62m: Cs, 50mm
5.72-5.76m: B (x4) 0°, he, cly, 2mm
5.84-5.88m: Cs, 40mm
5.91-5.96m: Cs, 50mm
6.27m: B0°, fe, cly, 1mm
8.22m: B0°, cly, 3mm
9.45m: B0°, cly, 2mm
9.6m: B0°, cly, 5mm

RIG: Scout 2 **DRILLER:** Ground Test **LOGGED:** LS **CASING:** HW to 1.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 1.5m; NMLC-Coring to 21.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering. Water level at 13.45m depth on 12/12/17

REMARKS: MC = Moisture Content; PL = Plastic Limit. Ground well (blank 0.3-1.5m; screen 1.5-21.0m; fill 0-0.6m; bentonite 0.6-1.2m; gravel 1.2-21.0m)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 59.1 AHD
EASTING: 325545
NORTHING: 6260402
DIP/AZIMUTH: 90°/--

BORE No: 07
PROJECT No: 86043.01
DATE: 7-11-2017
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
49	11	SANDSTONE - high strength, fresh, unbroken, light grey, medium grained sandstone, thinly and thickly bedded with some siltstone laminations *(continued)*							C	100	100	PL(A) = 1.4
48								11.56m: B0°, cly, 3mm				PL(A) = 1.6
47	12											
46	13							13.1-13.3m: B (x3) 0°, he, cly				PL(A) = 1.5
45	14					12-12-17			C	100	100	PL(A) = 1.5
44	15											PL(A) = 1.6
43	16							15.44m: B20°, cbs, 1mm				PL(A) = 1.8
42	17											PL(A) = 2.6
41	18	18.0m: shale clast							C	100	100	PL(A) = 2.7
	18.65							17.64-17.74m: Cs, 10mm 17.67m: B0°, cly, 4mm				
40	19	SANDSTONE - high strength, slightly weathered and fresh, slightly fractured, medium grained sandstone with trace siltstone clasts						18.22m: B0°, cly, 1mm, cbs 18.81m: B0°, fe, cbs	C	100	100	PL(A) = 2.7 PL(A) = 2.6
	20.0							19.67m: B0°, cly, 2mm				

RIG: Scout 2 **DRILLER:** Ground Test **LOGGED:** LS **CASING:** HW to 1.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 1.5m; NMLC-Coring to 21.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering. Water level at 13.45m depth on 12/12/17

REMARKS: MC = Moisture Content; PL = Plastic Limit. Ground well (blank 0.3-1.5m; screen 1.5-21.0m; fill 0-0.6m; bentonite 0.6-1.2m; gravel 1.2-21.0m)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 59.1 AHD
EASTING: 325545
NORTHING: 6260402
DIP/AZIMUTH: 90°/--

BORE No: 07
PROJECT No: 86043.01
DATE: 7-11-2017
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec: %	RQD %	Test Results & Comments
39		SANDSTONE - very high strength, slightly weathered, slightly fractured, medium grained sandstone with siltstone clasts and some very low strength bands						20.05m: B0°, fe 20.46-20.49m: B0°, cly, 10mm	C	100	100	PL(A) = 3.3
21	21.0	Bore discontinued at 21.0m										
38	22											
37	23											
36	24											
35	25											
34	26											
33	27											
32	28											
31	29											
30												

RIG: Scout 2 **DRILLER:** Ground Test **LOGGED:** LS **CASING:** HW to 1.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 1.5m; NMLC-Coring to 21.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering. Water level at 13.45m depth on 12/12/17

REMARKS: MC = Moisture Content; PL = Plastic Limit. Ground well (blank 0.3-1.5m; screen 1.5-21.0m; fill 0-0.6m; bentonite 0.6-1.2m; gravel 1.2-21.0m)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 07 PROJECT: MACQUARIE PARK OCTOBER 2017

1.5 – 6.0m

BORE: 07 PROJECT: MACQUARIE PARK OCTOBER 2017

6.0 – 11.0m

BORE: 07 PROJECT: MACQUARIE PARK OCTOBER 2017

11.0 – 16.0m

BORE: 07 PROJECT: MACQUARIE PARK OCTOBER 2017

16.0 – 18.27m

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 50.1 AHD
EASTING: 325647
NORTHING: 6260426
DIP/AZIMUTH: 90°/--

BORE No: 08
PROJECT No: 86043.01
DATE: 7-11-2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
50	0.2	FILLING - dark brown clay filling, slightly sandy with some concrete fragments and trace metal wire, MC<PL, root affected to 0.05m							A/E			
	0.7	FILLING - brown clay filling with some sand and a trace of concrete fragments, MC<PL 0.5m: metal wire observed							A/E			
49	1								A/E S			7,7,7 N = 14
	1.6	CLAY - stiff, light orange-brown clay with some fine sand and silt and a trace of ironstone gravel, MC<PL										
48	2	SANDSTONE - low to medium strength, red-brown and light grey, medium grained sandstone with some very low strength bands							A			
	2.6							2.5m: CORE LOSS: 100mm				
	2.75	SANDSTONE - medium and high strength, slightly weathered and fresh, light grey with purple-brown bands, medium grained sandstone, medium bedded						2.7m: B0°, cly, 2mm 2.9-2.93m: Cs, 30mm				PL(A) = 0.2
47	3							3.3m: B0°, cly, 5mm 3.36-3.38m: Cs, 30mm 3.64m: B0°, fe, cly, 3mm				PL(A) = 1.6
46	4								C	96	86	
								4.2-4.22m: Ds, 20mm 4.28-4.3m: Cs, 20mm				PL(A) = 0.8
45	5.1	Bore discontinued at 5.1m										
44	6											
43	7											
42	8											
41	9											

RIG: Scout 2 **DRILLER:** Ground Test **LOGGED:** LS **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.5m; NMLC-Coring to 5.1m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: MC = Moisture Content; PL = Plastic Limit

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 08 **PROJECT: MACQUARIE PARK** **OCTOBER 2017**

2.5 – 5.10m

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 45.8 AHD
EASTING: 325720
NORTHING: 6260386
DIP/AZIMUTH: 90°/--

BORE No: 09
PROJECT No: 86043.01
DATE: 8-11-2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
45	0.05	BRICK PAVERS							A/E			
	0.16	FILLING - dark grey medium to coarse sand filling with some roadbase and sandstone gravel and a trace of slag, moist							A/E			
1	1.0	FILLING - light brown sandy clay and clay filling with trace sandstone gravel and fine sand, MC<PL							A/E S			6,4,6/50mm refusal bouncing
	1.5	SANDSTONE - very low to low strength, red-brown sandstone										
44		SANDSTONE - medium strength, extremely and moderately weathered, fractured, light grey and orange-brown, medium grained sandstone						1.72m: B0°, fe 1.87m: CORE LOSS: 130mm 2.0-2.12m: Cs, 120mm	C	89	73	PL(A) = 0.67
2	2.0							2.34m: B0°, cly, 5mm 2.44-2.45m: Ds, 10mm				
	2.5	SANDSTONE - medium and high strength, slightly weathered, slightly fractured, medium grained sandstone, medium bedded										PL(A) = 1.5
43								2.88m: B10°, fe				
3								3.11-3.29m: B (x5) 0°-5°, cly, 3-5mm				PL(A) = 0.69
42												PL(A) = 0.86
4								4.03m: B0°, fe	C	100	98	PL(A) = 0.86
								4.43-4.47m: Cs, 40mm 4.57m: B0°, fe 4.7m: B0°, fe, cly, 2mm				
41												
5								5.13m: B5°, cly, 3mm				PL(A) = 0.57
	5.44	Bore discontinued at 5.44m										
40												
6												
39												
7												
38												
8												
37												
9												
36												

RIG: Scout 2 **DRILLER:** Ground Test **LOGGED:** LS **CASING:** HW to 1.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 1.5m; NMLC-Coring to 5.44m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 09 **PROJECT: MACQUARIE PARK** **OCTOBER 2017**

1.5 – 5.44m

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 45.2 AHD
EASTING: 325736
NORTHING: 6260351
DIP/AZIMUTH: 90°/--

BORE No: 10
PROJECT No: 86043.01
DATE: 2-11-2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Water	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
45	0.2	FILLING - dark brown clayey sand filling with ironstone gravel and a trace of concrete fragments, moist - root affected to 0.05m				A/E			
	0.6	FILLING - red-brown silty clay filling with some fine sandstone and roadbase gravel, moist				A/E			
44	1.0	SILTY SAND - medium dense, dark brown, fine to medium silty sand with some clay and a trace of ironstone gravel, moist				A/E			
		SANDY CLAY - soft to firm, light brown, fine to medium sandy clay, moist				S			pp = 100 1,1,3 N = 4
43	2.1	SANDSTONE - low and medium strength, light grey and orange-brown sandstone with extremely low strength bands			Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	E			
	2.75	SANDSTONE - medium and high strength, moderately weathered to fresh, slightly fractured and unbroken, medium grained sandstone, thinly to medium bedded			2.47m: J90°, pl, ro, cly, 2mm 2.47m: B0°, cly, 2mm 2.6m: B0°, cly, 2mm 2.7-2.74m: Cs, 40mm 3.05-3.64m: B (x2) 0°, cly, 4mm	C	100	84	PL(A) = 0.24 PL(A) = 1.2
42					4.14-4.16m: B (x2) 0°, fe				PL(A) = 1.3
41				12-12-17					
40		5.45-6.48m: fresh			5.17-5.18m: B (x2) 0°, cly, 1mm 5.25m: B15°, he, cly, 2mm 5.49m: B15°, fe 5.55-5.56m: Cs, 10mm 5.87m: B0°, cly, 5mm	C	100	92	PL(A) = 1.1 PL(A) = 0.36
39					6.48m: B0°, fe 6.8-7.22m: B (x7) 0°, fe, cbs				PL(A) = 1.9
38		7.07m: siltstone clast			7.23m: J20°, he, cbs 7.25m: B0°, he, cbs 7.3-7.32m: B (x2) 0°, fe, cbs	C	100	84	PL(A) = 2.6
37					8.82m: J30°, pl, ro, cly, 1mm				PL(A) = 1.8
36	8.97	Bore discontinued at 8.97m - target depth reached							

RIG: Scout 2 **DRILLER:** Ground Test **LOGGED:** LS **CASING:** HW to 2.4m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.4m; NMLC-Coring to 8.97m

WATER OBSERVATIONS: No free groundwater observed whilst augering. Water level at 4.5m depth on 12/12/17

REMARKS: Well installed to 5.6m (blank 0.0-2.5m; screen 2.5-5.6m; bentonite 1.3-2.6m; gravel 2.6-5.6m)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 10 **PROJECT: MACQUARIE PARK** **OCTOBER 2017**

2.4 – 7.0m

BORE: 10 **PROJECT: MACQUARIE PARK** **OCTOBER 2017**

7.0 – 8.97m

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 43.2 AHD
EASTING: 325768
NORTHING: 6260337
DIP/AZIMUTH: 90°/--

BORE No: 11
PROJECT No: 86043.01
DATE: 2-11-2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
43	0.16	CONCRETE - 20mm reinforcement at 60mm and 80mm			A			
	0.21	SUBBASE - roadbase gravel, 25-30mm, angular to sub-angular			A/E			
	0.7	FILLING - light brown, sandy clay filling, MC>PL						
42	1	CLAYEY SILT - stiff, grey mottled orange-brown, clayey silt and fine sand, moist			A/E			pp = 340
					A/E			2,5,6 N = 11
					S			
	1.9	SILTY CLAY - firm, red-brown mottled grey, silty clay with a trace of fine and coarse sand, moist		Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
41	2	2.6m: becoming wet, gravelly MC>PL			S			6,3,7/40mm refusal bouncing
	2.8	LATERITIC SANDSTONE - high strength, highly weathered, fragmented, dark red-brown mottled dark grey and orange-brown lateritic sandstone		2.85-3.0m: fg 3.13m: B0°, cly, 10mm 3.22m: B0°, cly, 2mm 3.3m: J60°, he, fe 3.37-3.42m: Cz, 50mm 3.46m: B0°, cly, 2mm, fe 3.48m: J25°, he, cly, 2mm, fe				PL(A) = 1
40	3							
	3.8	SANDSTONE - high strength, slightly weathered, light red-grey, medium grained sandstone, thickly bedded		3.6m: CORE LOSS: 200mm	C	81	42	
39	4							PL(A) = 1.1
	5			4.98m: J70°, pl, ro, cln 5m: CORE LOSS: 310mm				
38	5.31			5.33-5.87m: J85°- 90°, un, ro, cln				PL(A) = 1.2
	6							
	6.0			5.92m: B0°, cly, 1mm CORE LOSS: 80mm 6.0-6.41m: J85°- 90°, un, ro, cly, 1mm 6.23-6.63m: J70°, pl, ro, cln				PL(A) = 1.3
37	7	- fresh, light grey from 6.97m		6.89-8.09m: J85°- 90°, un, ro, cln	C	97	98	
36	8							PL(A) = 1.3
35		- thinly bedded with 5% siltstone laminae from 8.17-8.35m		8.13-8.16m: Cs, 30mm 8.35m: B0°, cly, 3mm				
	8.6	Bore discontinued at 8.6m - target depth reached						PL(A) = 2.4
34	9							

Degree of Weathering: EW, HW, MW, SW, FS, FR
Rock Strength: Ex Low, Very Low, Low, Medium, High, Very High, Ex High
Water
Fracture Spacing (m): 0.01, 0.05, 0.10, 0.50, 1.00

RIG: Scout 2 **DRILLER:** Ground Test **LOGGED:** LS **CASING:** HW to 2.85m

TYPE OF BORING: Diacore to 0.16m; Solid flight auger (TC-bit) to 2.5m; Washbore to 2.85m; NMLC-Coring to 8.6m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: MC = Moisture Content; PL = Plastic Limit

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 11 **PROJECT: MACQUARIE PARK** **OCTOBER 2017**

2.85 – 7.0m

BORE: 11 **PROJECT: MACQUARIE PARK** **OCTOBER 2017**

7.0 – 8.60m

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 45.2 AHD
EASTING: 325735
NORTHING: 6260295
DIP/AZIMUTH: 90°/--

BORE No: 12
PROJECT No: 86043.01
DATE: 3-11-2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
45	0.15	FILLING - dark grey, medium to fine sand filling (topsoil), slightly clayey with bark and rootlets and a trace of ironstone gravel, damp							A/E			
		FILLING - brown, medium to fine clayey sand filling with some ironstone gravel and trace of rootlets, damp							A/E			
44	1.2	0.4-0.5m: metal and plastic wire fragment							A			
		SANDY CLAY - stiff, brown, medium grained sandy clay, moist							S			4,5,5 N = 10
43	2.1	SANDSTONE - extremely low to very low strength, red-brown and light grey sandstone						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	A/E			
	2.4	SANDSTONE - medium strength, moderately to highly weathered, fractured to slightly fractured, red-brown medium grained sandstone						2.54m: B0°, cly, 3mm				PL(A) = 0.55
42								3.15m: B0°, cly, 2mm 3.21m: B0°, cly, 10mm	C	95	80	PL(A) = 0.46
	3.69							3.46m: B0°, cly, 1mm 3.49-3.59m: Cs, 100mm 3.61m: CORE LOSS: 80mm				
41	4.0	SANDSTONE - high strength, moderately weathered, slightly fractured, red-brown medium to coarse grained sandstone				12-12-17		3.86m: B0°, cly, 1mm, fe 4.2m: B0°, cly, 1mm 4.58m: B15°, cly, 1mm, fe				PL(A) = 1.7 PL(A) = 1.8
40									C	100	96	
39								6.31-6.33: B (x2) 0°, fe 6.51-6.79m: B (x3) 0°, cly, 1mm				PL(A) = 1.2
38	6.93	Bore discontinued at 6.93m - target depth reached										
37												
36												

RIG: Scout 2 **DRILLER:** Ground Test **LOGGED:** LS **CASING:** HW to 2.4m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.4m; NMLC-Coring to 6.93m

WATER OBSERVATIONS: No free groundwater observed whilst augering. Water level at 4.1m depth on 12/12/17

REMARKS: Well installed to 6.93m (blank 0.0-2.1m; screen 2.1-6.93m; filling 0.0-1.5m; bentonite 1.5-2.3m; sand 2.3-6.93m)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 12 **PROJECT: MACQUARIE PARK** **OCTOBER 2017**

2.4 – 6.93m

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 46.8 AHD
EASTING: 325702
NORTHING: 6260260
DIP/AZIMUTH: 90°/--

BORE No: 13
PROJECT No: 86043.01
DATE: 3-11-2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
46	0.0	FILLING - light brown sandy clay filling with some roadbase gravel, damp							A/E			
		- root affected to 0.09m							A/E			
	0.6	0.3m: with some ironstone gravel										
45	1	FILLING - dark brown clay filling, slightly sandy with some fine sandstone gravel, damp							A/E			
	1.35	SILTY CLAY - stiff to very stiff, yellow-brown silty clay, slightly sandy, with a trace of ironstone gravel, moist						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			2,4,6 N = 10 pp = 440
	2.0	SANDSTONE - extremely low to very low strength, light grey and red-brown sandstone							A/E			
	2.3	SANDSTONE - low to medium then high strength, slightly weathered, slightly fractured and unbroken, light grey sandstone bands and light brown thinly and thickly bedded						2.37-2.43m: Cs, 60mm 2.47-2.93m: B (x3) 0°, cly, 3mm 2.97-2.99m: Cs, 20mm	C	100	87	PL(A) = 0.2 PL(A) = 0.61
44	3											
43	4											
42	5	5.24-5.3m: highly fractured, iron-cemented				12-12-17		4.58m: B5°, fe, cly, 2mm 4.95m: B10°, cly, 1mm fr 5.25-5.31m: B (x5) 5°-10°, manganese, fe 5.54m: B0°, cly, 10mm	C	100	95	PL(A) = 1 PL(A) = 1.4 PL(A) = 2
	5.3	SANDSTONE - high strength, slightly weathred, slightly fractuerd, purple-grey, medium to coarse grained sandstone										
41	6											
40	7							6.43m: B0°, cly, 2mm, manganese				
	7.0	Bore discontinued at 7.0m - target depth reached										
39	8											
38	9											
37												

RIG: Scout 2 **DRILLER:** Ground Test **LOGGED:** LS **CASING:** HW to 2.3m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.3m; NMLC-Coring to 7.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering. Water level at 4.9m depth on 12/12/17

REMARKS: Well installed to 7.0m (blank 0.0-2.1m; screen 2.1-7.0m; filling 0.0-1.3m; bentonite 1.5-1.8m; gravel 1.8-7.0m; gravel bridge in hole)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 13 **PROJECT: MACQUARIE PARK** **OCTOBER 2017**

2.3 – 7.0m

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 45.1 AHD
EASTING: 325807
NORTHING: 6260305
DIP/AZIMUTH: 90°/--

BORE No: LP1
PROJECT No: 86043.01
DATE: 9-11-2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec: %	RQD %	Test Results & Comments
45	0.2	FILLING - brown sandy gravelly clay filling, fine to medium gravel, moist, medium plasticity, MC<PL - root affected to 0.02m							A/E			
		FILLING - brown silty sand filling, slightly clayey with some fine sandstone and ironstone gravel, humid, MC<<PL							A/E			
44	1								A			
	1.3	CLAY - stiff to very stiff, red-brown mottled brown clay with some fine sand, MC<PL, medium plasticity (residual)							S			14,10,10 N = 20
43	2							Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
	2.2	SANDSTONE - extremely low strength, extremely weathered, light grey sandstone (very stiff to hard sandy clay properties), - very low strength from 2.5m							S			10/50mm refusal bouncing
	2.63	SANDSTONE - low and medium strength, moderately weathered, slightly fractured, red-brown, brown and light grey, medium grained sandstone										
42	3											
	3.75	SANDSTONE - low and medium strength with extremely low strength bands, fresh, slightly fractured, light grey, medium grained sandstone with trace siltstone laminae <5%						3.61m: B30°, un, sm, cly 3.69m: B30°, pl, sm, cbs 3.77m: B30°, pl, sm, cly	C	100	65	PL(A) = 0.14
41	4											
	4.59	SANDSTONE - high strength, fresh, slightly fractured, light grey, medium grained sandstone						4.52m: B10°, pl, ro, cly 4.58m: B5°, pl, sm, cly				PL(A) = 0.59
40	5											PL(A) = 1.5
	5.88							5.56m: B10°, un, ro, cln 5.65m: J50°, pl, ro, cln 5.74m: J45°, pl, ro, he 5.8m: CORE LOSS: 80mm				
39	6							6.32m: B15°, un, ro, cln				PL(A) = 1.5
								6.67m: B15°, pl, ro, cly				
38	7							7m: J45°, pl, ro, un 7.05m: B0°, pl, ro, cly	C	97	78	
								7.35m: B5°, pl, he				
								7.57m: B5°, pl, he 7.58m: B30°, pl, ro, cln				PL(A) = 1.4
37	8							7.98m: J75°, pl, ro, cln				
	8.52							8.4m: B30°, pl, ,ro				
	8.59	SANDSTONE - very low strength with some medium strength bands, moderately weathered, slightly fractured, light brown, medium grained sandstone						8.42m: J80°, pl, ro 8.55m: CORE LOSS: 40mm	C	92	32	PL(A) = 0.07
36	9							8.63m: B10°, pl, sm, cln 8.74m: B10°, pl, sm, cly				
	9.0	Bore discontinued at 9.0m - target depth reached										

RIG: Scout 2 **DRILLER:** Ground Test **LOGGED:** SCP **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger to 2.5m; Washbore to 2.63m; NMLC-Coring to 9.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: LP1 PROJECT: MACQUARIE PARK OCTOBER 2017

2.03 – 7.0m

BORE: LP1 PROJECT: MACQUARIE PARK OCTOBER 2017

7.0 – 9.0m

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 66.9 AHD
EASTING: 325490
NORTHING: 6260594
DIP/AZIMUTH: 90°/--

BORE No: 31
PROJECT No: 86043.01
DATE: 9-11-2017
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 150mm)
66	0.15	FILLING - apparently compacted, dark brown, clayey sand filling, medium sand with some ironstone gravel and traces of brick fragments, damp		A/E	0.0 0.1				
		FILLING - light brown, silty clay filling, slightly sandy, medium to fine sand, MC<PL - typically in an apparently compacted condition		A/E B	0.4 0.5 0.7				
65		1.7m: becoming light orange-brown (possibly natural)		A	1.7 1.8				
	2.1	SHALE - very low to low strength, light grey shale with orange bands		A	2.1 2.2				
64	2.35	Bore discontinued at 2.35m - auger refusal on low strength shale							
63									
62									

RIG: 3.5t excavator **DRILLER:** A & A Hire **LOGGED:** LS **CASING:** Uncased

TYPE OF BORING: 300mm diameter solid flight auger to 2.35m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: MC = Moisture Content; PL = Plastic Limit

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 63.1 AHD
EASTING: 325538
NORTHING: 6260575
DIP/AZIMUTH: 90°/--

BORE No: 32
PROJECT No: 86043.01
DATE: 9-11-2017
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 150mm)
63	0.2	FILLING - apparently compacted, dark brown, sand filling, medium sand with some clay and sandstone gravel, moist		A/E	0.0 0.1				
		SANDSTONE - very low to low strength, light brown sandstone with extremely low strength bands (hard clay properties)		B	0.5 0.7				
62	1								1
	1.5	Bore discontinued at 1.5m - auger refusal on low to medium strength sandstone							
61	2								2
60	3								3
59	4								4

5 10 15 20

RIG: 3.5t excavator **DRILLER:** A & A Hire **LOGGED:** LS **CASING:** Uncased

TYPE OF BORING: 300mm diameter solid flight auger to 1.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 62.7 AHD
EASTING: 325497
NORTHING: 6260509
DIP/AZIMUTH: 90°/--

BORE No: 33
PROJECT No: 86043.01
DATE: 9-11-2017
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 150mm)
62	0.0	FILLING - apparently compacted, brown clayey sand filling with some sandstone gravel and silt, damp		A/E	0.0 - 0.1				1
				A/E	0.4 - 0.5				
	0.5	FILLING - apparently compacted, light brown sand filling, medium to fine sand, slightly clayey, with some ironstone and roadbase gravel, damp		B	0.5 - 0.7				
	1.0	FILLING - apparently compacted, light yellow-brown medium to fine sand filling, damp							
	1.2	Bore discontinued at 1.2m - due to possible concrete boulder or service (concrete at side of hole)							
61	1								2
60	2								3
59	3								4
58	4								

RIG: 3.5t excavator **DRILLER:** A & A Hire **LOGGED:** LS **CASING:** Uncased

TYPE OF BORING: 300mm diameter solid flight auger to 1.2m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 65.3 AHD
EASTING: 325461
NORTHING: 6260475
DIP/AZIMUTH: 90°/--

BORE No: 34
PROJECT No: 86043.01
DATE: 3-10-2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	VWP Construction Details
65	0.0	FILLING - brown gravelly sand filling, medium grained ironstone and roadbase gravel with some clay, moist - root affected to 0.1m		E	0.0				
				A/E	0.1				
					0.2				
	0.4	SANDSTONE - medium strength, orange-brown sandstone with some low strength bands							
		0.6m: becoming light grey, medium and high strength		A	0.5				
					0.6				
				A	0.9				
	1.0	Bore discontinued at 1.0m - target depth reached			1.0				

RIG: Scout 2 **DRILLER:** Ground Test **LOGGED:** LS **CASING:** Uncased

TYPE OF BORING: Solid flight auger (TC-bit) to 1.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 65.1 AHD
EASTING: 325463
NORTHING: 6260433
DIP/AZIMUTH: 90°/--

BORE No: 35
PROJECT No: 86043.01
DATE: 11-9-2017
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 150mm)
65	0.15	FILLING - apparently compacted, dark brown clayey sand filling, medium grained, with a trace of roadbase gravel, damp		A/E	0.0 0.1				
		FILLING - apparently compacted, light brown clay filling, slightly sandy, medium to fine sand with some sandstone gravel, MC<PL		B	0.2				
	0.8	SANDSTONE - very low to low strength, light grey sandstone			0.7				
64	1.1	Bore discontinued at 1.1m - auger refusal on low to medium strength rock		A	1.0 1.1				
63									
62									
61									

RIG: 3.5t excavator **DRILLER:** A & A Hire **LOGGED:** LS **CASING:** Uncased

TYPE OF BORING: 300mm diameter solid flight auger to 1.1m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: MC = Moisture Content; PL = Plastic Limit

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 59.4 AHD
EASTING: 325532
NORTHING: 6260471
DIP/AZIMUTH: 90°/--

BORE No: 36
PROJECT No: 86043.01
DATE: 14-11-2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	VWP Construction Details
59	0.11	FILLING - apparently hard, light brown, silty clay filling with some fine sand and sandstone gravel, MC<PL							
		Bore discontinued at 0.11m - hand auger refusal on sandstone gravel and hard clay							
58	1								
57	2								
56	3								
55	4								

RIG: Hand tools **DRILLER:** LS **LOGGED:** LS **CASING:** Uncased

TYPE OF BORING: 150mm diameter hand auger to 0.11m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Bore hand augered only due to high risk of potential services after services scanning. MC = Moisture Content; PL = Plastic Limit

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 52.2 AHD
EASTING: 325645
NORTHING: 6260488
DIP/AZIMUTH: 90°/--

BORE No: 37
PROJECT No: 86043.01
DATE: 9-11-2017
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 150mm)
52	0.2	FILLING - apparently compacted, brown silty clay filling, slightly sandy, medium to fine grained, with a trace of ironstone gravel, MC<PL		A/E	0.0 0.1				
		FILLING - apparently compacted, light brown, clayey sandy filling, medium to fine grained with some sandstone gravel, damp		A/E B	0.4 0.5				
	0.8	Bore discontinued at 0.8m - auger refusal on concrete boulder			0.8				
51	1								1
50	2								2
49	3								3
48	4								4

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 3.5t excavator **DRILLER:** A & A Hire **LOGGED:** LS **CASING:** Uncased

TYPE OF BORING: 300mm diameter solid flight auger to 0.8m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: MC = Moisture Content; PL = Plastic Limit

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 63.9 AHD
EASTING: 325482
NORTHING: 6260409
DIP/AZIMUTH: 90°/--

BORE No: 38
PROJECT No: 86043.01
DATE: 8-11-2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	VWP Construction Details
63.9	0.0	FILLING - dark brown, sandy clay filling, slightly silty, with a trace of ironstone and riverstone gravel, MC<PL		A/E	0.0 - 0.1				
63.5	0.4	SANDSTONE - medium to high strength, red-brown sandstone		A/E	0.4 - 0.5				
				A/E	0.9 - 1.0				
62.9	1.0	Bore discontinued at 1.0m - target depth reached							

RIG: Scout 2 **DRILLER:** Ground Test **LOGGED:** LS **CASING:** Uncased

TYPE OF BORING: Solid flight auger (TC-bit) to 1.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 57.9 AHD
EASTING: 325554
NORTHING: 6260381
DIP/AZIMUTH: 90°/--

BORE No: 39
PROJECT No: 86043.01
DATE: 9-11-2017
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 150mm)
	0.0								
	0.1	FILLING - poorly compacted, dark brown, sand filling, slightly clayey with some sandstone gravel, moist		A/E	0.1				
		CLAYEY SAND - dense, yellow-brown medium to coarse sandy clay with some ironstone gravel, moist		B	0.4				
	0.5	SANDSTONE - extremely low to very low strength, orange-brown sandstone		A/E/B	0.5				
	0.8	Bore discontinued at 0.8m - auger refusal on low to medium strength sandstone							

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RL: 57, 56, 55, 54, 53 — Depth (m): 1, 2, 3, 4

RIG: 3.5t excavator **DRILLER:** A & A Hire **LOGGED:** LS **CASING:** Uncased

TYPE OF BORING: 300mm diameter solid flight auger to 0.8m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 53.6 AHD
EASTING: 325600
NORTHING: 6260407
DIP/AZIMUTH: 90°/--

BORE No: 40
PROJECT No: 86043.01
DATE: 9-11-2017
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 150mm)
53	0.05	BRICK PAVERS		A/E	0.05				
	0.15	FILLING - brown sand filling, moist			0.1				
		FILLING - apparently compacted, brown clay filling with some silt and ironstone gravel, MC>PL, moist		A/E	0.4				
					0.5				
	1.2	CLAY - apparently stiff, brown clay with some coarse sand and ironstone gravel, MC>PL		A/E/B	1.2				
				B	1.3				
52	1.5	SANDSTONE - extremely low to very low strength, light grey mottled orange-brown sandstone			1.5				
				A	1.6				
					1.7				
		2.0m: turning light grey mottled red							
				A	2.3				
					2.4				
51	2.6	Bore discontinued at 2.6m - auger refusal on low to medium strength sandstone							

RIG: 3.5t excavator **DRILLER:** A & A Hire **LOGGED:** LS **CASING:** Uncased

TYPE OF BORING: 300mm diameter solid flight auger to 2.6m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: MC = Moisture Content; PL = Plastic Limit

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 53.7 AHD
EASTING: 325603
NORTHING: 6260366
DIP/AZIMUTH: 90°/--

BORE No: 41
PROJECT No: 86043.01
DATE: 30-10-2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	VWP Construction Details
53	0.2	FILLING - dark brown sand filling (topsoil), slightly clayey, medium to fine grained with some ironstone gravel and trace of rootlets, damp		A/E	0.0 0.1				
		CLAY - apparently stiff, yellow-brown clay with some sand and a trace of ironstone gravel, damp, possibly disturbed		A/E	0.4 0.5				
	0.7	SANDSTONE - low to medium strength, light grey and red-brown sandstone with extremely low to very low and medium strength bands		A S	0.9 1.0 1.1		10/100mm refusal bouncing		
52	2.1	Bore discontinued at 2.1m - target depth reached		A	2.0 2.1				
51									
50									
49									

RIG: Scout 2 **DRILLER:** Ground Test **LOGGED:** LS **CASING:** Uncased

TYPE OF BORING: Solid flight auger (TC-bit) to 2.1m;

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 52.0 AHD
EASTING: 325633
NORTHING: 6260386
DIP/AZIMUTH: 90°/--

BORE No: 42
PROJECT No: 86043.01
DATE: 9-11-2017
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 150mm)
52	0	FILLING - apparently compacted, light brown, clayey sand filling, medium to fine grained with some ironstone and roadbase gravel, damp - root affected to 0.05m		A/E	0.05 0.1				
				A/E	0.4 0.5				
				B	0.6				
				A/E	0.9 1.0				
51	1								1
	1.3	CLAY - apparently stiff, light brown clay with some silt and fine grained sand, possibly extremely weathered sandstone		E	1.4				
				A	1.5 1.6				
	1.7	SANDSTONE - low strength, red-brown and light grey sandstone							
50	2			A	2.0 2.1				2
	2.2	Bore discontinued at 2.2m - auger refusal on low to medium strength sandstone							
49	3								3
48	4								4

RIG: 3.5t excavator **DRILLER:** A & A Hire **LOGGED:** LS **CASING:** Uncased

TYPE OF BORING: 300mm diameter solid flight auger to 2.1m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 52.2 AHD
EASTING: 325604
NORTHING: 6260317
DIP/AZIMUTH: 90°/--

BORE No: 43
PROJECT No: 86043.01
DATE: 14-11-2017
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 150mm)
52	0.0	FILLING - brown gravelly medium to coarse sand filling with some roadbase gravel and brick fragments, angular to subangular with some silt, trace of rootlets, damp		A/E/B	0.0				5 10 15 20
					0.1				
				B					
	0.4	SANDSTONE - extremely low to very low strength, orange-brown sandstone			0.4				
				A	0.5				
	0.7	Bore discontinued at 0.7m - auger refusal on low to medium strength sandstone			0.6				
51	1								1
50	2								2
49	3								3
48	4								4

RIG: 3.5t excavator **DRILLER:** A & A Hire **LOGGED:** LS **CASING:** Uncased

TYPE OF BORING: 300mm diameter solid flight auger to 0.7m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 47.0 AHD
EASTING: 325702
NORTHING: 6260345
DIP/AZIMUTH: 90°/--

BORE No: 44
PROJECT No: 86043.01
DATE: 10-11-2017
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 150mm)
47	0.0	FILLING - apparently compacted, brown clayey sand filling with a trace of sandstone gravel, damp		A/E	0.0 - 0.1				
				A/E	0.4 - 0.5				
	0.5	SANDSTONE - extremely low to very low strength, orange-brown mottled grey sandstone							
		0.8m: becoming low to medium strength		A/E	0.9				
46	1			S	1.0 - 1.05		7/50mm refusal bouncing		1
	1.15			A	1.1 - 1.15				
		Bore discontinued at 1.15m - auger refusal on medium strength sandstone							
45	2								2
44	3								3
43	4								4

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Bobcat **DRILLER:** A & A Hire **LOGGED:** LS **CASING:** Uncased

TYPE OF BORING: 125mm diameter solid flight auger to 1.15m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 49.6 AHD
EASTING: 325634
NORTHING: 6260281
DIP/AZIMUTH: 90°/--

BORE No: 45
PROJECT No: 86043.01
DATE: 14-11-2017
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 150mm)
49	0.0	FILLING - apparently compacted, brown sand filling, medium to fine grained with some clay and traces of roadbase gravel, damp		A/E	0.05 0.1				
		0.2m: plastic sheet		B					
		0.2m: concrete boulder							
	0.5	SANDSTONE - very low to low strength, light grey sandstone		A	0.5 0.6				
	0.65	Bore discontinued at 0.65m - auger refusal on low to medium strength sandstone							

RIG: 3.5t excavator **DRILLER:** A & A Hire **LOGGED:** LS **CASING:** Uncased

TYPE OF BORING: 300mm diameter solid flight auger to 0.65m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 47.3 AHD
EASTING: 325695
NORTHING: 6260305
DIP/AZIMUTH: 90°/--

BORE No: 46
PROJECT No: 86043.01
DATE: 14-11-2017
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 150mm)
47	0.05	FILLING - brown sand filling, fine grained sand with some clay and silt, with a trace of roadbase gravel 0.1m: pen 0.2m: brick 0.3m: sea shell		A/E	0.1				
	0.5	FILLING - light brown, fine to medium sandy clay filling with some silt, with a trace of roadbase gravel, MC<PL		A/E/B	0.5 0.6				
	0.8	Bore discontinued at 0.8m - auger refusal on low to medium strength sandstone (possible boulder)		B	0.8				
46	1								1
	2								2
45									
	3								3
44									
	4								4
43									

5 10 15 20

RIG: 3.5t excavator **DRILLER:** A & A Hire **LOGGED:** LS **CASING:** Uncased

TYPE OF BORING: 300mm diameter solid flight auger to 0.8m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: DCP 46A offset 1m from Bore 46

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: Ivanhoe Estate, Macquarie Park

SURFACE LEVEL: 44.1 AHD
EASTING: 325755
NORTHING: 6260398
DIP/AZIMUTH: 90°/--

BORE No: 47
PROJECT No: 86043.01
DATE: 14-11-2017
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 150mm)
44	0.0	FILLING - dark brown clay filling with some medium to fine sand and a trace of ironstone and roadbase gravel, MC<PL		A/E	0.05 0.1				
				A/E	0.4 0.5				
	0.6	CLAY - light brown clay filling with some fine sand, silt and a trace of ironstone gravel, MC<PL (possible filling to 1.3m)		B	1.0				
43	1			A/E	1.4 1.5				
				B	1.8				
	1.9	CLAY - red-brown mottled light brown clay, with some coarse to fine sand and slt, MC<PL, possibly extremely weathered sandstone		A	2.0 2.1				
42	2			A	2.4 2.5				
	3.1	Bore discontinued at 3.1m - maximum depth of auger		A	3.0 3.1				
41	3								
40	4								

RIG: 3.5t excavator **DRILLER:** A & A Hire **LOGGED:** LS **CASING:** Uncased

TYPE OF BORING: 300mm diameter solid flight auger to 3.1m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: MC = Moisture Content; PL = Plastic Limit

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

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Results of Dynamic Penetrometer Tests

Client Frasers Property Ivanhoe Pty Ltd **Project No.** 86043.01

Project Proposed Residential Development **Date** 14.11.17

Location Ivanhoe Estate, Macquarie Park **Page No.** 1 of 4

Test Location	01	02	03	04	04b	5	07	07a	08
RL of Test (AHD)	67.4	63.1	62.3	64.6	64.6	59.2	59.1	59.1	50.1
Depth (m)	**Penetration Resistance** Blows/150 mm								
0 - 0.15	18	6	5	2	4	3	4	4	4
0.15 - 0.30	20	22	16	16/100	10/23	6	7	5	7
0.30 - 0.45	19	28	21	B	B	12	30/140	28	18
0.45 - 0.60	13	27	10			28	B	30/125	13
0.60 - 0.75	12	23	10			20/100		B	8
0.75 - 0.90	16/100	20/100	8			B			7
0.90 - 1.05	B	B	6						8
1.05 - 1.20			10						8
1.20 - 1.35									
1.35 - 1.50									
1.50 - 1.65									
1.65 - 1.80									
1.80 - 1.95									
1.95 - 2.10									
2.10 - 2.25									
2.25 - 2.40									
2.40 - 2.55									
2.55 - 2.70									
2.70 - 2.85									
2.85 - 3.00									
3.00 - 3.15									
3.15 - 3.30									
3.30 - 3.45									
3.45 - 3.60									

Test Method AS 1289.6.3.2, Cone Penetrometer ☑ Tested By LS

AS 1289.6.3.3, Sand Penetrometer ☐ Checked By SCP

Remarks 20/100 = 20 BLOW COUNTS FOR 100mm PENETRATION

B = BOUNCING/REFUSAL

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
96 Hermitage Road
West Ryde NSW 2114
PO Box 472
West Ryde NSW 1685
Phone (02) 9809 0666
Fax (02) 9809 4095

Results of Dynamic Penetrometer Tests

Client Frasers Property Ivanhoe Pty Ltd **Project No.** 86043.01

Project Proposed Residential Development **Date** 14.11.17

Location Ivanhoe Estate, Macquarie Park **Page No.** 2 of 4

Test Location	09	10	11	12	LP1	31	32	33
RL of Test (AHD)	45.8	45.2	43.2	45.2	45.1	66.9	63.1	62.7
Depth (m)	**Penetration Resistance** Blows/150 mm							
0 - 0.15	4	3	5	4	5	12	16	6
0.15 - 0.30	13	3	10	6	11	28/100	28	16
0.30 - 0.45	13	16	19	6	14	B	16/50	20/50
0.45 - 0.60	16	12	20/50	5	11		B	B
0.60 - 0.75	4	7	B	17	11			
0.75 - 0.90	7	5		27	20/50			
0.90 - 1.05	8	4		17	B			
1.05 - 1.20	8	3		8				
1.20 - 1.35								
1.35 - 1.50								
1.50 - 1.65								
1.65 - 1.80								
1.80 - 1.95								
1.95 - 2.10								
2.10 - 2.25								
2.25 - 2.40								
2.40 - 2.55								
2.55 - 2.70								
2.70 - 2.85								
2.85 - 3.00								
3.00 - 3.15								
3.15 - 3.30								
3.30 - 3.45								
3.45 - 3.60								

Test Method AS 1289.6.3.2, Cone Penetrometer ☑ Tested By LS

AS 1289.6.3.3, Sand Penetrometer ☐ Checked By SCP

Remarks 20/100 = 20 BLOW COUNTS FOR 100mm PENETRATION

B = BOUNCING/REFUSAL

Douglas Partners
Geotechnics / Environment / Groundwater

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Results of Dynamic Penetrometer Tests

Client Frasers Property Ivanhoe Pty Ltd **Project No.** 86043.01

Project Proposed Residential Development **Date** 14.11.17

Location Ivanhoe Estate, Macquarie Park **Page No.** 3 of 4

Test Location	34	35	37	38	39	40	41	42
RL of Test (AHD)	65.3	65.1	52.2	63.9	57.9	53.8	53.7	52.0
Depth (m)	**Penetration Resistance** Blows/150 mm							
0 - 0.15	3	7	13	12	3	12	6	7
0.15 - 0.30	7	14	15	14	12	8	10	23
0.30 - 0.45	25/125	14/100	13	14	7	20/20	6	30
0.45 - 0.60	B	B	15	20/90	12/100	B	6	8/0
0.60 - 0.75			23	B	B		6	B
0.75 - 0.90			10/0				16	
0.90 - 1.05			B				20/100	
1.05 - 1.20							B	
1.20 - 1.35								
1.35 - 1.50								
1.50 - 1.65								
1.65 - 1.80								
1.80 - 1.95								
1.95 - 2.10								
2.10 - 2.25								
2.25 - 2.40								
2.40 - 2.55								
2.55 - 2.70								
2.70 - 2.85								
2.85 - 3.00								
3.00 - 3.15								
3.15 - 3.30								
3.30 - 3.45								
3.45 - 3.60								

Test Method AS 1289.6.3.2, Cone Penetrometer ☑ Tested By LS

AS 1289.6.3.3, Sand Penetrometer ☐ Checked By SCP

Remarks 20/100 = 20 BLOW COUNTS FOR 100mm PENETRATION

B = BOUNCING/REFUSAL

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Results of Dynamic Penetrometer Tests

Client Frasers Property Ivanhoe Pty Ltd
Project Proposed Residential Development
Location Ivanhoe Estate, Macquarie Park

Project No. 86043.01
Date 14.11.17
Page No. 4 of 4

Test Location	43	44	45	46A	46B	47
RL of Test (AHD)	52.2	47.0	49.6	47.3	47.3	44.1
Depth (m)	Penetration Resistance Blows/150 mm					
0 - 0.15	4	4	9	3	2	6
0.15 - 0.30	9	20/100	10	10	8	9
0.30 - 0.45	10	B	28	12	22	5
0.45 - 0.60	12/50		20/60	8	30	5
0.60 - 0.75	B		B	6	23	6
0.75 - 0.90				14	23/50	22/130
0.90 - 1.05				10	B	B
1.05 - 1.20				20		
1.20 - 1.35						
1.35 - 1.50						
1.50 - 1.65						
1.65 - 1.80						
1.80 - 1.95						
1.95 - 2.10						
2.10 - 2.25						
2.25 - 2.40						
2.40 - 2.55						
2.55 - 2.70						
2.70 - 2.85						
2.85 - 3.00						
3.00 - 3.15						
3.15 - 3.30						
3.30 - 3.45						
3.45 - 3.60						

Test Method AS 1289.6.3.2, Cone Penetrometer ☑
AS 1289.6.3.3, Sand Penetrometer ☐

Tested By LS
Checked By SCP

Remarks 20/100 = 20 BLOW COUNTS FOR 100mm PENETRATION
B = BOUNCING/REFUSAL

Appendix D

Results of Groundwater Monitoring

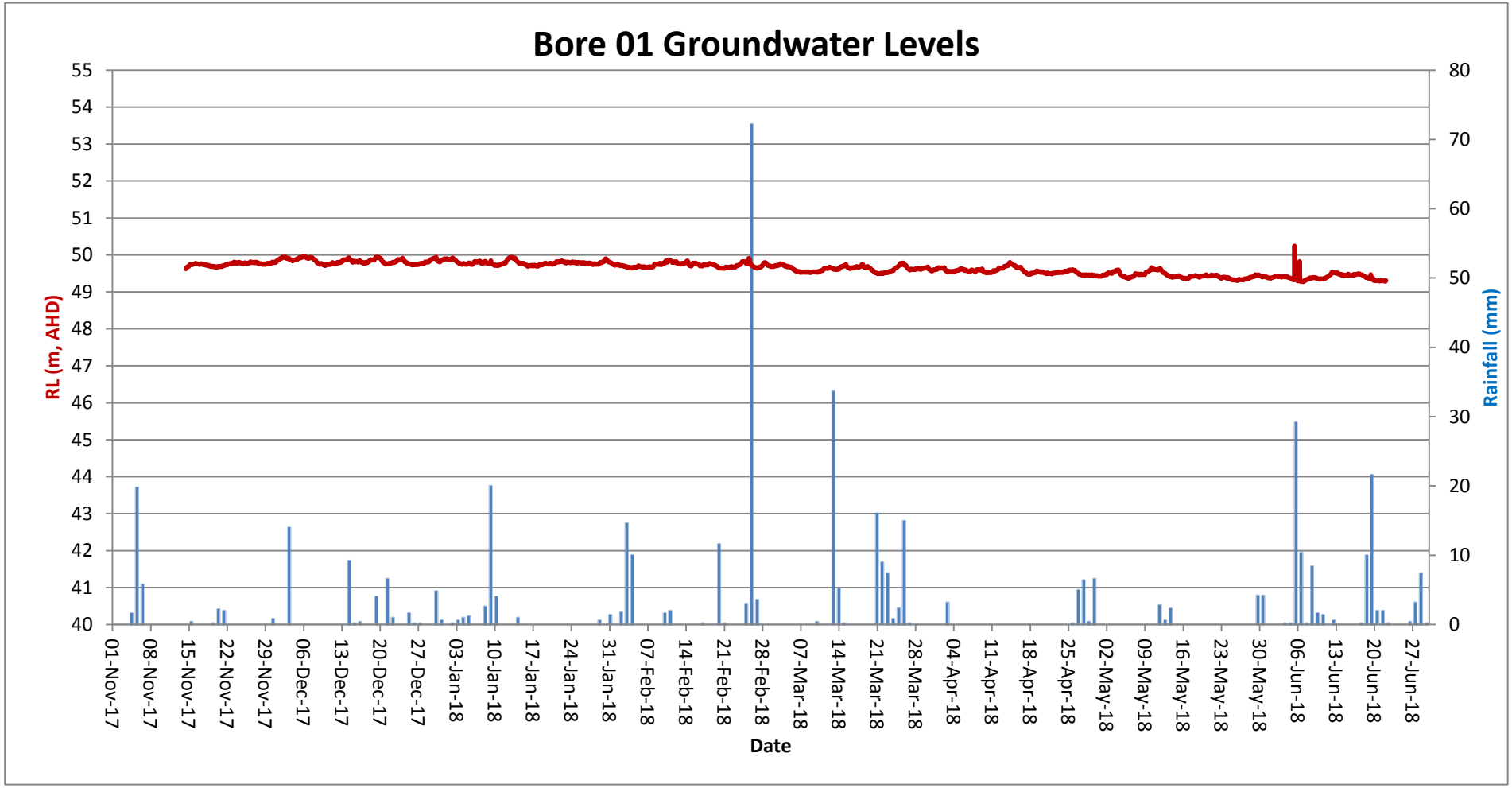

Figure 1: Groundwater Monitoring Results at Bore 01

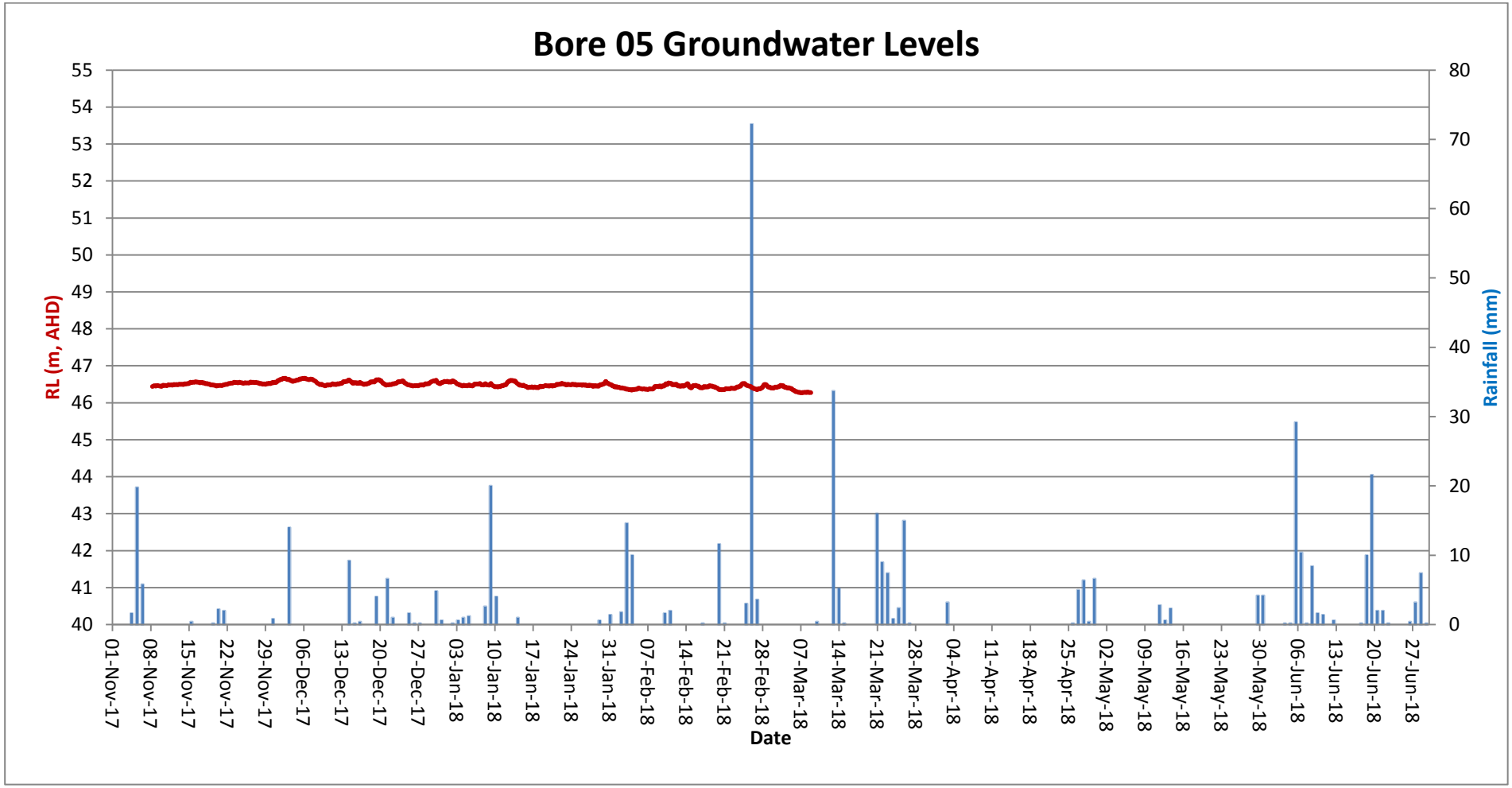

Figure 2: Groundwater Monitoring Results at Bore 05

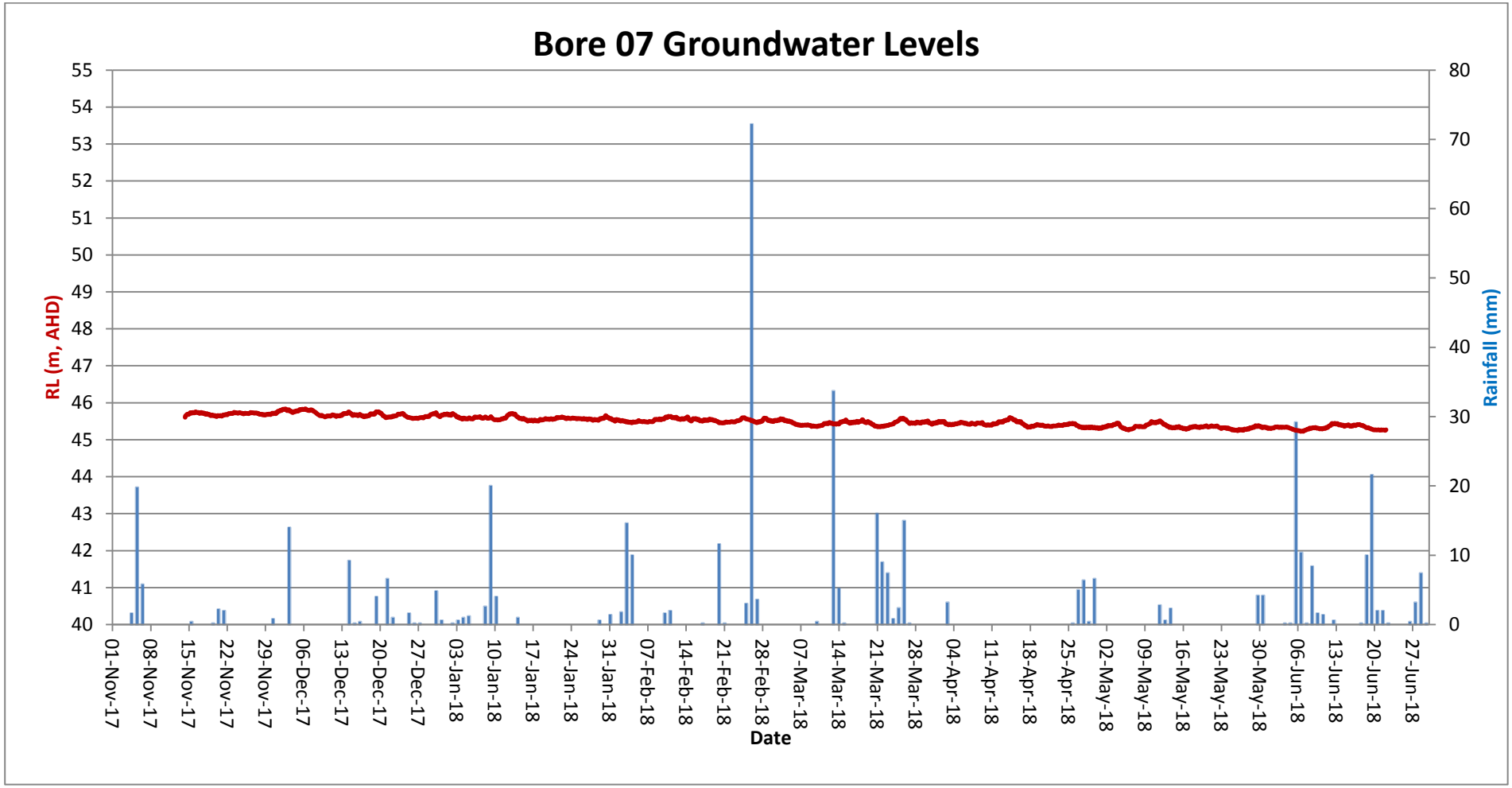

Figure 3: Groundwater Monitoring Results at Bore 07

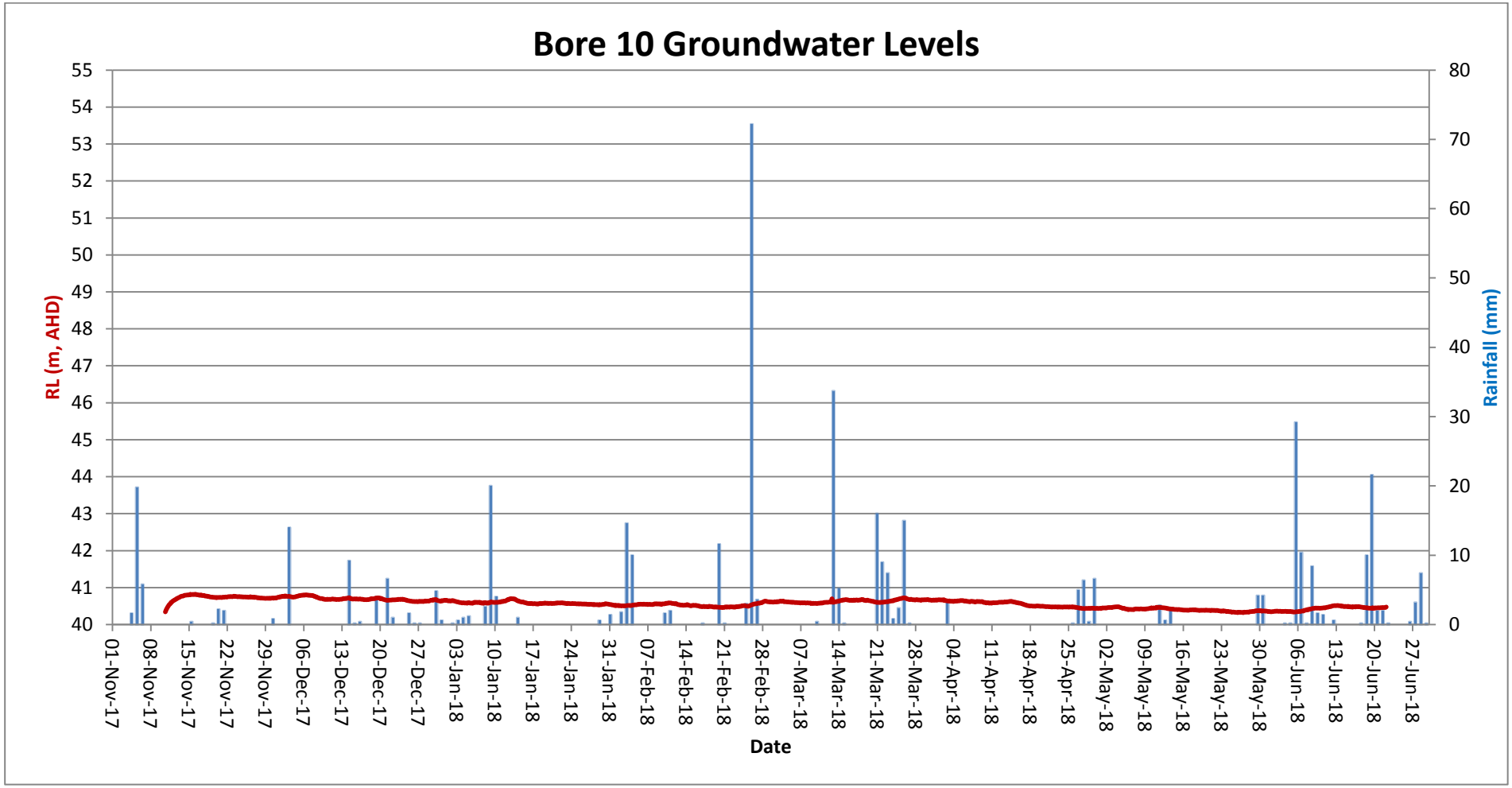

Figure 4: Groundwater Monitoring Results at Bore 10

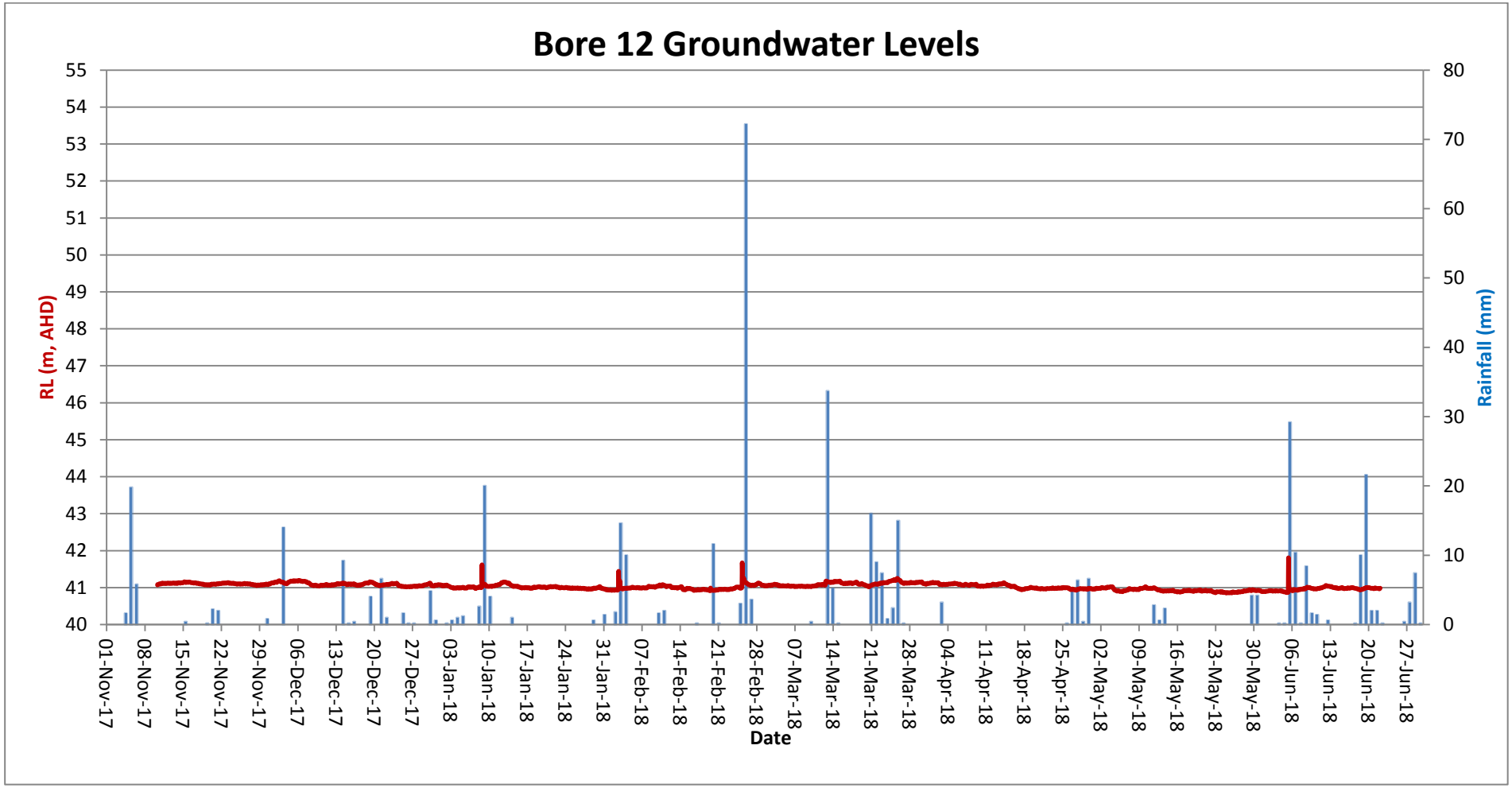

Figure 5: Groundwater Monitoring Results at Bore 12

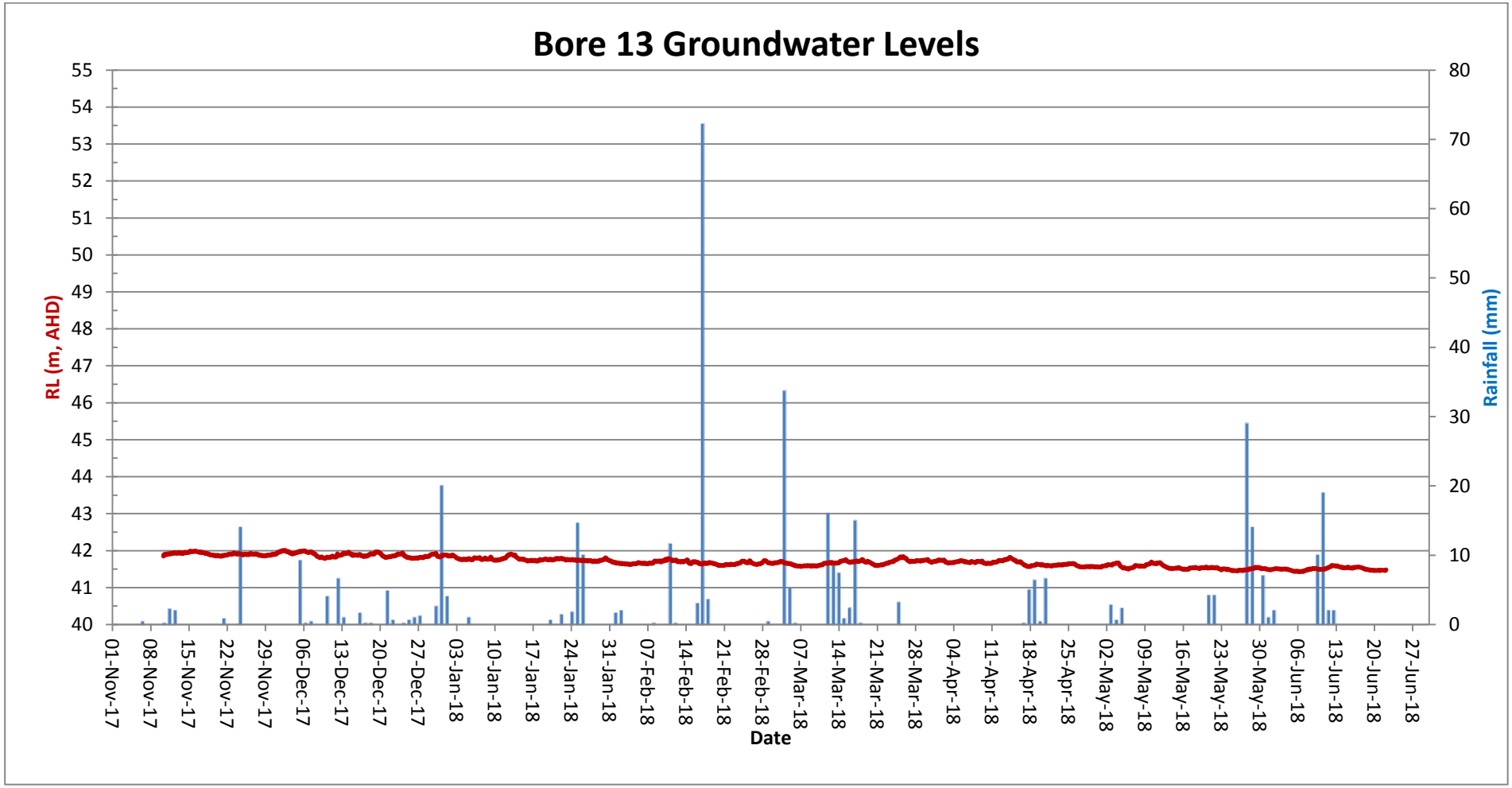

Figure 6: Groundwater Monitoring Results at Bore 13

Appendix E

Results of Laboratory Testing

Envirolab Services Pty Ltd
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12 Ashley St Chatswood NSW 2067
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customerservice@envirolab.com.au
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CERTIFICATE OF ANALYSIS 180301

Client Details

Client	Douglas Partners Pty Ltd
Attention	Sally Peacock, David Walker
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**86043.01, Ivanhoe**
Number of Samples	23 Soil
Date samples received	21/11/2017
Date completed instructions received	21/11/2017

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.

Report Details

Date results requested by	28/11/2017
Date of Issue	24/11/2017

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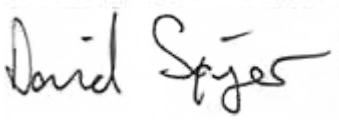
Results Approved By
Nancy Zhang, Assistant Lab Manager
Priya Samarawickrama, Senior Chemist

Authorised By



David Springer, General Manager

Misc Inorg - Soil						
Our Reference		180301-1	180301-2	180301-3	180301-4	180301-5
Your Reference	UNITS	01	02	03	03	06
Depth		0.9-1.0	0.9-1.0	2.5-2.85	0.9-1.0	0.9-1.0
Date Sampled		31/10/2017	01/11/2017	08/11/2017	08/11/2017	10/11/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/11/2017	22/11/2017	22/11/2017	22/11/2017	22/11/2017
Date analysed	-	22/11/2017	22/11/2017	22/11/2017	22/11/2017	22/11/2017
pH 1:5 soil:water	pH Units	5.1	4.9	5.7	8.2	7.9
Electrical Conductivity 1:5 soil:water	µS/cm	56	45	33	83	75
Chloride, Cl 1:5 soil:water	mg/kg	20	10	10	<10	<10
Sulphate, SO4 1:5 soil:water	mg/kg	63	54	37	10	20
Resistivity in soil*	ohm m	180	220	300	120	130

Misc Inorg - Soil						
Our Reference		180301-6	180301-7	180301-8	180301-9	180301-10
Your Reference	UNITS	08	08	10	11	13
Depth		0.9-1.0	2.4-2.5	1.0-1.45	1.5	0.4-0.5
Date Sampled		07/11/2017	07/11/2017	02/11/2017	02/11/2017	03/11/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/11/2017	22/11/2017	22/11/2017	22/11/2017	22/11/2017
Date analysed	-	22/11/2017	22/11/2017	22/11/2017	22/11/2017	22/11/2017
pH 1:5 soil:water	pH Units	6.4	5.1	5.3	5.0	5.7
Electrical Conductivity 1:5 soil:water	µS/cm	75	61	44	30	53
Chloride, Cl 1:5 soil:water	mg/kg	<10	20	<10	10	20
Sulphate, SO4 1:5 soil:water	mg/kg	120	81	57	28	69
Resistivity in soil*	ohm m	130	160	230	330	190

Misc Inorg - Soil						
Our Reference		180301-11	180301-12	180301-13	180301-14	180301-15
Your Reference	UNITS	05	LP1	43	39	38
Depth		0.9-1.0	2.5-2.55	0.5-0.6	0.4-0.5	0.9-1.0
Date Sampled		01/11/2017	09/11/2017	09/11/2017	09/11/2017	09/11/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/11/2017	22/11/2017	22/11/2017	22/11/2017	22/11/2017
Date analysed	-	22/11/2017	22/11/2017	22/11/2017	22/11/2017	22/11/2017
pH 1:5 soil:water	pH Units	4.9	5.3	8.1	6.7	4.6
Electrical Conductivity 1:5 soil:water	µS/cm	41	26	56	16	46
Chloride, Cl 1:5 soil:water	mg/kg	<10	<10	<10	<10	10
Sulphate, SO4 1:5 soil:water	mg/kg	58	34	<10	20	58
Resistivity in soil*	ohm m	240	380	180	630	220

Misc Inorg - Soil					
Our Reference		180301-16	180301-17	180301-19	180301-20
Your Reference	UNITS	41	42	34	31
Depth		0.4-0.5	2.0-2.1	0.9-1.0	2.1-2.2
Date Sampled		09/11/2017	09/11/2017	09/11/2017	09/11/2017
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	22/11/2017	22/11/2017	22/11/2017	22/11/2017
Date analysed	-	22/11/2017	22/11/2017	22/11/2017	22/11/2017
pH 1:5 soil:water	pH Units	7.7	5.3	4.6	4.6
Electrical Conductivity 1:5 soil:water	µS/cm	55	34	66	77
Chloride, Cl 1:5 soil:water	mg/kg	10	<10	26	50
Sulphate, SO4 1:5 soil:water	mg/kg	<10	47	70	53
Resistivity in soil*	ohm m	180	290	150	130

Moisture						
Our Reference		180301-2	180301-3	180301-5	180301-6	180301-10
Your Reference	UNITS	02	03	06	08	13
Depth		0.9-1.0	2.5-2.85	0.9-1.0	0.9-1.0	0.4-0.5
Date Sampled		01/11/2017	08/11/2017	10/11/2017	07/11/2017	03/11/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/11/2017	22/11/2017	22/11/2017	22/11/2017	22/11/2017
Date analysed	-	23/11/2017	23/11/2017	23/11/2017	23/11/2017	23/11/2017
Moisture	%	10	6.7	11	8.6	8.7

Moisture						
Our Reference		180301-16	180301-18	180301-21	180301-22	180301-23
Your Reference	UNITS	41	34	10	44	08
Depth		0.4-0.5	0.1-0.2	0.4-0.5	0.4-0.5	0.5
Date Sampled		09/11/2017	09/11/2017	09/11/2017	09/11/2017	09/11/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/11/2017	22/11/2017	22/11/2017	22/11/2017	22/11/2017
Date analysed	-	23/11/2017	23/11/2017	23/11/2017	23/11/2017	23/11/2017
Moisture	%	14	7.7	9.5	7.0	9.9

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA 22nd ED 2510 and Rayment & Lyons. Resistivity is calculated from Conductivity.
Inorg-008	Moisture content determined by heating at 105+/-5 °C for a minimum of 12 hours.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Alternatively determined by colourimetry/turbidity using Discrete Analyer.

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	180301-2
Date prepared	-			22/11/2017	1	22/11/2017	22/11/2017		22/11/2017	22/11/2017
Date analysed	-			22/11/2017	1	22/11/2017	22/11/2017		22/11/2017	22/11/2017
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	5.1	5.0	2	99	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	1	56	56	0	95	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	20	20	0	99	110
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	63	63	0	95	125
Resistivity in soil*	ohm m	1	Inorg-002	<1	1	180	180	0	[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	22/11/2017	22/11/2017		[NT]	[NT]
Date analysed	-			[NT]	11	22/11/2017	22/11/2017		[NT]	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	11	4.9	5.0	2	[NT]	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	11	41	46	11	[NT]	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	11	<10	10	0	[NT]	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	11	58	66	13	[NT]	[NT]
Resistivity in soil*	ohm m	1	Inorg-002	[NT]	11	240	220	9	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Envirolab Services Pty Ltd
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ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 180301-A

Client Details

Client	Douglas Partners Pty Ltd
Attention	Sally Peacock, David Walker
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**86043.01, Ivanhoe**
Number of Samples	Additonal testing 1 sample
Date samples received	21/11/2017
Date completed instructions received	06/12/2017

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.

Report Details

Date results requested by	08/12/2017
Date of Issue	08/12/2017

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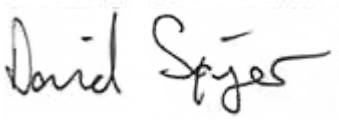
Results Approved By
Nick Sarlamis, Inorganics Supervisor

Authorised By



David Springer, General Manager

Misc Inorg - Soil		
Our Reference		180301-A-21
Your Reference	UNITS	10
Depth		0.4-0.5
Date Sampled		09/11/2017
Type of sample		Soil
Date prepared	-	07/12/2017
Date analysed	-	07/12/2017
pH 1:5 soil:water	pH Units	8.1
Electrical Conductivity 1:5 soil:water	µS/cm	85
Chloride, Cl 1:5 soil:water	mg/kg	10
Sulphate, SO4 1:5 soil:water	mg/kg	48
Resistivity in soil*	ohm m	120

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA 22nd ED 2510 and Rayment & Lyons. Resistivity is calculated from Conductivity.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Alternatively determined by colourimetry/turbidity using Discrete Analyer.

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			07/12/2017	[NT]	[NT]	[NT]	[NT]	07/12/2017	[NT]
Date analysed	-			07/12/2017	[NT]	[NT]	[NT]	[NT]	07/12/2017	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	102	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	98	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	112	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	115	[NT]
Resistivity in soil*	ohm m	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
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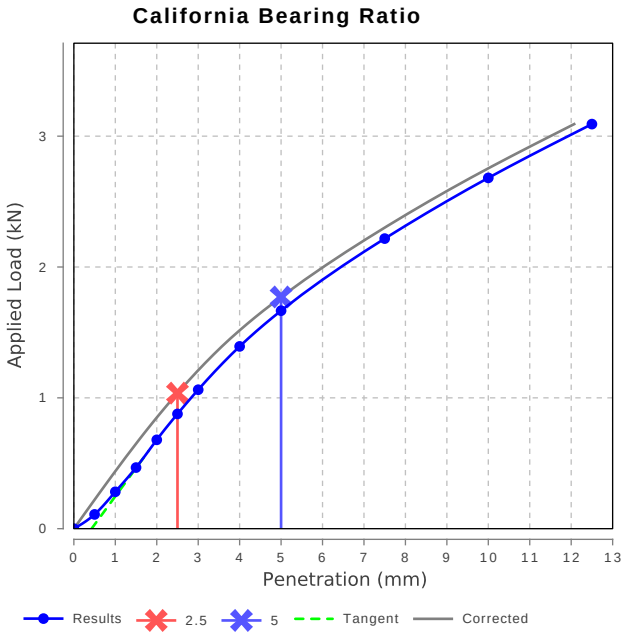
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Michael Gref
NATA Accredited Laboratory Number: 828

Report Number: **86043.01-1**
Issue Number: 1
Date Issued: 28/11/2017
Client: Frasers Property Ivanhoe Pty Ltd
c/- Citta Property Group Pty Limited, Sydney 2000
Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1896
Sample Number: 17-1896A
Date Sampled: 09/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **BH31 (0.5-0.7m)**
Material: Light brown silty clay filling

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**9**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.87		
Optimum Moisture Content (%)	13.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	101.0		
Dry Density after Soaking (t/m^3)	1.86		
Field Moisture Content (%)	8.8		
Moisture Content at Placement (%)	13.0		
Moisture Content Top 30mm (%)	15.5		
Moisture Content Rest of Sample (%)	15.1		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	2.6		



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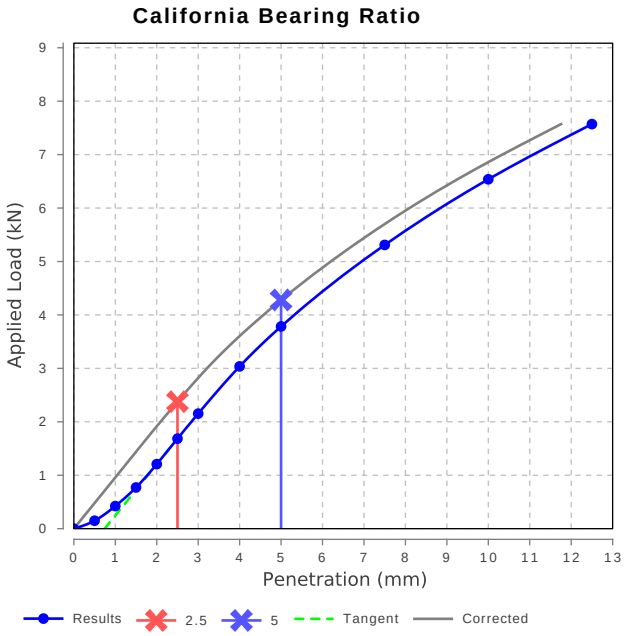
Client: Frasers Property Ivanhoe Pty Ltd
c/- Citta Property Group Pty Limited, Sydney 2000
Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1896
Sample Number: 17-1896B
Date Sampled: 09/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **BH33 (0.4-0.7m)**
Material: Light brown sand filling, slightly clayey

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**20**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.99		
Optimum Moisture Content (%)	10.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.98		
Field Moisture Content (%)	7.7		
Moisture Content at Placement (%)	10.4		
Moisture Content Top 30mm (%)	12.5		
Moisture Content Rest of Sample (%)	12.2		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	6.4		



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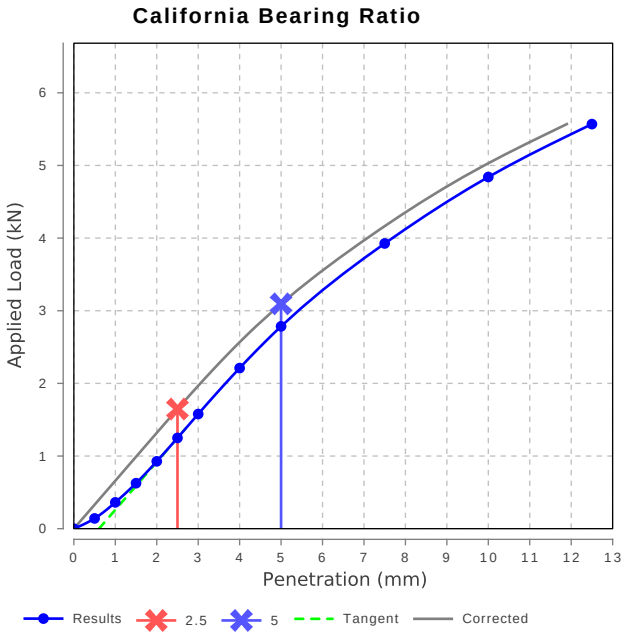
Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1896
Sample Number: 17-1896C
Date Sampled: 09/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **BH37 (0.5-0.8m)**
Material: Light brown sandy clay filling

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**16**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.90		
Optimum Moisture Content (%)	12.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.90		
Field Moisture Content (%)	8.1		
Moisture Content at Placement (%)	11.8		
Moisture Content Top 30mm (%)	13.5		
Moisture Content Rest of Sample (%)	13.5		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	1.6		



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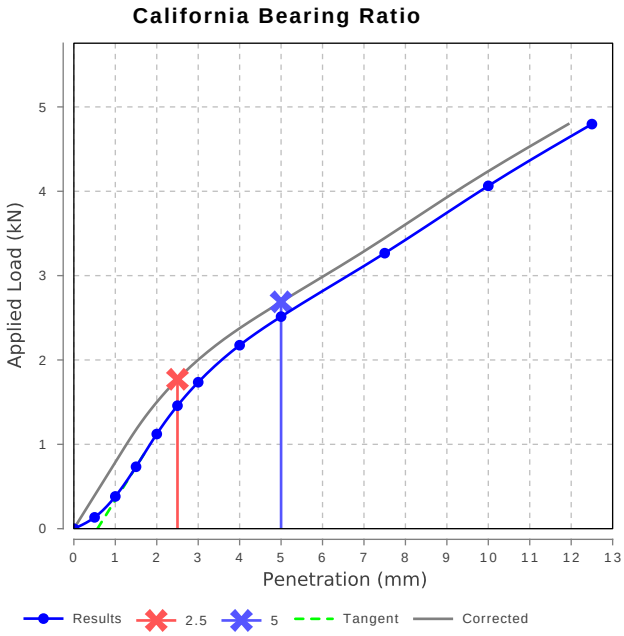
Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1896
Sample Number: 17-1896D
Date Sampled: 09/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **BH40 (1.3-1.5m)**
Material: Brown clay

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**14**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.80		
Optimum Moisture Content (%)	16.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.80		
Field Moisture Content (%)	15.7		
Moisture Content at Placement (%)	16.1		
Moisture Content Top 30mm (%)	17.3		
Moisture Content Rest of Sample (%)	16.9		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	2.3		



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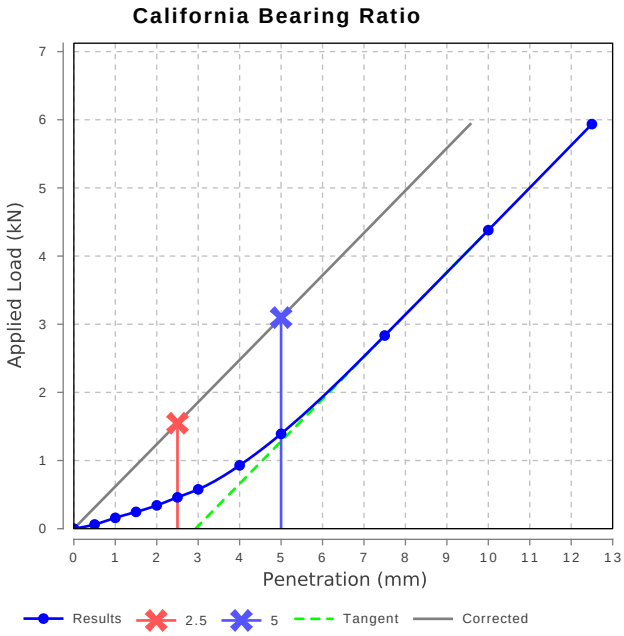
Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1896
Sample Number: 17-1896E
Date Sampled: 09/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **BH42 (0.6-0.9m)**
Material: Light brown clayey sand filling

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**16**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.96		
Optimum Moisture Content (%)	11.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.97		
Field Moisture Content (%)	5.5		
Moisture Content at Placement (%)	11.6		
Moisture Content Top 30mm (%)	11.8		
Moisture Content Rest of Sample (%)	11.7		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	-0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.6		



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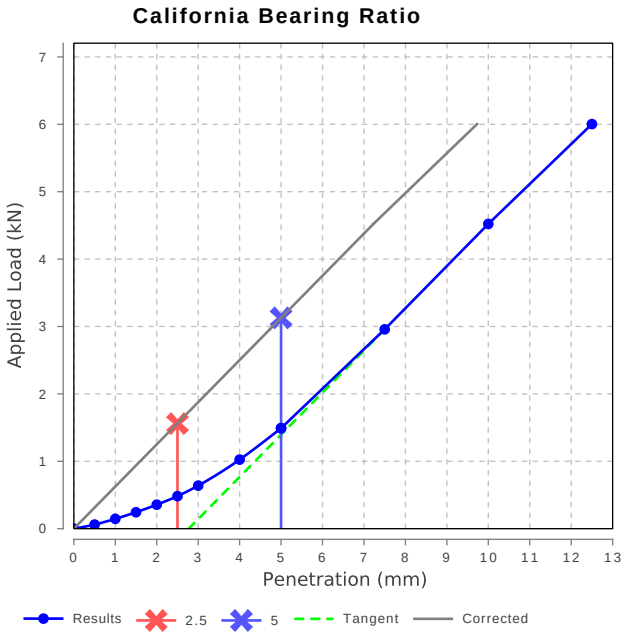
Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1896
Sample Number: 17-1896F
Date Sampled: 09/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **BH05 (0.6-0.9m)**
Material: Light brown sandy clay filling

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**16**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.95		
Optimum Moisture Content (%)	12.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.96		
Field Moisture Content (%)	6.4		
Moisture Content at Placement (%)	12.2		
Moisture Content Top 30mm (%)	13.1		
Moisture Content Rest of Sample (%)	12.3		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	1.5		



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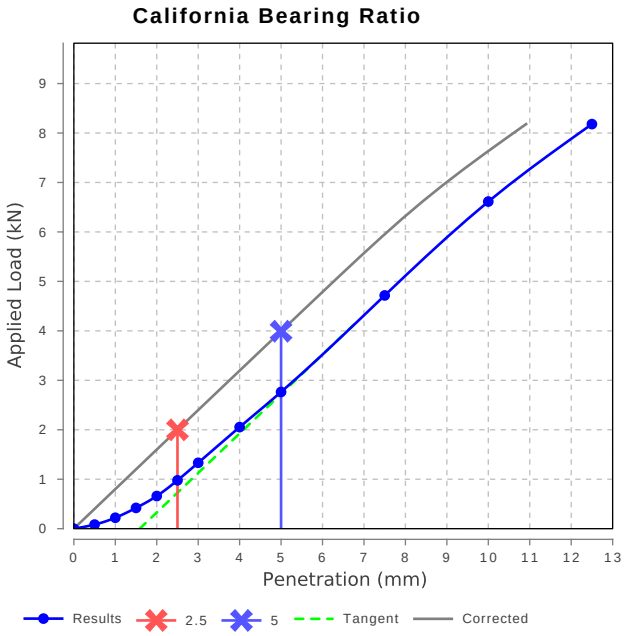
Date Issued: 28/11/2017
Client: Frasers Property Ivanhoe Pty Ltd
c/- Citta Property Group Pty Limited, Sydney 2000
Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1896
Sample Number: 17-1896G
Date Sampled: 09/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **BH39 (0.1-0.5m)**
Material: Yellow brown, clayey sand

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**20**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.96		
Optimum Moisture Content (%)	10.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.95		
Field Moisture Content (%)	10.3		
Moisture Content at Placement (%)	10.4		
Moisture Content Top 30mm (%)	12.4		
Moisture Content Rest of Sample (%)	11.5		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	1.3		



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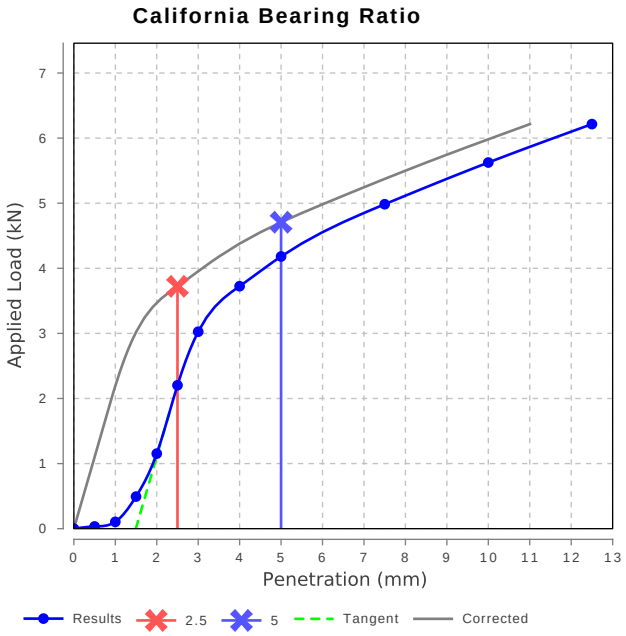
Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1896
Sample Number: 17-1896H
Date Sampled: 09/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **BH35 (0.2-0.7m)**
Material: Light brown clay filling, slightly sandy

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**30**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.97		
Optimum Moisture Content (%)	11.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.96		
Field Moisture Content (%)	7.1		
Moisture Content at Placement (%)	11.4		
Moisture Content Top 30mm (%)	14.1		
Moisture Content Rest of Sample (%)	11.9		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	3.0		



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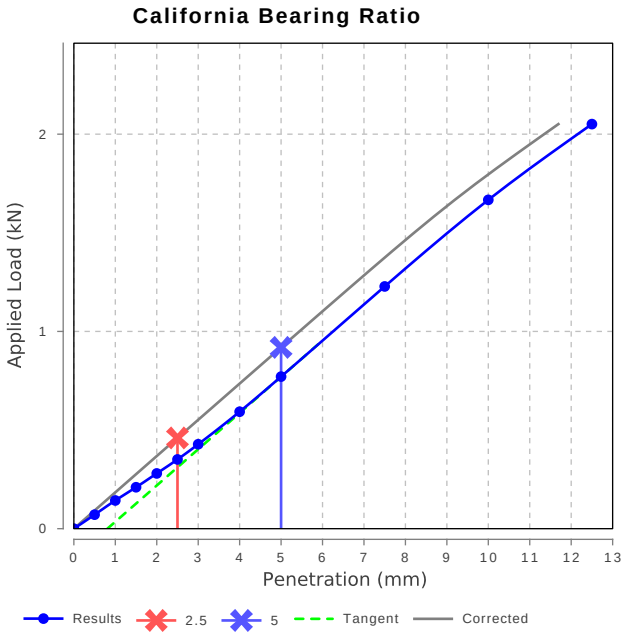
Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1896
Sample Number: 17-1896I
Date Sampled: 14/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **BH47 (0.5-1.0m)**
Material: Light brown clay filling, with some sand and silt

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**4.5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.91		
Optimum Moisture Content (%)	13.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.91		
Field Moisture Content (%)	9.8		
Moisture Content at Placement (%)	13.5		
Moisture Content Top 30mm (%)	15.1		
Moisture Content Rest of Sample (%)	13.6		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	-0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	1.3		



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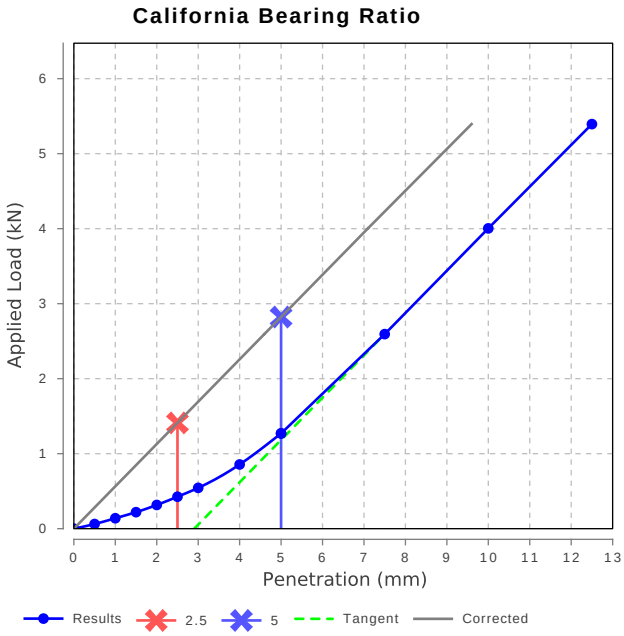
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1896
Sample Number: 17-1896J
Date Sampled: 14/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **BH46 (0.6-0.8m)**
Material: Light brown sandy clay

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**14**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.96		
Optimum Moisture Content (%)	12.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.97		
Field Moisture Content (%)	9.7		
Moisture Content at Placement (%)	12.1		
Moisture Content Top 30mm (%)	13.0		
Moisture Content Rest of Sample (%)	12.0		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	-0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	4.0		



Material Test Report

Douglas Partners
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96 Hermitage Road West Ryde NSW 2114
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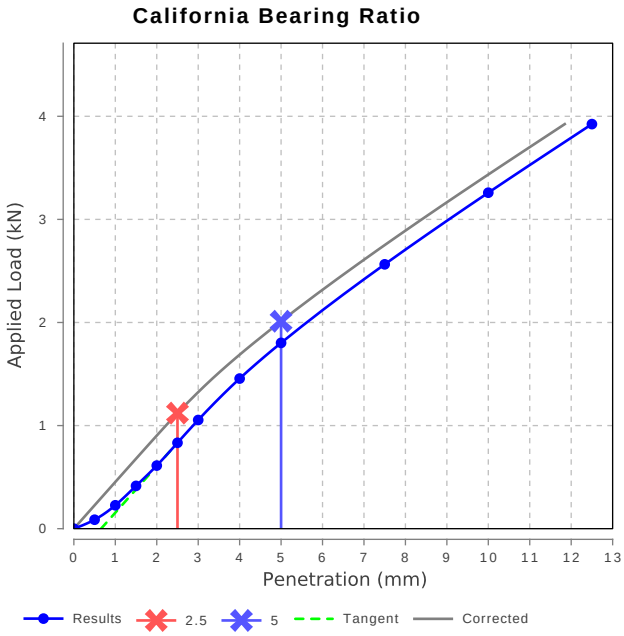
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Michael Gref
NATA Accredited Laboratory Number: 828

Report Number: **86043.01-1**
Issue Number: 1
Date Issued: 28/11/2017
Client: Frasers Property Ivanhoe Pty Ltd
c/- Citta Property Group Pty Limited, Sydney 2000
Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1896
Sample Number: 17-1896K
Date Sampled: 14/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **BH32 (0.5-0.7m)**
Material: Sandstone

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**10**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.95		
Optimum Moisture Content (%)	10.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.96		
Field Moisture Content (%)	6.0		
Moisture Content at Placement (%)	10.3		
Moisture Content Top 30mm (%)	12.9		
Moisture Content Rest of Sample (%)	12.6		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	4.7		



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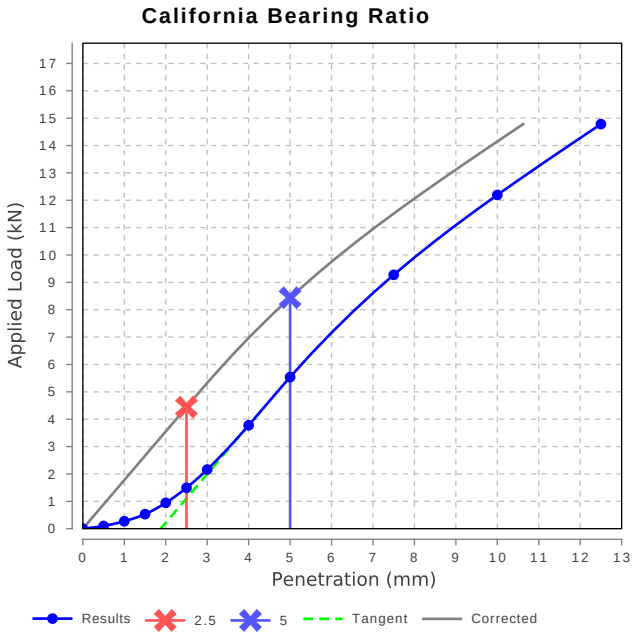
Report Number: **86043.01-1**
Issue Number: 1
Date Issued: 28/11/2017
Client: Frasers Property Ivanhoe Pty Ltd
c/- Citta Property Group Pty Limited, Sydney 2000
Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1896
Sample Number: 17-1896L
Date Sampled: 14/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **BH43 (0.1-0.4m)**
Material: Brown gravelly sand filling

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**45**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.95		
Optimum Moisture Content (%)	11.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.95		
Field Moisture Content (%)	7.3		
Moisture Content at Placement (%)	11.2		
Moisture Content Top 30mm (%)	12.0		
Moisture Content Rest of Sample (%)	12.5		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	6.8		



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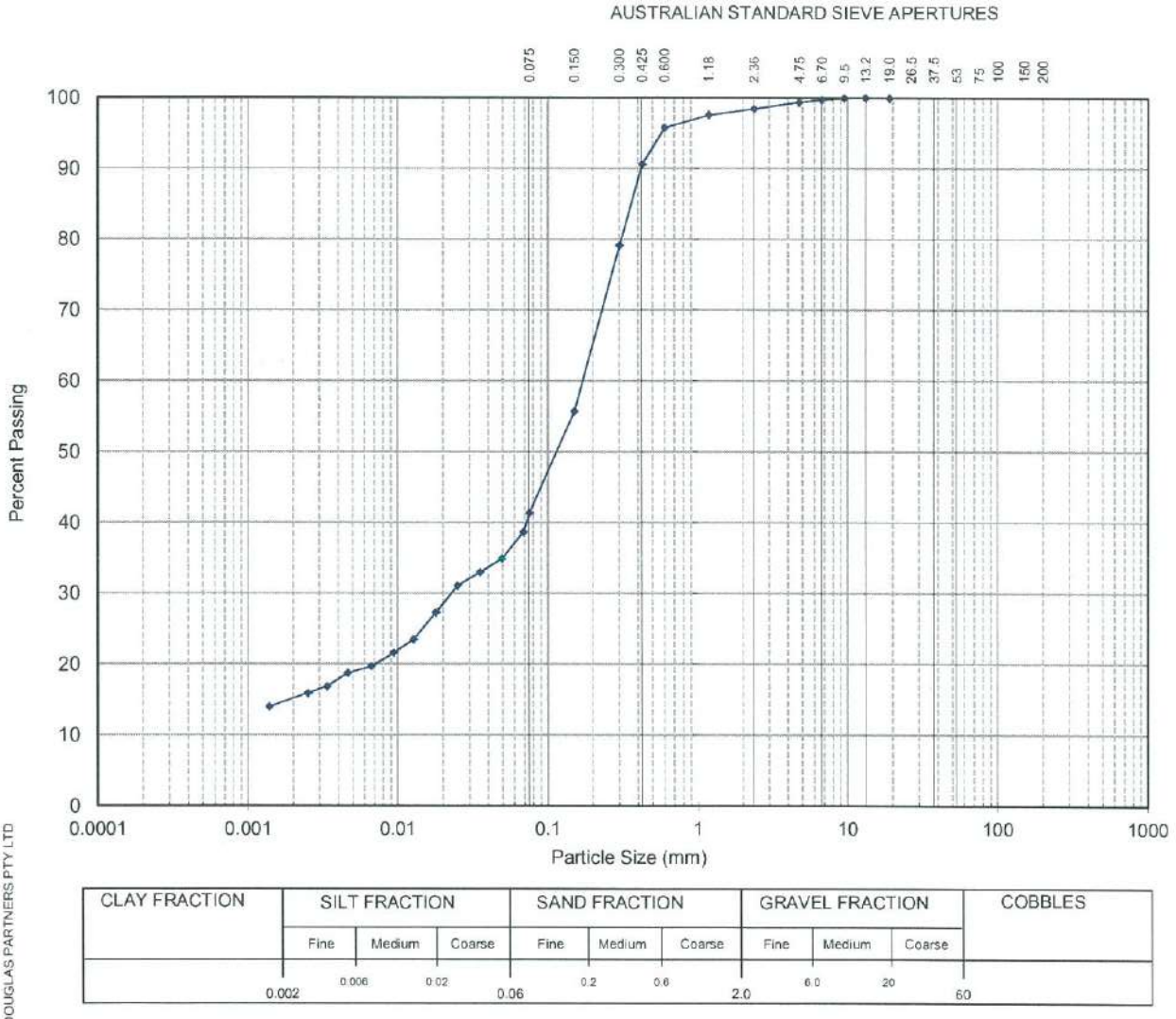
Results of Particle Size Distribution (Hydrometer)

Client :	Frasers Property Ivanhoe Pty Ltd			**Project No. :**	86043.01
				Report No. :	2A
Project :	Proposed Residential Development			**Report Date :**	6-Dec-17
				Date Sampled:	9-Nov-17
Location :	Ivanhoe Estate, Macquarie Park			**Date of Test:**	22-Nov-17
Road No:	-	**Sample / Pit No:**	LP1	**Depth / Layer:**	0.9m
Chainage:	-	**Section / Lot No:**	-	**Test Request No:**	17-1945A
				Page:	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	100%
13.2	100%
9.5	100%
6.7	100%
4.75	99%
2.36	98%
1.18	98%
0.600	96%
0.425	91%
0.300	79%
0.150	56%
0.075	41%
0.049	35%
0.035	33%
0.025	31%
0.018	27%
0.013	24%
0.009	22%
0.007	20%
0.005	19%
0.003	17%
0.003	16%
0.001	14%

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
	0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60

Description: Filling - dark brown slightly clayey, silty sand filling with trace of gravel

Test Method(s): AS 1289.3.6.1, AS 1289.3.6.3

Sampling Method(s): Sampled by Engineering Department

Loss in pretreatment: 0%

Remarks:

Type of Hydrometer: g/l

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NATA Accredited Laboratory Number:828
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Tested: LW
Checked: MG

Michael Gref
Soil Technician

Douglas Partners
Geotechnics / Environment / Groundwater

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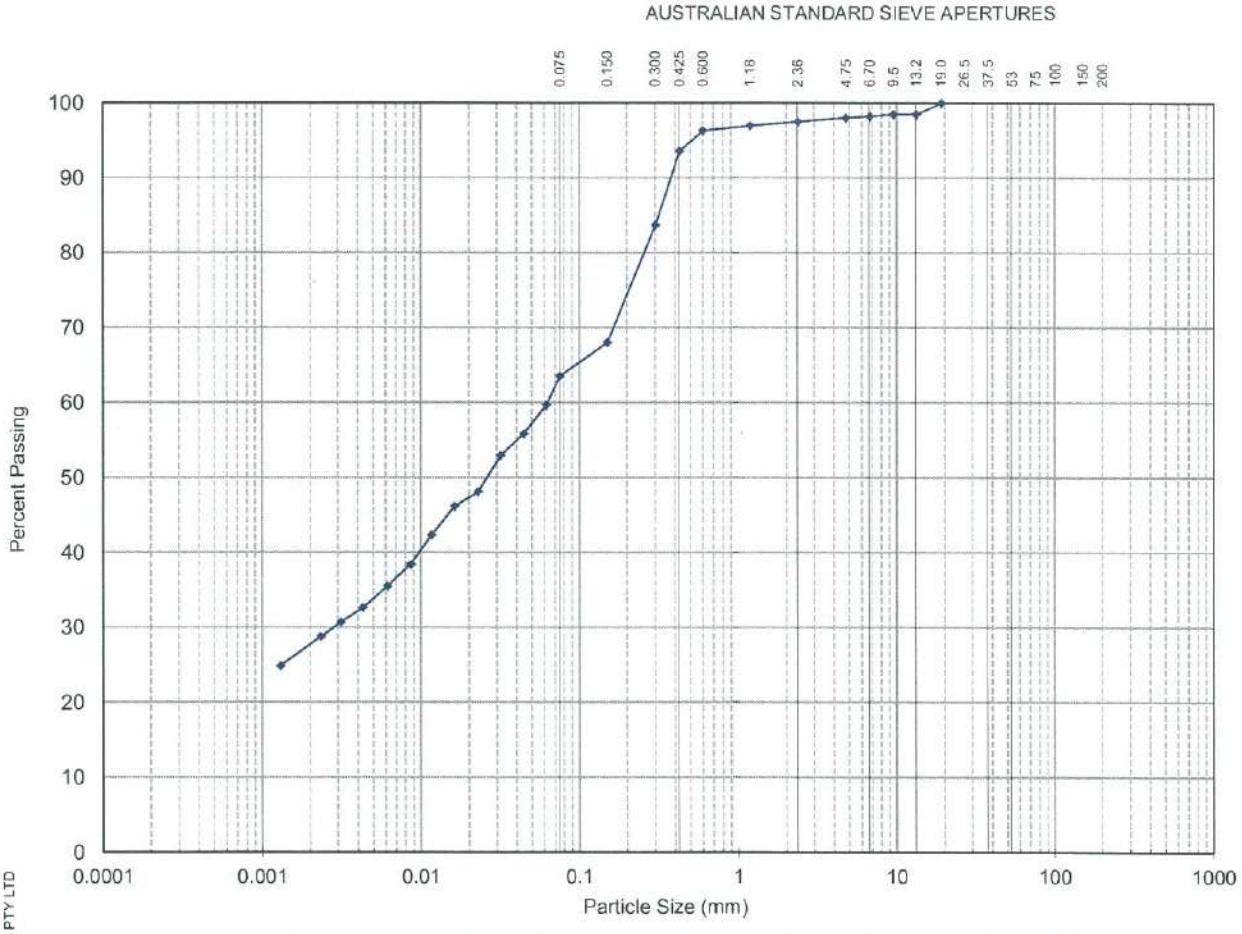
Results of Particle Size Distribution (Hydrometer)

Client :	Frasers Property Ivanhoe Pty Ltd			**Project No. :**	86043.01
				Report No. :	2B
Project :	Proposed Residential Development			**Report Date :**	6-Dec-17
				Date Sampled:	9-Nov-17
Location :	Ivanhoe Estate, Macquarie Park			**Date of Test:**	22-Nov-17
Road No:	-	**Sample / Pit No:**	BH11	**Depth / Layer:**	0.9-1.0m
Chainage:	-	**Section / Lot No:**	-	**Test Request No:**	17-1945B
				Page:	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	100%
13.2	98%
9.5	98%
6.7	98%
4.75	98%
2.36	98%
1.18	97%
0.600	96%
0.425	94%
0.300	84%
0.150	68%
0.075	64%
0.044	56%
0.032	53%
0.023	48%
0.016	46%
0.012	42%
0.009	38%
0.006	36%
0.004	33%
0.003	31%
0.002	29%
0.001	25%

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
0.002	0.006	0.02		0.06	0.2	0.6	2.0	6.0	20	60

Description: Dark yellow brown clayey silt and sand with trace of gravel

Test Method(s): AS 1289.3.6.1, AS 1289.3.6.3

Sampling Method(s): Sampled by Engineering Department

Loss in pretreatment: 0%

Remarks:

Type of Hydrometer: g/l

NATA Accredited Laboratory Number:828
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Tested:	LW
Checked:	MG

Michael Gref
Soil Technician

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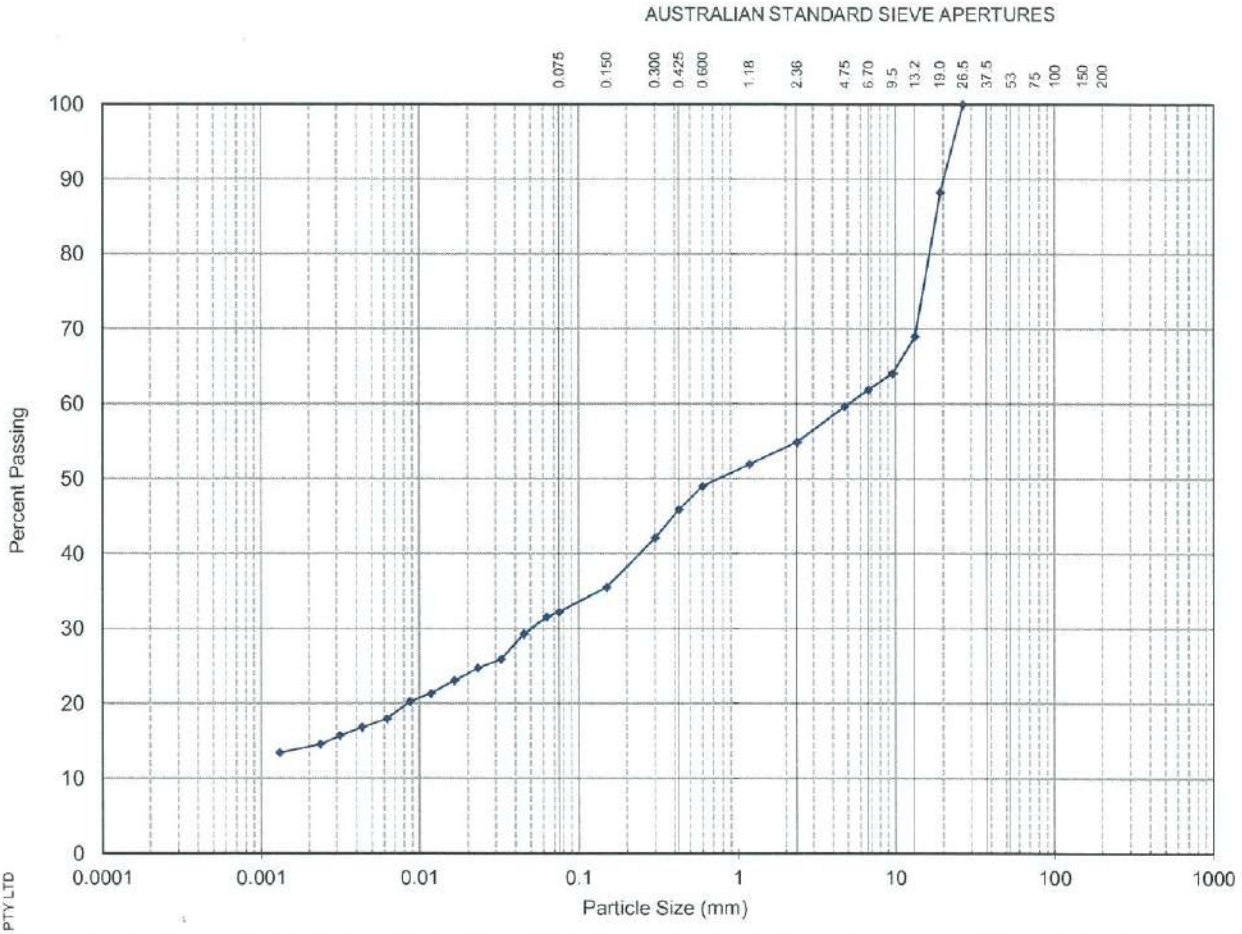
Results of Particle Size Distribution (Hydrometer)

Client :	Frasers Property Ivanhoe Pty Ltd	**Project No. :**	86043.01
		Report No. :	2C
Project :	Proposed Residential Development	**Report Date :**	6-Dec-17
		Date Sampled:	9-Nov-17
Location :	Ivanhoe Estate, Macquarie Park	**Date of Test:**	22-Nov-17
Road No:	- **Sample / Pit No:** BH11	**Depth / Layer:**	2.5-2.8m
Chainage:	- **Section / Lot No:** -	**Test Request No:**	17-1945C
		Page:	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	100%
19.0	88%
13.2	69%
9.5	64%
6.7	62%
4.75	60%
2.36	55%
1.18	52%
0.600	49%
0.425	46%
0.300	42%
0.150	36%
0.075	32%
0.045	29%
0.033	26%
0.023	25%
0.017	23%
0.012	21%
0.009	20%
0.006	18%
0.004	17%
0.003	16%
0.002	15%
0.001	13%

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60	

Description: Red brown slightly clayey, slightly silty, sandy gravel

Test Method(s): AS 1289.3.6.1, AS 1289.3.6.3

Sampling Method(s): Sampled by Engineering Department

Loss in pretreatment: 0%

Remarks:

Type of Hydrometer: g/l

NATA Accredited Laboratory Number:828
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Tested:	LW
Checked:	MG

Michael Gref
Soil Technician

Material Test Report

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Approved Signatory: Michael Gref
NATA Accredited Laboratory Number: 828

Report Number: **86043.01-3**
Issue Number: 1
Date Issued: 06/12/2017
Client: Frasers Property Ivanhoe Pty Ltd
c/- Citta Property Group Pty Limited, Sydney 2000
Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1945
Sample Number: 17-1945A
Date Sampled: 09/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **LP1 (0.9m)**
Material: Filling - dark brown slightly clayey, silty sand filling with trace of gravel

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**6**		
Soil Description	-		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	23		

Material Test Report

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Report Number: **86043.01-3**
Issue Number: 1
Date Issued: 06/12/2017
Client: Frasers Property Ivanhoe Pty Ltd
c/- Citta Property Group Pty Limited, Sydney 2000
Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1945
Sample Number: 17-1945B
Date Sampled: 09/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **11 (0.9-1.0m)**
Material: Dark yellow brown clayey silt and sand with trace of gravel

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**6**		
Soil Description	-		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	23		

Material Test Report

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Report Number: **86043.01-3**
Issue Number: 1
Date Issued: 06/12/2017
Client: Frasers Property Ivanhoe Pty Ltd
c/- Citta Property Group Pty Limited, Sydney 2000
Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1945
Sample Number: 17-1945C
Date Sampled: 09/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **11 (2.5-2.8m)**
Material: Red brown slightly clayey, slightly silty, sandy gravel

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**6**		
Soil Description	-		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	23		

Material Test Report

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Report Number: **86043.01-3**
Issue Number: 1
Date Issued: 06/12/2017
Client: Frasers Property Ivanhoe Pty Ltd
c/- Citta Property Group Pty Limited, Sydney 2000
Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1945
Sample Number: 17-1945D
Date Sampled: 09/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **01 (0.4-0.5m)**
Material: Filling

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**6**		
Soil Description	-		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	23		

Material Test Report

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Report Number: **86043.01-3**
Issue Number: 1
Date Issued: 06/12/2017
Client: Frasers Property Ivanhoe Pty Ltd
c/- Citta Property Group Pty Limited, Sydney 2000
Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1945
Sample Number: 17-1945E
Date Sampled: 09/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **34 (0.5-0.6m)**
Material: Sandstone

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	24		
Plastic Limit (%)	18		
Plasticity Index (%)	**6**		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**4 ***		
Soil Description	-		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	23		
* Mineral Present	Carbonate		

Material Test Report

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Report Number: **86043.01-3**
Issue Number: 1
Date Issued: 06/12/2017
Client: Frasers Property Ivanhoe Pty Ltd
c/- Citta Property Group Pty Limited, Sydney 2000
Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1945
Sample Number: 17-1945F
Date Sampled: 09/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **37 (0.4-0.5m)**
Material: Filling

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**7**		
Soil Description	-		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	23		

Material Test Report

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Report Number: **86043.01-3**
Issue Number: 1
Date Issued: 06/12/2017
Client: Frasers Property Ivanhoe Pty Ltd
c/- Citta Property Group Pty Limited, Sydney 2000
Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1945
Sample Number: 17-1945G
Date Sampled: 09/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **47 (0.4-0.5m)**
Material: Filling

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	22		
Plastic Limit (%)	15		
Plasticity Index (%)	**7**		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	-		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	23		

Material Test Report

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Report Number: **86043.01-3**
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Date Issued: 06/12/2017
Client: Frasers Property Ivanhoe Pty Ltd
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Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1945
Sample Number: 17-1945H
Date Sampled: 09/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **07 (0.9-1.0m)**
Material: Clay

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**6**		
Soil Description	-		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	23		

Material Test Report

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Client: Frasers Property Ivanhoe Pty Ltd
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Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1945
Sample Number: 17-1945I
Date Sampled: 09/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **41 (0.9-1.0m)**
Material: Sandstone

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	32		
Plastic Limit (%)	18		
Plasticity Index (%)	**14**		

Material Test Report

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Issue Number: 1
Date Issued: 06/12/2017
Client: Frasers Property Ivanhoe Pty Ltd
c/- Citta Property Group Pty Limited, Sydney 2000
Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1945
Sample Number: 17-1945K
Date Sampled: 09/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **12 (1.4-1.5m)**
Material: Sandy clay

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**6**		
Soil Description	-		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	23		

Material Test Report

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c/- Citta Property Group Pty Limited, Sydney 2000
Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1945
Sample Number: 17-1945L
Date Sampled: 09/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **46 (0.5-0.6m)**
Material: Filling

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	21		
Plastic Limit (%)	15		
Plasticity Index (%)	**6**		

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Sydney Laboratory
96 Hermitage Road West Ryde NSW 2114
Phone: (02) 9809 0666
Fax: (02) 9809 0666
Email: mick.gref@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Michael Gref
NATA Accredited Laboratory Number: 828

Report Number: **86043.01-3**
Issue Number: 1
Date Issued: 06/12/2017
Client: Frasers Property Ivanhoe Pty Ltd
c/- Citta Property Group Pty Limited, Sydney 2000
Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1945
Sample Number: 17-1945M
Date Sampled: 09/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **38 (0.4-0.5m)**
Material: Sandstone

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	38		
Plastic Limit (%)	19		
Plasticity Index (%)	**19**		

Material Test Report

Douglas Partners
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Fax: (02) 9809 0666
Email: mick.gref@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

NATA
WORLD RECOGNISED ACCREDITATION

Approved Signatory: Michael Gref
NATA Accredited Laboratory Number: 828

Report Number: **86043.01-3**
Issue Number: 1
Date Issued: 06/12/2017
Client: Frasers Property Ivanhoe Pty Ltd
c/- Citta Property Group Pty Limited, Sydney 2000
Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1945
Sample Number: 17-1945N
Date Sampled: 09/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **LP1 (1.3-1.45m)**
Material: Clay

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	37		
Plastic Limit (%)	16		
Plasticity Index (%)	**21**		

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Sydney Laboratory
96 Hermitage Road West Ryde NSW 2114
Phone: (02) 9809 0666
Fax: (02) 9809 0666
Email: mick.gref@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

NATA
WORLD RECOGNISED ACCREDITATION

Approved Signatory: Michael Gref
NATA Accredited Laboratory Number: 828

Report Number: **86043.01-3**
Issue Number: 1
Date Issued: 06/12/2017
Client: Frasers Property Ivanhoe Pty Ltd
c/- Citta Property Group Pty Limited, Sydney 2000
Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 1945
Sample Number: 17-1945O
Date Sampled: 09/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **O2 (1.0-1.45m)**
Material: Filling

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	46		
Plastic Limit (%)	22		
Plasticity Index (%)	**24**		

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Sydney Laboratory
96 Hermitage Road West Ryde NSW 2114
Phone: (02) 9809 0666
Fax: (02) 9809 0666
Email: mick.gref@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Michael Gref
NATA Accredited Laboratory Number: 828

Report Number: **86043.01-4**
Issue Number: 1
Date Issued: 13/12/2017
Client: Frasers Property Ivanhoe Pty Ltd
c/- Citta Property Group Pty Limited, Sydney 2000
Contact: Joe Zannino
Project Number: 86043.01
Project Name: Proposed Residential Development
Project Location: Ivanhoe Estate, Macquarie Park
Work Request: 2055
Sample Number: 17-2055A
Date Sampled: 09/11/2017
Sampling Method: Sampled by Engineering Department
Sample Location: **BH40 (1.3-1.5m)**
Material: Brown clay

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Oven Dried		
Liquid Limit (%)	42		
Plastic Limit (%)	23		
Plasticity Index (%)	**19**		

Appendix F

Results of Previous Field Work

TEST BORE REPORT

CLIENT: LIPMAN PTY LTD
PROJECT: PROPOSED MULTI STOREY BUILDING
LOCATION: 2-4 LYON PARK ROAD, NORTH RYDE

DATE: 1 AUGUST 00
PROJECT No.: 29190
SURFACE LEVEL: 45.12

BORE No. A1
SHEET 1 OF 1

Depth m	Description of Strata	Sampling & In Situ Testing: Type	Depth (m)	Results	Headspace PID (ppm)
0	FILLING – poorly compacted, light brown to brown clay filling with a trace of silt and gravel	A	0.5	1,1,2 N=3	2
		S	0.95		
1.4	CLAY – firm, brown mottled red brown clay with a trace of ironstone gravel				
1.8	IRONSTONE				
2.0	TEST BORE DISCONTINUED AT 2.0 METRES – auger refusal				

RIG: B40 **DRILLER:** DRIVER **LOGGED:** CARLE **CASING:**

TYPE OF BORING: 100mm DIAMETER SPIRAL FLIGHT AUGER

GROUND WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED

REMARKS: TBM GRATE IN LYON PARK ROAD RL 48.22

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 Penetration (kPa)	V shear vane (kPa)

CHECKED:
Initials:
Date: 10/8

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Geotechnics · Environment · Groundwater

TEST BORE REPORT

BORE No: 2A2

CLIENT: LIPMAN PTY LTD
PROJECT No: 29190
DATE: 2/8/00
PROJECT: PROPOSED MULTISTOREY BUILDING
SURFACE LEVEL: 45.91
SHEET 1 OF 1
LOCATION: 2-4 LYON PARK ROAD, NORTH RYDE
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
0	FILLING – poorly compacted, dark brown silty sandy clay									
0.75	FILLING – poorly compacted, dark grey and yellow brown sandy clay and gravel filling						S			1,2,4 N=6
1.1	FILLING – crushed sandstone and gravel filling									
1.7	SANDY CLAY – firm to stiff, light grey and yellow brown sandy clay						S			3,4,4 N=8
3.0	SANDSTONE – extremely low to very low strength, light grey brown sandstone									
3.5	TEST BORE DISCONTINUED AT 3.5 METRES						A			
4										
5										
6										
7										
8										
9										
10										

RIG: B40 **DRILLER:** DRIVER **LOGGED:** PARMAR **CASING:** UNCASED

TYPE OF BORING: SPIRAL FLIGHT AUGER TO 3.5m

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:
Date: 10/8

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TEST BORE REPORT

BORE No: A3
DATE: 2/8/00
SHEET 1 OF 1

CLIENT: LIPMAN PTY LTD
PROJECT: PROPOSED MULTISTOREY BUILDING
LOCATION: 2-4 LYON PARK ROAD, NORTH RYDE

PROJECT No: 29190
SURFACE LEVEL: 46.76
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
0	FILLING - brown clay filling									
0.3	FILLING - poorly compacted, yellow brown grey sandy clay filling with ironstone gravel						S			1,1,3 N=4
0.9	SANDY SILTY CLAY - soft to firm, light grey sandy silty clay									
1.2	SANDY CLAY - firm to stiff, brown sandy clay				Note: unless otherwise stated rock is fractured along slightly rough to smooth planar bedding planes					
1.8	SANDY CLAY - stiff, light yellow grey mottled red brown sandy clay						S			3,3,6 N=9
2.3	SANDSTONE - extremely low strength, extremely weathered sandstone									
2.5										
2.6	SANDSTONE - low strength sandstone				Core loss 200mm					PL (A)=0.8MPa
2.8	SANDSTONE - medium and high strength, moderately weathered, slightly fractured to unbroken, light yellow brown to grey brown and purple, medium to coarse grained sandstone				3.59m:J 5° ironstained rough 3.87m:B 5° with clayey veneer 4.29m:B 10° with 3-4mm sandy clay 4.32m:B 5° with 3-4mm sandy clay 4.37m:B 10° 4.42m:B 5° with 6-7mm sandy clay 4.82m:B 10° 5.13m:B 10° ironstained		C	93	89	PL (A)=1.2MPa PL (A)=1.8MPa
5.6	TEST BORE DISCONTINUED AT 5.6 METRES									
6										
7										
8										
9										
10										

RIG: B40 **DRILLER:** DRIVER **LOGGED:** PARMAR **CASING:** GL TO 2.6m

TYPE OF BORING: SPIRAL FLIGHT AUGER TO 2.6m,NMLC CORING TO 5.6m

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:
Date: 14/8

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TEST BORE REPORT

CLIENT: LIPMAN PTY LTD
PROJECT: PROPOSED MULTI STOREY BUILDING
LOCATION: 2-4 LYON PARK ROAD, NORTH RYDE

DATE: 1 AUGUST 00
PROJECT No.: 29190
SURFACE LEVEL: 47.3

BORE No. A4
SHEET 1 OF 1

Depth m	Description of Strata	Sampling & In Situ Testing: Type	Depth (m)	Results	Headspace PID (ppm)
0	FILLING – poorly compacted, brown, slightly sandy clay filling	AX	0.5	1,2,4 N=6	2
		S	0.95		
1	– 0.95m – traces of wood				
1.3	CLAY – red brown clay with a trace of silt and sand				
1.7	SILTY SANDY CLAY – grey silty sandy clay	A	1.8		2
2	CLAY – firm, red brown clay		2.0	2,3,5 N=8	
		S	2.45		
2.8	SANDSTONE – extremely low strength, light grey sandstone with some clay				
3					
3.5	TEST BORE DISCONTINUED AT 3.5 METRES – auger refusal				
4					
5					

RIG: B40 **DRILLER:** DRIVER **LOGGED:** CARLE **CASING:**

TYPE OF BORING: 100mm DIAMETER SPIRAL FLIGHT AUGER

GROUND WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED

REMARKS: *DENOTES DUPLICATE SAMPLE Z1 TAKEN

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 Penetration (kPa)	V shear vane (kPa)

CHECKED: Initials: Date: 19/8

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TEST BORE REPORT

BORE No: A5

CLIENT: LIPMAN PTY LTD
PROJECT No: 29190
DATE: 3/8/00
PROJECT: PROPOSED MULTISTOREY BUILDING
SURFACE LEVEL: 48.05
SHEET 1 OF 1
LOCATION: 2-4 LYON PARK ROAD, NORTH RYDE
DIP OF HOLE: 90°
AZIMUTH:

Depth (m)	Description of Strata	Degree of Weathering (EW, HW, MW, SW, 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
0	FILLING - poorly to moderately compacted, light brown sandy clay and gravel filling									2,3,5 N=8
1.8	SILTY SANDY CLAY - soft, light yellow brown mottled red silty sandy clay with a trace of ironstone grvel						S#A			
3.1	SANDSTONE - extremely low to very low strength, highly weathered, light grey sandstone				Note: unless otherwise stated rock is fractured along smooth planar bedding planes dipping at 10° -20°		S			2,1,2 N=3
4.58	SANDSTONE - medium then high strength, slightly weathered, fractured to slightly fractured, light grey, medium to coarse grained sugary sandstone with extremely low and very low strength bands				4.77m:B 10° with 2-3mm silty clay 4.95m:B 10° with clayey coating 5.04m:J 25° Core loss 200mm		S			7,20,17 N=37
5.07							C	84	37	PL (A)=1.4MPa
5.27										
5.37	SANDSTONE - medium then high strength, moderately and slightly weathered, slightly fractured to fractured, light yellow brown and grey, medium to coarse grained sandstone									PL (A)=0.5MPa
6					6.46m:B 10° with carbonaceous coating		C	100	90	PL (A)=1.9MPa
7					7.49m:B 10° with clayey coating					PL (A)=1.2MPa
7.75	TEST BORE DISCONTINUED AT 7.75 METRES									
8										
9										
10										

RIG: B40 **DRILLER:** DRIVER **LOGGED:** PARMAR **CASING:** GL TO 4.45m

TYPE OF BORING: SPIRAL FLIGHT AUGER TO 4.45m,NMLC CORING TO 7.75m

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:
Date: 10/8

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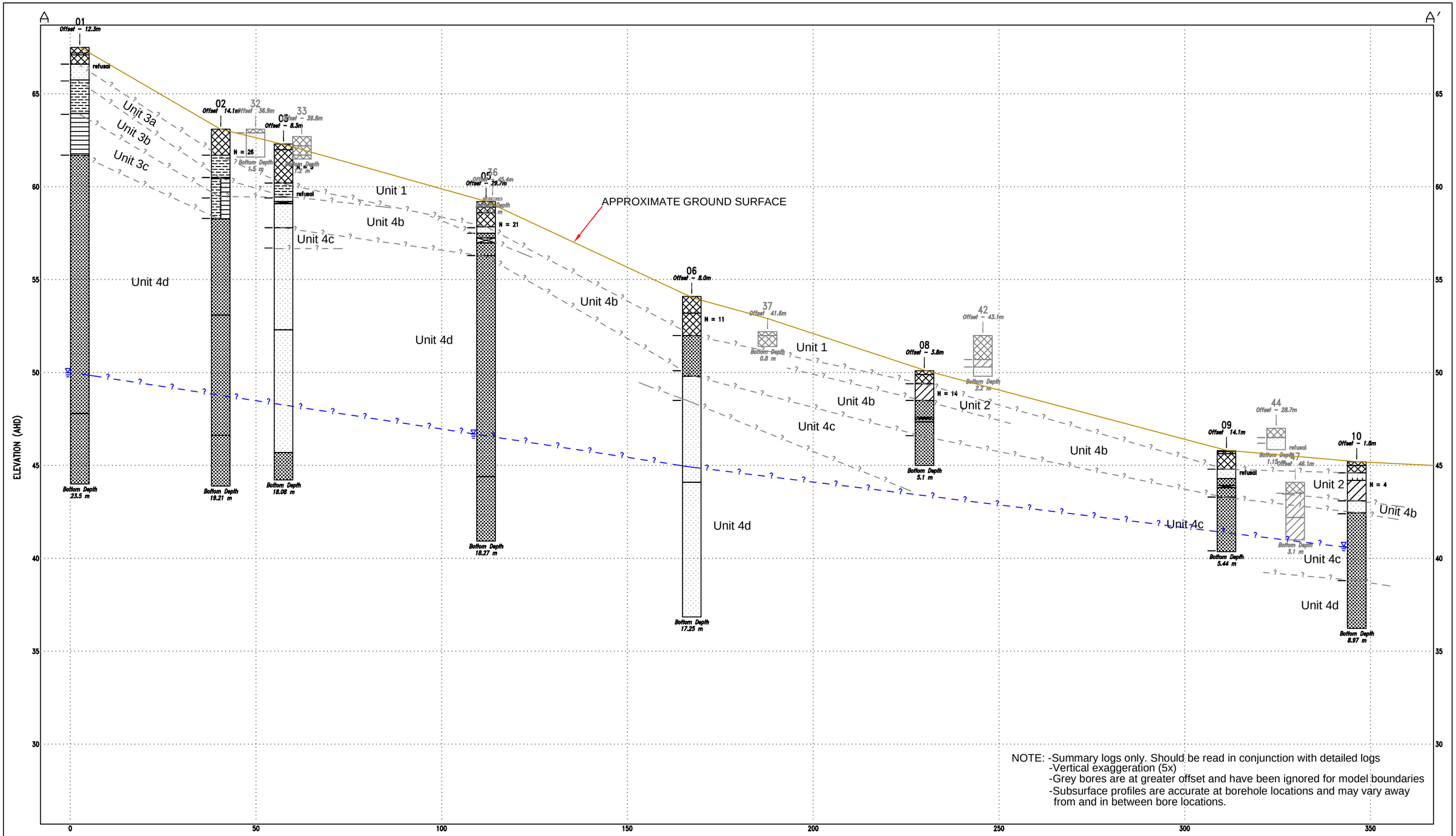
Appendix G

Drawings – Interpreted Geotechnical Long-Sections



NOTE: -Summary logs only. Should be read in conjunction with detailed logs
-Vertical exaggeration (5x)
-Grey bores are at greater offset and have been ignored for model boundaries
-Subsurface profiles are accurate at borehole locations and may vary away from and in between bore locations.

DISTANCE ALONG PROFILE (m)

LEGEND

- Core Loss
- Bricks
- Clay
- Filling
- Laminite
- Sandstone
- Sandstone
- Sandy Clay
- Shale
- Silty Sand

TESTS / OTHER

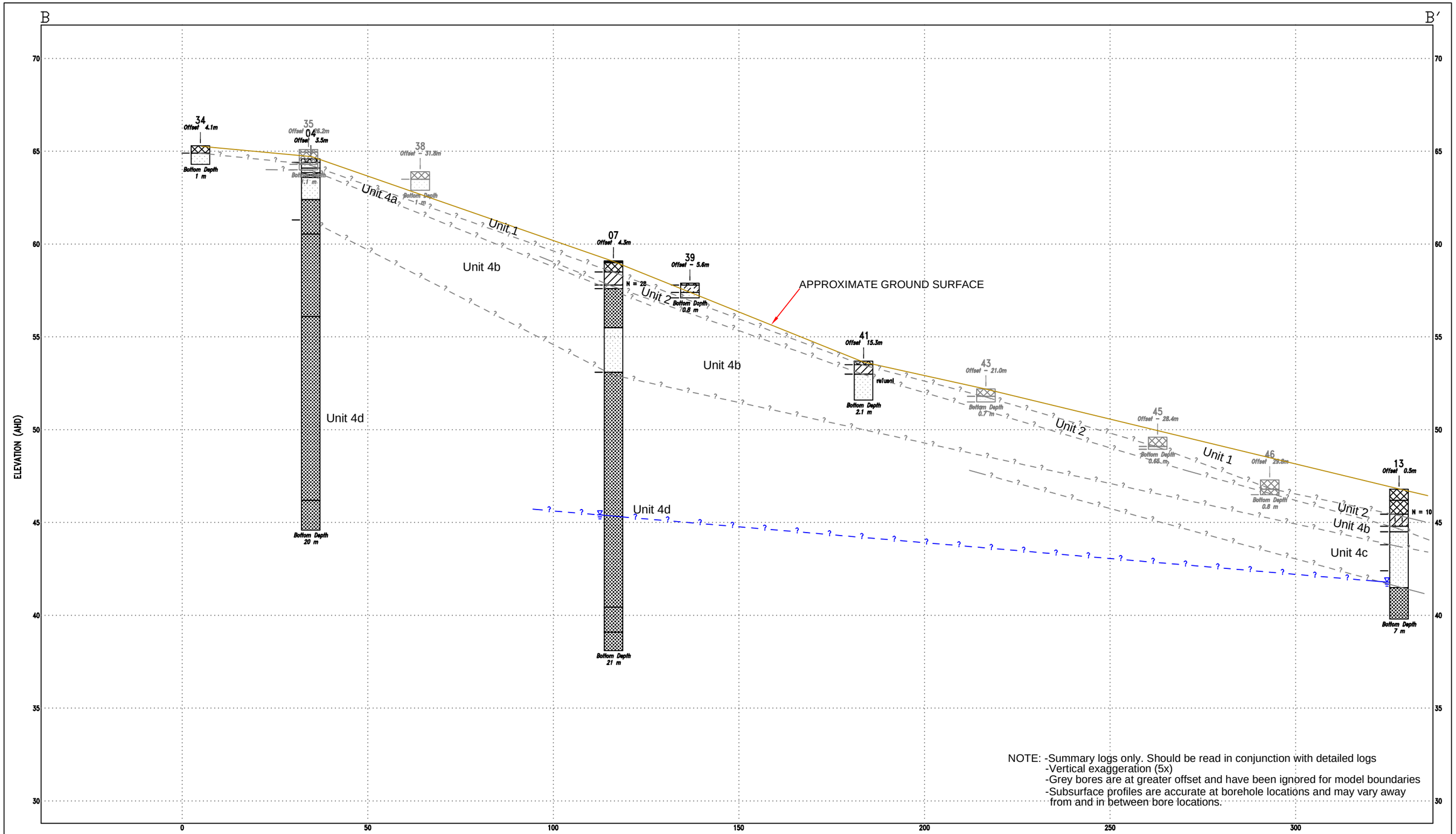
- N - Standard penetration test value
- ▼ - Water level
- PP- Pocket penetrometer test value
- Interpreted geotechnical model boundary
- Approximate groundwater level
- Unit 1 Geotechnical model unit (refer to DP Report 86043.01.R.00.1Rev0)

0 20

Horizontal Scale (metres)
Vertical Exaggeration = 5.0

Douglas Partners
Geotechnics | Environment | Groundwater

CLIENT: Frasers Property Ivanhoe Pty Ltd		TITLE: **Geotechnical Long-Section A-A'**	PROJECT No: 86043.01
OFFICE: Sydney	DRAWN BY: SCP	**Proposed Residential Development**	DRAWING No: 2
SCALE: 1:1000 (H) 1:200 (V) @ A3	DATE: 14.12.2017	**Ivanhoe Estate, MACQUARIE PARK**	REVISION: 0



LEGEND

- Core Loss
- Bricks
- Clay
- Clayey Sand
- Filling
- Sandstone
- Sandstone
- Silty Clay
- Topsoil

TESTS / OTHER

- N - Standard penetration test value
- ▽ - Water level
- PP- Pocket penetrometer test value
- Interpreted geotechnical model boundary
- Approximate groundwater level
- Unit 1 Geotechnical model unit (refer to DP Report 86043.01.R.00.1Rev0)

0 20

Horizontal Scale (metres)

Vertical Exaggeration = 5.0

Douglas Partners
Geotechnics | Environment | Groundwater

CLIENT: Frasers Property Ivanhoe Pty Ltd		TITLE: **Geotechnical Long-Section B-B'**	PROJECT No: 86043.01
OFFICE: Sydney	DRAWN BY: SCP	**Proposed Residential Development**	DRAWING No: 3
SCALE: 1:1000 (H) 1:200 (V) @ A3	DATE: 14.12.2017	**Ivanhoe Estate, MACQUARIE PARK**	REVISION: 0

C

C′

ELEVATION (AHD)

70
65
60
55
50
45
40
35
30

45
Offset 49.2m
Bottom Depth 0.95 m

13
Offset – 15.0m
N = 10
Unit 1
Unit 2
Unit 4b
Unit 4c
Unit 4d
Bottom Depth 7 m

46
Offset 20.7m
Bottom Depth 0.8 m

12
Offset – 15.5m
N = 10
Unit 4c
Unit 4d
Bottom Depth 6.93 m

44
Offset 42.7m
refusal
Bottom Depth 1.15 m

10
Offset 21.8m
N = 4
Unit 4d
Bottom Depth 8.97 m

11
Offset – 11.2m
N = 11
refusal
Unit 1
Unit 2
Unit 4b
Bottom Depth 8.6 m

47
Offset 39.7m
Bottom Depth 3.1 m

APPROXIMATE GROUND SURFACE

NOTE: -Summary logs only. Should be read in conjunction with detailed logs
-Vertical exaggeration (5x)
-Grey bores are at greater offset and have been ignored for model boundaries
-Subsurface profiles are accurate at borehole locations and may vary away from and in between bore locations.

−100 −50 0 50 100 150 200 250

DISTANCE ALONG PROFILE (m)

LEGEND

- Core Loss
- Clay
- Concrete
- Filling
- Sandstone
- Sandstone
- Sandy Clay
- Silty Clay
- Silty Sand
- Subbase
- Topsoil

TESTS / OTHER
N - Standard penetration test value
WL - Water level
PP - Pocket penetrometer test value
Interpreted geotechnical model boundary
Approximate groundwater level
Unit 1 Geotechnical model unit (refer to DP Report 86043.01.R.00.1Rev0)

0 20
Horizontal Scale (metres)

Vertical Exaggeration = 5.0

Douglas Partners
Geotechnics | Environment | Groundwater

CLIENT: Frasers Property Ivanhoe Pty Ltd		TITLE: **Geotechnical Long-Section C-C'**	PROJECT No: 86043.01
OFFICE: Sydney	DRAWN BY: SCP	**Proposed Residential Development**	DRAWING No: 4
SCALE: 1:1000 (H) 1:200 (V) @ A3	DATE: 14.12.2017	**Ivanhoe Estate, MACQUARIE PARK**	REVISION: 0

D

D′

ELEVATION (AHD)

70
65
60
55
50
45
40
35
30

0
50
100
150
200
250
300

APPROXIMATE GROUND SURFACE

09
Offset 6.1m
Unit 1
refusal
Unit 4b
Unit 4c
Bottom Depth 5.44 m

10
Offset 9.7m
N = 4
Unit 2
Bottom Depth 8.97 m

11
Offset 0.8m
N = 11
refusal
Bottom Depth 8.6 m

LP1 A1
Offset 4.4m
Unit 1
Unit 2
Unit 4a
Unit 4b
Unit 4d
Bottom Depth 9 m

A2
Offset – 5.8m
Unit 1
Unit 2
Unit 4b
Bottom Depth 3.5 m

A3
Offset – 3.9m
Unit 1
Unit 4b
Unit 4d
Bottom Depth 5.6 m

A4
Offset – 2.7m
Unit 2
Unit 4a
Bottom Depth 3.5 m

A5
Offset – 5.8m
Unit 4a
Unit 4c
Bottom Depth 7.75 m

NOTE: -Summary logs only. Should be read in conjunction with detailed logs
-Vertical exaggeration (5x)
-Grey bores are at greater offset and have been ignored for model boundaries
-Subsurface profiles are accurate at borehole locations and may vary away from and in between bore locations.

DISTANCE ALONG PROFILE (m)

LEGEND

- Core Loss
- Ironstone
- Bricks
- Clay
- Concrete
- Filling
- Sandstone
- Sandstone
- Sandy Clay
- Sandy Silty Clay
- Silty Clay
- Silty Sand
- Silty Sandy Clay
- Subbase

TESTS / OTHER

N - Standard penetration test value
PP- Pocket penetrometer test value
Interpreted geotechnical model boundary
Approximate groundwater level
Unit 1 Geotechnical model unit (refer to DP Report 86043.01.R.00.1Rev0)

0 20
Horizontal Scale (metres)
Vertical Exaggeration = 5.0

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Frasers Property Ivanhoe Pty Ltd		TITLE: **Geotechnical Long-Section D-D'**	PROJECT No: 86043.01
OFFICE: Sydney	DRAWN BY: SCP	**Proposed Residential Development**	DRAWING No: 5
SCALE: 1:1000 (H) 1:200 (V) @ A3	DATE: 18.12.2017	**Ivanhoe Estate, MACQUARIE PARK**	REVISION: 0