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Report on
Geotechnical Investigation of C2 Site

Stage 2 - Midtown
Herring Road, 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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Report on Geotechnical Investigation of C2 Site
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1. Introduction

This report presents the results of a geotechnical investigation undertaken by Douglas Partners Pty Ltd (DP) for the C2 site at the proposed Midtown development (Stage 2) at Herring Road, Macquarie Park. Midtown is located at the former Ivanhoe Estate Social Housing precinct. The investigation was commissioned by Chris Koukoutaris of Frasers Property Ivanhoe Pty Ltd (Frasers) and was undertaken in accordance with the Consulting Services Agreement dated 26 April 2021. This Revision 1 report has been issued due to the update of Figure 1, only.

The investigation was undertaken in conjunction with investigation for the C3 and C4 sites, although the detailed results of those investigations will be reported separately. The investigation also follows previous geotechnical investigation of the greater Midtown site in 2017 and groundwater monitoring from 2017 to 2018. The geotechnical report for the greater Midtown site was updated in 2018 following the completion of groundwater monitoring.

A community centre, swimming pool and park are proposed at the C2 site. The aim of the investigation was to assess the subsurface soil, rock and groundwater conditions at the site, in order to provide geotechnical comment relevant to the proposed development on:

- Excavation conditions, including excavatability, excavation stability, shoring and batters;
- Groundwater conditions; and
- Foundations.

The investigation included the drilling of five boreholes on or immediately adjacent to the C2 site area, and the installation of two groundwater monitoring standpipes or wells. The details of the field work are presented in this report, together with comments and recommendations on the items listed above.

2. Proposed Development

The proposed C2 development is for a community centre and will include a landscaped Village Green and swimming pool facilities. Ground surface levels at approximately RL 49.5 are generally proposed for landscaping and ground floor levels, with basement floor levels at RL 47.1 in local areas towards the western corner for plant rooms and basement foyer areas. The proposed swimming pools are also towards the western corner of the site, with pool depths at an intermediate level, between the ground surface and basement levels.

The building will be constructed up to the north-western boundary adjoining the C1 site, currently under development. The C1 site will have a lowermost basement level of RL47.1, level with the proposed C2 local basement and plant rooms.

The proposed buildings and landscaped areas are below the level of the proposed roads reserves beyond the north-eastern and south-western boundaries. It is understood that these roads will be in place prior to the C2 development and as such shoring walls will be required to support them. These walls will extend up to approximately 3 m to 4 m above the ground floor level, reducing to zero at the south-eastern side of the site. Where these walls adjoin basement levels, excavation to 6 m to 7 m below the road level is expected to be required.

The C2 site development is expected to be undertaken concurrently with the C3 development, immediately south-east of the park area, and batters may be excavated within the C2 site, adjacent to the C3 boundary to facilitate that excavation. Backfilling of the battered slope (and backfill retention) would then be required to provide the final landscaped park surface.

3. Background

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 new community will be known as Midtown MacPark, or Midtown.

Douglas Partners Pty Ltd undertook investigation for the greater Ivanhoe Estate (now Midtown) site, in 2017, and undertook groundwater monitoring at 6 bores from November 2017 to June 2018. The detailed results were reported in the following DP Reports:

- 86043.01.R.001.Rev1, Preliminary Geotechnical Investigation of Ivanhoe Estate, dated 30 July 2018, including several boreholes drilled in the general vicinity, but outside of the C2 site in 2017 and revised in 2018 with summary data relating to groundwater monitoring; and
- 86043.01.R.005.Rev0, Groundwater Monitoring, dated 30 July 2018.

Selected, relevant results from those previous investigations have been referenced or included in Appendix E of the current report. Reference should be made to the original reports for further details.

Since that time, demolition of the previous residences has been completed, and earthworks have commenced for the development of infrastructure, roads and public areas at Midtown. These works have necessarily destroyed several of the previous standpipes. While attempts were made during the current field work to locate possible remaining groundwater monitoring standpipes (at Bores 10, 12 and 13) near Shrimpton's Creek, these wells appear to have been either destroyed or obscured by overgrowth or temporary construction measures such as fencing and sedimentation controls.

The investigation for the C2 site was undertaken in conjunction with investigations for the C3 and C4 site, which together comprise the Stage 2 works. Reference is made in this report to the relevant results of those investigations, particularly with respect to standpipes and groundwater levels. The detailed results of those investigations, however, will be separately reported in the following DP Reports:

- 86043.06.R.002, Geotechnical Investigation of the C3 site; and
- 86043.06.R.003, Geotechnical Investigation of the C4 site.

4. Site Description

The greater Midtown site is in Macquarie Park near the corner of Epping Road and Herring Road, within the Ryde Local Government Area. The site is approximately 8.2 hectares. The approximate location of the proposed C2 development, with respect to the greater Midtown site, is shown in Figure 1.

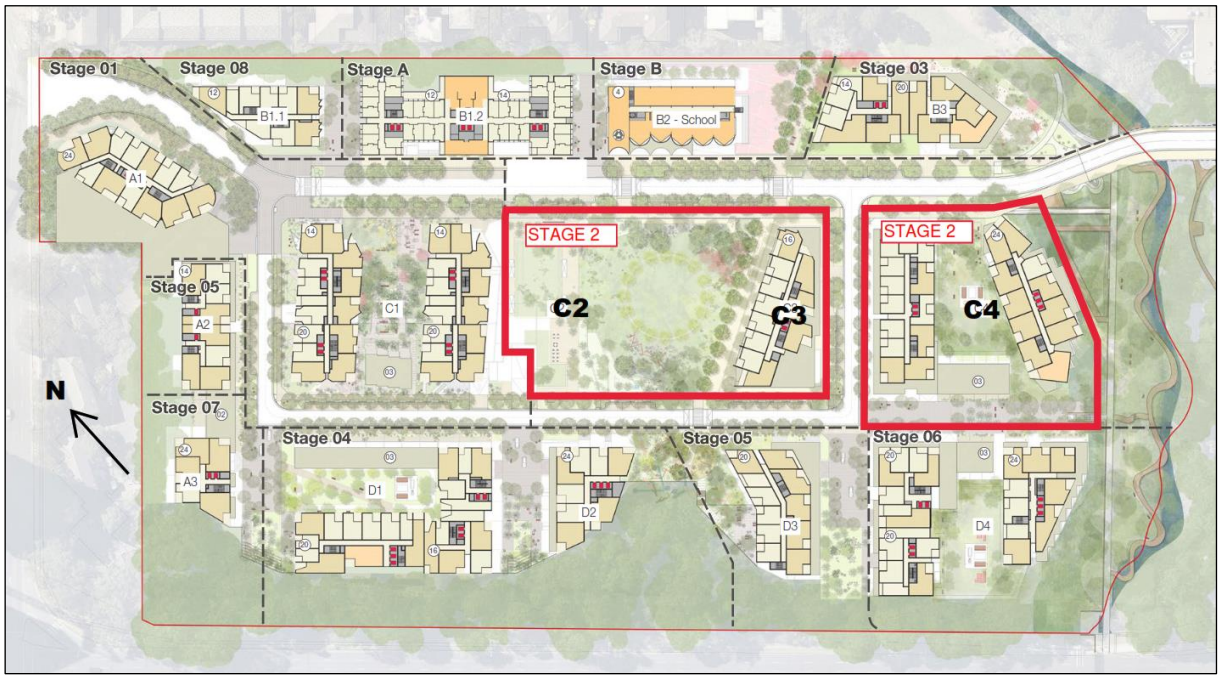


Figure 1: Location of the Stage 2 development areas (red), relative to the greater Midtown site (provided by Client).

Topographically, the Midtown site is located on a sideslope, with ground surface levels falling from approximately RL 71 near Herring Road, to approximately RL 42 at Shrimpton's Creek, at the south-eastern boundary.

Ground levels in the C2 development area typically fall from approximately RL54 to RL50, towards the east and south east, though local variation was also present due to earthworks for haul roads, sedimentation controls, and due to temporary stockpiles.

5. Published Data

Reference to the regional mapping indicates the following at the C2 site:

- The Sydney Soils Landscape Series Sheet indicates that the site is underlain by the residual Lucas Heights soil landscape. These soils typically comprise sandy clay and clayey sand soils developed from Mittagong Formation and Hawkesbury Sandstone;
- The Sydney Geology Series Sheet indicates that the site is underlain by Hawkesbury Sandstone, near the boundary with Ashfield Shale; and

- The site is in an area of no known risk of coastal Acid Sulfate soils and is outside of the Salinity Potential in Western Sydney mapping.

The results of past and present field work indicate that ground conditions are consistent with the mapping of residual soils over Hawkesbury Sandstone, though a layer of fill is generally present, overlying the residual soil.

Reference to the WaterNSW data on registered boreholes indicates that groundwater monitoring bores (i.e. wells) in the vicinity of the Midtown site are relatively distant from the site but that the results are broadly consistent with the previous groundwater monitoring at the greater Midtown site.

6. Field Work

6.1 Field Work Methods

The field work for the current investigation of the C2 site comprised five deep, small-diameter boreholes (Bore 101 to 103, 117 and 106), drilled with a truck-mounted (Explora) drilling rig under the supervision of a geotechnical engineer. The boreholes were drilled using auger or rotary drilling methods to the bedrock surfaces, 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. Point load strength index tests were also undertaken on the recovered rock core at typical intervals of 1.0 m. The bores were taken to depths of between 10.8 m and 16.0 m.

Groundwater monitoring wells or standpipes were installed in three of the boreholes; Bores 101, 103 and 106. The wells were installed with screen lengths within the bedrock, backfilled with a gravel pack, then with a bentonite seal above the screened length. Where the original cored borehole was taken to greater depth, the cored length below the standpipe screened was sealed by bentonite. Spoil (ie cuttings) was used to backfill the standpipe above the bentonite to near ground surface level, and the standpipe was finished at ground surface with a Gatic cover, concreted in place. The bentonite seal is intended to isolate surface water inflow and shallow 'perched' groundwater flows from the screened length of the borehole.

Following the installation of the standpipes, they were purged by pumping to remove drilling fluid from the standpipe. A follow-up visit was then undertaken to obtain a groundwater level (following stabilisation of the water levels after purging) and to perform a rising head permeability test at Bore 106, only. The standpipe at Bore 103 was destroyed by site works shortly after installation and purging of the standpipe, prior to any measurements.

The investigation was undertaken in conjunction with investigations for the nearby C3 and C4 sites, which included investigation using similar small-diameter boreholes, in similar geology and the installation of additional standpipes downslope of the C2 site.

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

Test locations and ground surface levels at test locations were determined relative to Australian Height Datum (AHD) by high precision differential GPS equipment, as per the previous test locations.

The locations of the bores and monitoring wells (ie standpipes) are shown in Drawing 201, in Appendix B, together with other boreholes drilled nearby during the current and previous investigations.

6.2 Field Work Results

The detailed results of the field work for site C2 are given in Appendix C of this report, together with relevant notes on classification terms, symbols and abbreviations. The results of point load tests are included at the relevant depths on the borehole logs and photographs of the rock cores are included with the borehole logs.

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

- **Fill** – variable fill, including concrete, gravelly sand and clay, of apparently variable compaction, to depths of 0.2 m to 1.2 m; underlain by,
- **Sandy Clay and Clayey Sand** – residual soil, typically stiff and very stiff or dense, to depths of 1.5 m to 3.2 m, absent at some locations; underlain by,
- **Sandstone** – variable, typically fractured to highly fractured, very low to medium strength, but including extremely low strength bands, to depths of 1.9 m to 4.3 m; underlain by, typically fractured to slightly fractured, low and medium strength to depths of 3.5 m to 7.3 m; underlain by, typically slightly fractured to unbroken, medium and high strength, with occasional very high strength bands (eg Bores 103, 07 and 117) to the limit of investigation.

No groundwater was observed whilst augering at the borehole locations. Measurement at the standpipes, after allowing the wells to stabilise following purging, indicated groundwater at a depth of:

- 7.3 m (RL 46.8) at Bore 101, with a screen interval from 8.0 m to 11.0 m; and
- 4.93 m (RL 44.6) at Bore 106, with a screen interval from 8.0 m to 11.0 m.

These levels are shown on the relevant borehole logs.

The results of the groundwater measurements from the current investigation are summarised with together with previous groundwater measurements in the vicinity of the Stage 2 development area of the Midtown site, in Table D1, in Appendix D.

The results of the rising head permeability test at Bore 106 are summarised in Appendix C, together with the base calculations associated with the rising head permeability calculation. A hydraulic conductivity of $3x10^{-8}$ m/s was estimated from the testing at Bore 106, which is considered to be consistent with the fresh sandstone with limited defects logged in the screened depth.

The results of the field work were generally consistent with the results of previous investigations, although higher groundwater levels were indicated by the current investigation when compared to interpolated levels from previous investigations.

7. Comments

7.1 Geotechnical and Hydrogeological Model

7.1.1 Geotechnical Model

An interpreted geological model has been developed for the C2 site, based on the results of current and previous field work. The model is summarised in Table 1.

Table 1: Simplified Geotechnical Model

Unit	Summary	Typical Description
1	Fill	Variable fill, including gravelly sand and clay soils, to depths of up to approximately 1.5 m, but possibly deeper in areas of stockpiles, recent earthworks and past services
2	Residual Soil	Stiff to very stiff sandy clay and clayey sand, with trace iron-indurated bands, often grading into hard clay and dense clayey sand (extremely weathered sandstone), to depths of 1.5 m to 3.5 m, where present, though absent at some locations.
3a	Sandstone – Variable	Typically very low to low strength, but with extremely low (soil strength), medium and high strength bands, highly weathered, typically fractured to highly fractured sandstone
3b	Sandstone – Low and Medium Strength	Typically low and medium strength, highly to slightly weathered, fractured and slightly fractured sandstone with some highly fractured fractured bands. This layer is only distinct at the upslope side of the site, and is apparently absent due to deeper weathering at the downslope side of the site.
3c	Sandstone – Medium and High Strength	Typically medium and high strength, with possible very high strength bands moderately weathered to fresh, slightly fractured with some fractured and unbroken length. This unit includes significant beds of high strength sandstone at some boreholes, but has been distinguished from Unit 3d by weathering.
3d	Sandstone – High Strength	Typically high strength, fresh, slightly fractured to unbroken, but with some very high strength bands (Bores 07, 103)

The above interpreted units are shown in relation to the C2 boreholes and site levels in the Interpreted Geotechnical Cross-Sections of Drawings 202 to 204, in Appendix B. Some boreholes have been cropped near the base of the section drawings, with the information to greater depth provided in the borehole logs. It should be noted that the subsurface profile is accurate only at the borehole locations, and that substantial variation can occur in between and away from the boreholes. The interpreted geotechnical boundaries are for illustrative purposes and should not be relied upon.

Previous investigation by DP in the general vicinity of the site have also indicated the presence of dykes and thrust faults, which are considered likely to be encountered at the greater Midtown site, though investigations to date have not confirmed their presence. They are nonetheless considered a possible presence at the C2 area.

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

- **Dykes** – Dykes may be present on this site. Dykes have been identified by previous DP experience on sites to the north-east of the site and in the geological mapping north-west of the site. Both of these dykes may project to near the site, but given that dykes may "step" or "fork" in plan, they may potentially 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;

- **Thrust Faults –** Thrust faulting, often associated with dykes, have been previously identified on nearby sites. A photograph showing the subsurface profile exposed by bulk excavation at a recently developed site to the north-west of the greater Midtown site, is included in Figure 2.

Figure 2: Back thrusts in an excavation wall at a nearby site

These features are of limited lateral extent and may be present but remain undetected by even significant geotechnical investigation. If encountered, 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 Hydrogeological Model

The hydrogeology at the C2 site, in the depth of interest, can be characterised by the following:

- A temporary, 'perched' groundwater, or seepage, 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. Some ephemeral seepage may also migrate through defects within the rock; and
- Long-term groundwater levels, at depth, within the sandstone. These water levels are expected to respond to climatic and weather variations, which would be expected to be reflected by natural fluctuations in groundwater levels. 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.

The existing, and past standpipes were installed with bentonite seals to limit the influence of the 'perched' groundwater on standpipe measurements. These measurements within the bedrock are therefore generally considered to reflect the groundwater levels within bedrock.

Due to the damage to Bore 103 shortly after installation, only groundwater levels at Bores 101 and 106 are known within the site, where water levels were measured at 7.3 m (RL 46.8) and 4.9 m depth (RL 44.6), respectively. An interpreted water table at the site, based on these measurements, is shown in Drawing 203, in Appendix B.

Natural groundwater fluctuations in the order of 1.5 m are suggested by comparison of previous water level monitoring at standpipes at the (now destroyed) Bore 07 and recent measurements in the standpipe at the nearby Bore 101, with the recent groundwater levels being at the upper end of the measured range, approximately 1 m above previous monitored levels. The contrast in measured levels at these locations illustrated in Drawing 204, with the interpreted water table reflecting recent measurements.

7.2 Excavation

The proposed Ground Floor Level is at approximately RL 49.5 and the Basement Floor Level is at RL 47.1. Excavation of up to approximately 0.5 m below these levels is anticipated for bulk excavation levels, although this has not been confirmed.

Based on the existing information, excavation of up to approximately 4.5 m to 7.5 m below existing ground levels (for Ground Level and Basement Level excavations, respectively) is anticipated, with the greatest excavation at the north-western side of the site, but reducing to less than 1 m of excavation at the eastern corner.

Reference to the results of the geotechnical investigation indicates that the excavation will extend through fill and natural soils (Units 1 and 2) and into sandstone bedrock. Within the sandstone, excavation is expected to proceed through variable strength (Unit 3a), then through generally low and medium strength (Unit 3b) into medium and high strength sandstone (Unit 3c). This may include excavation through significant beds of unbroken, high strength sandstone.

Materials in Units 1, 2 and 3a are likely to be readily excavated using conventional earthmoving equipment (eg bulldozers and hydraulic excavators, with some rock hammering of stronger bands within the variable sandstone). Medium and high strength sandstone (Unit 3c) is likely to require excavation by ripping tynes mounted on large bulldozers (eg D12 or larger), large rock hammers, rock saws and milling heads. Productivity would slow if very high strength bands are encountered (see Bores 07 and 103, though these bands are in Unit 3d, below the depth of excavation). Excavation into the typically fractured low and medium strength sandstone of Unit 3b 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 medium and higher strength bands within the unit, and defects within the rock.

The excavatability of the medium and high strength (Unit 3c) bedrock will be governed by the defects within the rock mass. Based on the rock cores, the rock in this unit frequently includes bed spacings of more than 1 m, although more fractured zones are also present. In general the excavation of high strength sandstone (which is a significant proportion of the Unit 3c sandstone), is likely to be difficult and slow, with low productivity and high hammer/tyne wear expected.

7.2.1 Vibrations

Significant vibrations are anticipated during excavation within low to high strength bedrock. Excavation methods may therefore be limited by acceptable vibration levels, particularly if the new services installed in the adjacent roads are sensitive to vibrations. At this stage, no buildings are within 50 m of the site, but depending on the staging of other site works, consideration may also need to be given to other structures, particularly if they are occupied at the time of the works. Acceptable vibration levels should therefore be confirmed with the asset owners prior to excavation.

The limit may need to be adjusted to reflect the asset requirements, response of neighbouring structures during excavation and vibration dosage once the neighbouring building is occupied.

A vibration trial may be required to size equipment at the commencement of excavation into rock. The trial may indicate that minimum offset distances are required from vibration-sensitive assets for the preferred plant, or that alternative excavation methods or equipment are required.

Where a vibration trial indicates that the equipment may potentially exceed vibration levels, or where buildings or occupants are otherwise sensitive to vibration levels, consideration could be given to continuous vibration monitoring during the works. These monitors may be set up to activate a flashing ‘alarm’ light, or send text messages, if pre-set vibration levels are exceeded during the work.

7.2.2 Batters

Batters or excavation support will be required for excavations through soil and extremely low to very low strength sandstone, and fractured low and medium strength rock (ie Units 1, 2, 3a and 3b),

Preliminary safe batter slopes are provided in Table 2, for temporary 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.

Table 2: Preliminary Safe Batter Slopes for Batter Slopes ≤ 3 m Height

Unit	Material	Maximum Temporary Safe Batter Slope (Horizontal:Vertical)
1	Fill	2:1
2	Residual Soil	1.5:1
3a	Sandstone – Variable	1:1
3b	Sandstone – Low and Medium Strength	0.5:1
3c	Sandstone – Medium and High Strength	Vertical

Batters higher than 3 m, steeper batters, or batters subject to surcharges behind the crest (within an exclusion zone equal to the height of the batter, extending back from the crest), adjacent sloping ground or seepage would generally require more detailed geotechnical assessment.

Permanent batters may be used as part of the landscaping works connecting the park area to the neighbouring road reserves. Flatter batters are generally required for the permanent case, and it is suggested that permanent batters be no steeper than 3 (Horizontal): 1 (Vertical), assuming that the slope is formed in natural clay, bedrock or engineered fill. More detailed slope stability assessment may be required if such permanent slopes are more than 3 m in height or will experience significant surcharges near the crest of the slope.

All batter slopes should be subject to inspection by an experienced geotechnical professional at maximum 1.5 m drops. Flatter or steeper slopes may be required, depending on the results of assessment. Protection for the face of the batter slope may also be required to reduce the risk of loose materials falling into the excavation below.

Within the medium and high strength sandstone (Unit 3c) the rock is likely to be able to be cut vertically and stand unsupported, even for cut depths greater than 3 m, but subject to regular defect and localised stability assessment by an experienced geotechnical professional, at drops no greater than 1.5 m. This may indicate that additional local support (eg bolts or anchors) and/or shotcrete is required due to adverse jointing or other defects.

7.2.3 Waste Classification

All excavated materials will need to be disposed of in accordance with the provisions of the current legislation and guidelines including the Waste Classification Guidelines (EPA, 2014). This includes fill and natural materials that may be removed from the site.

7.3 Shoring/Retaining Walls

7.3.1 General

Shoring will be required where the rock strength or condition is unsuitable for vertical excavation, and conditions are unsuitable for batters. Shoring is therefore anticipated along the north-eastern and south-western boundaries, to support the higher levels of the road reserve as site levels are excavated down to the proposed Ground Level and, locally, to the proposed Basement Level. Shoring depths of 3 m to 4 m, or up to 6 m to 7 m in basement areas, are anticipated.

Soldier pile shoring walls are considered suitable for this site, with walls taken down through the Unit 1, 2, 3a and 3b material to socket in or bear on at least medium strength, slightly fractured sandstone (ie Unit 3c) with infill shotcrete panels constructed between the piles as excavation proceeds. Typical soldier pile spacings at 2 m to 2.5 m are likely to be suitable for the support of the natural clay soils and weathered rock above the groundwater table, but closer spacings may be required to control deflections, particularly if cantilevered walls are proposed.

Bored, concrete piles would be suitable for the construction of shoring piles at this site, although casing may be required for drilling through filling and possibly soil materials, to prevent side wall material falling into the pile excavation. A heavy-duty, high torque drilling rig is likely to be required to obtain significant

socket (ie embedment) into medium and high strength sandstone, as is expected at this site, particularly given the medium and high strength bands present in some areas in the Unit 3b material. DP note that while some significant bands of medium strength materials are present in the Unit 3b material (eg at Bore 103), the investigation results suggest that these layers are fractured to slightly fractured, with some relatively steep defects, and that the medium strength bands are relatively discontinuous across the site.

Given the depth of excavation, anchors would generally be required to provide temporary lateral support to the shoring wall, with final support provided by the basement structure. At the north-eastern boundary, the building will only extend along a short length of wall (at the northern end). Beyond the building, and cantilevered soldier pile walls may be required to support the (expected up to 3 m to 4 m) high walls in the long-term.

Inspections are recommended during the pile excavation to allow for geotechnical assessment of the foundation material, deepening of the piles where necessary, and advance notice of areas where poorer ground conditions are present. Inspections of the exposed rock face between soldier piles during excavation is also recommended at 1.5 m drops, prior to placement of mesh and shotcrete, to allow assessment of possible steep joints or defects which might require additional support.

If encountered, the presence of dykes or thrust faulting may result in locally poorer rock conditions, which may lead to additional support being required in some areas of the site. 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 is determined during an earlier stage of works at the site.

7.3.2 Shoring Design

For a shoring wall in clay and sandstone supported by multiple rows of anchors or props, preliminary design may be based on a uniform rectangular pressure distribution of 4H (where H is the wall height in metres, and pressure is in kPa), provided that deflections are not a concern. Where walls are constructed close to existing deflection-sensitive structures or utilities, a pressure of between 6H and 8H should be considered, depending on the sensitivity of the utilities and the soil profile to be retained. Higher pressures would be appropriate where batters (ie sloping ground) is present above the wall, or where concentrated loads are proposed behind the wall.

For a cantilevered shoring wall, or wall supported by a single row of anchors/struts, preliminary design may be based on a triangular pressure distribution, using the parameters given in Table 3. The parameters assume lateral movement of the wall is permitted, 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 3: Preliminary Design Parameters for Shoring Retaining Walls

Unit	Material	Unit Weight (kN/m^3)	Earth Pressure Coefficient/Value	
			Active	Passive
1	Fill	20	0.4	-
2	Residual Soil	20	0.3	2
3a	Sandstone – Variable	22	0.25	200 kPa
3b	Sandstone – Low and Medium Strength	22	0.2	400 kPa
3c	Sandstone – Medium and High Strength	24	0	4000 kPa

Note: Additional support may be required due to defects, subject to inspection of faces. Ultimate passive pressures - an appropriate factor of safety (of at least 2) should be applied to these values for design, particularly if deflections are to be limited.

Where deflections are to be controlled, the use of 'at rest' earth pressure coefficients 50% greater than the active earth pressure coefficients are recommended.

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

The 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 sequence (eg Wallap, Flac, Plaxis.)

Allowance should be made for the provision of drainage behind retaining structures, or alternatively the walls should be designed for full hydrostatic pressures. Appropriate drainage (eg strip or core drains) should be included to prevent hydrostatic water levels rising above the design hydrostatic level of the shoring/retaining wall design.

For piled wall systems terminating above the bulk excavation level it may be necessary, depending on the design of wall restraint, to install 'toe bolts' or anchors at the base of each pile for stability purposes.

7.3.3 Anchor Design

The preliminary design of anchors may be based on the bond strengths indicated in Table 4.

Table 4: Parameters for Preliminary Anchor Design

Material	Ultimate Bond Strength
Variable sandstone (Unit 3a)	100 kPa
Low and medium strength sandstone (Unit 3b)	300 kPa
Medium and High strength Sandstone (Unit 3c)	1000 kPa

The above values assume that the anchor holes are adequately cleaned and free of clay smear. It would be appropriate for these values to be confirmed by the anchoring contractor based on their specific

installation methods and experience, and for the rock conditions encountered during anchor installation at the site. Pull-out tests may be appropriate if higher bond values are to be adopted.

After installation, all temporary anchors should be proof loaded to 125% of the nominal working load, then locked off at 70% of the working load. For anchors supporting any structures on the boundaries, lock off values should be 90% of the working load. Checks should also be made at regular intervals to ensure that load is maintained in anchors and not lost due to creep effects.

While it is expected that the adjacent sites will be under the control of the developer at the time of construction, appropriate permissions from adjacent landowners would be required if support measures (eg anchors) are proposed across site boundaries. Anchors should also be de-stressed following the provision of permanent lateral support by the basement structure.

7.3.4 Shoring Wall and Excavation Movement

Typical horizontal movements in the order of 0.15% of the wall height would be expected for a well-constructed and designed, high stiffness shoring wall (ie with multiple rows of anchors), but depending on the excavation and support sequence and support provided. For a 6 m high shoring wall, this corresponds to approximately 10 mm movement.

In addition to retaining wall movements, basement excavations into medium and high strength 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 and 2 mm per metre depth of excavation into medium and high strength sandstone, at the midpoint of the excavation. It is not practical to provide restraint against stress-relief movements, and appropriate allowance should instead be made for such movements in construction and planning.

Survey monitoring of the excavation and retaining walls would generally be appropriate to assess movement of any shoring walls during excavation, particularly where any deflection-sensitive structures or services are present behind the walls.

7.4 Groundwater

As can be seen from Drawing 203 and Drawing 204 in Appendix B, the proposed basement floor levels are above the measured groundwater levels, within bedrock. In addition, given that the (upslope) C1 site will have a similar basement level, it is expected that most groundwater seepage from elevated groundwater levels would be intercepted by that basement.

Therefore, no permanent groundwater inflows are anticipated, although some ephemeral seepage may still occur through defects within the rock and allowance should be made for drainage of these inflows.

From a practical perspective, the anticipated ephemeral groundwater seepage into the basement excavation is likely to be readily managed using ‘sump-and-pump’ methods, in the temporary and long-term case. This is consistent with DP experience with similar excavations near the subject site.

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.

While not identified by the current investigation, dykes or thrust faults may be associated with significantly increased permeabilities if encountered during excavation. Further assessment may be required if these are encountered during the excavation works.

7.5 Foundations

At the proposed the building, the footprint is expected to be excavated into Unit 3b (low and medium strength) and Unit 3c (medium and high strength) sandstone. Given the relatively low loads expected for a two storey building shallow foundations are expected to be adopted to support the building loads.

Preliminary rock classification of the sandstone below RL 40 at the subject bores has been undertaken for foundation performance based on Pells et al (1998) and summarised in Table 5. These classifications are for foundation performance only, and accordingly the rock 'strength' has been downgraded due to defects. A 1.0 m plan dimension has been assumed to perform the classification.

Table 5: Sandstone Foundation Classification at Bore Locations from RL49 to RL44

Sandstone Class	RL at Bore						
	101	102	103	106	06	07	08
III/IV	49.0	49.0	49.0	47.0	49.0	49.0	47.8
II/III	45.6	47.1	-	-	47.8	49.0	46.7

Note: The classification is based on an interval of rock below the foundation level, with the interval dependent on the plan dimension of the footings.

As can be observed in the above table, a range of allowable bearing pressures may be adopted, though higher classifications may be more difficult to achieve on site, and so require additional excavation and/or re-design during the construction stage, depending on local conditions.

Maximum allowable bearing pressures for the design of shallow foundations founded on sandstone below bulk excavation level are provided in Table 6. These values assume that the foundations are in a confined state, and lower values (generally 50% of those given in Table 6) would apply where foundations are above a line drawn up at 45 degrees from the corner of adjacent basement excavations, and provided that geotechnical assessment is undertaken to assess the presence of adversely oriented defects that may daylight in the C1 excavation.

Table 6: Foundation Design Parameters (Confined Foundation State)

Sandstone Class	Allowable Bearing Pressure[1,2] (MPa)	Ultimate Bearing Pressure[2,3] (MPa)	Typical Youngs Modulus (MPa)	Minimum Additional Testing / Requirements[4]
III/IV	3.5	15	350	-
II/III	6	40	900	Spoon testing of 1/3 of footings

Note: 1. Allowable pressures assume a confined state, and allowable settlements of less than 1% of the minimum footing plan dimension. Alternative, settlements can be estimated for the proposed load based on the typical Youngs Modulus.

2. All bearing pressures may be limited by defects, or lack of confinement, 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 current or future excavations are present below an imaginary 'influence' line drawn at 1H:1V down from the edge of the footing. Such excavations would require inspection to confirm that adverse jointing is not present, and reduced values may apply.

3. Ultimate values assume settlement of more than 5% to 10% of the minimum footing plan dimension.

4. Geotechnical inspection of all footing excavations is recommended to confirm that the material is consistent with the design requirements; the minimum testing is to provide additional information on defects to confirm that foundation performance is as expected. Additional or lesser testing may be warranted, subject to the results of initial foundation testing and depending on the design bearing pressures.

All foundations should be inspected by a geotechnical professional following excavation and cleaning, to confirm that the foundation material is consistent with the design requirements.

Spoon testing should be carried out in at least one third of all footings that are designed for an allowable end bearing capacity of more than 3.5 MPa. Spoon testing involves drilling a 50 mm diameter hole below the base of the footing, to a depth of at least 1.5 times the footing width, with the hole left full of water for 24 hours prior to testing to check for the presence of weak/clay bands. If excessive weak seams are detected then the foundation capacity may need to be downgraded, or the footings taken deeper to reach suitable foundation material.

Should thrust faults or dykes be identified near foundation level then the foundation parameters given in Table 6 may not be achieved, and re-design may be required in the affected area to suit to the conditions encountered.

7.6 Earthworks and Site Preparation

The potential use of batters within the C2 site, to reduce retention requirements at the neighbouring C3 site, would likely require backfill in the C2 site to achieve the final park levels. A retaining wall would also be required to support the backfilled soil against the new C3 basement. It is expected that permanent lateral support for the retaining wall would be provided by that basement.

In order to limit settlement of the replaced fill and long-term loads on the retaining wall, it is recommended that the backfilled material be placed as engineered fill.

To allow compaction, therefore, the batter slope should be cut into a series of level benches, to facilitate compaction of placed filling. The precise compaction requirements would depend on the proposed loads for the filling, proposed backfill and height of fill, and requirements of any services, if present in the backfill area. Careful control of compactive loads behind the wall will be required to avoid excessive loading of the retaining structure.

'Level 1' testing of filling, in accordance with AS3798-2007 is recommended if the filling is to be used for the support of any structures.

8. References

Pells, P. J., Mostyn, G., & Walker, B. F. (1998). Foundations on Sandstone and Shale in the Sydney Region. *Australian Geomechanics, No 33 Part 3*, 17-29.

9. Limitations

Douglas Partners (DP) has prepared this report for this project at Midtown, Macquarie Park in accordance with the Consultancy Services Agreement dated 26 April 2021, and approved variations. 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 on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. 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 field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

The assessment of atypical safety hazards arising from this advice is restricted to the geotechnical components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

This report must be read in conjunction with all of the attached 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 investigation/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.

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

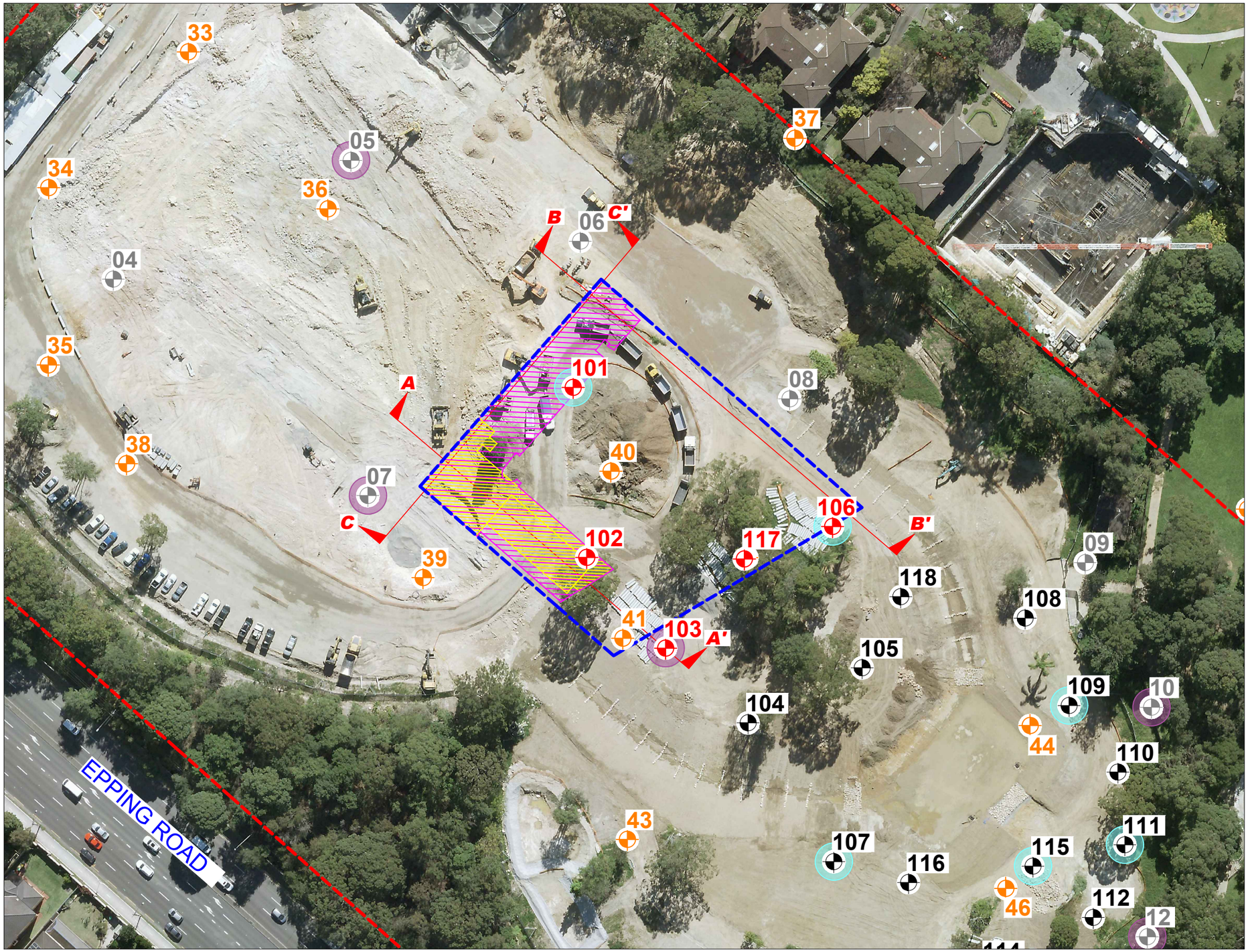
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate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

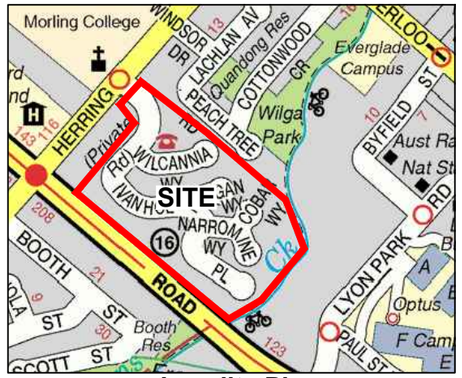
Site Inspection

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





Locality Plan

LEGEND

- Borehole Location
- Cored Bore Location (2021, Beyond C2 Site)
- Previous (2017) Cored Bore Location
- Previous (2017) Shallow Cored Bore Location
- Standpipe Location (Current)
- Standpipe Location (Damaged or Missing)
- C2 Area Boundary
- Greater Midtown Site Boundary
- Approximate Proposed Building Footprint
- Approximate Proposed Basement and Pool Footprint

NOTE:
1: Base image from MetroMap (Dated 15.04.2021)

0 10 20 30 40 50 75 100m
1:1000 @ A3

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Frasers Property Ivanhoe Pty Ltd		TITLE: **Test Location Plan - C2 Site** **Proposed Residential Development** **Midtown, Macquarie Park**
OFFICE: Sydney	DRAWN BY: PSCH/MG	
SCALE: 1:1000 @ A3	DATE: 21.05.2021	

PROJECT No: 86043.06
DRAWING No: 201
REVISION: 0

A

A'

07
Offset - 19.0m
Rock Strength
EL VL L M H VH EH
N = 28

102
Offset 4.5m
Rock Strength
EL VL L M H VH EH

103
Offset 0.1m
Rock Strength
EL VL L M H VH EH

APPROXIMATE SITE BOUNDARY WITH C1

APPROXIMATE SITE BOUNDARY WITH C3

Excavation Commenced for C1 Site

3b - Sandstone (Low & Medium Strength)

1 - FILL

refusal

3a - Sandstone (variable)

3b - Sandstone (Low & Medium Strength)

refusal

GROUND LEVEL RL 49.5 m

BASEMENT LEVEL RL 47.1 m

3c - Sandstone (Medium and High Strength)

3d - Sandstone (High Strength)

Bottom Depth 21 m

Bottom Depth 10.8 m

Borehole Continues to 17.1 m

ELEVATION (AHD)

58 56 54 52 50 48 46 44 42 40 38

-20 0 20 40 60 80 100 120

DISTANCE ALONG PROFILE (m)

LEGEND

- Core Loss
- Clay
- Concrete
- Filling
- Sandstone
- Sandstone coarse grained
- Sandstone fine grained

NOTES:
1. Subsurface conditions are accurate at the borehole locations only. Variations in subsurface conditions may occur between borehole locations. Interpreted strata boundaries are approximate and should be used as a guide only.
2. Summary logs only and should be read in conjunction with detailed logs.
3. Horizontal and vertical scales are not equal.

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

TESTS / OTHER
- N - Standard penetration test value
- — ? — - Interpreted geotechnical boundary
- ▽ - Water level

0 8
Horizontal Scale (metres)
Vertical Exaggeration = 4.0

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Frasers Property Ivanhoe Pty Ltd		TITLE: **Interpreted Geotechnical Cross-Section A-A'**	PROJECT No: 86043.06
OFFICE: Sydney	DRAWN BY: MG	**Proposed Stage 2 Development - C2 Site**	DRAWING No: 202
SCALE: 1:400 (H) 1:100 (V) @ A3	DATE: 19.05.2021	**Midtown, Maquarie Park**	REVISION: 0

B

B'

ELEVATION (AHD)

58
56
54
52
50
48
46
44
42
40
38

APPROXIMATE SITE BOUNDARY WITH C1

APPROXIMATE SITE BOUNDARY WITH C3

06
Offset 8.0m
Rock Strength
EL VL L M H VH EH
N = 11
Borehole Continues to 17.25 m

101
Offset - 20.1m
Rock Strength
EL VL L M H VH EH
N = 12
refusal
Bottom Depth 11 m

08
Offset 11.5m
Rock Strength
EL VL L M H VH EH
N = 14
Bottom Depth 5.1 m

117
Offset - 24.8m
Rock Strength
EL VL L M H VH EH
N = 10
Borehole Continues to 16 m

106
Offset - 4.1m
Rock Strength
EL VL L M H VH EH
N = 23
Borehole Continues to 13.8 m

GROUND LEVEL
RL 49.5 m

1 - FILL

2 - NATURAL SOIL

3a - Sandstone (variable)

3b - Sandstone (Low & Medium Strength)

3c - Sandstone (Medium and High Strength)

-20 0 20 40 60 80 100 120

DISTANCE ALONG PROFILE (m)

LEGEND

- Core Loss
- Clay
- Clayey Sand
- Filling
- Sandstone
- Sandstone coarse grained
- Sandstone fine grained
- Sandy Clay

NOTES:
1. Subsurface conditions are accurate at the borehole locations only. Variations in subsurface conditions may occur between borehole locations. Interpreted strata boundaries are approximate and should be used as a guide only.
2. Summary logs only and should be read in conjunction with detailed logs.
3. Horizontal and vertical scales are not equal.

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

TESTS / OTHER
N - Standard penetration test value
— ? — — - Interpreted geotechnical boundary
- Water level

0 8
Horizontal Scale (metres)
Vertical Exaggeration = 4.0

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Frasers Property Ivanhoe Pty Ltd		TITLE: **Interpreted Geotechnical Cross-Section B-B'**	PROJECT No: 86043.06
OFFICE: Sydney	DRAWN BY: MG	**Proposed Stage 2 Development - C2 Site**	DRAWING No: 203
SCALE: 1:400 (H) 1:100 (V) @ A3	DATE: 19.05.2021	**Midtown, Maquarie Park**	REVISION: 0

C

C'

07

Offset 9.7m

Rock Strength

EL VL L M H VH EH

N = 28

101

Offset - 11.2m

Rock Strength

EL VL L M H VH EH

N = 12

refusal

06

Offset 10.4m

Rock Strength

EL VL L M H VH EH

N = 11

Excavation Commenced for C1 Site

NEIGHBOURHOOD STREET

APPROXIMATE BOUNDARY WITH NEIGHBOURHOOD STREET

APPROXIMATE BOUNDARY WITH MAIN STREET

MAIN STREET

GROUND LEVEL RL 49.5 m

BASEMENT LEVEL RL 47.1 m

1 - FILL

2 - NATURAL SOIL

3a - Sandstone (variable)

3b - Sandstone (Low & Medium Strength)

3c - Sandstone (Medium and High Strength)

3d - Sandstone (High Strength)

Bottom Depth 21 m

Bottom Depth 11 m

Borehole Continues to 17.25 m

ELEVATION (AHD)

58 56 54 52 50 48 46 44 42 40 38

-20 0 20 40 60 80 100 120

DISTANCE ALONG PROFILE (m)

LEGEND

- Core Loss
- Clay
- Clayey Sand
- Filling
- Sandstone
- Sandstone coarse grained
- Sandstone fine grained
- Sandy Clay

NOTES:

1. Subsurface conditions are accurate at the borehole locations only. Variations in subsurface conditions may occur between borehole locations. Interpreted strata boundaries are approximate and should be used as a guide only.
2. Summary logs only and should be read in conjunction with detailed logs.
3. Horizontal and vertical scales are not equal.

ROCK STRENGTH

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

TESTS / OTHER

- N - Standard penetration test value
- — ? — — - Interpreted geotechnical boundary
- ▽ - Water level

0 8

Horizontal Scale (metres)

Vertical Exaggeration = 4.0

Douglas Partners

Geotechnics / Environment / Groundwater

CLIENT: Frasers Property Ivanhoe Pty Ltd		TITLE: **Interpreted Geotechnical Cross-Section C-C'**	PROJECT No: 86043.06
OFFICE: Sydney	DRAWN BY: MG	**Proposed Stage 2 Development - C2 Site**	DRAWING No: 204
SCALE: 1:400 (H) 1:100 (V) @ A3	DATE: 19.05.2021	**Midtown, Maquarie Park**	REVISION: 0

Appendix C

Results of Field Work

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Stage 2 Development
LOCATION: Midtown, Maquarie Park

SURFACE LEVEL: 54.1 AHD
EASTING: 325595.2
NORTHING: 6260428.6
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 86043.06
DATE: 22/4/2021
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
54	0	FILL/Gravelly SAND: fine to medium, dark grey, fine to medium igneous gravel, dry										
	0.6	Sandy CLAY CI: medium plasticity, yellow-brown mottled red-brown, fine to medium sand, w<PL, stiff, residual							A			
53	1								S			3,5,7 N = 12
	1.9	Clayey SAND SC: fine to medium sand, pale grey and red-brown, trace iron indurated bands, moist, very dense, extremely weathered Hawkesbury Sandstone							S			20,24,25/130 mm refusal
52	2											
51	3											
	3.15	SANDSTONE: fine to medium grained, pale grey and red-brown, very low to medium strength with an extremely low strength band, highly weathered, fractured, Hawkesbury Sandstone						3m: CORE LOSS: 150mm 3.15m: Cs 10mm 3.2m: Fg 100mm 3.33m: J90°, pl, ti 3.43m: Ds 130mm 3.62m: Cs 10mm 3.92m: J90°, un ro, cln	C	65	0	
50	4											PL(A) = 0.06
	4.3	SANDSTONE: fine to medium grained, orange-brown and pale grey, medium strength, moderately weathered to fresh, fractured to slightly fractured, Hawkesbury Sandstone						4.2m: J90°, un, ro, cln 4.32m: B0°, pl, cly 1mm 4.33m: B0°, pl, ro, fe stn 4.73-4.75m: B0° (x2), pl, sm, cly vn	C	100	35	PL(A) = 0.7
49	5											
	5.07							5m: CORE LOSS: 70mm 5.07m: Cs 50mm 5.12m: B0°, pl, ro, fe stn 5.15m: J90°, cu, fe he 5.32-6.14m: B0°-5° (x8), pl, ro fe stn				
		Between 5.8-6.2m: low strength										PL(A) = 0.26
48	6								C	98	90	
		Between 6.8-8.0m: medium to high strength										PL(A) = 0.95
47	7					11-05-21						
	8.0							7.64m: B0°, pl, ro, cln 7.75m: B0°, pl, ro, cbs				PL(A) = 1.5
46	8.03							co 8m: CORE LOSS: 30mm				
	8.47	SANDSTONE: medium to coarse grained, orange-brown then pale grey, high strength, moderately weathered to fresh, slightly fractured, Hawkesbury Sandstone						8.14m: B0°, pl, ro, cly vn 8.40-8.45m: B0°-5° (x5), pl, ro, fe stn & he	C	99	92	PL(A) = 1.7
45	9							9.2m: B5°, pl, ro, cln 9.44m: B5°, pl, ro, cly vn				
								9.85m: Cs 10mm (x2)				PL(A) = 1.4

RIG: Explora **DRILLER:** JD **LOGGED:** TM **CASING:** HW to 2.5m, HQ to 3.0m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.5m; Rotary to 3.0m; NMLC-Coring to 11.0m; PCD to 11.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Groundwater well installed to 11.0m (screen 11.0-8.0m; blank 8.0-0.0m; gravel 11.0-7.5m; bentonite 7.5-7.0m; backfill to GL; gatic at surface); Coordinates and surface levels obtained from differential GPS

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 Stage 2 Development
LOCATION: Midtown, Maquarie Park

SURFACE LEVEL: 54.1 AHD
EASTING: 325595.2
NORTHING: 6260428.6
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 86043.06
DATE: 22/4/2021
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: medium to coarse grained, orange-brown then pale grey, high strength, moderately weathered to fresh, slightly fractured, Hawkesbury Sandstone *(continued)*						10.15m: J70°, pl, fe he	C	99	92	PL(A) = 1.5
43	11 11.0	Bore discontinued at 11.0m Target depth reached										
42	12											
41	13											
40	14											
39	15											
38	16											
37	17											
36	18											
35	19											

RIG: Explora **DRILLER:** JD **LOGGED:** TM **CASING:** HW to 2.5m, HQ to 3.0m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.5m; Rotary to 3.0m; NMLC-Coring to 11.0m; PCD to 11.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Groundwater well installed to 11.0m (screen 11.0-8.0m; blank 8.0-0.0m; gravel 11.0-7.5m; bentonite 7.5-7.0m; backfill to GL; gatic at surface); Coordinates and surface levels obtained from differential GPS

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

BORE: 101 PROJECT: MACQUARIE PARK APRIL 2021

3.00 – 7.00m

BORE: 101 PROJECT: MACQUARIE PARK APRIL 2021

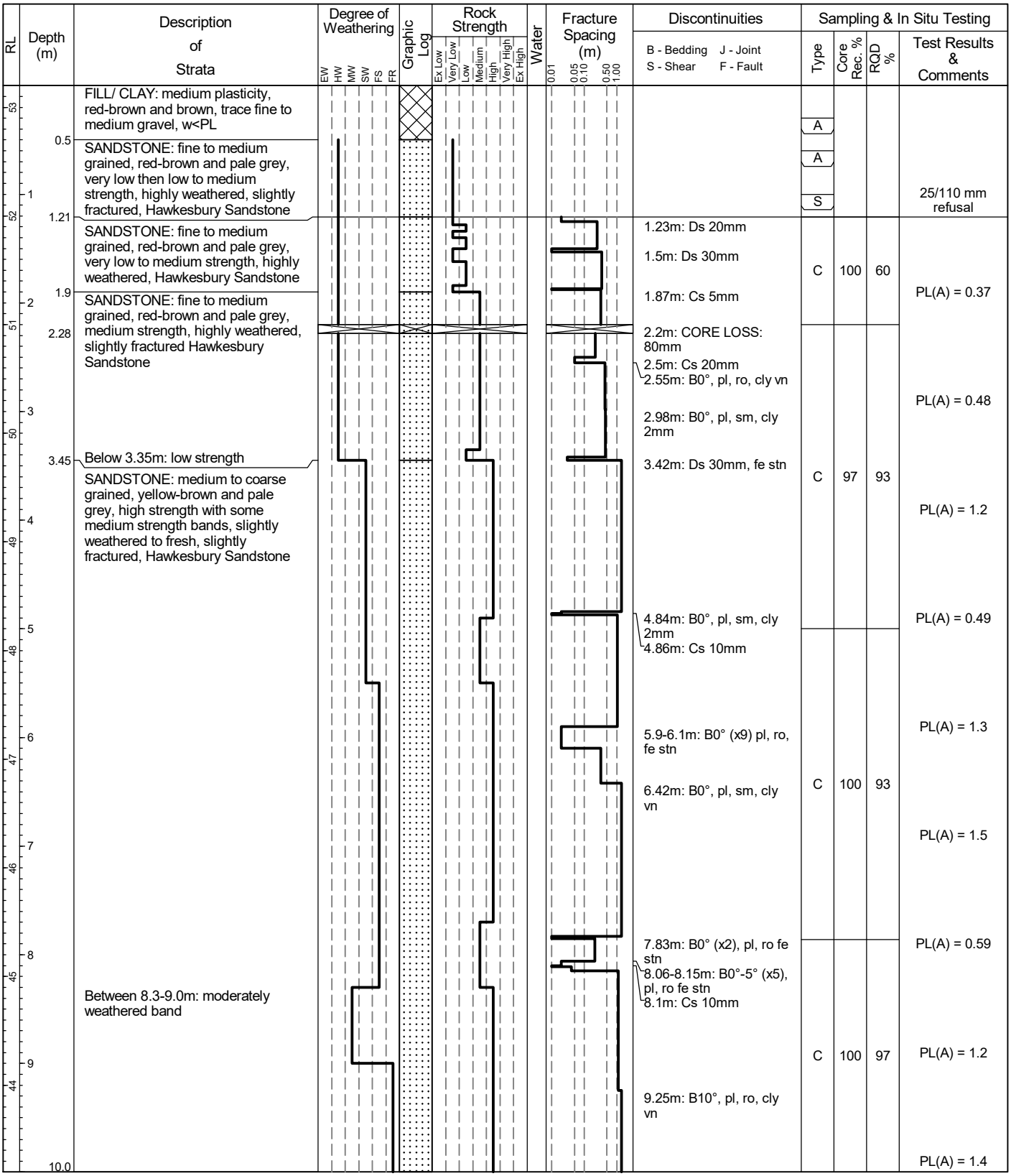
7.00 – 11.00m

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Stage 2 Development
LOCATION: Midtown, Maquarie Park

SURFACE LEVEL: 53.2 AHD
EASTING: 325598.5
NORTHING: 6260387.2
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 86043.06
DATE: 22/4/2021
SHEET 1 OF 2



RIG: Explora **DRILLER:** JD **LOGGED:** TM **CASING:** HW to 1.m, HQ to 1.1m

TYPE OF BORING: Solid flight auger (TC-bit) to 1.0m; Rotary to 1.21m; NMLC-Coring to 10.8m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Coordinates and surface levels obtained from differential GPS

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 Stage 2 Development
LOCATION: Midtown, Maquarie Park

SURFACE LEVEL: 53.2 AHD
EASTING: 325598.5
NORTHING: 6260387.2
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 86043.06
DATE: 22/4/2021
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
43		SANDSTONE: medium to coarse grained, yellow-brown and pale grey, high strength with some medium strength bands, slightly weathered to fresh, slightly fractured, Hawkesbury Sandstone *(continued)*							C	100	97	
	10.8							10.65m: B0°, pl, ro, cly vn				PL(A) = 1.2
42	11	Bore discontinued at 10.8m Target depth reached										
41	12											
40	13											
39	14											
38	15											
37	16											
36	17											
35	18											
34	19											

RIG: Explora **DRILLER:** JD **LOGGED:** TM **CASING:** HW to 1.m, HQ to 1.1m

TYPE OF BORING: Solid flight auger (TC-bit) to 1.0m; Rotary to 1.21m; NMLC-Coring to 10.8m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Coordinates and surface levels obtained from differential GPS

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

BORE: 102 PROJECT: MACQUARIE PARK APRIL 2021

1.21 – 5.00m

BORE: 102 PROJECT: MACQUARIE PARK APRIL 2021

5.00 – 10.00m

BORE: 102 PROJECT: MACQUARIE PARK APRIL 2021

10.00 – 10.80m

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Stage 2 Development
LOCATION: Midtown, Maquarie Park

SURFACE LEVEL: 52.4 AHD
EASTING: 325617.7
NORTHING: 6260365.1
DIP/AZIMUTH: 90°/--

BORE No: 103
PROJECT No: 86043.06
DATE: 28/4/2021
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
52	0.1	FILL/ Clayey SAND: fine to medium, brown, trace fine to medium sandstone gravel, moist		C			
	0.2	LEAN MIX CONCRETE		A			
		SANDSTONE: fine to medium grained, yellow-brown, very low strength, highly weathered, Hawkesbury Sandstone		S			25/70 mm refusal
51	1.1		1.13m: CORE LOSS: 70mm	C	94	24	PL(A) = 0.17
	1.2	SANDSTONE: fine to medium grained, red-brown and pale grey, very low to medium strength with an extremely low strength band, highly weathered, fractured, Hawkesbury Sandstone	1.2m: Fg 30mm 1.25m: Cs 30mm 1.41-1.73m: B0°-5° (x6) pl, ro, cln & cly vn 1.58m: Cs 20mm 1.8m: Cs30mm 1.9m: Cs 30mm 2.2m: Ds 50mm 2.37m: Cs 20mm				PL(A) = 0.3
50	2.4	SANDSTONE: fine to medium grained, pale grey with some red-brown and orange-brown staining, low and medium strength, moderately weathered, fractured to slightly fractured, Hawkesbury Sandstone					PL(A) = 0.73
49			3.37m: B0°, pl, ro, cly 2mm 3.42m: Cs 10mm 3.52m: Cs 15mm, fe stn 3.75m: J30°, pl, ro, cbs vn 3.96m: Cs 10mm 4.25m: Cs 10mm 4.52m: Ds 10mm 4.62m: Ds 10mm	C	100	90	PL(A) = 0.36
48							
47			5.08m: B0°-5° (x2), pl, sm, cly co 5.45m: Cs 10mm 5.52m: Fg 20mm, cly inf, fe stn 5.62m: J45° (x2), pl, ro, fe stn 6.03m: J80°, pl, sm, cly vn 6.33m: Cs 10mm 6.74m: Ds 60mm 6.75m: B5°, pl, ro, fe stn 6.84m: B0° (x3), pl, ro, fe stn 6.91m: J70°-90°, ir, ro, fe stn	C	100	85	PL(A) = 0.53
46							PL(A) = 0.4
45	7.0	SANDSTONE: medium to coarse grained, yellow-brown and pale grey, medium and high strength, moderately to slightly weathered, slightly fractured, Hawkesbury Sandstone					PL(A) = 1.9
44			8.49m: B10°, pl, ro, fe stn 8.75m: Cs 20mm 8.84m: B0°, pl, ro, fe stn 8.95m: B5°, un, ro, cly vn 9.06m: B5°, pl, ro, fe stn 9.06-9.42m: B0°-10° (x4), pl, ro, fe stn 9.27m: B10°, pl, sm, cly 1mm, fe stn	C	100	82	PL(A) = 0.39
43		Below 9.4m: high strength					

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

RIG: Explora **DRILLER:** JD **LOGGED:** TM **CASING:** HW to 1.0m, HQ to 1.1m

TYPE OF BORING: Solid flight auger (TC-bit) to 1.0m; Rotary to 1.1m; NMLC-Coring to 17.1m; PCD to 11.0 m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Groundwater well installed to 15.0m (screen 15.0-12.0m; blank 12.0-0.0m; gravel 15.0-11.5m; bentonite 11.5-11.0m; backfill to GL; gatic at surface); Coordinates and surface levels obtained from differential GPS

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 Stage 2 Development
LOCATION: Midtown, Maquarie Park

SURFACE LEVEL: 52.4 AHD
EASTING: 325617.7
NORTHING: 6260365.1
DIP/AZIMUTH: 90°/--

BORE No: 103
PROJECT No: 86043.06
DATE: 28/4/2021
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
42		SANDSTONE: medium to coarse grained, yellow-brown and pale grey, medium and high strength, moderately to slightly weathered, slightly fractured, Hawkesbury Sandstone *(continued)*						10.12m: B5°, pl, ro, cly vn				PL(A) = 1.6
	11	Below 11.07m: slightly fractured to unbroken						11.07m: B5°, pl, sm, cly co	C	100	82	PL(A) = 1.2
41												
	12											PL(A) = 1.6
40									C	100	100	
	13											PL(A) = 1.5
39												
	14							13.83m: B0°, pl, sm, cly 2mm, fe stn 13.92m: Fg 20mm, fe stn				PL(A) = 2
38	14.88											
	15	SANDSTONE: medium to coarse grained, pale grey, strength, fresh, slightly fractured to unbroken, Hawkesbury Sandstone										PL(A) = 3.5
37									C	100	99	
	16							16.1m: Fg 10mm				PL(A) = 1.9
36												
	17											PL(A) = 1
	17.1	Bore discontinued at 17.1m Target depth reached										
35												
	18											
34												
	19											
33												

RIG: Explora **DRILLER:** JD **LOGGED:** TM **CASING:** HW to 1.0m, HQ to 1.1m

TYPE OF BORING: Solid flight auger (TC-bit) to 1.0m; Rotary to 1.1m; NMLC-Coring to 17.1m; PCD to 11.0 m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Groundwater well installed to 15.0m (screen 15.0-12.0m; blank 12.0-0.0m; gravel 15.0-11.5m; bentonite 11.5-11.0m; backfill to GL; gatic at surface); Coordinates and surface levels obtained from differential GPS

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

BORE: 103 PROJECT: MACQUARIE PARK APRIL 2021

1.10 – 5.00m

BORE: 103 PROJECT: MACQUARIE PARK APRIL 2021

5.00 – 10.00m

BORE: 103 PROJECT: MACQUARIE PARK APRIL 2021

10.00 – 15.00m

BORE: 103 PROJECT: MACQUARIE PARK APRIL 2021

15.00 – 17.10m

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Stage 2 Development
LOCATION: Midtown, Maquarie Park

SURFACE LEVEL: 49.5 AHD
EASTING: 325658.4
NORTHING: 6260394.7
DIP/AZIMUTH: 90°/--

BORE No: 106
PROJECT No: 86043.06
DATE: 28/4/2021
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
49	0.3	FILL/ Sandy CLAY: low plasticity, brown, trace rootlets and fine to medium igneous gravel, w<PL							A			
		Sandy CLAY CL-CI: low to medium plasticity, yellow-brown, fine to medium sand, trace fine to medium sandstone gravel, w<PL, stiff, residual							A			
1									A			
									S			3,6,17 N = 23
48	1.5	SANDSTONE: fine to medium grained, pale grey and red-brown, very low to medium strength, highly weathered, fractured, Hawkesbury Sandstone						1.5m: Ds 150mm 1.68m: J45°, pl, ro, fe stn 1.78m: Ds 20mm 1.95m: Ds 20mm 2.19m: Ds 150mm 2.35m: J60°, pl, ro, cln 2.47m: B0°-5° (x3), pl, ro, cly vn	C	100	0	PL(A) = 0.09
2												
47												PL(A) = 0.7
3								3.06m: Cs 30mm 3.3m: Cs 20mm				
	3.4	SANDSTONE: fine to medium grained, pale grey, orange-brown and red-brown, low to medium strength, moderately weathered, slightly fractured										
46								3.8m: Cs 10mm 3.85m: Cs 40mm 3.9m: B0°, pl, sm, cly co	C	100	70	PL(A) = 0.16
4												
45								4.71m: B5°, pl, ro, cly vn				PL(A) = 0.51
5						11-05-21		5.02m: B0°-10° (x6), pl, sm, cly co & fe stn				
44	5.7	SANDSTONE: medium to coarse grained, red-brown, orange-brown and pale grey, high strength, slightly weathered to fresh, slightly fractured, Hawkesbury Sandstone						5.68m: B10°, pl, ro, fe stn & Fg 20mm	C	100	95	PL(A) = 2.6
6												
43								6.8m: B0° (x4), pl, ro, fe stn				PL(A) = 1.2
7												
42		Below 7.4m: moderately weathered band										
8												PL(A) = 1.1
41									C	100	96	
9												PL(A) = 1.5
40								9.36m: Cs 5mm				
									C	100	98	PL(A) = 1.6

RIG: Explora **DRILLER:** JD **LOGGED:** TM **CASING:** HW to 1.0m, HQ to 1.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 1.0m; Rotary to 1.5m; NMLC-Coring to 13.8m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Groundwater well installed to 11.0m (screen 11.0-8.0m; blank 8.0-0.0m; gravel 11.0-7.5m; bentonite 7.5-7.0m; backfill to GL; gatic at surface); Coordinates and surface levels obtained from differential GPS

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 Stage 2 Development
LOCATION: Midtown, Maquarie Park

SURFACE LEVEL: 49.5 AHD
EASTING: 325658.4
NORTHING: 6260394.7
DIP/AZIMUTH: 90°/--

BORE No: 106
PROJECT No: 86043.06
DATE: 28/4/2021
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
39	11	SANDSTONE: medium to coarse grained, red-brown, orange-brown and pale grey, high strength, slightly weathered to fresh, slightly fractured, Hawkesbury Sandstone *(continued)*						10.21m: B0°, pl, ro, cln				PL(A) = 1.6
38	12								C	100	98	PL(A) = 2
37	13							12.52m: Cs 10mm 12.67m: Cs 10mm 12.88m: B0°, pl, ro,cln				PL(A) = 2.7
36	13.08 13.11							13.08m: CORE LOSS: 30mm 13.11m: B0°, pl, ro, fe stn 13.17m: B10°, pl, ro, fe stn 13.24m: Fg 60mm, fe stn 13.35m: J30°, pl,ro, fe stn 13.64m: J30°, pl, ro, cbs co	C	97	70	PL(A) = 2.3
35	13.8 14	Bore discontinued at 13.8m Target depth reached										
34	15											
33	16											
32	17											
31	18											
30	19											

RIG: Explora **DRILLER:** JD **LOGGED:** TM **CASING:** HW to 1.0m, HQ to 1.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 1.0m; Rotary to 1.5m; NMLC-Coring to 13.8m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Groundwater well installed to 11.0m (screen 11.0-8.0m; blank 8.0-0.0m; gravel 11.0-7.5m; bentonite 7.5-7.0m; backfill to GL; gatic at surface); Coordinates and surface levels obtained from differential GPS

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

BORE: 106 PROJECT: MACQUARIE PARK APRIL 2021

1.50 – 5.00m

BORE: 106 PROJECT: MACQUARIE PARK APRIL 2021

5.00 – 10.00m

BORE: 106 PROJECT: MACQUARIE PARK APRIL 2021

10.00 – 13.80m

BOREHOLE LOG

CLIENT: Frasers Property Ivanhoe Pty Ltd
PROJECT: Proposed Stage 2 Development
LOCATION: Midtown, Maquarie Park

SURFACE LEVEL: 51.7 AHD
EASTING: 325636.9
NORTHING: 6260386.8
DIP/AZIMUTH: 90°/--

BORE No: 117
PROJECT No: 86043.06
DATE: 21/4/2021
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
51	0	FILL/ SAND: fine to medium, dark brown, trace silt, clay and fine to medium gravel, moist							A			
	1								A			
	1.2	Sandy CLAY CL: low plasticity, yellow-brown, fine to medium sand, w<PL, stiff, residual							S			5,4,6 N = 10
50		Below 1.6m: pale grey and red-brown, grading to extremely weathered Hawkesbury Sandstone							A			
	2											
	2.2	SANDSTONE: fine to medium, pale grey and red-brown, very low and medium strength, highly weathered, Hawkesbury Sandstone							A			
									S			25/130 mm refusal
49	3							2.70-4.02m: B0°-10° (x12), pl, ro, fe stn	C	100	8	PL(A) = 0.4
												PL(A) = 0.91
48	3.98							3.8m: CORE LOSS: 180mm				
	4	SANDSTONE:fine to medium grained, pale grey and red brown with some yellow-brown, very low to medium strength, highly weathered, slightly fractured, Hawkesbury Sandstone										
47	4.0							4.69m: Cs 10mm	C	89	70	PL(A) = 0.23
	5							5.13m: B5°, pl, ro, cly vn 5.29m: B5°, pl, ro, fe stn 5.33m: J70°, pl, ti				
46												PL(A) = 0.16
	6							6.27m: Cs 10mm 6.32m: J30°, pl, ro, cly vn				
45	6.76	Below 6.76m: moderately to slightly weathered						6.56-6.88m: B0°-10° (x9), pl, ro, fe stn & he	C	95	70	PL(A) = 0.4
	7							6.71m: CORE LOSS: 50mm 7.04m: Ds 20mm 7.09m: Ds 20mm				
	7.3	SANDSTONE: medium to coarse grained, pale grey and orange, medium and high strength, moderately weathered, slightly fractured, Hawkesbury Sandstone						7.3m: Ds 10mm				
44												PL(A) = 1.6
	8							8.56m: B0°, pl, ro, fe stn				
43									C	100	100	PL(A) = 1.3
	9											
42	10.0											PL(A) = 1

RIG: Explora **DRILLER:** JD **LOGGED:** TM **CASING:** HW to 2.5m, HQ to 2.67m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.5m; Rotary to 2.67m; NMLC-Coring to 16.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Coordinates and surface levels obtained from differential GPS

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 Stage 2 Development
LOCATION: Midtown, Maquarie Park

SURFACE LEVEL: 51.7 AHD
EASTING: 325636.9
NORTHING: 6260386.8
DIP/AZIMUTH: 90°/--

BORE No: 117
PROJECT No: 86043.06
DATE: 21/4/2021
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
41	11	SANDSTONE: medium to coarse grained, pale grey and yellow-brown, medium to high strength, moderately weathered, slightly fractured, Hawkesbury Sandstone *(continued)*						10.05m: J80°, pl, ro, cln 10.38m: B10°, pl, ro, cly vn 10.44m: B0°, pl, ro, cly vn 10.98m: J80°, pl, ro, cln 11.06m: J80°, pl, ro, cln 11.41m: J80°, pl, ro, cln 11.55m: J80°, pl, ro, cln	C	100	95	
40	12								C	100	95	PL(A) = 0.56
39	13							11.86m: B10°, pl, sm, cly vn 12.08m: J70°, pl, ro, cln				PL(A) = 0.41
38	14								C	100	97	PL(A) = 2.2
37	15	Between 14.8-15.0m: very high strength Between 15.0-15.2m: band of interbedded siltstone clasts and low strength, highly weathered sandstone						14.14m: B10°, pl, sm, cly 2mm 14.2m: B5°, pl, ro, cly vn 14.38m: B5°, pl, ro, cly vn 15.0-15.2m: J50°-70° (x4), pl, ro, fe stn				PL(A) = 0.78
36	16 16.0	Bore discontinued at 16.0m Target depth reached							C	100	100	PL(A) = 3.2
35	17								C	100	80	PL(A) = 1.8
34	18											
33	19											
32												

RIG: Explora **DRILLER:** JD **LOGGED:** TM **CASING:** HW to 2.5m, HQ to 2.67m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.5m; Rotary to 2.67m; NMLC-Coring to 16.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Coordinates and surface levels obtained from differential GPS

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: 117 PROJECT: MACQUARIE PARK APRIL 2021

2.67 – 7.00m

BORE: 117 PROJECT: MACQUARIE PARK APRIL 2021

7.00 – 12.00m

BORE: 117 PROJECT: MACQUARIE PARK APRIL 2021

12.00 – 16.00m

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au

Permeability Testing - Rising Head Test Report

Client:	Frasers Property Ivanhoe Pty Ltd	Project No:	86043.06
Project:	Midtown in Macquarie Park	Test date:	11-May-21
Location:	C3 Development Area	Tested by:	TM

Test Location

Description:	Standpipe in borehole	**Test No.**	BH106	
Material type:	Sandstone	Easting:	325658.4	m
		Northing	6260394.7	m
		Surface Level:	49.5	m AHD

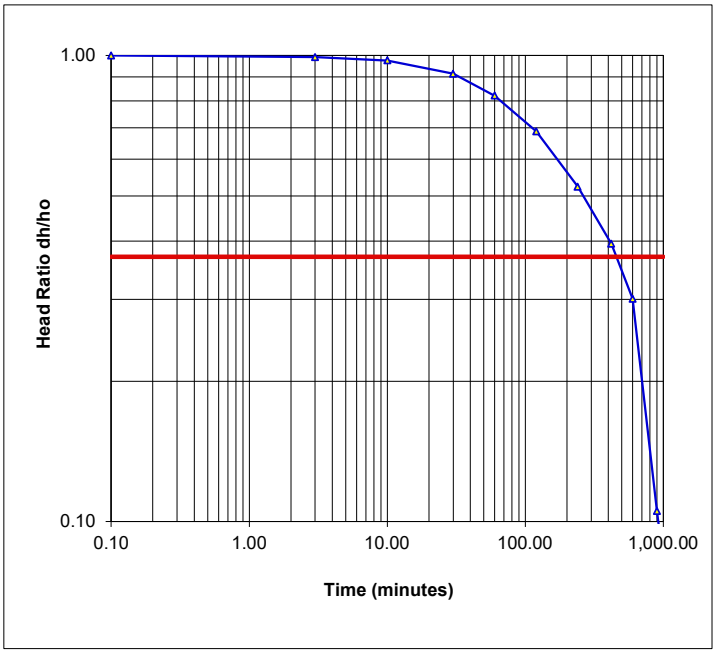
Details of Well Installation

Well casing diameter (2r)	70	mm	Depth to water before test	4.93	m
Well screen diameter (2R)	100	mm	Depth to water at start of test	7.49	m
Length of well screen (Le)	3.5	m			

Comments:

Test Results

Time (min)	Depth (m)	Change in Head δH (m)	δH/Ho
0	7.49	2.56	1.000
3.0	7.47	2.54	0.992
10	7.43	2.50	0.977
30	7.27	2.34	0.914
60	7.03	2.10	0.820
120	6.69	1.76	0.688
240	6.27	1.34	0.523
420	5.94	1.01	0.395
600	5.7	0.77	0.301
900	5.2	0.27	0.105
1000	5.14	0.21	0.082



To = 430 mins
25800 secs

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$ where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity	**k =**	**2.9E-08**	m/sec
	=	**0.010**	cm/hour

Appendix D

Summary of Groundwater Measurements

Appendix D - Summary of Groundwater Measurements – Midtown, Macquarie Centre

Groundwater level measurements at standpipes in the vicinity of the Stage 2 development area of the Midtown site are summarised in Table D1, below, together with reference to the reports which provide additional detail on standpipe installation and construction details.

Table D1 – Summary of Groundwater Measurements – Stage 2 Midtown, Macquarie Centre

Test Location	Ground Surface RL	Depth to Water (m)	Water Level (RL)	Comment	Screen Interval (m)	Status	Original Report(s)
07	59.1	13.2-13.9	45.2-45.8	Monitoring Period November 2017-June 2018	1.5-21.0	Destroyed	86043.01.R.005.Rev0; 86043.01.R.001.Rev1
10	45.2	4.4-4.9	40.3-40.8	Monitoring Period November 2017-June 2018	2.5-5.6	Missing	86043.01.R.005.Rev0; 86043.01.R.001.Rev1
12	45.2	3.3-4.3	40.8-41.8	Monitoring Period November 2017-June 2018; Responsive to rainfall events	2.1-6.93	Missing	86043.01.R.005.Rev0; 86043.01.R.001.Rev1
13	46.8	4.8-5.3	41.2-42.0	Monitoring Period November 2017-June 2018	2.1-7.0	Missing	86043.01.R.005.Rev0; 86043.01.R.001.Rev1
101	54.1	7.28	46.8	11/05/2021	8.0-11.0	Intact	86043.06.R.001
103	52.4	-	-	No reading obtained before destruction	12.0-15.0	Destroyed	86043.06.R.002
106	49.5	4.93	44.6	11/05/2021	8.0-11.0	Intact	86043.06.R.002
107	49.7	8.61	41.1	28/04/2021	14.2-17.2	Intact	86043.06.R.003
109	46.1	6.4	39.7	28/04/2021	10.8-13.8	Intact	86043.06.R.003
109A	46.1	2.2	43.9	17/5/21; Nested well	5.5-8.5	Intact	86043.06.R.003
111	45.8	4.9-6.0	39.8-40.9	28/4/21 (6.0m), 17/5/21 (4.9m)	8.8-11.8	Intact	86043.06.R.003
111A	45.8	2.9	42.9	17/5/21; Nested well	5.5-8.5	Intact	86043.06.R.003
113	46.9	6.23	40.7	28/04/2021	11.29-14.29	Intact	86043.06.R.003
114	47.3	6.28	41.0	28/04/2021	8.92-14.92	Intact	86043.06.R.003
115	46.4	5.3	41.1	17/05/2021	8.0-11.0	Intact	86043.06.R.003

Appendix E

Selected Results of Previous Field Work

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

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

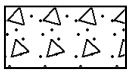
Symbols & Abbreviations

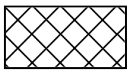
Graphic Symbols for Soil and Rock

General

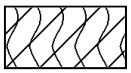

Asphalt

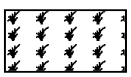

Road base

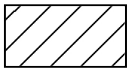

Concrete

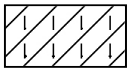

Filling

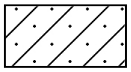
Soils


Topsoil

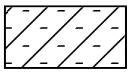

Peat

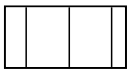

Clay

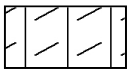

Silty clay

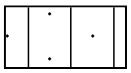

Sandy clay

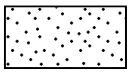

Gravelly clay

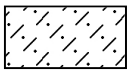

Shaly clay

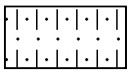

Silt


Clayey silt


Sandy silt

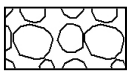

Sand

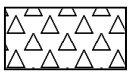

Clayey sand


Silty sand


Gravel

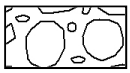

Sandy gravel


Cobbles, boulders

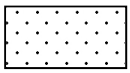

Talus

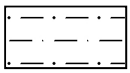
Sedimentary Rocks

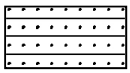

Boulder conglomerate

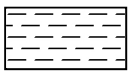

Conglomerate


Conglomeratic sandstone

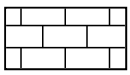

Sandstone


Siltstone

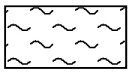

Laminite

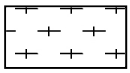

Mudstone, claystone, shale

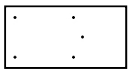

Coal


Limestone

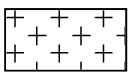
Metamorphic Rocks

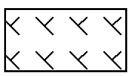

Slate, phyllite, schist

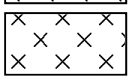

Gneiss

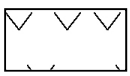

Quartzite

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: 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			
	0.9								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°	S			4,7,4 N = 11
									A/E			
52	2											
	2.1	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											
	4.3	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
49	5											
48	6											
47	7											
								7.64m: B0°, cly, 3mm				PL(A) = 1.5
46	8							8.38-8.56m: B (x2) 0°-5°, cly, 1-4mm	C	100	98	PL(A) = 0.96
45	9											PL(A) = 1.2
	10.0							9.6-9.65m: Cs, 50mm				

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				PL(A) = 1.2
43	11							10.77m: B5°, cbs	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								C	100	100	PL(A) = 2
39	15	- slightly weathered below 15.0m						14.64m: B0°, cly, 2mm				PL(A) = 2.4
38	16											
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	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
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						1.5-1.56m: fg 1.56-1.59m: Cs, 30mm	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						2.2m: B5°, cly, 8mm				PL(A) = 1
56	3							3.28-3.34m: Cs, 60mm 3.4-3.6m: Cs, 200mm				
	3.6	SANDSTONE - medium strength, slightly weathered, fractured, light grey fine grained sandstone, thinly bedded with some siltstone laminations						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	C	100	77	PL(A) = 0.32 PL(A) = 0.94 PL(A) = 1
55	4											
54	5											
53	6											PL(A) = 1.6
	6.0	SANDSTONE - high strength, fresh, unbroken, light grey, medium grained sandstone, thinly and thickly bedded with some siltstone laminations										
52	7											PL(A) = 1.4
51	8							8.22m: B0°, cly, 3mm	C	100	100	PL(A) = 1.5
50	9							9.45m: B0°, cly, 2mm 9.6m: B0°, cly, 5mm				PL(A) = 1.7

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)

Douglas Partners
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 2 OF 3

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				
49		SANDSTONE - high strength, fresh, unbroken, light grey, medium grained sandstone, thinly and thickly bedded with some siltstone laminations *(continued)*										PL(A) = 1.4
48	11								C	100	100	
								11.56m: B0°, cly, 3mm				PL(A) = 1.6
47	12											
												PL(A) = 1.5
46	13							13.1-13.3m: B (x3) 0°, he, cly				
						12-12-17			C	100	100	PL(A) = 1.5
45	14											PL(A) = 1.6
44	15											
								15.44m: B20°, cbs, 1mm				PL(A) = 1.8
43	16											PL(A) = 2.6
									C	100	100	
42	17											PL(A) = 2.7
								17.64-17.74m: Cs, 10mm				
41	18	18.0m: shale clast						17.67m: B0°, cly, 4mm				PL(A) = 2.7
								18.22m: B0°, cly, 1mm, cbs				
	18.65	SANDSTONE - high strength, slightly weathered and fresh, slightly fractured, medium grained sandstone with trace siltstone clasts						18.81m: B0°, fe, cbs				
40	19								C	100	100	PL(A) = 2.6
								19.67m: B0°, cly, 2mm				
	20.0											

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)

Douglas Partners
Geotechnics / Environment / Groundwater

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: 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				
					1.3				
				B					
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							
					2.3				
				A					
					2.4				
51	2.6	Bore discontinued at 2.6m - auger refusal on low to medium strength sandstone							
50									
49									

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

Douglas Partners
Geotechnics / Environment / Groundwater

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	1								1
	2			A	2.0				2
	2.1	Bore discontinued at 2.1m - target depth reached			2.1				
51	3								3
50	4								4
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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