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Report on
Geotechnical Investigation

Proposed Commercial Development
2-8a Lee Street, Haymarket

Prepared for
Toga Development and Construction Pty Ltd

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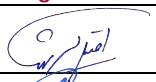
Author		15 July 2022
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Executive Summary

This Geotechnical Investigation Report has been prepared by Douglas Partners Pty Ltd to accompany a detailed State significant development (SSD) development application (DA) for the mixed-use redevelopment proposal at TOGA Central, located at 2 & 8A Lee Street, Haymarket (the site). The site is legally described as Lot 30 in Deposited Plan 880518 and Lot 13 in Deposited Plan 1062447. The site is also described as 'Site C' within the Western Gateway sub-precinct at the Central Precinct.

This report has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) issued for the SSD DA (SSD 33258337).

Report on Geotechnical Investigation
Proposed Commercial Development
2-8a Lee Street, Haymarket

1. Introduction

This report presents the results of geotechnical investigation undertaken for a proposed commercial development at 2-8a Lee Street, Haymarket. The investigation was commissioned by Mr. David McLaren of Toga Development and Construction Pty Ltd via email (approvals dated 17 February 2021 and 27 May 2021) and was undertaken in accordance with Douglas Partners' proposals SYD201237.P.001.Rev2 dated 16 February 2021, and SYD201237.P.002.Rev1 dated 6 May 2021.

This report has been prepared to accompany a SSD DA for the for the mixed-use redevelopment proposal at TOGA Central, located at 2 & 8A Lee Street, Haymarket.

The Minister for Planning, or their delegate, is the consent authority for the SSD DA and this application is lodged with the NSW Department of Planning and Environment (DPE) for assessment.

The purpose of the SSD DA is to complete the restoration of the heritage-listed building on the site, delivery of new commercial floorspace and public realm improvements that will contribute to the realisation of the Government's vision for an iconic technology precinct and transport gateway. The application seeks consent for the conservation, refurbishment and adaptive re-use of the Adina Hotel building (also referred to as the former Parcel Post building (fPPb)), construction of a 45-storey tower above and adjacent to the existing building and delivery of significant public domain improvements at street level, lower ground level and within Henry Deane Plaza. Specifically, the SSD DA seeks development consent for:

- Site establishment and removal of landscaping within Henry Deane Plaza;
- Demolition of contemporary additions to the fPPb and public domain elements within Henry Deane Plaza;
- Conservation work and alterations to the fPPb for retail premises, commercial premises, and hotel and motel accommodation. The adaptive reuse of the building will seek to accommodate:
  - Commercial lobby and hotel concierge facilities;
  - Retail tenancies including food and drink tenancies and convenience retail with back of house areas;
  - 4 levels of co-working space;
  - Function and conference area with access to level 6 outdoor rooftop space, and
  - Reinstatement of the original fPPb roof pitch form in a contemporary terracotta materiality.
- Provision of retail floor space including a supermarket tenancy, smaller retail tenancies, and back of house areas below Henry Deane Plaza (at basement level 1 (RL12.10) and lower ground (RL 16));
- Construction of a 45-storey hotel and commercial office tower above and adjacent to the fPPb. The tower will have a maximum building height of RL 202.28 m, and comprise:

  - 10 levels of hotel facilities between level 10 – level 19 of the tower including 204 hotel keys and 2 levels of amenities including a pool, gymnasium and day spa to operate ancillary to the hotel premises. A glazed atrium and hotel arrival is accommodated adjacent to the fPPb, accessible from Lee Street;
  - 22 levels of commercial office space between level 23 – level 44 of the tower accommodated within a connected floor plate with a consolidated side core; and
  - Rooftop plant, lift overrun, servicing and BMU.
- Provision of vehicular access into the site via a shared basement, with connection points provided to both Block A (at RL 5) and Block B (at RL5.5) basements. Primary access will be accommodated from the adjacent Atlassian site at 8-10 Lee Street, Haymarket, into 4 basement levels in a split-level arrangement. The basement will accommodate:
  - Car parking for 106 vehicles, 4 car share spaces and 5 loading bays;
  - Hotel, commercial and retail and waste storage areas; and
  - Plant, utilities and servicing.
- Provision of end of trip facilities and 165 employee bicycle spaces within the fPPb basement, and an additional 72 visitor bicycle spaces within the public realm;
- Delivery of a revitalised public realm across the site that is coordinated with adjacent development, including an improved public plaza linking Railway Square (Lee Street), and Block B (known as 'Central Place Sydney'). The proposal includes the delivery of a significant area of new publicly accessible open space at street level, lower ground level, and at Henry Deane Plaza, including the following proposed elements:
  - Provision of equitable access within Henry Deane Plaza including stairways and a publicly accessible lift;
  - Construction of raised planters and terraced seating within Henry Deane Plaza; and
  - Landscaping works within Henry Deane Plaza.
- Utilities and service provision; and
- Realignment of lot boundaries.

This report has been prepared in response to the requirements contained within the Secretary's Environmental Assessment Requirements (SEARs) dated 17 December 2021 and issued for the SSD DA. Specifically, this report has been prepared to respond to the SEARs requirement issued below.

Table 1: SEARs Requirement addressed in this report

Item	Description of requirement	Section Reference (this report)
14 – Geotechnical Assessment	Provide and assessment of the potential impact on soil resources, including related infrastructure and riparian lands on and near the site	10.10
14 – Salinity Management Plan and/or Acid Sulfate Soils Management plan	Provide an assessment of salinity and acid sulfate soil impacts	4.2

The geotechnical investigation was carried out to provide information on the subsurface profile and groundwater levels for the assessment of excavation conditions, and to provide information for the design of the basement excavation, shoring systems and foundations. The geotechnical investigation was completed in conjunction with environmental contamination testing, and included drilling boreholes, installation of standpipes with data loggers, and laboratory testing of selected soil and rock samples.

Details of the field work are given in this report, together with comments relevant to design and construction practice.

This revised report is prepared to comply with the final architectural drawings provided by the client (Ref.: S12550, prepared by Bates Smart Architects Pty Ltd, dated 1 July 2022)

2. Previous Investigations

A desktop study for the site has previously been prepared by Douglas Partners Pty Ltd (DP), and the following reports from previous investigations completed near to the site have been supplied by the client:

- Report on "Supplementary Geotechnical Investigation, Proposed Commercial Development, 8-10 Lee Street, Haymarket", prepared by Douglas Partners Pty Ltd (Report reference: 86767.00.R.006.Rev5, dated 26 November 2020); and
- Report on "Supplementary Geotechnical Investigation, Proposed Commercial Development, 8-10 Lee Street, Haymarket (Devonshire Street Tunnel)", prepared by Douglas Partners Pty Ltd (Report reference: 86767.07.R.001.Rev0, dated 20 November 2020).

It is understood that a data-sharing agreement is in place between the site neighbour and Toga Development and Construction Pty Ltd (Toga), with the shared information including boreholes completed adjacent to the eastern site boundary, and groundwater monitoring data from standpipes.

The site investigations presented in the supplied geotechnical reports include:

- Vertical boreholes drilled to either refusal on the underlying rock (17 locations), or cored into the underlying rock (a further 16 locations);
- Angled boreholes drilled a short distance into the underlying rock using a diatube (2 locations); and
- Installation of standpipe piezometers in 11 of the cored boreholes, with the installed pipes screened within either alluvial sand, very low to low strength sandstone of the Mittagong Formation, or within the underlying medium to high strength sandstone of the Hawkesbury Sandstone geological unit.

Groundwater monitoring data and permeability test results (i.e. rising or falling head tests) from the 11 standpipes (to 15 September 2020) are included in the provided reports. It is noted that the results of extended groundwater monitoring for the site, incorporating some of the available data, has been prepared as a separate report (DP Report reference 86884.02.R.004.Rev0, dated 15 July 2021).

Some of the supplied site investigation results are reproduced in Appendix F of this report: the source boreholes are presented on Drawings 1 and 2 in Appendix C. The data from boreholes completed for both geotechnical and environmental purposes at the site from previous investigations has been considered in preparation of this report.

3. Site Description

The site is located within the City of Sydney Local Government Area (LGA). The site is situated 1.5 km south of the Sydney CBD and 6.9 km north-east of the Sydney International Airport within the suburb of Haymarket.

The site is located within the Western Gateway sub-precinct, an area of approximately 1.65 ha that is located immediately west of Central Station within Haymarket on the southern fringe of the Sydney CBD. Immediately north of Central Station is Belmore Park, to the west is Haymarket (including the University of Technology, Sydney and Chinatown), to the south and east is rail lines and services and Prince Alfred Park and to the east is Elizabeth Street and Surry Hills.

Central Station is a public landmark, heritage building, and the largest transport interchange in NSW. With regional and suburban train services, connections to light rail, bus networks and to Sydney Airport, the area around Central Station is one of the most-connected destinations in Australia.

The site is located at 2 & 8A Lee Street, Haymarket and is legally described as Lot 30 in Deposited Plan 880518, Lot 13 in Deposited Plan 1062447 and part of Lot 14 in Deposited Plan 1062447.

The land that comprises the site under the Proponent's control (either wholly or limited in either height or depth) comprises a total area of approximately 4,159 sqm.

The location of the TOGA Central site is illustrated in Figure 1.

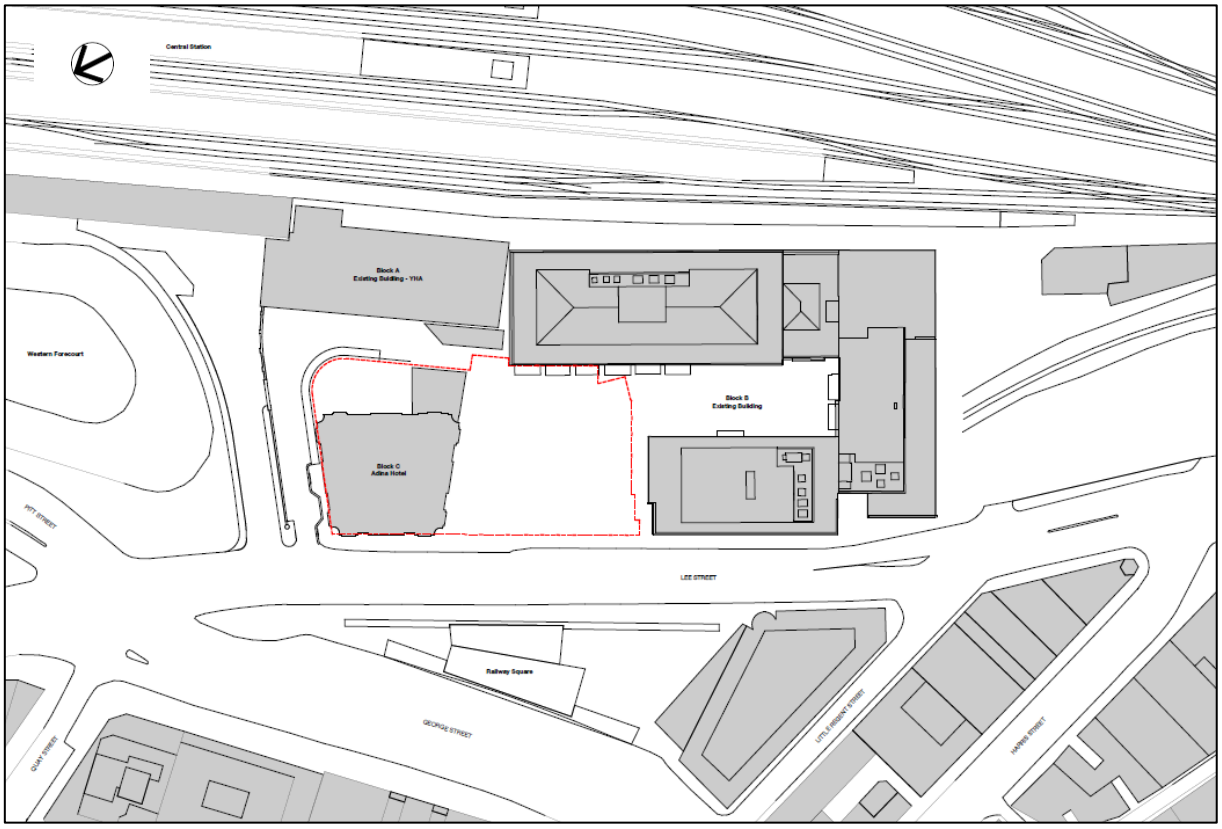

Figure 1: Site Identification Plan (Source: Bates Smart)

The site currently comprises the following existing development:

- Lot 30 in Deposited Plan 880518 (Adina Hotel building): the north-western lot within the Western Gateway sub-precinct accommodates a heritage-listed building which was originally developed as the Parcels Post Office building. The building has been adaptively re-used and is currently occupied by the Adina Hotel Sydney Central. The eight-storey building provides 98 short-stay visitor apartments and studio rooms with ancillary facilities including a swimming pool and outdoor seating at the rear of the site; and
- Lot 13 in Deposited Plan 1062447 and part of Lot 14 in Deposited Plan 1062447 (Henry Deane Plaza): the central lot within the Western Gateway sub-precinct adjoins Lot 30 to the south. It accommodates 22 specialty food and beverage, convenience retail and commercial service tenancies. The lot also includes publicly accessible space which is used for pop-up events and a pedestrian thoroughfare from Central Station via the Devonshire Street Tunnel. At the entrance to Devonshire Street Tunnel is a large public sculpture and a glazed structure covers the walkway leading into Railway Square. This area forms part of the busy pedestrian connection from Central Station to Railway Square and on to George and Pitt Streets, and pedestrian subways.

The site is listed as an item of local significance under Schedule 5 of the *Sydney Local Environmental Plan 2012* 'Former Parcels Post Office including retaining wall, early lamp post and building interior', Item 855.

The site is also included within the Central Railway Station State heritage listing. This is listed on the State Heritage Register 'Sydney Terminal and Central Railway Station Group', Item SHR 01255, and in Schedule 5 of the *Sydney Local Environmental Plan 2012* 'Central Railway Station group including buildings, station yard, viaducts and building interiors' Item 824.

The site is not however listed independently on the State Heritage Register. There is an array of built forms that constitute Central Station, however the Main Terminal Building (particularly the western frontage) and associated clocktower constitute key components in the visual setting of the Parcel Post building.

4. Published Mapping

4.1 Geology

Reference to the Sydney 1:100 000 Geological Series Sheet (Ref. 1) indicates that the site is underlain by Triassic age Ashfield Shale overlying Hawkesbury Sandstone, and that the site is located near Quaternary age alluvial sediments, including transgressive dune sands.

Although not specifically shown on the geological map, the Mittagong Formation is likely to be present at the transition between the Ashfield Shale and Hawkesbury Sandstone geological units.

The Quaternary sediments typically comprise medium to fine grained sand. The Ashfield Shale typically comprises black to dark grey shales and laminite. The Mittagong Formation consists of interbedded shale, laminite and fine grained quartz sandstone, and the underlying Hawkesbury Sandstone typically comprises horizontally bedded and vertically jointed, massive and cross-bedded, medium grained quartz sandstone with a few shale interbeds.

A former creek is shown on a plan from the year 1855 from the City of Sydney Archives (Ref. 2). The Devonshire Street Pedestrian Tunnel is inferred to be aligned sub-parallel to and either co-incident with or adjacent to the former creek.

The geological map indicates the possible presence of igneous dykes near to and north of the site, striking in a north-westerly direction. These dykes are commonly steeply dipping (often near-vertical) slabs of igneous rock which intrude through the bedrock, with measured widths in the Greater Sydney Region ranging between a centimetre or less to about 6 m (Ref. 3). These dykes could be associated with zones of closely spaced fractures within high strength rock. Although no evidence of dykes was found in the investigation there is a possibility that a dyke could cross the site.

Site investigations during the present study encountered alluvial and residual soils, and sandstone bedrock consistent with the Mittagong Formation and Hawkesbury Sandstone.

4.2 Acid Sulfate Soils

The 1:25 000 Acid Sulfate Soil Risk map for Botany Bay (Ref. 4) indicates that the Site does not lie within an area known for acid sulfate soils, nor does the site occur within an area known for soil salinity issues.

5. Field Work Methods

5.1 General

The field work for the investigation was completed in two stages, with the first stage of site work completed within both the Adina Hotel basement and Henry Deane Plaza during March 2021, and the second stage completed within a retail tenancy area on the southern side of the Adina Hotel footprint during June 2021.

Drilling within the Adina Hotel basement was completed between 11-12 March 2021 whereas works within the Henry Deane Plaza were completed over a period of six nights (commencing on the evenings of 10-11 March, and 15-18 March 2021). Drilling within the retail tenancy area was completed between 21-23 June 2021.

The two stages of work included the drilling of twelve boreholes at the locations shown on Drawing 1 and Drawing 2 in Appendix C (Boreholes BH1001-BH1007, BH1003A, BH1004A, BH2001-BH2002, and BH2001A), and installation of standpipes in boreholes BH1002, BH1003A and BH1007.

In conjunction with groundwater sampling activities for contamination assessment purposes, water levels were measured in the new standpipes during March 2021 and June 2021, and also in a selection of existing standpipes near the eastern and northern site boundaries (i.e. boreholes BH8, BH107A, BH107B, BH109B and BH202). Rising head tests were also carried out within boreholes BH1002, BH1003A, BH1007 and BH202. Extended groundwater monitoring within standpipes was concluded following the completion of drilling in June 2021 (reported under separate cover: DP Report 86884.02.R.004.Rev0 dated 15 July 2021).

5.2 Boreholes

Each of the boreholes were drilled vertically, and included:

- two boreholes within the Adina Hotel basement (i.e. Boreholes BH1001 and BH1002);
- seven boreholes in the open-air portion of the Henry Deane Plaza, between a retail tenancy on the southern side of the Plaza ('Priceline') and the northern side of a ramp leading down into the Lee Street pedestrian tunnel (i.e. Boreholes BH1003-BH1007, BH1003A and BH1004A); and
- three boreholes within a retail tenancy on the southern side of the Adina Hotel footprint, which is adjacent to the Lee Street pedestrian tunnel and beneath the ramp leading down eastwards into the Plaza from Lee Street (i.e. BH2001, BH2001A and BH2002).

Following coring of stone paving tiles (Henry Deane Plaza only) and concrete slabs using a diatube, each of the boreholes was commenced within soils using either non-destructive digging (NDD) vacuum excavation methods (Henry Deane Plaza only), or hand tools (e.g. hand auger). It is noted that refusal on buried obstructions or sandstone boulders within rubble or sand fill was encountered in Boreholes BH1003, BH1004, BH1006 and BH2001, with Borehole BH1006 abandoned in favour of a new location nearby (i.e. BH1007), whilst the other three boreholes were offset a short distance to new locations (i.e. BH1003A, BH1004A, BH2001A).

The boreholes were extended through the soils to the top of the underlying rock by either a track-mounted or tripod-mounted portable drilling rig, using auger and rotary drilling techniques.

Regularly spaced standard penetration tests (SPTs) were completed below the termination depth of NDD excavation in four of the Henry Deane Plaza boreholes (ie. BH1003A, BH1004A, BH1005 and BH1007). Dynamic cone penetrometer (DCP) testing was carried out prior to the start of rotary drilling within two of the boreholes (i.e. BH2001A and BH2002), to depths ranging between 0.75 m and 2.10 m. Photographs of the recovered SPT samples from these boreholes are presented together with the logs in Appendix D.

Following installation of drilling casing, the boreholes were advanced into the underlying sandstone using NMLC-sized diamond core drilling equipment to depths ranging between 12.0 m and 18.22 m, to obtain 50 mm diameter, continuous samples of the rock for identification and strength testing purposes.

Selected soil samples obtained during auger drilling were submitted to an analytical laboratory, with analysis of soil pH, electrical conductivity, sulfate and chloride ion concentrations.

All field work was carried out under the full-time supervision of a geotechnical engineer, with logging of the soil and rock materials undertaken in general accordance with Australian Standard AS 1726 (Ref. 5). Surface levels were interpolated from the provided site drawings, including Drawing WG.05 prepared by Synman, Justin and Bialek Architects, dated 21 March 1998 (for boreholes BH1001,-BH1002, BH2001-BH2002 and BH2001A), and Drawing Sheet D1, Reference 37908 by Norton Survey Partners Pty Ltd, dated 29 April 2019. Borehole co-ordinates were interpolated from known site features using tape measurements. The inferred accuracy is 0.1 m for surface levels, and 0.5 m for plan co-ordinates but they are approximate only.

5.3 Standpipes

Three new standpipe piezometers were installed into completed boreholes at the site to measure groundwater levels (i.e. Boreholes BH1002, BH1003A, and BH1007), comprising screened PVC pipe with gravel backfill, a bentonite pellet seal, and ‘gatic’ cover at ground level (refer to Borehole ‘Well’ Logs in Appendix D for specific details). It is noted that the screened intervals of the standpipes were selected to target either the medium or high strength sandstone (i.e. BH1002, BH1007), or the alluvial sand (i.e. BH1003A).

The standpipes installed within and adjacent to the site (in Boreholes BH8, BH107A, BH107B, BH202, BH1002, BH1003A and BH1007) were pumped on 19 March 2021 to remove drilling fluids and to prepare the standpipes for groundwater sampling, which was completed on 22 March 2021. Following the completion of sampling activities, data loggers were installed into BH202, BH1003A and BH1007 on 22 March 2021, to automatically measure groundwater levels at pre-determined time intervals. It is noted that there is a short gap in measurements between 30-31 March 2021 due to the loggers being temporarily removed. A data logger was subsequently installed into BH1002 on 31 March 2021. Water levels were also measured by hand on five occasions between 19 March 2021 and 24 June 2021. Rising head tests were carried out on 22 March 2021 after which time the dataloggers were re-programmed for groundwater monitoring through to 24 June 2021.

Further details of the methods and procedures employed during the site investigation are presented in the attached Notes About This Report.

6. Field Work Results

6.1 Boreholes

The detailed conditions encountered are presented on the borehole logs given in Appendix D, along with standard notes defining the descriptive terms and the classification methods used. Photographs of concrete cores, SPT soil samples, disturbed samples and the rock cores are included together with the borehole logs in Appendix D. Selected borehole logs, well logs and core photographs from the supplied reports are included in Appendix F.

The subsurface conditions encountered in the boreholes within the site can be summarised as:

STONE TILE (Henry Deane Plaza only):	Stone tiles (20-40 mm thick) laid over a layer of sand and cement 0.05-0.08 m thick; over
CONCRETE:	Single concrete slab (steel reinforcement not observed in Boreholes BH1001, BH1002, BH2001, BH2001A and BH2002), thickness ranging between 0.08-0.24 m; over
FILL:	Gravel or gravel and bricks (110 mm thick: Boreholes BH1001 and BH1002 only), or layers of clayey sand, sand, silt, or sandy clay, with either silty clay and gravel, cobble or boulder-sized fragments of sandstone, siltstone, igneous rock (railway ballast), concrete and brick rubble, or other anthropogenic materials (e.g. plastic bottles), trace ash and slag. The boreholes within the Henry Deane Plaza included one or more layers of building rubble in a clayey sand matrix, to depths ranging between 1.2 m and 3.5 m (refusal to Boreholes BH1003, BH1004 and BH1006 within these materials); over
ALLUVIAL SAND:	Medium dense to very dense alluvial sand (absent in Boreholes BH1001, BH1002 and BH2001A), typically wet, 1.0-3.7 m thick, including a thin layer (0.8 m thick) of stiff to very stiff silty clay in BH1007; over
ALLUVIAL SILTY CLAY:	Very soft to very stiff alluvial silty clay (Boreholes BH1004A and BH1005 only), 1.0-1.6 m thick, with traces of either charcoal and fine gravel; over
RESIDUAL CLAY:	Firm to very stiff residual silty clay or sandy clay (absent in Borehole BH1004A), 0.18-1.8 m thick, with traces of fine sand and/or gravel; over
RESIDUAL CLAYEY SAND or SANDY CLAY:	Medium dense to very dense residual clayey sand with occasional thin clay bands or very stiff to hard sandy clay (present in Boreholes BH1003, BH1005, BH1007 and BH2002 only), with relict rock texture (extremely weathered sandstone); over
SANDSTONE (MEDIUM GRAINED):	Very low to medium strength, medium grained sandstone, with both clay seams and iron-cemented bands of up to medium to high strength (absent in Boreholes BH1005 and BH1007); over
SANDSTONE (MEDIUM TO COARSE GRAINED):	Medium or high strength, medium to coarse grained sandstone, typically with widely spaced extremely low or very low strength bands.

The medium grained sandstone is interpreted to be part of the Mittagong Formation, and the underlying medium to coarse grained sandstone is interpreted to be Hawkesbury Sandstone.

Interpreted cross-sections through the site (including three cross-sections approximately parallel with the alignment of the Devonshire Street Pedestrian Tunnel) are presented as Drawings 3 to 7 in Appendix C.

Surface levels and depths at which various materials were encountered in the current boreholes are summarised in Table 2, with data from selected previous investigation locations summarised in Table 3 (these locations are shown on Drawings 1 and 2, and investigation data is included in Appendix F).

With the exception of Borehole BH1007 (and the four boreholes terminated prematurely at shallow depth in fill materials), groundwater was not observed during auger drilling and prior to the commencement of rotary drilling or rock coring. As outlined in Section 5.3, standpipe piezometers were installed in Boreholes BH1002, BH1003A and BH1007 to enable groundwater sampling and further groundwater observations to be made, and to enable permeability tests to be completed.

Table 2: Borehole Surface levels and Summary of Subsurface Profile (Current Boreholes)

Bore hole ID	Surface RL (m AHD)	Top of Alluvial soil		Top of Residual soil		Top of Very low Strength Rock		Top of Medium Strength Rock	
		Depth (m)	RL (2)	Depth (m)	RL (2)	Depth (m)	RL (2)	Depth (m)	RL (2)
BH1001	13.4	*ne*	*ne*	0.4	13.0	1.5	11.9	1.9	11.5
BH1002	13.4	*ne*	*ne*	0.4	13.0	0.5	12.9	0.7	12.7
BH1003	14.3	*ne*	*ne*	*ne*	*ne*	*ne*	*ne*	*ne*	*ne*
BH1003A	14.3	1.2	13.1	4.0	10.3	4.6	9.7	4.9	9.4
BH1004	15.8	*ne*	*ne*	*ne*	*ne*	*ne*	*ne*	*ne*	*ne*
BH1004A	15.8	3.0	12.8	*ne*	*ne*	5.6	10.2	6.8	9.0
BH1005	15.9	2.8	13.1	6.2	9.7	8.7	7.2	8.9	7.0
BH1006	15.7	*ne*	*ne*	*ne*	*ne*	*ne*	*ne*	*ne*	*ne*
BH1007	15.8	3.5	12.3	7.2	8.6	9.2	6.6	9.8	6.0
BH2001	14.0	*ne*	*ne*	*ne*	*ne*	*ne*	*ne*	*ne*	*ne*
BH2001A	14.0	*ne*	*ne*	2.0	12.0	*ne*	*ne*	2.5	11.5
BH2002	14.0	0.6	13.4	1.7	12.3	2.5	11.5	3.5	10.5

Notes: (1) "*ne*" indicates Not Encountered
(2) Elevation (RL) in metres AHD.

Table 3: Borehole Surface levels and Summary of Subsurface Profile (Selected Previous Boreholes)

Bore hole ID	Surface RL (m AHD)	Top of Alluvial soil		Top of Residual soil		Top of Very low Strength Rock		Top of Medium Strength Rock	
		Depth (m)	RL (2)	Depth (m)	RL (2)	Depth (m)	RL (2)	Depth (m)	RL (2)
BH8	15.5	0.6	14.9	*ne*	*ne*	2.1	13.4	4.2	11.3
BH107A	15.5	*ne*	*ne*	2.2	13.3	2.8	12.7	>3.9	<11.6
BH107B	15.5	*ne*	*ne*	2.2	13.3	2.8	12.7	4.0	11.5
BH110	15.3	*ne*	*ne*	*ne*	*ne*	*ne*	*ne*	*ne*	*ne*
W2	15.4	*ne*	*ne*	1.0	14.4	1.1	14.3	>1.3	<14.1
W3	13.4	*ne*	*ne*	*ne*	*ne*	0.0	13.4	>1.2 (3)	<12.3 (3)
W4	13.4	*ne*	*ne*	*ne*	*ne*	0.9	12.6 (3)	2.2 (3)	11.5 (3)
BH201	16.4	2.3	14.1	4.7	11.7	*ne*	*ne*	7.2	9.2
BH202	16.3	1.3	15.0	6.7	9.6	*ne*	*ne*	7.2	9.1
BH203	16.3	2.2	14.1	5.0	11.3	6.4	9.9	7.6	8.7

Notes: (1) "*ne*" indicates Not Encountered.
(2) Elevation (RL) in metres AHD.
(3) Depth along the hole, elevation in metres AHD allowing for the hole inclination.

6.2 Standpipe Piezometers

Groundwater observations for the new standpipes are summarised in Table 4, and for the existing available standpipes in both Table 5 and Table 6. Graphs of the measured groundwater levels from the dataloggers in BH1002, BH1003A and BH1007 (corrected for barometric pressure effects) are presented in Appendix E, and the supplied groundwater level data for the existing standpipes is included in Appendix F (including borehole BH202). Manual water level measurements obtained using a dip meter were almost identical to measurements obtained using the data logger.

Table 4: Groundwater Observations in New Standpipes

Measurement Date	Standing Water Level Measurements in Boreholes					
	BH1002		BH1003A		BH1007	
	Depth (m)	RL (1)	Depth (m)	RL (1)	Depth (m)	RL (1)
19 March 2021	16.4	-3.0	2.8	11.5	9.2 (2)	6.6 (2)
22 March 2021	16.3	-2.9	2.8	11.5	9.3 (2)	6.5 (2)
30 March 2021	16.3	-2.9	2.5	11.8	14.4	1.4
31 March 2021	16.3	-2.9	2.5	11.8	14.4	1.4

Measurement Date	Standing Water Level Measurements in Boreholes					
	BH1002		BH1003A		BH1007	
	Depth (m)	RL (1)	Depth (m)	RL (1)	Depth (m)	RL (1)
24 June 2021	16.6	-3.2	3.0	11.4	14.4	1.4

Notes: (1) Elevation (RL) in metres AHD.

(2) Water levels prior to completion of well development activities.

Table 5: Groundwater Observations in Existing Available Standpipes

Measurement Date	Standing Water Level Measurements in Boreholes					
	BH8		BH107A		BH107B	
	Depth (m)	RL (1)	Depth (m)	RL (1)	Depth (m)	RL (1)
23 July 2019	2.3	13.2	-	-	-	-
26 November 2019	2.3	13.2	-	-	-	-
19 February 2020	1.9	13.6	-	-	-	-
5 May 2020	2.2	13.3	-	-	-	-
17 May 2020	-	-	3.2	12.3	1.8	13.7
26 May 2020	-	-	2.1	13.4	2.6	12.9
05 June 2020	-	-	2.0	13.5	2.2	13.3
7 September 2020	2.3	13.2	2.1	13.4	2.4	13.1
08 December 2020	2.3	13.2	2.1	13.4	2.5	13.0
09 March 2021	2.2	13.3	2.0	13.5	2.3	13.2
19 March 2021	2.0	13.5	1.9	13.6	2.2	13.3
22 March 2021	1.9	13.6	1.6	13.9	1.9	13.6

Notes: (1) Elevation (RL) in metres AHD.

(2) "-" indicates Not Measured.

Table 6: Groundwater Observations in Available Standpipes

Measurement Date	Standing Water Level Measurements in Boreholes			
	BH109B		BH202	
	Depth (m)	RL (1)	Depth (m)	RL (1)
7 September 2020	2.5	12.8	-	-
06 November 2020	-	-	4.5 (3)	11.8 (3)
09 November 2020	-	-	3.5	12.8
10 November 2020	-	-	3.5	12.8
12 November 2020	-	-	3.4	12.9

Measurement Date	Standing Water Level Measurements in Boreholes			
	BH109B		BH202	
	Depth (m)	RL (1)	Depth (m)	RL (1)
08 December 2020	2.5	12.8	3.6	12.7
09 March 2021	2.5	12.8	3.6	12.7
19 March 2021	-	-	3.3	13.0
22 March 2021	-	-	3.0	13.3
30 March 2021	-	-	2.9	13.4
31 March 2021	-	-	2.9	13.4
24 June 2021	-	-	3.7	12.6

Notes: (1) Elevation (RL) in metres AHD..
(2) "-" indicates Not Measured
(3) Observation during auger drilling.

Periods of high rainfall were recorded during the monitoring period. The graphs of groundwater level measurements in Appendix E and Appendix F include daily rainfall data obtained from Observatory Hill, Sydney (Bureau of Meteorology, reference http://www.bom.gov.au, Station 066062: 30 July 2019 to 31 August 2020, and Station 066214: 01 September 2020 to 24 June 2021).

Aside from temporary water level changes due to pumping activities for groundwater sampling and permeability testing (and considering also the varying duration of standpipe monitoring), the groundwater level measurements indicate the following:

- The range of maximum water levels for the available standpipes, screened in the following materials, were:
  - Alluvial soils: between elevations of RL11.9 m and RL13.5 m;
  - Mittagong Formation: between elevations of RL13.7 m and RL13.9 m; and
  - Hawkesbury Sandstone: between elevations of RL-2.8 m and RL13.5 m;
- The variation in water level elevations ranged between 0.4-0.7 m for standpipes screened within rock (for both Mittagong Formation, Hawkesbury Sandstone, or both), and 0.6-0.9 m for standpipes screened within alluvial soil.

Electrical conductivity measurements of groundwater were made during sampling from standpipes BH1002, BH1003A, BH1007, BH202, BH107A and BH107B (refer to groundwater development field sheets within Appendix E). Measurements from standpipes screened within alluvial soils were in the range 178-241 µS/cm, whereas measurements from standpipes screened within sandstone (either the Mittagong Formation or Hawkesbury Sandstone) were in the range 349-461 µS/cm.

6.3 Permeability Testing

Permeability testing was completed within standpipes installed within BH202, BH1003A and BH1007 on 22 March 2021 using a rising head test method. The permeability of the screened intervals were

calculated using the Hvorslev analytical method. A summary of the calculated permeability results from BH1003A, BH1007 and BH202 from the current works are presented in Table 7 and included in Appendix E, whilst the permeability test results from the supplied reports are presented in Table 8 and included in Appendix F.

Table 7: Calculated Permeability Results from Standpipe Piezometers.

Borehole ID	Material Types within Screened Interval	Calculated Permeability (m/sec)
BH1003A	Alluvial Sand: medium grained, medium dense to dense	2.5×10^{-4}
BH1007	Sandstone: medium to coarse grained, slightly fractured then unbroken, medium or high strength	3.5×10^{-5}
BH202 (1)	Alluvial Sand and Silty Clay, and residual Silty Clay	2.6×10^{-6}

Note: (1) Three tests carried out, refer Table 8.

Table 8: Calculated Permeability Results from Supplied Reports.

Borehole ID	Material Types within Screened Interval	Calculated Permeability (m/sec)
BH8 (1)	Sandstone: medium grained, with clay seams in upper metre of screened interval, low then high strength, fractured then unbroken	1.0×10^{-6}
BH107A (2)	Sandstone: fine to medium grained, high strength with very low strength bands, fractured	1.4×10^{-7} to 2.0×10^{-7}
BH107B (2)	Sandstone: medium grained, slightly fractured then unbroken, high strength	5.0×10^{-8} to 7.7×10^{-8}
BH109B	Sandstone: medium grained, slightly fractured then unbroken, high strength	4.7×10^{-8}
BH202 (3)	Alluvial Sand and Silty Clay, and residual Silty Clay	7.4×10^{-7} to 1.0×10^{-6}

Note: (1) Well screen includes an interval of core loss and clay seams below the top of rock (inferred to be Mittagong Formation).
(2) Two tests carried out.
(3) Three tests carried out, refer Table 7.

Typical permeability values for sand, both from DP's previous experience in the area, Borehole BH1003A and from published values, are usually in the range 1×10^{-4} to 1×10^{-5} m/sec. The calculated permeability values from tests completed in borehole BH202 are not consistent with these values and are considered to be not representative of the permeability of sand. Borehole BH202 was positioned close to buildings which may have deep concrete footings founded on rock, and it is possible that these footings combined with a layer of alluvial clay may limit inflows from the soils. Based on the test results from BH1003A, the permeability of the alluvial sand is much higher than measured in the tests completed within borehole BH202.

A relatively rapid recharge rate was observed following well development in Borehole BH1002, and attempts to complete permeability testing were unsuccessful: a loss of water return was encountered during drilling in this borehole between depths of 16.0 m and 18.0 m within Hawkesbury Sandstone bedrock.

7. Laboratory Testing

From the better quality rock core obtained from the current boreholes, 102 samples were selected and tested for axial point load strength index ($Is_{(50)}$). The results of the point load strength testing, presented on the borehole logs, indicate Is_{50} values of 0.05 MPa to 0.9 MPa in the medium grained sandstone (Mittagong Formation) and 0.1 MPa to 2.6 MPa in the medium to coarse grained sandstone (Hawkesbury Sandstone). These values indicate rock ranging from very low strength to high strength. To obtain inferred unconfined compressive strengths (UCS) from point load strength test results, a conversion factor of 20 is suggested, indicating a UCS of up to about 52 MPa for the rock encountered during the current investigation (this conversion factor varies and could also be slightly higher).

Eleven selected disturbed samples of various materials from the boreholes were tested in a NATA-accredited analytical laboratory to determine soil aggressivity (pH, electrical conductivity, sulfate and chloride ion concentrations).

The soil aggressivity results for the current investigation are summarised in Table 9, with the laboratory test reports included in Appendix G. A selection of the laboratory test results presented in the supplied previous investigation reports are summarised in Table 10 (laboratory test reports are not reproduced in this report).

Table 9: Laboratory Test Results for Aggressivity to Buried Concrete and Steel from Current Boreholes

Sample ID	Sample Description	Sample Elevation (RL m) (1)	pH	EC (2) (µS/cm)	Chloride (mg/kg)	Sulfate (mg/kg)
BH1001, 0.9-1.0m	Silty CLAY (Residual)	12.5	5.4	29	<10	32
BH1003A, 0.8-0.9m	Clayey SAND (Fill material)	13.5	8.9	77	<10	20
BH1003A, 1.9-2.0m	SAND (Alluvium)	12.4	8.2	8	<10	<10
BH1004A, 4.5-4.95m	Silty CLAY (Alluvium)	11.3	6.1	40	<10	20
BH1005, 1.55-1.65m	Clayey SAND (Fill material)	14.3	9.5	1	20	51
BH1005, 7.0-7.45m	Silty CLAY (Residual)	8.9	6.4	27	10	<10
BH1007, 8.5-8.95m	Clayey SAND (Extremely weathered sandstone)	7.3	6.3	14	<10	<10
BH2001A, 1.0-1.1m	SAND (Fill material)	13.0	8.6	66	<10	23
BH2001A, 1.8-1.9m	SAND (Fill material)	12.2	8.8	40	<10	<10
BH2002, 0.5-0.6m	SAND (Fill material)	13.5	9.6	70	<10	20
BH2002, 0.9-1.0m	SAND (Alluvium)	13.1	8.9	21	<10	<10

Notes: (1) Elevation quoted is for the 'top' of the sample.
(2) EC = Electrical Conductivity.
(3) Analysed soil was tested as a 1:5 mixture of soil:water prior to testing.

Table 10: Laboratory Test Results for Aggressivity to Buried Concrete and Steel (Selected Previous Boreholes)

Sample ID	Sample Description	Sample Elevation (RL m) (1)	pH	EC(2) (µS/cm)	Chloride (mg/kg)	Sulfate (mg/kg)
BH107B, 2.4-2.5m (4)	Sandy CLAY (Residual)	13.1	5.9	24	<10	20
BH202, 1.4-1.5m	SAND (Alluvium)	14.9	7.7	17	<10	<10
BH203, 3.4-3.5m		12.9	8.0	12	<10	<10
BH203, 5.0-5.1m (5)	Silty CLAY (Residual)	11.3	5.6	34	<10	34

Notes: (1) Elevation quoted is for the 'top' of the sample.
(2) EC = Electrical Conductivity.
(3) Analysed soil was tested as a 1:5 mixture of soil:water prior to testing.
(4) Sample mislabelled on Chain of Custody as 'BH107'.
(5) Sample mislabelled on Chain of Custody as 'BH203, 4.9-5.0 m'.

8. Geotechnical Model

The field work results are summarised on four geotechnical cross-sections in Appendix C (Drawings 3 to 7), which show the interpreted layers of fill materials, alluvial and residual soil, and sandstone units between the test locations. The interpreted boundaries shown on the sections are accurate only at the test locations and layers shown diagrammatically on the drawings are inferred only. Bands of lower or higher strength rock may be present within the generalised sandstone layers.

Below a surface layer of tiles (for Henry Deane Plaza only), a single concrete slab layer is inferred to be present across the site, with a thicker strip of concrete inferred to be present in the southern part of the site, inferred to be associated with footings and a (buried) wall on the southern side of the Adina Hotel retail tenancy. Fill materials are inferred to be present across the site, being of greater thickness and with building and demolition rubble inclusions in the southern part of the site (i.e. within the Henry Deane Plaza). Alluvial sand and clay soils are also inferred to be present within the Henry Deane Plaza (sub-parallel with the Devonshire Street pedestrian tunnel), whilst residual silty clay and sandy clay soils are inferred to be present across most of the site, overlying sandstone.

The interpreted geotechnical models for the site are:

- Northern part of the site (i.e. below the Adina Hotel: refer to Drawings 3, 5 and 7):
  - Loose to medium dense fill materials (gravel and bricks or sand: about 0.1 m thick increasing southwards to about 2 m thick); over
  - Dense to very dense sand alluvium (up to 1 m thick: Borehole BH2002 only);
  - Firm to very stiff sandy or silty clay residual soil (possibly up to 1.5 m thick); overlying
  - Fine to medium grained sandstone (very low strength, with medium to high strength bands: up to about 1.5 m thick); and then overlying
  - Medium grained, medium to high strength sandstone.

- Southern part of the site (i.e. within the Henry Deane Plaza: refer to Drawings 4, 5 and 6):
  - Stiff or loose to medium dense fill materials (clayey sand, sand, gravelly sand, sandy clay or silty clay, with building rubble, bricks, sandstone gravel and cobbles: up to 3.3 m thick); over
  - Medium dense to very dense sand and very soft to very stiff silty clay alluvium (up to 5.4 m thick); over
  - Firm to very stiff silty clay, sandy clay or clayey sand residual soil / extremely weathered sandstone (up to 2.5 m thick); overlying
  - Medium grained sandstone (extremely low or very low strength, with medium strength bands: up to about 1.2 m thick); and then overlying
  - Medium to coarse grained, medium to high strength sandstone;

The rock materials encountered in the boreholes (summarised in Table 11) have been classified in accordance with the system given in Pells et. al. (Ref. 6), and Bertuzzi and Pells (Ref. 7), which grades Sydney sandstone into five classes on the basis of strength and defects from Class I (high strength with virtually no defects) to Class V (very low strength sandstone or higher strength rock with closely spaced defects). It should be noted that the profiles are accurate at the borehole locations only, and that variations must be expected away from the boreholes. It should be noted that bands of higher strength rock can occur within lower class and lower strength rock.

To simplify the interpreted model, the classes given in Table 11 are based on the lower class applicable within a depth zone. A selection of the rock classifications presented in the supplied investigation reports is presented as Table 12.

Table 11: Summary of Material Strata Levels and Rock Classifications

Borehole ID	Top of Stratum (1)									
	Class V (2)		Class IV (2)		Class III (2)		Class II (2)		Class I (2)	
	Depth (m)	Level (RL)	Depth (m)	Level (RL)	Depth (m)	Level (RL)	Depth (m)	Level (RL)	Depth (m)	Level (RL)
BH1001	1.5	11.9	1.9	11.5	2.7	10.7	3.0	10.4	-	< -0.8
BH1002	0.5	12.9	0.7	12.7	1.3	12.1	3.0 (4)	10.4 (4)	-	< -4.7
BH1003A	4.6	9.7	4.9	9.4	6.8 (4)	7.5 (4)	11.2	3.1	-	< -0.1
BH1004A	5.6	10.2	6.8	9.0	8.4 (4)	7.4 (4)	-	-	-	< -2.4
BH1005	8.0	7.9	-	-	8.9 (4)	7.0 (4)	-	-	-	< 0.0
BH1007	9.2	6.6	9.8	6.0	11.0	4.8	-	-	-	< -0.4
BH2001A	-	-	2.5	11.5	3.8	10.2	5.7	8.3	-	< 2.0
BH2002	2.5	11.5	-	-	3.5	10.5	4.3	9.7	9.3	4.7

Notes: (1) Depths and levels shown are to the top of rock classes in boreholes, with depths in metres and elevations in m AHD.
(2) Rock classifications are based on Pells et. al (Ref. 6), and Bertuzzi and Pells (Ref. 7).
(3) '-' indicates the material was not encountered within the drilled length.
(4) A seam of extremely low strength was encountered within this interval.

Table 12: Summary of Material Strata Levels and Rock Classifications

Borehole ID	Top of Stratum (1)									
	Class V (2)		Class IV (2)		Class III (2)		Class II (2)		Class I (2)	
	Depth (m)	Level (RL)	Depth (m)	Level (RL)	Depth (m)	Level (RL)	Depth (m)	Level (RL)	Depth (m)	Level (RL)
BH107B	2.8	12.7	4.1	11.5	-	-	-	-	4.9	10.6
BH201	-	-	-	-	-	-	7.2	9.2	-	-
BH202	-	-	-	-	7.2	9.1	10.8	5.5	-	-
BH203	6.4	9.9	7.6	8.7	9.1	7.2	11.8	4.5	-	-

Notes: (1) Depths and levels shown are to the top of rock classes in boreholes, with depths in metres and elevations in m AHD.
(2) Rock classifications are based on Pells et. al (Ref. 6), and Bertuzzi and Pells (Ref. 7).
(3) '-' indicates the material was not encountered within the drilled length.

9. Proposed Development

It is understood that the proposed development of the site will include excavation beneath part of the northern area of the site (i.e. east of the Adina Hotel) for a four-level basement (to an elevation of RL1.9 m) and a localised deeper excavation for lift shafts , and excavation within the southern part of the site (within the Henry Deane Plaza) for a four split level basement to split elevations of RL1.0 m and RL 2.5 m, followed by construction of a multi-storey mixed-use tower. Based on the information provided by the client, detailed excavations of up to 4.5 m below bulk excavation level may be required for lift pits. It is further understood that buried services passing through the site south of the Adina Hotel and above the final basement floor level (i.e. stormwater and sewer pipes, and electrical cables) are to be structurally supported.

Based on the provided drawings, it is understood that the proposed southern basement will extend close to property boundaries, intersecting both the Lee Street and Devonshire Street pedestrian tunnels, and will need to interact with both existing and future basements on neighbouring sites. The proposed northern basement adjacent to the Adina Hotel will extend to the eastern boundary and partially to the northern boundary of the site. The drawings indicate that there will be two entry points into the basement, at Basement 3 level via a turntable from a neighbouring basement to the east (i.e. beneath the Devonshire Tunnel) at levels RL 5.5 m and RL 5.0 m.

Excavation for the basement will require excavation to depths ranging between about 11.7 m within the northern part of the site and 14.7 m within the southern part of the site, being deepened further for lift shafts.

10. Comments

10.1 Geotechnical Issues

Some of the geotechnical issues that need to be considered for the proposed development are:

- Maintaining the stability and integrity of adjoining structures, services and tunnels (i.e. the Adina hotel, Henry Deane Plaza buildings, the existing pedestrian tunnels, and buried stormwater/sewer services);
- Excavation-induced movement adjacent to Lee Street, which is a Roads and Maritime Services (RMS) asset;
- Interactions with adjoining basements, including to the east and south of the site;
- Groundwater is likely to be present within the basement excavation envelope, in the form of seepage within the fill and soils, at the soil-rock interface and along rock joints and bedding planes;
- Water-tight shoring walls will need to be designed around the perimeter of the site to retain fill, alluvial and residual soils, to reduce groundwater inflow and to control drawdown of water levels on adjacent sites;
- The shoring will need to be socketed into competent rock, which may be problematic for some shoring systems;
- Shoring installed (by others) along boundaries for adjoining basement developments will need to be assessed, to determine support strategies where narrow rock plinths will be formed;
- Design of the shoring walls (including anchors, props or struts) will need to take into consideration the positions of current or future proposed basement levels and connections;
- If water-tight shoring walls (cut-off walls) are constructed into rock to reduce inflow and drawdown of water levels, then it is technically feasible to construct a drained basement, however, this will be subject to review and approval by both the City of Sydney Council (Council) and by Water NSW; and
- Alternatively, a tanked basement could be constructed to reduce the need for long term collection, possible treatment and removal of groundwater inflows. A tanked basement would need to be designed for horizontal hydrostatic pressure behind shoring walls and hydrostatic uplift of the basement floor slab.

10.2 Site Preparation

Site preparation may require the partial demolition of portions of existing structures to facilitate access for machinery, and access tracks and ramps may be required to enable machinery (e.g. piling rigs) to access the southern part of the Site. Careful attention should also be made to the staging of the works, to prevent damage or over-loading of existing supporting structures, such as the concrete and sandstone columns supporting the Adina Hotel (which may be founded at relatively shallow depths on the underlying sandstone). Prior to the commencement of basement excavation works, a strategy to monitor building movement during the construction period will need to be implemented.

It is likely that removal and replacement of fill materials (e.g. including clay or sand fill, and demolition rubble) and construction of working platforms will be required. Subject to confirmation testing, existing

concrete slabs within the northern part of the site may be suitable as working platforms for piling rigs, prior to their removal as part of the bulk excavation works. Further geotechnical advice should be sought when further details are known.

Installation of water-tight shoring walls around the site perimeter will be required, prior to the commencement of the basement bulk excavation works. Low-height equipment is likely to be required, if piling works are to be carried out within indoor areas.

Sand, clay and rubble fill materials, and sand and clay alluvial soils, are likely to be exposed within the upper 4-7 m of the southern part of the excavation which is likely to pose challenges for construction vehicles with pneumatic tyres. Some rutting and surface damage should be expected, particularly if traversed following periods of prolonged rainfall. It is anticipated that tracked machines would be able to safely traverse and work upon this material while it is exposed.

If placement of fill is required, or there is a need to improve the allowable bearing capacity of the underlying site soils, additional site preparation will be required. Typical site preparation measures could include:

- Removal of loose soil to create a level surface, to a depth to be determined on a case-by-case basis by a geotechnical engineer;
- Compact the exposed material, then test roll the exposed surface using at least six passes of a minimum 12-tonne roller in non-vibration mode. The final pass should be witnessed by an experienced geotechnical engineer to detect any weak zones which would require additional rectification work, as directed by the geotechnical engineer;
- If required, replacement fill material should be free of oversize particles (>100 mm) and materials which could break down or degrade, and should be placed in layers of loose thickness not greater than 200 mm (dependent upon the size of compaction machinery), and compacted to a dry density ratio of at least 98% relative to Standard compaction. Moisture contents should be maintained within 2% of Standard optimum moisture content. Compaction should be increased to a dry density ratio of 100% relative to Standard compaction for the top layer of the fill material (if the replacement filling used is sand, compact to a density index of 75%);
- Moisture conditioning (i.e. drying or wetting) of the replacement fill material may be required, to enable a greater degree of compaction to be achieved; and
- All fill materials should be placed in accordance with Australian Standard AS 3798 (Ref. 8), with earthworks quality control testing undertaken to verify that the required compaction/moisture criteria are achieved.

Stabilisation of the underpinned brick retaining wall along the northern and eastern sides of the Adina Hotel basement will be required if it is to be retained as part of the works, such as by further underpinning of the brick retaining wall and the existing concrete underpin down to medium strength rock.

Dilapidation surveys should be carried out on adjacent properties, including structures, pathways, walls or roadways prior to commencement of the works. The dilapidation survey should document existing conditions and the presence of defects, and thereby allow appropriate responses should any claims arise from construction at this site. Buildings supported on shallow foundations are especially prone to the detrimental effects of settlement and vibration. The extent of dilapidation surveys can be reviewed once the detailed design has been completed.

10.3 Bulk Excavation

Following completion of the site preparation works, including the installation of shoring walls, excavation for the basement levels is expected to be required through up to about 7.5 m of soil (including clay, sand and rubble fill, alluvial sand and silty clay, and residual clayey sand, silty clay or sandy clay), then through rock of varying strength, including high strength sandstone.

The fill, alluvial and residual soils should be readily excavated using conventional earthmoving equipment. Very low to low strength rock will likely require light to medium ripping. The use of heavy ripping equipment, rock hammers or rock saws will be required to for excavation medium or high strength rock.

Rippability of the sandstone is critically dependent upon the spacing of bedding and vertical joints, as well as on strength. Effective removal of the medium or higher strength sandstone within the lower levels of the excavation should be achieved by heavy bulldozers ripping in conjunction with rock hammers, however, excavation contractors should make their own assessment of likely productivity depending on their equipment capabilities and operator skills. Some of the less fractured high strength rock may be effectively unrippable with low productivity. Detailed footing excavations adjacent to boundary lines can be achieved by use of rock hammers or hydraulic rotary rock saws, or milling heads. Rock saws should also be used along the site boundaries to minimise over-break and vibrations.

10.4 Vibration Control

Noise and vibration will be caused by excavation and earthworks activities at the site. The use of rock hammers will cause vibrations which, if not controlled, could possibly result in damage to nearby structures and disturbance to occupants, and it will be necessary to use appropriate methods and equipment to keep ground vibrations at adjacent buildings and structures within acceptable limits.

Based on previous experience and with reference to Australian / International Standard AS/ISO 2631.2 (Ref. 9), an initial vibration limit of 8 mm/sec vector sum peak particle velocity (VSPPV) is suggested at the foundation level of adjacent buildings, for human comfort considerations. This initial vibration limit may need to be reduced if there are vibration-sensitive buildings or equipment in the area (e.g. buried pipes). It is noted that brick buildings or structures near to the proposed excavation (e.g. the brick retaining wall along the northern and eastern site boundary) may be founded on pad or strip footings in sand at shallow depths, which could be affected by ground vibration. A lower vibration limit of 3-5 mm/s is recommended for any structures founded on loose sand. The owners of any in-ground utilities within and around the property should also be consulted regarding allowable vibration levels.

If generation or construction vibration is a potential problem, consideration should be given to rock sawing and rock milling methods of rock excavation. A site-specific vibration monitoring trial may be required to determine vibration attenuation, once excavation plant and methods have been finalised.

10.5 Disposal of Excavated Material

Off-site disposal of excavated material will require assessment and environmental testing for re-use or classification, in accordance with *Waste Classification Guidelines* (Ref. 10), prior to disposal to an appropriately licensed landfill or receiving site. This includes fill materials and virgin excavated natural

materials (VENM), such as may be removed from this site. The type and extent of testing undertaken will depend on the final use or destination of the spoil, and requirements of the receiving site.

10.6 Batter Slopes

Based upon the provided drawings, excavation up to site boundaries is proposed and it is likely that internal batters will be required during construction for temporary site access and driveways. Vertical excavations along the site boundaries in the fill, soils and very low to low strength rock cannot be relied upon to remain stable and will require shoring.

The suggested maximum batter slopes for temporary batters of up to 3 m height above the water table, which are not subjected to surcharge loads, are presented in Table 13. Where surcharges apply shallower batters will be required.

An assessment of stability using analytical techniques would be necessary for excavations deeper than 3 m, and flatter batters would usually be appropriate.

Table 13: Recommended Maximum Batter Slopes for Excavated Slopes

Excavated material	Temporary Batter	Permanent Batter
Fill materials	1.5H:1V	2H:1V
Residual soils	1.5H:1V	2H:1V
Extremely low to low strength sandstone	0.5H:1V	1H:1V
Medium strength sandstone (or better)	Vertical (1)	Vertical (1)

Note: (1) Must be inspected by an engineering geologist or geotechnical engineer for unstable wedges, which should be cleared or rock bolted

Care should be taken where any surcharge loads are planned at the crest of batter slopes (e.g. placement of scaffolding sole boards). A slope stability analysis should be undertaken for batters subjected to surcharge loads on a case-by-case basis, following inspection and testing by a geotechnical engineer. Material stockpiles and machinery or equipment should not be stored at the crest of unsupported excavations.

Given the proximity to adjacent structures and the depth of excavation, shoring walls are likely to be required around the excavation perimeter.

Medium to high strength sandstone can be cut vertically, provided the exposed faces are carefully inspected by a suitably qualified geotechnical engineer or engineering geologist as the excavation progresses.
Regular inspections of the rock face will be required during excavation (recommended at about every 1.5 m ‘drop’ in excavation), to determine whether there are any adversely oriented defects which require rectification works to maintain stability, such as rock bolts or anchors or installation of steel mesh-reinforced shotcrete. Based upon the quality of the medium to high strength sandstone encountered in boreholes during the investigation, it is expected that there should only be a few minor beds of very low or low strength sandstone requiring shotcrete protection within the sides of the excavation.

10.7 Groundwater

10.7.1 General

Groundwater measurements from standpipe piezometers within and adjacent to the site indicate that the proposed design floor level of 'Basement 4' at a minimum elevation of RL1.0 m will be below the permanent groundwater table: the highest measured groundwater elevation was RL13.9 m within the Mittagong Formation, and RL13.5 m within the underlying Hawkesbury Sandstone. Perched groundwater is also indicated to be present within the overlying alluvial soils, for which the highest recorded water level was at an elevation of RL13.5 m, and at or near the soil-rock interface within the residual clay.

The measurements indicate that water inflows within the sandstone bedrock appear to be controlled by rock joints. The seams and other fractures in the weathered rock may also be acting as conduits for water flow, and temporary water storage. Groundwater data and observations from the supplied reports indicate minimal variability in groundwater levels following rainfall periods between July 2019 and September 2020. Recent groundwater observations made during the current study show a similar trend.

Previous experience indicates that groundwater from the geological units which are present at the site can have moderate concentrations of dissolved solids, including iron. Once the groundwater comes into contact with the atmosphere, precipitation of iron oxides is likely to occur and provision should be made for the filtering and cleaning of this precipitate from subsoil drains, sumps, pumps and other fittings over the medium to longer term.

It is likely that groundwater modelling will be required for the proposed basement, to indicate the volume of dewatering which is likely to be required during both the construction stage and over the longer term, noting that basements to similar levels are proposed for construction on adjoining sites to the east and south.

10.7.2 Seepage Rates and Groundwater Drawdown

The design of the basement is likely to target a groundwater drawdown in soils or extremely low strength rock at neighbouring properties (below existing water levels) of no more than 1.5 m. To achieve this, the basement construction will need to include a relatively water-tight perimeter 'cut-off' wall to minimise water ingress. This wall could be either socketed a minimum of 2 m into competent, slightly weathered to fresh, slightly fractured and unbroken, medium to high strength sandstone, or drilled through the medium or high strength sandstone to below the base of the excavation.

Extending the cut-off wall to below the level of the basement excavation would reduce the risk of seepage occurring through fractures in the rock in the sides of the excavation and would also further reduce the inflow to the basement. If excessive water ingress becomes an issue during excavation in the case whether the walls have been terminated above the basement design floor level, then grouting of open joints and bedding partings may be necessary and will be relatively difficult and costly to achieve.

A drained basement may be feasible for the site, provided a perimeter water-tight cut-off wall is constructed for the height of perimeter walls which are retaining soil, and extended at least 2 m into the slightly fractured or unbroken sandstone.

If seepage flows need to be further reduced then cut-off walls could be extended below the basement floor level, as the seepage would then only be able to occur up through the medium to high strength rock below the basement floor. It will be necessary to provide under-floor drainage to safeguard against uplift pressures for a slab designed for drained conditions. This could comprise a minimum 100 mm thick, durable open graded crushed rock with subsurface drains and sumps.

Approval for a drained basement will be subject to review and approval by Council and by Water NSW. If a drained basement slab is not permitted, or it is preferred to eliminate issues associated with long term removal of groundwater, then a water-tight 'tanked' basement will be required for the permanent basement structure. A tanked basement would need to be designed to resist uplift forces associated with hydrostatic groundwater pressures which could be in the order of 15 m of hydraulic head.

10.7.3 Disposal

It is noted that off-site disposal of collected groundwater will need to be carried out in accordance with New South Wales Government Legislation (Ref. 11), and that water to be discharged into the natural environment should comply with the relevant guidelines (e.g. Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand Environment and Conservation Council (ANZECC), Agricultural and Resource Management Council of Australia and New Zealand), and/or City of Sydney Council's local stormwater discharge conditions. It is considered that preparation of a dewatering management plan will likely be required during a later stage of the project.

10.8 Excavation Support

10.8.1 General

Shoring will be required around the sides of the basement excavation, and the installation of a water-tight shoring wall will be required around the basement perimeter, socketed at least 2 m into the slightly fractured or unbroken sandstone.

10.8.2 Shoring / Retaining Walls

Shoring wall systems which could be considered include diaphragm walls and interlocking secant pile walls, as follows:

- Diaphragm walls may be used as the permanent basement wall. They are usually considered to have a reduced risk of adverse construction issues, but are relatively slow to construct and consequently more expensive. They are constructed using a large 'grab' bucket, which excavates the soil and rock in vertical panels which are supported by bentonite fluid. Each panel is then cast using concrete tremmied into the bentonite-supported excavation, with steel reinforcement cages installed prior to the concrete being tremmied. The joints between the panels are sealed with a 'waterstop', so that a completely water-tight wall is achieved; or
- Interlocking secant pile walls are typically formed by drilling alternate 'soft' grout or concrete piles and then installing 'hard' reinforced concrete piles by cutting into the previously drilled soft piles. This overlap typically ensures that piles are sealed, but some misalignment can occur even at relatively shallow depths to create minor gaps in the wall. The potential for misalignment and therefore seepage ingress and soil loss through the wall is high for deep secant pile walls. Drilling

of piles into rock can also be problematic for secant piles, and may result in decompression or disturbance of the surrounding soils which can result in damage to adjacent buildings. The use of segmental casing through the soils would be required to avoid issues associated with decompression and hole collapse in sandy soils, and pumps may be required to remove seepage from pile excavations prior to placement of concrete.

10.8.3 Design of Excavation Support

The shoring may need to be supported by internal bracing (e.g. props or struts) or ground anchors to control deflections.

Excavation faces retained either temporarily or permanently will be subjected to earth pressures from the ground surface down to the top of medium strength rock. The values of active earth pressure coefficient (K_a) given in Table 14 may be used for a level ground surface and a 'flexible' wall which is allowed some lateral movement. 'At rest' earth pressure (K_o) values should be used where the wall movement needs to be reduced, such as next to neighbouring building footings.

Table 14: Preliminary Design Parameters for Shoring Systems

Material Description	Unit Weight (kN/m^3)	Coefficient of Active Earth Pressure (K_a)	Coefficient of Earth Pressure 'at Rest' (K_o)	Effective Cohesion (c': kPa)	Effective Friction Angle (Degrees)
Fill materials, sand or clay alluvium, firm sandy or silty clay residual soil	18	0.4	0.6	0	28
Very stiff to hard silty clay, sandy clay or clayey sand residual soil / extremely weathered sandstone	20	0.25	0.4	5	25
Extremely low to low strength sandstone	22	0.1	0.2	100	25
Medium strength or stronger sandstone	24	0 (1)	0 (1)	300	40

Note: (1) Subject to geotechnical inspection.

The design for lateral earth pressures of multiple anchored or propped walls may be based on a trapezoidal earth pressure distribution, with additional allowances made for surcharge loads from adjacent buildings, sloping ground surfaces, the rail corridor, and construction machinery. Hydrostatic pressures acting on the full height of the shoring wall should also be included in the design where adequate drainage is not provided behind its full height.

The following earth pressure magnitudes are considered appropriate, where H is the height of soil and rock to be retained (in metres):

- 4H kPa, where some lateral movement is allowed; and

- 6H kPa, where lateral movements need to be minimised (e.g. next to buildings or services).

In each case the maximum pressure generally acts over the central 60% of the wall height, reducing to zero at the top and base of the wall.

If the shoring terminates in rock above the bulk excavation level then rock bolts or anchors will be required to ensure that the toe of the shoring is not undermined by further excavation of the rock below the shoring level. Passive resistance for shoring founded in rock below the base of the bulk excavation (including allowance for services or footings) may be based on the ultimate passive restraint values provided in Table 15. These ultimate values represent the pressure mobilised at high displacements and therefore it will be necessary to incorporate a factor of safety of say 2 to limit wall movement. The top 0.5 m of the socket should be ignored due to possible disturbance and over-excavation.

Table 15: Preliminary Passive Resistance Values

Foundation Stratum	Ultimate Passive Pressure (kPa)
Low strength sandstone	2,000
Medium strength or stronger sandstone	4,000

Detailed design of shoring and should preferably be carried out using WALLAP, PLAXIS or other accepted computer analysis programs capable of modelling progressive excavation and anchoring, and predicting potential lateral movements, stresses and bending moments. PLAXIS (or similar) would be required if it is necessary to assess ground movements on surrounding properties (e.g. 8-10 Lee Street), as WALLAP can only assess wall movements.

10.8.4 Ground Anchors

For estimation purposes the design of temporary ground anchors for the support of shoring systems may be carried out on the basis of the maximum bond stresses given in Table 16. The anchors should preferably have their bond length within the medium strength or stronger sandstone.

To prevent excessive lateral deformation, installation of temporary ground anchors may be required below any adjoining footings (i.e. located on or close to the site boundaries), or into the toes of shoring piles installed above the basement design floor level. Additional anchors may be required if potentially unstable blocks or wedges are observed during excavation of rock.

Table 16: Preliminary Bond Stresses for Rock Anchor Design

Material Description	Maximum Allowable Bond Stress (kPa)	Maximum Ultimate Bond Stress (kPa)
Very low strength sandstone	100	200
Low strength sandstone	200	400
Medium strength or stronger sandstone	500	1000

The parameters given in Table 16 assume that the anchor holes are clean and adequately flushed, with grouting and other installation procedures carried out carefully and in accordance with good anchoring

practice. Careful installation and close supervision by a geotechnical specialist may allow increased bond stresses to be adopted during construction, subject to testing. The use of permanent anchors would require careful attention to corrosion protection. Further advice on design and specification should be sought if permanent anchors are to be employed at this site.

Ground anchors should be designed to have an appropriate free length (minimum of 3 m) and have a minimum 3 m bond length. After installation they should be proof loaded to 125% of the design working load and locked-off at no higher than 80% of the working load. Periodic checks should be carried out during the construction phase to ensure that the lock-off load is maintained and not lost due to creep effects or other causes.

It will be necessary to obtain permission from neighbouring landowners prior to installing anchors that will extend beyond the site boundaries. In addition, care should be taken to avoid damaging buried services, pipes and subsurface structures (possibly including neighbouring piled footings) during anchor installation. Anchoring should only be carried out by an experienced contractor with demonstrated experience in similar ground conditions.

Vertical anchors for uplift support (e.g., for uplift resistance of the side core) could also be designed using the parameters given in Table 16. The designer should check the cone pull-out failure mechanism by assuming a 90-degree cone for both the soil and rock.

10.9 Excavation-Induced Ground Movement

10.9.1 Transport for NSW Infrastructure

Lee Street is a Transport for NSW (TfNSW) asset, and the Devonshire Street pedestrian tunnel is a Sydney Trains asset. Reference should be made to a TfNSW Technical Direction for excavation adjacent to TfNSW infrastructure (Ref. 12), which outlines their requirements and includes the level of geotechnical investigation required, dilapidation surveying, instrumentation and monitoring during construction, trigger levels and contingency plans. Sydney Trains, TfNSW or other local authorities may have specific requirements, which will need to be discussed and implemented before construction commences.

A Geotechnical Impact Assessment (GIA: that is, numerical modelling) will typically be required as part of a Development Application (imposed by both TfNSW and Sydney Trains). The purpose of the GIA is to assess the likely amount of excavation-induced ground movement resulting from the proposed excavation.

During construction, instrumentation (e.g. inclinometers) and survey monitoring are typically required where the excavation exceeds heights of either 3 m (for cantilevered shoring walls) or 6 m (for anchored or propped shoring walls). A geotechnical monitoring plan is likely to be required by TfNSW prior to construction for this site.

10.9.2 Stress Relief

For an excavation which extends to a depth of up to about 11 m below the top of medium or high strength sandstone, there is likely to be some inward horizontal movement due to stress relief effects. It is impracticable to provide restraint for the relatively high in-situ horizontal stresses present within the

Hawkesbury Sandstone. Release of these stresses due to the excavation will generally cause horizontal movement along the rock bedding surfaces and partings.

Based on monitoring experience for excavations in the Sydney region, excavation to about 11 m below the top of weathered rock may give rise to lateral movements of between 0.5 mm and 1.5 mm for every 1 m depth of excavation below the top of rock (i.e. in the order of 5 – 16 mm total movement at the centre of the face, at the top of the excavation). The stress relief movements behind the top of the excavation typically reduce by 1 mm per metre of distance back from the face.

The new building structure should be designed to allow for some stress relief movements, i.e. leaving a gap between the structure and the rock face. The differences in stress relief movements behind the top of the excavation may result in cracking of adjacent brittle buildings. It is recommended that appropriate allowance also be made for the repair of pavements and public utilities, where excavations are carried out close to structures.

Regular monitoring of survey targets along the excavation perimeter during construction, such as following each successive 'drop' in excavation level, should be undertaken to monitor the effects of stress relief.

10.10 Foundations

It is anticipated that the foundations for the building above the proposed basement will be constructed within a uniform founding stratum, at or below the floor level of 'Basement 4' (i.e. RL1.0 m). New foundation columns to be installed beneath the Adina Hotel, and within a few metres of deep excavations for the basement, are proposed to be founded within a uniform stratum below an elevation of about RL10 m.

As depicted in the interpreted cross-sections (Drawings 3 to 7, Appendix C), medium to high strength Hawkesbury Sandstone with bands of lower strength and with occasional clayey seams (assessed to be either Class III or Class II sandstone) is expected to be exposed at 'Basement 4' level across the basement excavation floor, and at the positions of the new foundation columns beneath the Adina Hotel.

On this basis, spread footings (i.e. pad footings) should be suitable for supporting building loads within the excavation footprint of the southern basement. Pile foundations are likely to be considered for the main tower to resist uplift forces and overturning moment. Pile foundations will also be suitable for the new columns beneath the Adina Hotel. These foundations may be designed for the support of axial compression loads using the bearing pressures, shaft adhesions and modulus values presented in Table 17, which are based on the assumption that the excavations are clean and free of loose debris, with pile sockets free of smear and adequately roughened immediately prior to concrete placement. Shaft adhesion values for uplift (tension) may be taken as being equal to 70% of the values for compression.

Where footings are located within the zone of influence of adjacent excavations, drawn upward at 45 degrees from the toe of the excavation (such as tunnels, lift shafts or tanks), the allowable bearing pressure should be reduced by 25% and the excavation floor carefully inspected for adversely oriented joints. Alternatively, the footings may be taken deeper, below the zone of influence.

If allowable bearing pressures of more than 3.5 MPa are used in design, then additional testing will be required in the form of cored boreholes and spoon testing of pad footings, to ensure there are no defects

beneath footings. Spoon testing involves drilling a 50 mm diameter hole below the base of the pad footing, to a depth of 1.5 times the footing width, followed by testing to check for the presence of weak/clay bands. If weak seams are detected, then footings may need to be taken deeper to reach suitable foundation material.

Alternatively, if the bearing pressures are limited to a maximum of 3.5 MPa then visual inspection of foundations during construction will be sufficient. If an allowable bearing pressure of 10 MPa is used for design then 100% of the footings should be spoon tested to a depth equivalent to 1.5 times the footing width, with cored boreholes drilled at 50% of the footings and taken to 3 m below bulk excavation level. If the adopted bearing pressure is 6 MPa then the frequency of spoon testing could be reduced, needing to be completed for 33% of the footings.

Table 17: Recommended Design Parameters and Moduli for Foundation Design

Foundation Stratum (1)	Allowable Parameters		Ultimate Parameters (3)		Field Elastic Modulus (MPa)
	End Bearing (kPa)	Shaft Adhesion (kPa) (2)	End Bearing (kPa)	Shaft Adhesion (kPa) (2)	
Sandstone – Class V	1,000	75	3,000	150	50
Sandstone – Class IV	2,000	100	6,000	250	100
Sandstone – Class III	3,500	350	20,000	800	350
Sandstone – Class II	6,000	600	60,000	1,500	900
Sandstone – Class I	10,000	600	120,000	3,000	2000

Notes: (1) Rock classification based on Pells et. al (1998) and Bertuzzi and Pells (2002).
(2) Shaft adhesion applicable to the design of bored piles, uncased over the rock socket length, where adequate sidewall cleanliness and roughness are achieved.
(3) Ultimate end bearing parameters mobilized at large settlements (i.e. >5% of pile diameter).

The settlement of a spread footing is dependent on the loads applied to the footing and the foundation conditions below the footing. The total settlement of a spread footing designed using the allowable parameters provided in Table 17 should be less than 1% of the footing width upon application of the design load. Differential settlements between adjacent footings may be in the order of 50% of the value of total settlement. The design of footings is usually governed by settlement criteria and performance rather than the ultimate bearing capacity or Ultimate Limit State condition.

For limit state design, selection of the geotechnical strength reduction factor (ϕ_g) in accordance with Australian piling code AS 2159 (Ref. 13) is based on a series of individual risk ratings (IRR), which are weighted on numerous factors and lead to an average risk rating (ARR). Therefore, it is recommended that an appropriate geotechnical strength reduction factor be calculated by the pile designer. Preliminary design could be based on a ϕ_g of 0.4 (i.e. no pile testing), and refined as the design progresses. Footing settlements may be calculated for assessment of the serviceability limiting state using the elastic modulus values given in Table 17.

All spread footings should be inspected by an experienced geotechnical engineer to check the adequacy of the foundation material, and proof-drilled or spoon tested as appropriate.

10.11 Soil Aggressivity to Concrete and Steel Structures

In accordance with Australian Standard AS 2159 (Ref. 13), the results of chemical laboratory testing completed on soil samples during the current investigation indicate that:

- all of the soils tested are non-aggressive to buried steel;
- clayey sand fill materials, the alluvial sand and silty clay (above the water table), and the sandy clay residual soils are non-aggressive to buried concrete;
- silty clay residual soils above the water table are mildly aggressive to buried concrete; and
- soils below the water table, including sand fill materials, alluvial sand, and clayey sand residual soils, are mildly aggressive to buried concrete.

The results of previous tests presented in the supplied reports (i.e. DP Report 86767.00.R.006.Rev5 dated 26 November 2020, and 86767.07.R.001.Rev0 dated 2 November 2020) indicate that:

- samples of alluvial sand from below the inferred water table are mildly aggressive to buried concrete; and
- samples of weathered sandstone (inferred to be Hawkesbury Sandstone) are mildly aggressive to buried concrete.

It is considered that the silty clay residual soils are likely to be derived from weathering of fine to medium grained sandstone (i.e. the Mittagong Formation), and so it is considered that the upper layer of fine to medium or medium grained sandstone is also likely to be mildly aggressive to buried concrete and non-aggressive to buried steel.

10.12 Seismic Design

In accordance with the Earthquake Loading Standard, AS 1170.4 (Ref. 14), the Site has a hazard factor (z) of 0.08. Given that most of the basement excavation is in Class V rock or better and that the building may be connected to the shoring, a site sub-soil class of rock (B_e) is considered appropriate, assuming that all major structural loads are carried to rock of at least extremely low to very low strength.

11. Further Geotechnical Work

It is suggested that the following further geotechnical work, to be completed at a later stage of the Project, could include:

- Supplementary geotechnical boreholes within the footprints of both the proposed foundation columns for the Adina Hotel;
- Preparation of a geotechnical monitoring plan (i.e. Lee Street and Devonshire Street Pedestrian Tunnel for TfNSW). Both TfNSW and Sydney Trains will typically require this as part of the later detailed development application or prior to Construction Certificate;
- Instrumentation (inclinometers and survey markers) installed during construction to monitor excavation-induced movements, and to confirm that they are within the approved / tolerable limits specified in both the geotechnical monitoring plan and track monitoring plan;

- Dilapidation surveys;
- Waste classification of all material to be excavated and transported off site; and
- Footing inspections during construction.

It is recommended that a meeting be held after the initial design has been completed to confirm that the recommendations given in this report have been interpreted correctly.

12. Cumulative Impacts

As discussed in Section 10.10, excavation for the proposed basement levels will likely produce some inward horizontal movement due to stress relief effects within Hawkesbury Sandstone. The differences in stress relief movements behind the top of the excavation may result in cracking of adjacent brittle buildings. It is recommended that appropriate allowance also be made for the repair of pavements and public utilities, where excavations are carried out close to structures.

Consideration should be given to drawdown effect to the neighbouring buildings and TfNSW assets (Lee Street and Devonshire Street Pedestrian Tunnel) due to dewatering during the bulk excavations. Further reference should be made to DP's groundwater assessment report (Ref.: 86884.02.R.006.Rev01).

13. Mitigation Measures

The following DA consents are anticipated to be required by different authorities during a later stage of DA process of the proposed development:

- Geotechnical Impact Assessment (GIA) by TfNSW to indicate the effects of excavation to the existing TfNSW assets (Lee Street and Devonshire Street Pedestrian Tunnel);
- Sydney Water Impact Assessment, to indicate the effects of the excavations and proposed development to the existing DN400 Sewer Main; and
- Groundwater assessment and Dewatering Monitoring Plan by City of Sydney Council and WaterNSW.

14. Conclusion

This report has discussed various geotechnical aspects of the proposed development and has outlined appropriate construction methods, monitoring requirements, and design parameters. Similar basements have been constructed in Sydney without significant impacts to surrounding properties. It is considered that once the DA consents are obtained with appropriate mitigation measure in place, the basement could be designed and constructed without significant adverse impacts to surrounding properties.

15. References

1 Herbert C. (1983), *Sydney 1:100 000 Geological Sheet 9130, 1st edition*. Geological Survey of New South Wales, Sydney.

2 City of Sydney Archives *Detail Plans, 1855: Sheet 23 [A-00880168]* from website https://archives.cityofsydney.nsw.gov.au/nodes/view/1709095.

3 Rickwood, P.C. (1985), *Igneous intrusives in the Greater Sydney Region*, in *Engineering Geology of the Sydney Region*, pages 215-308 (ed. Pells P.J.N), A.A Balkema, 1985.

4 Murphy C.L. (1997), *Acid Sulfate Soil Risk Map for Botany Bay, 2nd edition*. Department of Land and Water Conservation, New South Wales, Sydney.

5 AS 1726:2017, Geotechnical Site Investigations, Standards Australia.

6 Pells, P.J.N., Mostyn, G., Walker, B.F. (1998), *Foundations on Sandstone and Shale in the Sydney Region.* Australian Geomechanics Journal, December 1998.

7 Bertuzzi, R. and Pells, PJN (2002), Geotechnical parameters of Sydney Sandstone and Shale. Australian Geomechanics Journal, Vol. 37, No. 5.

8 AS 3798:2007, Guidelines on earthworks for commercial and residential developments, Standards Australia.

9 AS/ISO 2631.2: 2014, Mechanical vibration and shock – Evaluation of human exposure to whole-body vibration – Vibration in buildings (1 Hz to 80 Hz), Standards Australia / International Standards Organisation.

10 NSW Environment Protection Authority (NSW EPA: 2014), *Waste Classification Guidelines*.

11 New South Wales Government Legislation (1997), *Protection of the Environment Operations Act 1997 No. 156* (POEO Act), "https://www.legislation.nsw.gov.au/~/view/act/1997/156/full".

12 Transport for New South Wales (2020), *TfNSW Technical Direction 2020/001*, 2 July 2020.

13 AS 2159:2009, *Piling Design and Installation*, Standards Australia.

14 AS 1170.4:2007, *Structural design actions Part 4: Earthquake actions in Australia*, Standards Australia.

16. Limitations

Douglas Partners (DP) has prepared this report for this project at 2-8a Lee Street, Haymarket, in accordance with DP's proposals SYD201237.P.001.Rev2 dated 16 February 2021, and SYD201237.P.002.Rev1 dated 6 May 2021, and approvals received from Mr. David McLaren dated 17 February 2021 and 27 May 2021. The work was carried out under an amended Toga Major Consultancy Services agreement (contract number CSC-01, dated 10 March 2021). This report is provided for the exclusive use of Toga Development and Construction Pty Ltd or their agents, for this project only and for the purposes as described in the report. It should not be used by or be 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 / groundwater 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 pages 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 included the assessment of sub-surface materials for contaminants within the Site, which is presented under separate cover. 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.

Asbestos was detected by laboratory analysis of soil samples taken from specific borehole locations (refer to Douglas Partners Reports 86884.02.R.002.Rev0 and 86884.02.R.003.Rev0 for further details). Building demolition materials, such as brick and concrete rubble, sandstone boulders, ash, slag, igneous gravel and cobbles (railway ballast) were located in previous below-ground filling, which are considered as indicative of the possible presence of hazardous building materials (HBM), including asbestos.

Although the sampling plan adopted for this investigation is considered appropriate to achieve the stated project objectives, there are necessarily parts of the Site that have not been sampled and analysed. This is either due to undetected variations in ground conditions or to budget constraints (as discussed above), or to parts of the Site being inaccessible and not available for inspection/sampling. It is therefore considered possible that HBM, including asbestos, may be present in unobserved or untested parts of the Site, between and beyond sampling locations, and hence no warranty can be given that asbestos is not present.

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.

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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

Site Photographs

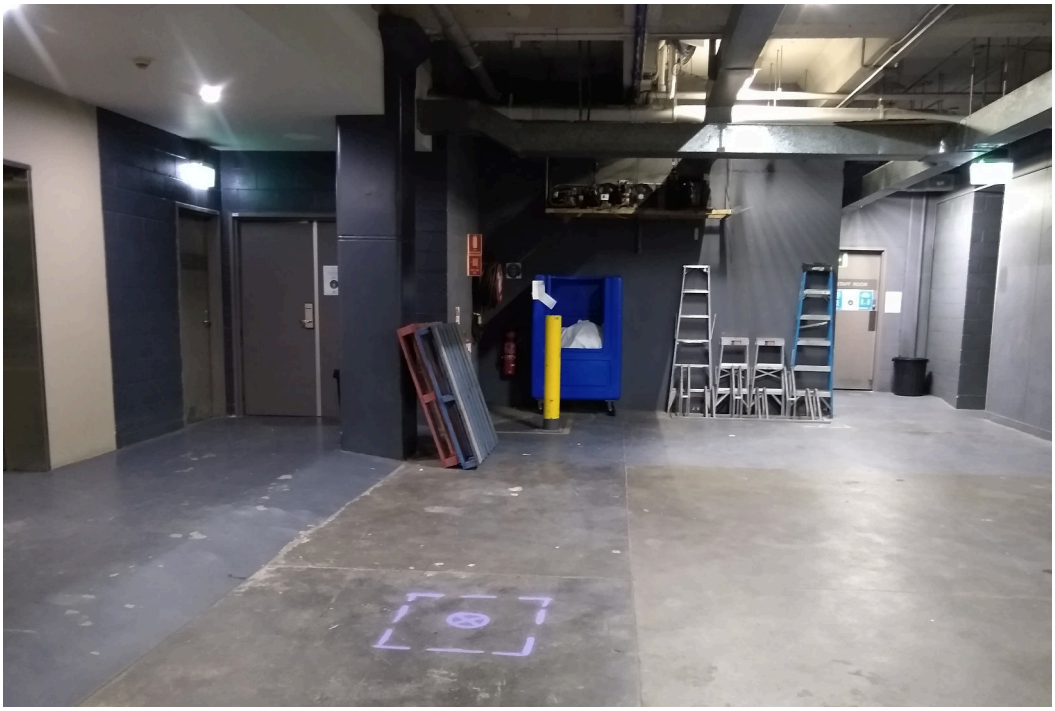


Photo B1 – View north-west at the location of Borehole BH1001, within the Adina Hotel basement.

Photo B2 – View north-east at the location of Borehole BH1001, within the Adina Hotel basement.

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs** **Proposed Commercial Development** **2-8a Lee Street, Haymarket**	PROJECT: 86884.02 PLATE No: B1 REV: 0
	CLIENT: Toga Development and Construction	DATE: 25-Mar-21

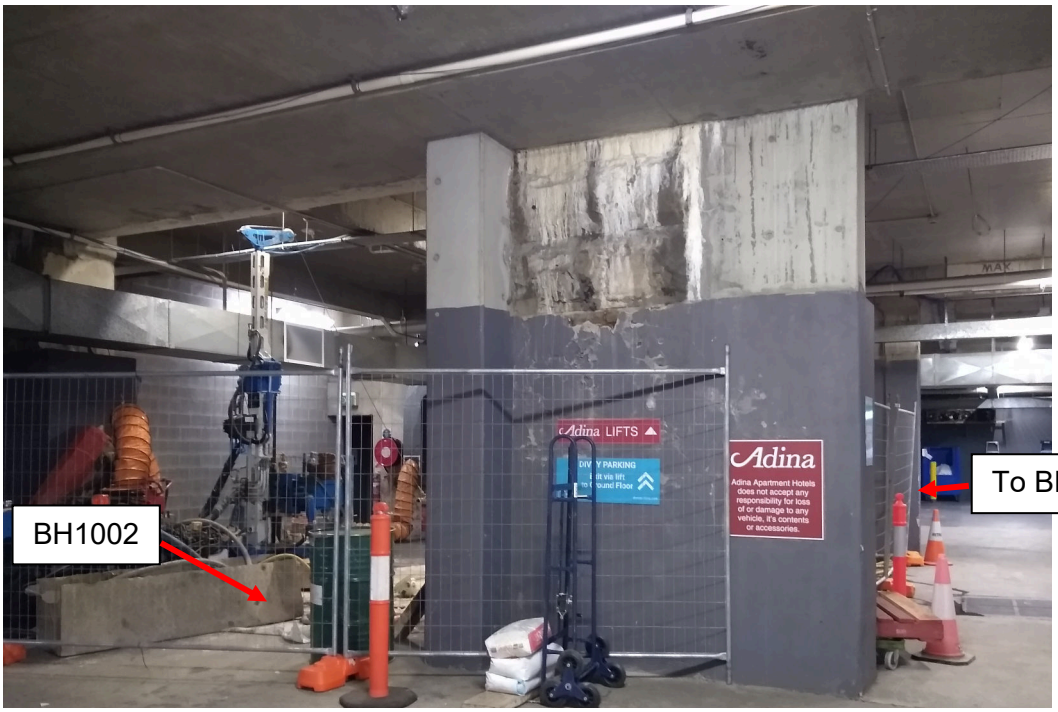


Photo B3 – View west near the location of Borehole BH1002, within the Adina Hotel basement during drilling.

Photo B4 – View north-west at the location of Borehole BH1002, within the Adina Hotel basement.

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs** **Proposed Commercial Development** **2-8a Lee Street, Haymarket**	PROJECT: 86884.02 PLATE No: B2 REV: 0
	CLIENT: Toga Development and Construction	DATE: 25-Mar-21

Photo B5 – View south-west at the location of Borehole BH1002, within the Adina Hotel basement during drilling.

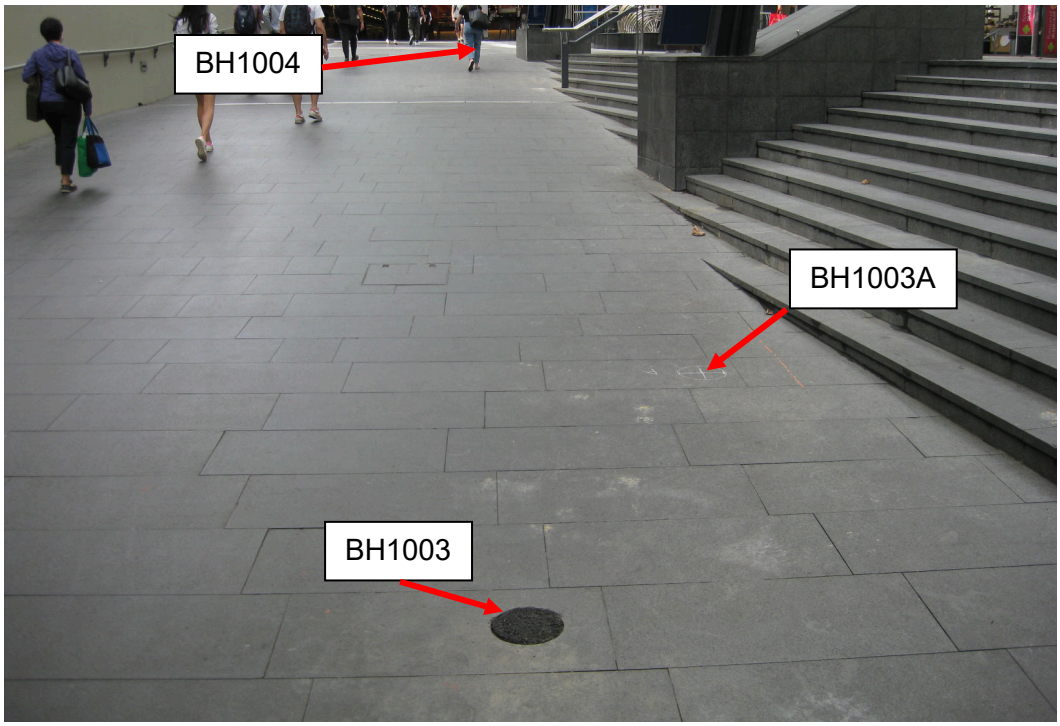


Photo B6 – View south-east towards the Devonshire Street Pedestrian Tunnel, adjacent to the portal of the Lee Street Tunnel. The locations of Borehole BH1003 and BH1003A are indicated as shown.

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs** **Proposed Commercial Development** **2-8a Lee Street, Haymarket**	PROJECT:	86884.02
		PLATE No:	B3
		REV:	0
	CLIENT: Toga Development and Construction	DATE:	25-Mar-21

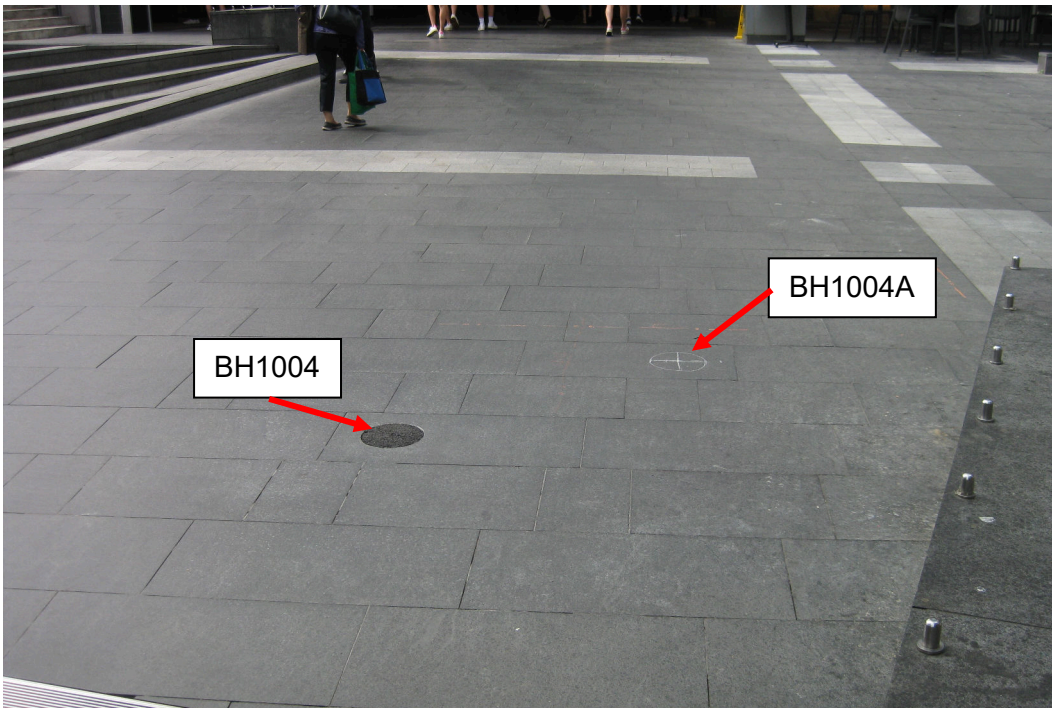


Photo B7 – View south-east towards the Devonshire Street Pedestrian Tunnel at the locations of Boreholes BH1004 and BH1004A, on the northern side of the Henry Deane Plaza.

Photo B8 – View east towards the Devonshire Street Pedestrian Tunnel at the location of Borehole BH1005, on the southern side of the Henry Deane Plaza.

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs** **Proposed Commercial Development** **2-8a Lee Street, Haymarket**	PROJECT: 86884.02 PLATE No: B4 REV: 0
	CLIENT: Toga Development and Construction	DATE: 25-Mar-21

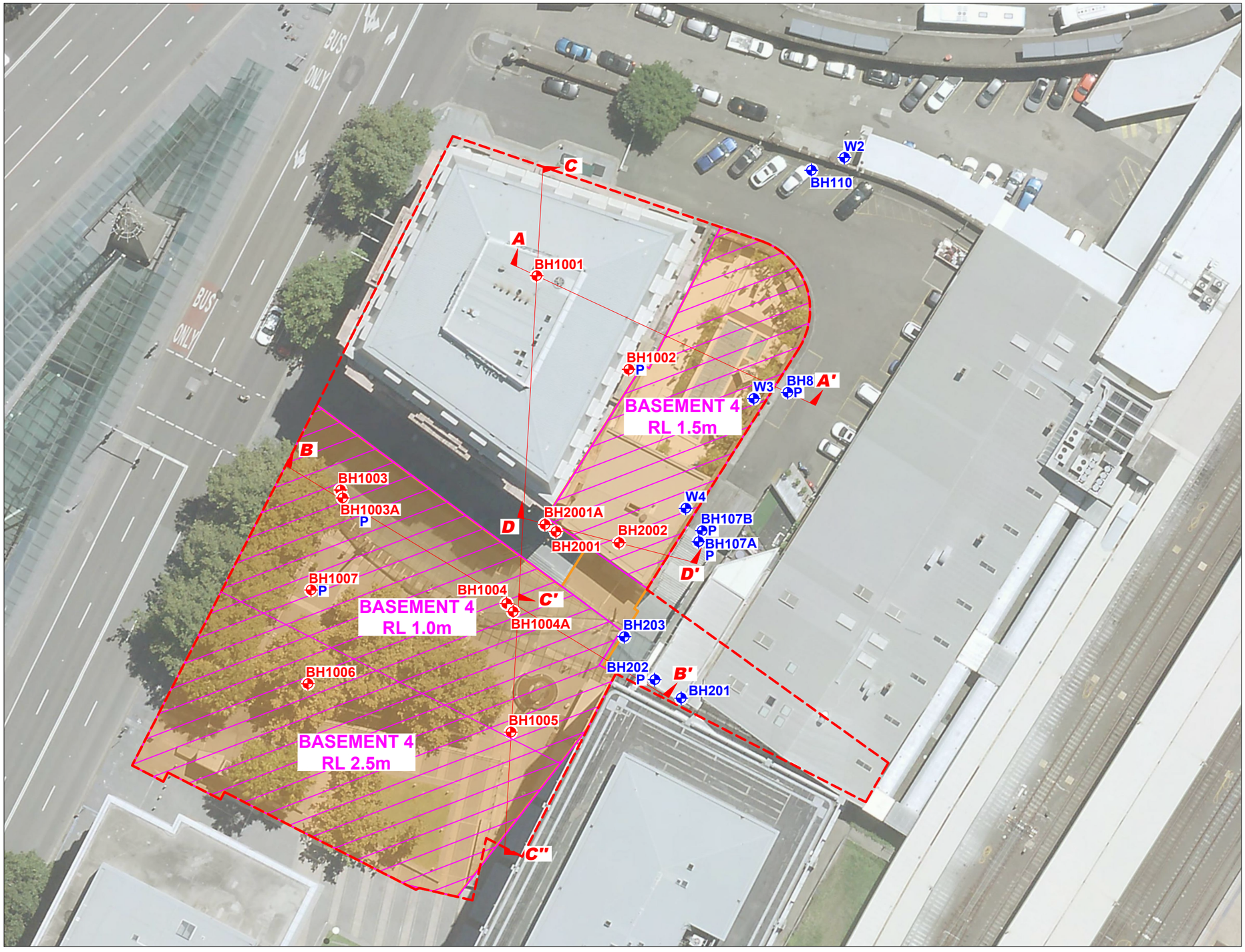
Photo B9 – View south-west across the Henry Deane Plaza towards Lee Street. The locations of Boreholes BH1006 and BH1007 are indicated as shown.

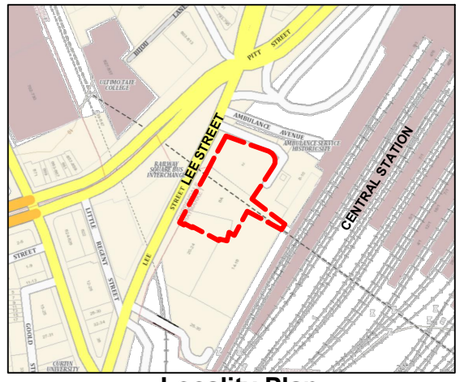
Photo B10 – View south within the Henry Deane Plaza near Lee Street, at the location of Borehole BH1007.

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs** **Proposed Commercial Development** **2-8a Lee Street, Haymarket**	PROJECT: 86884.02 PLATE No: B5 REV: 0
	CLIENT: Toga Development and Construction	DATE: 25-Mar-21

Appendix C

Drawings





Locality Plan

LEGEND

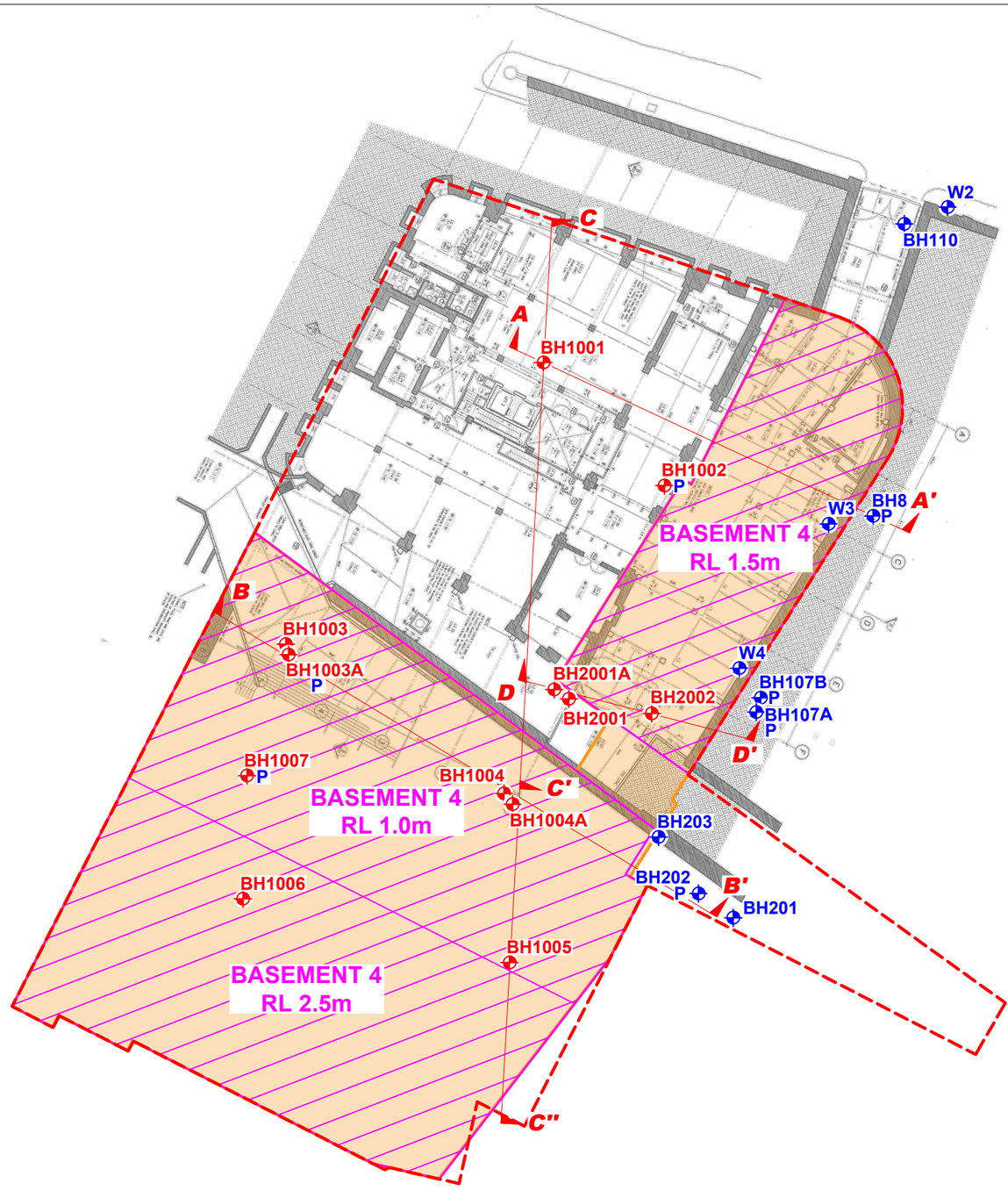
- BH — Previous Borehole Location, (DP Reports 86767.00.R.006.Rev5 and 86767.07.R.001.Rev0)
- BH — Current Geotechnical Borehole
- P — Standpipe Piezometer
- Site Boundary
- Approximate Extent of Excavation for Basement Level 3
- Approximate Extent of Excavation for Basement Level 4
- Interpreted Geological Cross Section

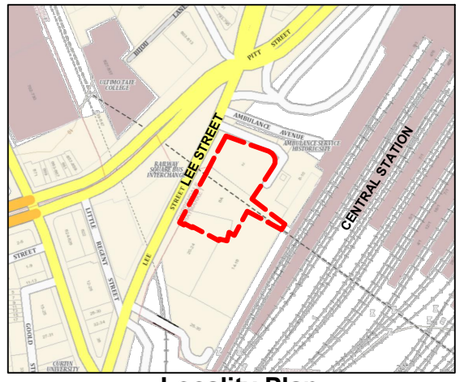
NOTE:
1: Base image from MetroMap (Dated 09.02.2022)
2: Approximate Extent of Basement Levels 3 and 4 Outlines are from Bates Smart Architects Pty Ltd, Drawing No. BSMART-AR-DAD-10B03000 and BSMART-AR-DAD-10B04000, Draft Issue (Dated 17.06.2022)
3: Co-ordinate system relative to Map Grid of Australia 1994 (MGA94).

0 5 10 15 20 30 40 50m
1:500 @ A3

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Toga Development and Construction Pty Ltd		TITLE: **Site and Test Location Plan**	PROJECT No: 86884.02
OFFICE: Sydney	DRAWN BY: MG	**Proposed Commercial Development**	DRAWING No: 1
SCALE: 1:500 @ A3	DATE: 29.06.2022	**2-8A Lee Street, Haymarket**	REVISION: 1





Locality Plan

LEGEND

- BH — Previous Borehole Location, (DP Reports 86767.00.R.006.Rev5 and 86767.07.R.001.Rev0)
- BH — Current Geotechnical Borehole
- P — Standpipe Piezometer
- Site Boundary
- Approximate Extent of Excavation for Basement Level 3
- Approximate Extent of Excavation for Basement Level 4
- Interpreted Geological Cross Section

NOTE:
1: Base plan from Synman Justin Bialek Architects Pty Ltd, Job No. 4000, Drawing No. WD 05, Rev D, Dated 29 July 1999.
2: Approximate Extent of Basement Levels 3 and 4 Outlines are from Bates Smart Architects Pty Ltd, Drawing No. BSMART-AR-DAD-10B03000 and BSMART-AR-DAD-10B04000, Draft Issue (Dated 17.06.2022)
3: Co-ordinate system relative to Map Grid of Australia 1994 (MGA94).

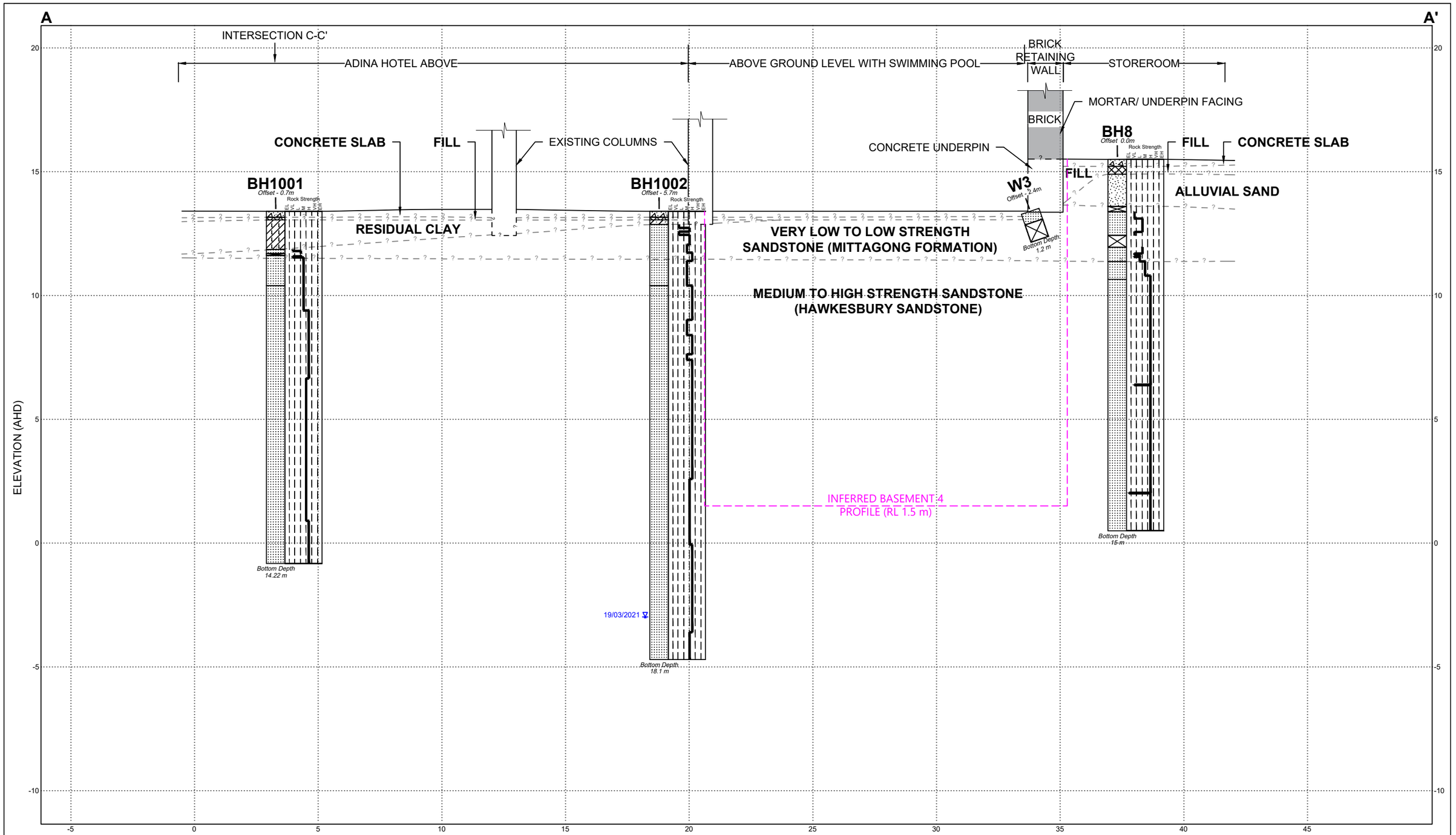
0 5 10 15 20 30 40 50m
1:500 @ A3

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Toga Development and Construction Pty Ltd		TITLE: **Site and Test Location Plan** **Proposed Commercial Development** **2-8A Lee Street, Haymarket**
OFFICE: Sydney	DRAWN BY: MG	
SCALE: 1:500 @ A3	DATE: 29.06.2022	

N

PROJECT No:	86884.02
DRAWING No:	2
REVISION:	1



LEGEND

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

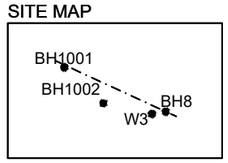
NOTES:

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 equal.

TESTS / OTHER

- ▽ - Water level
- — ? — — - Interpreted geotechnical boundary

SITE MAP



0 3

Horizontal Scale (metres)

Natural Scale

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Toga Development and Construction Pty Ltd		TITLE: **Interpreted Geotechnical Cross-Section A-A'**	PROJECT No: 86884.02
OFFICE: Sydney	DRAWN BY: HDS/MG	**Proposed Commercial Development**	DRAWING No: 3
SCALE: 1:150 (H) 1:150 (V) @ A3	DATE: 29.06.2022	**2-8a Lee Street, Haymarket**	REVISION: 1

B

B'

PROPERTY BOUNDARY

PROPERTY BOUNDARY

INTERSECTION C'-C"

STONE TILE COVERED WALL (PORTAL TO LEE STREET TUNNEL)

CONCRETE

FILL

STONE TILES AND CONCRETE SLAB

SAND FILL

SAND FILL

CLAY

BH1003 Offset 0.1m Bottom Depth 1.3 m

BH1003A Offset 0.3m Rock Strength Bottom Depth 14.41 m

BH1004 Offset 1.5m Bottom Depth 1.1 m

BH1004A Offset 1.8m Rock Strength Bottom Depth 18.22 m

BH203 Offset 2.8m Rock Strength Bottom Depth 13.43 m

BH202 Offset 0.1m Rock Strength Bottom Depth 13.77 m

FILL - CLAYEY SAND OR SANDY CLAY AND BUILDING RUBBLE / BRICKS / BOULDERS

MEDIUM DENSE TO VERY DENSE ALLUVIAL SAND

MEDIUM DENSE TO DENSE ALLUVIAL SAND

19/03/2021 N = 37

N = 30

N = 0

12/11/2020 & 19/03/2021

DURING DRILLING 4/11/2020

DURING DRILLING 6/11/2020

VERY SOFT ALLUVIAL CLAY

CLAY AND CLAYEY SAND RESIDUAL SOIL

CLAY RESIDUAL SOIL

refusal

refusal

VERY LOW AND LOW STRENGTH SANDSTONE WITH MEDIUM STRENGTH BANDS (MITTAGONG FORMATION)

MEDIUM TO HIGH STRENGTH SANDSTONE (HAWKESBURY SANDSTONE)

INFERRED BASEMENT 4 PROFILE (RL 1.0 m)

ELEVATION (AHD)

20 15 10 5 0 -5 -10

0 5 10 15 20 25 30 35 40 45 50

DISTANCE ALONG PROFILE (m)

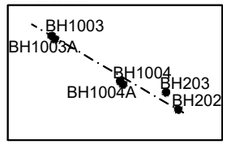
LEGEND

- Cemented sand
- Clayey Sand
- Concrete
- Filling
- Pavers
- Sand
- Sandstone
- Silty 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 equal.

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

SITE MAP



0 3
Horizontal Scale (metres)
Natural Scale

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Toga Development and Construction Pty Ltd		TITLE: **Interpreted Geotechnical Cross-Section B-B'**	PROJECT No: 86884.02
OFFICE: Sydney	DRAWN BY: HDS/MG	**Proposed Commercial Development**	DRAWING No: 4
SCALE: 1:150 (H) 1:150 (V) @ A3	DATE: 29.06.2022	**2-8a Lee Street, Haymarket**	REVISION: 1

C

C'

INTERSECTION A-A'

ADINA HOTEL ABOVE

STORAGE ROOM

INTERSECTION D-D'

RETAIL TENANCY

AMBULANCE AVENUE

PROPERTY BOUNDARY

NEARBY COLUMN

CONCRETE SLAB OVER

STAIR WELL

WALL

WALL

PEDESTRIAN RAMP

SUSPENDED SLAB OVER RETAIL SPACE

HENRY DEANE PLAZA

STONE TILES AND SLAB

JOINS TO DRAWING 6

PEDESTRIAN RAMP DOWN TO LEE STREET

CONCRETE SLAB

FILL

CONCRETE SLAB

CONCRETE SLAB

WALL

FILL - CLAYEY SAND OR SANDY CLAY AND BUILDING RUBBLE

BH1001

Offset - 0.5m

Rock Strength

VL L M H VH EH

BH2001A

Offset 2.5m

Rock Strength

VL L M H VH EH

EXISTING BASEMENT (RL13.4 m)

EXISTING BASEMENT (RL 13.9 m)

(RL 14.0 m)

CONCRETE

FILL

FILL

FILL

RESIDUAL CLAY

RESIDUAL CLAY

RESIDUAL CLAY

ALLUVIAL SAND

ALLUVIAL CLAY VERY SOFT

MEDIUM TO HIGH STRENGTH SANDSTONE (HAWKESBURY SANDSTONE)

VERY LOW TO LOW STRENGTH SANDSTONE

MEDIUM TO HIGH STRENGTH SANDSTONE (HAWKESBURY SANDSTONE)

VERY LOW TO LOW STRENGTH SANDSTONE WITH MEDIUM STRENGTH BANDS (MITTAGONG FORMATION)

MEDIUM TO HIGH STRENGTH SANDSTONE (HAWKESBURY SANDSTONE)

Bottom Depth 14.22 m

Bottom Depth 12 m

INFERRED BASEMENT 4 PROFILE (RL 1.0 m)

ELEVATION (AHD)

20 15 10 5 0 -5 -10

0 5 10 15 20 25 30 35 40 45 50

DISTANCE ALONG PROFILE (m)

LEGEND

- Core Loss
- Concrete
- Filling
- Sandstone
- Silty 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 equal.
4. Surface features based on plan from Synman Justin Bialek Architects Pty Ltd, Job No. 4000, Drawing No. WD 05, Rev. D, Dated 29 July 1999.

TESTS / OTHER

- ▽ - Water level
- — ? — — - Interpreted geotechnical boundary

SITE MAP

BH1001

BH2001A

0 3

Horizontal Scale (metres)

Natural Scale

Douglas Partners

Geotechnics / Environment / Groundwater

CLIENT: Toga Development and Construction Pty Ltd		TITLE: **Interpreted Geotechnical Cross-Section C-C'**	PROJECT No: 86884.02
OFFICE: Sydney	DRAWN BY: HDS/MG	**Proposed Commercial Development**	DRAWING No: 5
SCALE: 1:150 (H) 1:150 (V) @ A3	DATE: 29.06.2022	**2-8a Lee Street, Haymarket**	REVISION: 1

C'

C''

INTERSECTION B-B'

HENRY DEANE PLAZA

JOINS TO DRAWING 5

PROPERTY BOUNDARY

STONE TILES AND SLAB

STEPS CONCRETE

CONCRETE

BH1004 Offset - 1.3m

BH1004A Offset - 0.2m

BH1005 Offset - 0.4m

Rock Strength

EL VL L M H VH EH

Bottom Depth 1.1 m

Bottom Depth 18.22 m

Bottom Depth 15.85 m

FILL - CLAYEY SAND OR SANDY CLAY AND BUILDING RUBBLE / BRICKS / BOULDERS

FILL

ALLUVIAL CLAY VERY SOFT

N = 30

MEDIUM DENSE TO VERY DENSE ALLUVIAL SAND

N = 30

refusal

ALLUVIAL SAND

N = 9

ALLUVIAL CLAY VERY SOFT

N = 19

ALLUVIAL CLAY - STIFF TO VERY STIFF

VERY LOW AND LOW STRENGTH SANDSTONE WITH MEDIUM STRENGTH BANDS

refusal

RESIDUAL CLAY

N = 12

RESIDUAL CLAY

refusal

RESIDUAL CLAYEY SAND / WEATHERED ROCK

MEDIUM TO HIGH STRENGTH SANDSTONE (HAWKESBURY SANDSTONE)

INFERRED BASEMENT 4 PROFILE (RL 1.0 m)

INFERRED BASEMENT 4 PROFILE (RL 2.5 m)

ELEVATION (AHD)

20 15 10 5 0 -5 -10

45 50 55 60 65 70 75 80 85 90 95

DISTANCE ALONG PROFILE (m)

LEGEND

- Cemented sand
- Clayey Sand
- Concrete
- Filling
- Pavers
- Sand
- Sandstone
- Silty 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 equal.
4. Surface features based on plan from Synman Justin Bialek Architects Pty Ltd, Job No. 4000, Drawing No. WD 05, Rev. D, Dated 29 July 1999.

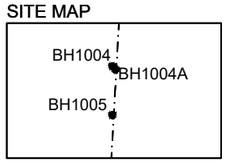
TESTS / OTHER

N - Standard penetration test value

▽ - Water level

— ? — — - Interpreted geotechnical boundary

SITE MAP



0 3

Horizontal Scale (metres)

Natural Scale

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Toga Development and Construction Pty Ltd		TITLE: **Interpreted Geotechnical Cross-Section C'-C''**	PROJECT No: 86884.02
OFFICE: Sydney	DRAWN BY: HDS/MG	**Proposed Commercial Development**	DRAWING No: 6
SCALE: 1:150 (H) 1:150 (V) @ A3	DATE: 29.06.2022	**2-8a Lee Street, Haymarket**	REVISION: 1

D

D'

INTERSECTION C-C'

RETAIL TENANCY

UNDERSIDE OF STEPS DOWN TO HENRY DEANE PLAZA

ACCESS CORRIDOR AND STORE ROOM

SITE BOUNDARY

TILED ACCESS RAMP ABOVE

SUSPENDED SLAB OVER RETAIL SPACE

CONCRETE SLAB

COLUMN

WALL

HOIST/ STEPS

WALL

BH2001A Offset - 0.4m

BH2001 Offset - 0.5m

BH2002 Offset - 0.1m

BH107B Offset 5.7m

Rock Strength VL L M H VH EH

Bottom Depth 0.8 m

Bottom Depth 12 m

Bottom Depth 12 m

Bottom Depth 15 m

FILL

ALLUVIAL

SAND

SANDSTONE

FILL

RESIDUAL CLAY

SANDSTONE

FILL

RESIDUAL CLAY

VERY LOW TO LOW STRENGTH SANDSTONE WITH MEDIUM STRENGTH BANDS (MITTAGONG FORMATION)

MEDIUM TO HIGH STRENGTH SANDSTONE (HAWKESBURY SANDSTONE)

INFERRED BASEMENT 4 PROFILE (RL 1.5 m)

ELEVATION (m AHD)

20 15 10 5 0 -5 -10

-10 -5 0 5 10 15 20 25 30 35 40

DISTANCE ALONG PROFILE (m)

LEGEND

- Core Loss
- Concrete
- Filling
- Sand
- Sandstone
- 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 equal.
4. Surface features based on plan from Synman Justin Bialek Architects Pty Ltd, Job No. 4000, Drawing No. WD 05, Rev. D, Dated 29 July 1999.

TESTS / OTHER

- Water level
- Interpreted geotechnical boundary

SITE MAP

BH2001A BH2001 BH107B BH2002

0 3

Horizontal Scale (metres)

Natural Scale

Douglas Partners

Geotechnics / Environment / Groundwater

CLIENT: Toga Development and Construction Pty Ltd		TITLE: **Interpreted Geotechnical Cross-Section D-D'**	PROJECT No: 86884.02
OFFICE: Sydney	DRAWN BY: HDS/MG	**Proposed Commercial Development**	DRAWING No: 7
SCALE: 1:150 (H) 1:150 (V) @ A3	DATE: 29.06.2022	**2-8a Lee Street, Haymarket**	REVISION: 1

Appendix D

Field Work Results

Sampling Methods

Douglas Partners

Sampling

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

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

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

Test Pits

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

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

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

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

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

The test results are reported in the following form.

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

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

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

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

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

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are generally based on Australian Standard AS1726:2017, Geotechnical Site Investigations. 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	19 - 63
Medium gravel	6.7 - 19
Fine gravel	2.36 – 6.7
Coarse sand	0.6 - 2.36
Medium sand	0.21 - 0.6
Fine sand	0.075 - 0.21

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

The proportions of secondary constituents of soils are described as follows:

In fine grained soils (>35% fines)

Term	Proportion of sand or gravel	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	>30%	Sandy Clay
With	15 – 30%	Clay with sand
Trace	0 - 15%	Clay with trace sand

In coarse grained soils (>65% coarse)
- with clays or silts

Term	Proportion of fines	Example
And	Specify	Sand (70%) and Clay (30%)
Adjective	>12%	Clayey Sand
With	5 - 12%	Sand with clay
Trace	0 - 5%	Sand with trace clay

In coarse grained soils (>65% coarse)
- with coarser fraction

Term	Proportion of coarser fraction	Example
And	Specify	Sand (60%) and Gravel (40%)
Adjective	>30%	Gravelly Sand
With	15 - 30%	Sand with gravel
Trace	0 - 15%	Sand with trace gravel

The presence of cobbles and boulders shall be specifically noted by beginning the description with ‘Mix of Soil and Cobbles/Boulders’ with the word order indicating the dominant first and the proportion of cobbles and boulders described together.

Soil Descriptions

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
Friable	Fr	-

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	Density Index (%)
Very loose	VL	<15
Loose	L	15-35
Medium dense	MD	35-65
Dense	D	65-85
Very dense	VD	>85

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;
- Extremely weathered material – formed from in-situ weathering of geological formations. Has soil strength but retains the structure or fabric of the parent rock;
- Alluvial soil – deposited by streams and rivers;
- Estuarine soil – deposited in coastal estuaries;
- Marine soil – deposited in a marine environment;
- Lacustrine soil – deposited in freshwater lakes;
- Aeolian soil – carried and deposited by wind;
- Colluvial soil – soil and rock debris transported down slopes by gravity;
- Topsoil – mantle of surface soil, often with high levels of organic material.
- Fill – any material which has been moved by man.

Moisture Condition – Coarse Grained Soils

For coarse grained soils the moisture condition should be described by appearance and feel using the following terms:

- Dry (D) Non-cohesive and free-running.
- Moist (M) Soil feels cool, darkened in colour.
  Soil tends to stick together.
  Sand forms weak ball but breaks easily.
- Wet (W) Soil feels cool, darkened in colour.
  Soil tends to stick together, free water forms when handling.

Moisture Condition – Fine Grained Soils

For fine grained soils the assessment of moisture content is relative to their plastic limit or liquid limit, as follows:

- ‘Moist, dry of plastic limit’ or ‘w <PL’ (i.e. hard and friable or powdery).
- ‘Moist, near plastic limit’ or ‘w ≈ PL (i.e. soil can be moulded at moisture content approximately equal to the plastic limit).
- ‘Moist, wet of plastic limit’ or ‘w >PL’ (i.e. soils usually weakened and free water forms on the hands when handling).
- ‘Wet’ or ‘w ≈LL’ (i.e. near the liquid limit).
- ‘Wet’ or ‘w >LL’ (i.e. wet of the liquid limit).

Rock Strength

Rock strength is defined by the Unconfined Compressive Strength and it 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 Point Load Strength Index $Is_{(50)}$ is commonly used to provide an estimate of the rock strength and site specific correlations should be developed to allow UCS values to be determined. The point load strength test procedure is described by Australian Standard AS4133.4.1-2007. The terms used to describe rock strength are as follows:

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

* 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
Residual Soil	RS	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely weathered	XW	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible
Highly weathered	HW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Moderately weathered	MW	The whole of the rock material is discoloured , usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.
Slightly weathered	SW	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh	FR	No signs of decomposition or staining.
Note: If HW and MW cannot be differentiated use DW (see below)		
Distinctly weathered	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching or may be decreased due to deposition of weathered products in pores.

Rock Descriptions

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 occasional fragments
Fractured	Core lengths of 30-100 mm with occasional shorter and longer sections
Slightly Fractured	Core lengths of 300 mm or longer with occasional sections of 100-300 mm
Unbroken	Core contains very few fractures

Rock Quality Designation

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

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

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

Stratification Spacing

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

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

Symbols & Abbreviations

Douglas Partners

Introduction

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

Drilling or Excavation Methods

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

Water

▷	Water seep
▽	Water level

Sampling and Testing

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

Description of Defects in Rock

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

Defect Type

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

Orientation

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

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

Coating or Infilling Term

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

Coating Descriptor

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

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

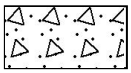
Symbols & Abbreviations

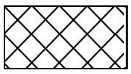
Graphic Symbols for Soil and Rock

General

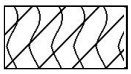

Asphalt

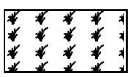

Road base

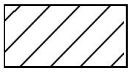

Concrete

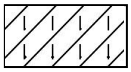

Filling

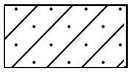
Soils


Topsoil

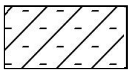

Peat

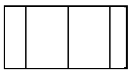

Clay

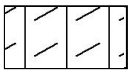

Silty clay

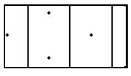

Sandy clay

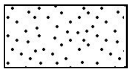

Gravelly clay

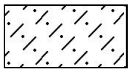

Shaly clay

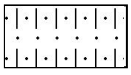

Silt


Clayey silt


Sandy silt

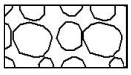

Sand

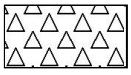

Clayey sand


Silty sand


Gravel

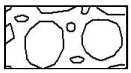

Sandy gravel


Cobbles, boulders

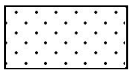

Talus

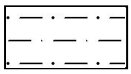
Sedimentary Rocks

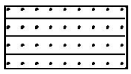

Boulder conglomerate

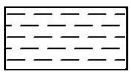

Conglomerate


Conglomeratic sandstone

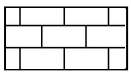

Sandstone


Siltstone

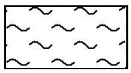

Laminite

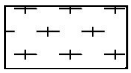

Mudstone, claystone, shale

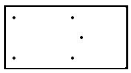

Coal


Limestone

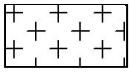
Metamorphic Rocks

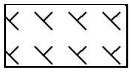

Slate, phyllite, schist

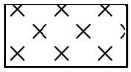

Gneiss

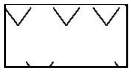

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

BOREHOLE LOG

CLIENT: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 13.4 m AHD
EASTING: 333923
NORTHING: 6249301
DIP/AZIMUTH: 90°/--

BORE No: BH1001
PROJECT No: 86884.02
DATE: 12/3/2021
SHEET 1 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)	Type	Core Rec. %	RQD %	Test Results & Comments
		CONCRETE SLAB										
	0.24	FILL/GRAVEL: coarse, brown, with fine to coarse sand, apparently in loose to medium dense condition							A/E*			PID<1ppm
13	0.35	Silty CLAY CI-CH: medium to high plasticity, orange-brown, trace fine to medium ironstone gravel and fine sand, w~PL (affected by diatube), apparently firm to stiff, residual soil							A/E			PID<1ppm
	1								A/E			PID<1ppm
12		Below 1.2m: relict rock texture, extremely weathered sandstone (Mittagong Formation)							C	100	20	
	1.54	SANDSTONE: medium grained, red-brown, orange-brown and pale grey, bedded at 0°-20°, with ironstone bands, very low strength to low to medium strength, highly weathered, fractured, Mittagong Formation						1.59m: B0°, pl, ro, cly vn 1.7m: CORE LOSS: 80mm				PL(A) = 0.3
	1.78 1.87							1.87m: B0°, pl, ro, cly co 2mm				PL(A) = 0.8
	2	SANDSTONE: medium to coarse grained, orange-brown and pale grey, bedded at 0°-20°, with ironstone bands, medium strength, highly weathered, fractured, Hawkesbury Sandstone						2.20-2.55m: J70°-80°, cu, ro, cbs	C	92	84	
11		Below 2.7m: moderately to slightly weathered						2.56m: Cs, 20mm 2.62m: B0°, pl, ro, cly co 15mm 2.68m: B0°, pl, ro, cly co 15mm 2.7m: B0°, pl, ro, cly co 5mm 2.93m: B0-5°, un, ro, fe stn 2.95 & 2.96m: B5-10° (x2), un, ro, fe stn				PL(A) = 0.7
	3 3.0	SANDSTONE: medium to coarse grained, pale grey, cross-bedded at 0°-20°, with 20% fine grained, grey to dark grey sandstone laminations and 5-10% carbonaceous laminations and flecks, medium to high strength, fresh, slightly fractured to unbroken, Hawkesbury Sandstone							C	100	98	PL(A) = 0.8
10												PL(A) = 0.8
	4								C	100	100	
9												PL(A) = 1.3

RIG: XC Drill **DRILLER:** Terratest **LOGGED:** IT **CASING:** HWT to 1.2m

TYPE OF BORING: Diatube (200mm dia.) to 0.24m, Solid Flight Auger (TC-bit) 0.24-1.2m, NMLC Coring 1.2-14.22m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *Field replicate BD2/120312 collected from 0.25-0.3m

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: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 13.4 m AHD
EASTING: 333923
NORTHING: 6249301
DIP/AZIMUTH: 90°/--

BORE No: BH1001
PROJECT No: 86884.02
DATE: 12/3/2021
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		SANDSTONE: medium to coarse grained, pale grey, cross-bedded at 0°-20°, with 20% fine grained, grey to dark grey sandstone laminations and 5-10% carbonaceous laminations and flecks, medium to high strength, fresh, slightly fractured to unbroken, Hawkesbury Sandstone *(continued)*							C	100	100	
								5.6m: B0°-5°, un, ro, cbs 5.75m: B0°-5°, un, ro, cbs 5.88m: B5°-10°, un, ro, cbs	C	100	100	PL(A) = 1.3
								6.72m: B0°, pl, un, cly vn				PL(A) = 1
									C	100	100	PL(A) = 1
								>>				
									C	100	100	PL(A) = 0.7
									C	100	100	PL(A) = 1.3

RIG: XC Drill **DRILLER:** Terratest **LOGGED:** IT **CASING:** HWT to 1.2m

TYPE OF BORING: Diatube (200mm dia.) to 0.24m, Solid Flight Auger (TC-bit) 0.24-1.2m, NMLC Coring 1.2-14.22m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *Field replicate BD2/120312 collected from 0.25-0.3m

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: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 13.4 m AHD
EASTING: 333923
NORTHING: 6249301
DIP/AZIMUTH: 90°/--

BORE No: BH1001
PROJECT No: 86884.02
DATE: 12/3/2021
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
3		SANDSTONE: medium to coarse grained, pale grey, cross-bedded at 0°-20°, with 20% fine grained, grey to dark grey sandstone laminations and 5-10% carbonaceous laminations and flecks, medium to high strength, fresh, slightly fractured to unbroken, Hawkesbury Sandstone *(continued)*						10.33m: B0°, pl, ro, cly co 5mm	C	100	100	
	11											PL(A) = 1
2								11.27m: B0°-5°, pl, ro, cly vn				
	12								C	100	100	PL(A) = 0.7
1								12.5m: B0°, pl, ro, cly co 2mm				
	13											PL(A) = 1.5
0									C	100	95	
								13.66m: B10°, pl, ro, cly vn				PL(A) = 1.2
	14											
	14.22	Bore discontinued at 14.22m - Target depth reached						14.15m: B0°-5°, pl, ro, cly vn				
-1												

RIG: XC Drill **DRILLER:** Terratest **LOGGED:** IT **CASING:** HWT to 1.2m

TYPE OF BORING: Diatube (200mm dia.) to 0.24m, Solid Flight Auger (TC-bit) 0.24-1.2m, NMLC Coring 1.2-14.22m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *Field replicate BD2/120312 collected from 0.25-0.3m

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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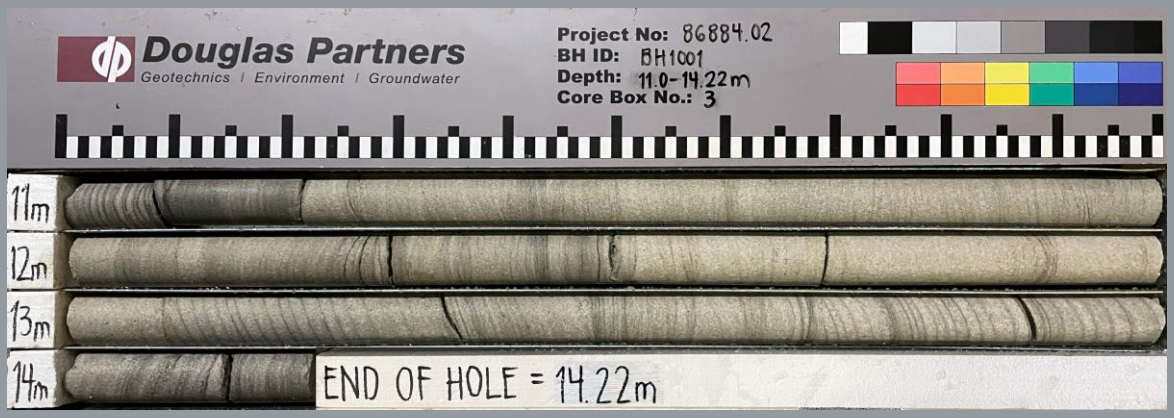
BORE: 1001 PROJECT: HAYMARKET MARCH 2021

1.2 – 6.0m

BORE: 1001 PROJECT: HAYMARKET MARCH 2021

6.0 – 11.0m

BORE: 1001 PROJECT: HAYMARKET MARCH 2021



11.0 – 14.22m

BOREHOLE LOG

CLIENT: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 13.4 m AHD
EASTING: 333935
NORTHING: 6249290
DIP/AZIMUTH: 90°/--

BORE No: BH1002
PROJECT No: 86884.02
DATE: 11/3/2021
SHEET 1 OF 4

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
		CONCRETE SLAB										
	0.24	FILL/MIXTURE OF GRAVEL and BRICKS: coarse sandstone gravel and bricks, brown, apparently in loose to medium dense condition							A/E			PID<1ppm
	0.35								A/E			PID<1ppm
	0.53	Sandy CLAY CI: medium plasticity, pale grey with pale brown, with fine sandstone gravel and silt, w~PL (affected by diatube), apparently very stiff, extremely weathered sandstone (Mittagong Formation)						0.53m: Cs, 30mm (sandy clay) 0.63m: Cs, 40mm	C	100	60	PL(A) = 0.1
	0.67							0.82m: B0°, pl, ro, cly vn 0.87m: B0°, pl, ro, cly vn				PL(A) = 0.2
13	1	SANDSTONE: medium grained, orange-brown and pale grey, bedded at 0°-10°, highly weathered, very low to low strength, fractured, Mittagong Formation						1.17m: B0°, pl, ro, fe stn 1.19m: J10°-20°, un, ro, fe stn 1.21m: Cs, 40mm (with ironstone gravel)	C	100	95	PL(A) = 1.1
12		SANDSTONE: medium to coarse grained, red-brown and orange-brown with some pale grey, with ironstone bands, distinct and indistinct bedding at 0°-10°, highly weathered, high strength with very low strength bands, slightly fractured, Hawkesbury Sandstone										PL(A) = 0.4
	2	Below 1.67m: orange-brown and pale grey, moderately weathered to slightly weathered						1.88m: B10°, pl, ro, cly vn	C	100	100	PL(A) = 1.9
11								2.29m: B10°, pl, ro, cly vn				PL(A) = 0.6
	3							2.56 & 2.58m: B0-5° (x2), un, ro, cly co 2mm 2.62m: J20°, un, ti 2.67m: B5°-10°, pl, ti 2.77m: B5°, pl, ro, cly vn 2.8m: B5°-10°, pl, ro, cly vn 2.81m: B5°-10°, pl, ro, cly vn 2.82-3.00m: J80°, pl, ro, fe stn, partially ti	C	100	86	PL(A) = 0.5
10	3.0	SANDSTONE: medium to coarse grained, pale grey, cross-bedded at 10°-20°, with 20% fine grained, grey to dark grey sandstone laminations, medium or high strength, slightly weathered, slightly fractured to unbroken, Hawkesbury Sandstone										
	4											PL(A) = 1.1
9		Below 4.36m: grading to fresh						4.36m: B5°, pl, ro, fe stn 4.39m: B5°, pl, ro, cly vn	C	100	98	PL(A) = 0.6
												PL(A) = 1.2

RIG: XC Drill **DRILLER:** Terratest **LOGGED:** IT **CASING:** HWT to 0.5m

TYPE OF BORING: Diatube (200mm dia.) to 0.24m, Solid Flight Auger (TC-bit) 0.24-0.53m, NMLC Coring 0.53-18.1m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *Field replicate BD1/110311 collected from 0.35-0.5m; Groundwater well installed: blank PVC 0.0-1.5m, screen PVC 1.5-18.0m, bentonite 0.0-1.3m, gravel 1.3-18.0m, backfill 18.0-18.1m, gatic cover at the surface; 100% water loss from 16.0-18.1m

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: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 13.4 m AHD
EASTING: 333935
NORTHING: 6249290
DIP/AZIMUTH: 90°/--

BORE No: BH1002
PROJECT No: 86884.02
DATE: 11/3/2021
SHEET 2 OF 4

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
8		SANDSTONE: medium to coarse grained, pale grey, cross-bedded at 10°-20°, with 20% fine grained, grey to dark grey sandstone laminations, medium or high strength, slightly weathered, slightly fractured to unbroken, Hawkesbury Sandstone *(continued)*						5.2m: B5°, un, ro, cly vn	C	100	98	
		Below 5.2m: distinct and indistinct bedding at 0°-20°, with 5-10% carbonaceous laminations and flecks										
	6							5.91m: Cz, 50mm 5.96m: B10°, pl, un, cly vn				PL(A) = 0.7
7									C	100	97	
	7											PL(A) = 1.7
6												PL(A) = 1.3
								7.66m: B0°-5°, pl, ro, cbs	C	100	100	
	8											PL(A) = 1.2
5								8.29m: B5°, pl, ro, cbs				PL(A) = 1.1
	9											PL(A) = 1
4									C	100	100	
												PL(A) = 1.6

RIG: XC Drill **DRILLER:** Terratest **LOGGED:** IT **CASING:** HWT to 0.5m

TYPE OF BORING: Diatube (200mm dia.) to 0.24m, Solid Flight Auger (TC-bit) 0.24-0.53m, NMLC Coring 0.53-18.1m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *Field replicate BD1/110311 collected from 0.35-0.5m; Groundwater well installed: blank PVC 0.0-1.5m, screen PVC 1.5-18.0m, bentonite 0.0-1.3m, gravel 1.3-18.0m, backfill 18.0-18.1m, gatic cover at the surface; 100% water loss from 16.0-18.1m

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: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 13.4 m AHD
EASTING: 333935
NORTHING: 6249290
DIP/AZIMUTH: 90°/--

BORE No: BH1002
PROJECT No: 86884.02
DATE: 11/3/2021
SHEET 3 OF 4

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
3		SANDSTONE: medium to coarse grained, pale grey, cross-bedded at 10°-20°, with 20% fine grained, grey to dark grey sandstone laminations, medium or high strength, slightly weathered, slightly fractured to unbroken, Hawkesbury Sandstone *(continued)*						10.12m: B5°-10°, un, ro, cly vn				
2	11							10.82m: B0°, pl, ro, cly vn	C	100	100	PL(A) = 1.3
1	12							12.33m: B20°, pl, ro, cbs 12.48m: B5°, pl, ro, cly co 5mm	C	100	100	PL(A) = 0.8 PL(A) = 0.8
0	13								C	100	95	PL(A) = 1.4
-1	14							14.12m: B0°-5°, un, ro, cbs 14.19m: B5°, pl, ro, cly co 5mm	C	100	100	PL(A) = 2.6

RIG: XC Drill **DRILLER:** Terratest **LOGGED:** IT **CASING:** HWT to 0.5m

TYPE OF BORING: Diatube (200mm dia.) to 0.24m, Solid Flight Auger (TC-bit) 0.24-0.53m, NMLC Coring 0.53-18.1m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *Field replicate BD1/110311 collected from 0.35-0.5m; Groundwater well installed: blank PVC 0.0-1.5m, screen PVC 1.5-18.0m, bentonite 0.0-1.3m, gravel 1.3-18.0m, backfill 18.0-18.1m, gatic cover at the surface; 100% water loss from 16.0-18.1m

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: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 13.4 m AHD
EASTING: 333935
NORTHING: 6249290
DIP/AZIMUTH: 90°/--

BORE No: BH1002
PROJECT No: 86884.02
DATE: 11/3/2021
SHEET 4 OF 4

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
-2		SANDSTONE: medium to coarse grained, pale grey, cross-bedded at 10°-20°, with 20% fine grained, grey to dark grey sandstone laminations, medium or high strength, slightly weathered, slightly fractured to unbroken, Hawkesbury Sandstone *(continued)*						15.16m: B0°-5°, un, ro, cly vn	C	100	100	
	16											PL(A) = 1.2
-3						19-03-21		16.19m: B20°, pl, ro, cly vn				PL(A) = 1.3
									C	100	100	
								16.86m: B10°, un, ti				
	17	Between 17.10-17.35m: siltstone clasts, up to 10mm						17.11m: B5°-10°, un, ro, cly vn 17.23m: fg/Cz, 70mm				PL(A) = 0.8
-4								17.43m: B0°, pl, ro, cly vn 17.55-17.80m: F80°, pl, ti, <5mm displacement	C	100	87	
	18							17.92-18.10m: J80°, pl, ro, cln				
	18.1	Bore discontinued at 18.1m - Target depth reached										
-5												
	19											
-6												

RIG: XC Drill **DRILLER:** Terratest **LOGGED:** IT **CASING:** HWT to 0.5m

TYPE OF BORING: Diatube (200mm dia.) to 0.24m, Solid Flight Auger (TC-bit) 0.24-0.53m, NMLC Coring 0.53-18.1m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *Field replicate BD1/110311 collected from 0.35-0.5m; Groundwater well installed: blank PVC 0.0-1.5m, screen PVC 1.5-18.0m, bentonite 0.0-1.3m, gravel 1.3-18.0m, backfill 18.0-18.1m, gatic cover at the surface; 100% water loss from 16.0-18.1m

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: 1002 PROJECT: HAYMARKET MARCH 2021

0.53 – 5.0m

BORE: 1002 PROJECT: HAYMARKET MARCH 2021

5.0 – 10.0m

BORE: 1002 PROJECT: HAYMARKET MARCH 2021

10.0 – 15.0m

BORE: 1002 PROJECT: HAYMARKET MARCH 2021

15.0 – 18.1m

BOREHOLE LOG

CLIENT: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 13.4 m AHD
EASTING: 333935
NORTHING: 6249290
DIP/AZIMUTH: 90°/--

BORE No: BH1002
PROJECT No: 86884.02
DATE: 11/3/2021
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
13.4	0.24	CONCRETE SLAB							
13.1	0.35	FILL/MIXTURE OF GRAVEL and BRICKS: coarse sandstone gravel and bricks, brown, apparently in loose to medium dense condition		A/E	0.25 0.35		PID<1ppm PID<1ppm		
12.9	0.53			A/E	0.5		PL(A) = 0.1		
12.8	0.67	Sandy CLAY CI: medium plasticity, pale grey with pale brown, with fine sandstone gravel and silt, w~PL (affected by diatube), apparently very stiff, extremely weathered sandstone (Mittagong Formation)			0.57				Bentonite 0.0-1.3m
12.4	1			A/E	0.9 0.91		PL(A) = 0.2		
				C	1.0 1.18		PL(A) = 1.1		
11.9		SANDSTONE: medium grained, orange-brown and pale grey, bedded at 0°-10°, highly weathered, very low to low strength, fractured, Mittagong Formation			1.46 1.5		PL(A) = 0.4		
11.4	2	SANDSTONE: medium to coarse grained, red-brown and orange-brown with some pale grey, with ironstone bands, distinct and indistinct bedding at 0°-10°, highly weathered, high strength with very low strength bands, slightly fractured, Hawkesbury Sandstone		C	1.96		PL(A) = 1.9		
					2.29		PL(A) = 0.6		
					2.5				
10.9		Below 1.67m: orange-brown and pale grey, moderately weathered to slightly weathered			2.67		PL(A) = 0.5		
10.4	3	SANDSTONE: medium to coarse grained, pale grey, cross-bedded at 10°-20°, with 20% fine grained, grey to dark grey sandstone laminations, medium or high strength, slightly weathered, slightly fractured to unbroken, Hawkesbury Sandstone		C					
10.4	3.0								
9.4	4				3.95 4.0		PL(A) = 1.1		
		Below 4.36m: grading to fresh			4.42		PL(A) = 0.6		
				C					
8.9	5				4.95		PL(A) = 1.2		
		Below 5.2m: distinct and indistinct bedding at 0°-20°, with 5-10% carbonaceous laminations and flecks							
					5.5				
7.9	6				5.96		PL(A) = 0.7		
				C					
7.4	7				6.95 7.0		PL(A) = 1.7		
					7.19		PL(A) = 1.3		
				C					
6.4	8				7.95		PL(A) = 1.2		
					8.3		PL(A) = 1.1		
					8.5				
5.4	9				8.96		PL(A) = 1		
				C					
4.4					9.95		PL(A) = 1.6		Sand filter 1.3-18.0m Slotted PVC pipe

RIG: XC Drill **DRILLER:** Terratest **LOGGED:** IT **CASING:** HWT to 0.5m

TYPE OF BORING: Diatube (200mm dia.) to 0.24m, Solid Flight Auger (TC-bit) 0.24-0.53m, NMLC Coring 0.53-18.1m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *Field replicate BD1/110311 collected from 0.35-0.5m; Groundwater well installed: blank PVC 0.0-1.5m, screen PVC 1.5-18.0m, bentonite 0.0-1.3m, gravel 1.3-18.0m, backfill 18.0-18.1m, gatic cover at the surface; 100% water loss from 16.0-18.1m

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: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 13.4 m AHD
EASTING: 333935
NORTHING: 6249290
DIP/AZIMUTH: 90°/--

BORE No: BH1002
PROJECT No: 86884.02
DATE: 11/3/2021
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		SANDSTONE: medium to coarse grained, pale grey, cross-bedded at 10°-20°, with 20% fine grained, grey to dark grey sandstone laminations, medium or high strength, slightly weathered, slightly fractured to unbroken, Hawkesbury Sandstone *(continued)*			10.03				1.5-18.0m
				C	10.92		PL(A) = 1.3		
					11.55				
				C	11.95		PL(A) = 0.8		
					12.95		PL(A) = 0.8		
				C	13.0				
					13.95		PL(A) = 1.4		
				C	14.5				
					14.95		PL(A) = 2.6		
				C	15.95		PL(A) = 1.2		
					16.0				
				C	16.38		PL(A) = 1.3	19-03-21	
		Between 17.10-17.35m: siltstone clasts, up to 10mm			17.38		PL(A) = 0.8		
				C	17.43				
	18.1	Bore discontinued at 18.1m - Target depth reached			18.1				Backfill 18-18.1m End Cap

RIG: XC Drill **DRILLER:** Terratest **LOGGED:** IT **CASING:** HWT to 0.5m

TYPE OF BORING: Diatube (200mm dia.) to 0.24m, Solid Flight Auger (TC-bit) 0.24-0.53m, NMLC Coring 0.53-18.1m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *Field replicate BD1/110311 collected from 0.35-0.5m; Groundwater well installed: blank PVC 0.0-1.5m, screen PVC 1.5-18.0m, bentonite 0.0-1.3m, gravel 1.3-18.0m, backfill 18.0-18.1m, gatic cover at the surface; 100% water loss from 16.0-18.1m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 14.3 m AHD
EASTING: 333899
NORTHING: 6249275
DIP/AZIMUTH: 90°/--

BORE No: BH1003
PROJECT No: 86884.02
DATE: 10/3/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
14	0.04	STONE TILE							
	0.09	SAND and CEMENT							
	0.25	CONCRETE SLAB At 0.2m: 8mm steel reinforcement		A/E	0.25 0.3		PID<1ppm		
		FILL/Clayey SAND: fine to medium, brown, with medium to coarse sandstone gravel, boulders, concrete and brick rubble, trace ash and slag		A/E	0.7 0.8		PID<1ppm		
13	1.3	Bore discontinued at 1.3m - Refusal on bricks (3 courses deep, minimum 4 bricks long)							
12									
11									
10									

RIG: NDD and hand tools **DRILLER:** Excavac **LOGGED:** JS **CASING:** Uncased

TYPE OF BORING: Diatube (200mm dia.) to 0.25m, Non-Destructive Digging 0.25-1.3m

WATER OBSERVATIONS: No free ground water observed

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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Photo D1 – View of the location of Borehole BH1003, with some of the retrieved rubble.

Photo D2 – View of concrete rubble retrieved from Borehole BH1003 during non-destructive digging through the upper part of the borehole.

Douglas Partners Geotechnics / Environment / Groundwater	**Borehole Photographs** **Proposed Commercial Development** **2-8a Lee Street, Haymarket**	PROJECT: 86884.02 PLATE No: D1 REV: 0
	CLIENT: Toga Development and Construction	DATE: 25-Mar-21

Photo D3 – View down Borehole BH1003 at the borehole refusal depth, showing a section of mortared brick rubble.

Douglas Partners Geotechnics / Environment / Groundwater	**Borehole Photographs** **Proposed Commercial Development** **2-8a Lee Street, Haymarket**	PROJECT: 86884.02 PLATE No: D2 REV: 0
	CLIENT: Toga Development and Construction	DATE: 25-Mar-21

BOREHOLE LOG

CLIENT: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 14.3 m AHD
EASTING: 333900
NORTHING: 6249274
DIP/AZIMUTH: 90°/--

BORE No: BH1003A
PROJECT No: 86884.02
DATE: 10 - 19/3/2021
SHEET 1 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
14	0.04	STONE TILE										
	0.12	SAND and CEMENT										
	0.23	CONCRETE SLAB At 0.2m: 8mm steel reinforcement							A/E*			PID<1
		FILL/Clayey SAND: fine to medium, brown, with sandstone gravel and cobbles, concrete and brick rubble and bricks, trace ash and slag							A/E			PID<1
13	1.2	SAND SP: medium, pale brown and pale grey, moist, medium dense, alluvial							A/E			PID<1
12	2								A/E*			PID<1
		Below 2.8m: dense				19-03-21			S			8,15,22 N = 37
11	3											
	4	4.0 Silty CLAY CI-CH: medium to high plasticity, pale grey and brown, with ironstone gravel, w<PL, apparently stiff to very stiff, residual soil						Unless otherwise stated, rock is fractured along rough, planar bedding dipping 0-5°, with iron staining or clay coating				
10	4.3	Clayey SAND SC: medium, brown, moist, apparently medium dense to dense, extremely weathered sandstone							S			5/0 refusal
	4.58	SANDSTONE: medium grained, brown, pale grey and red-brown, bedded at 0-10°, very low to low strength, highly weathered, fractured, Mittagong Formation						4.83-4.87m: Ds 40mm	C	100	73	PL(A) = 0.05
	4.87											
	5.0											

RIG: NDD, hand tools, XC Drill **DRILLER:** Excavac, Terratest **LOGGED:** JS **CASING:** HW to 2.0m, HQ to 5.0m

TYPE OF BORING: Diatube (200mm dia.) to 0.23m, Non-Destructive Digging 0.23-2.0m, Solid Flight Auger (TC-bit) 2.0-4.58m, NMLC Coring 4.58-14.41m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *Field replicate BD2/100321 from 0.23-0.30m and field replicate BD3/100321 from 1.9-2.0m; Groundwater well installed: Blank PVC 0.0-1.7m, screen PVC 1.7-4.0m, bentonite 0.5-1.5m and 4.0-6.0m, sand 1.5-4m, backfill 0-0.5m and 6.0-14.41m, gatic cover

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
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BOREHOLE LOG

CLIENT: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 14.3 m AHD
EASTING: 333900
NORTHING: 6249274
DIP/AZIMUTH: 90°/--

BORE No: BH1003A
PROJECT No: 86884.02
DATE: 10 - 19/3/2021
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
9		SANDSTONE: medium to coarse grained, brown, pale grey and red-brown, cross-bedded at 0-20°, medium strength with extremely low and very low strength bands, highly weathered, slightly fractured, Hawkesbury Sandstone						5.03m: B20°, pl, ro, fe co	C	100	73	PL(A) = 0.6
	6							5.60-5.64m: Ds 40mm				
8									C	100	80	PL(A) = 0.5
								6.61m: B10° (x2), pl, ro, fe co				
								6.70-6.82m: Ds 120mm				
	7	Below 6.85m: pale grey, distinct and indistinct bedding at 0-10° with some cross-bedding, medium and medium to high strength, slightly weathered then fresh										PL(A) = 1
7								7.62-7.67m: Ds 50mm				
								7.68m: J50°, pl, ro, cly co				
	8							7.9m: B5°, pl, ro, cly co 10mm	C	100	95	PL(A) = 1
6												
	9											
5		Between 9.23-9.35m: grey, fine to medium grained band						9.28-9.31m: B10° (x3), pl, ro, cly co	C	100	82	PL(A) = 0.9

RIG: NDD, hand tools, XC Drill **DRILLER:** Excavac, Terratest **LOGGED:** JS **CASING:** HW to 2.0m, HQ to 5.0m

TYPE OF BORING: Diatube (200mm dia.) to 0.23m, Non-Destructive Digging 0.23-2.0m, Solid Flight Auger (TC-bit) 2.0-4.58m, NMLC Coring 4.58-14.41m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *Field replicate BD2/100321 from 0.23-0.30m and field replicate BD3/100321 from 1.9-2.0m; Groundwater well installed: Blank PVC 0.0-1.7m, screen PVC 1.7-4.0m, bentonite 0.5-1.5m and 4.0-6.0m, sand 1.5-4m, backfill 0-0.5m and 6.0-14.41m, gatic cover

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 14.3 m AHD
EASTING: 333900
NORTHING: 6249274
DIP/AZIMUTH: 90°/--

BORE No: BH1003A
PROJECT No: 86884.02
DATE: 10 - 19/3/2021
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
		SANDSTONE: medium to coarse grained, brown, pale grey and red-brown, cross-bedded at 0-20°, medium strength with extremely low and very low strength bands, highly weathered, slightly fractured, Hawkesbury Sandstone *(continued)*							C	100	82	PL(A) = 0.7
	11	Between 10.93-11.14m: extremely weathered seam						10.93-11.14m: Ds 210mm	C	100	86	PL(A) = 0.8
	12							12.35-12.40m: J50°, ir, ro, cln 12.46-12.53m: J60°, ir, ro, cln, healed	C	100	91	PL(A) = 1
	13	Between 13.58-13.84m: grey, fine to medium grained bed, with 10% dark grey siltstone laminations						13.81-13.83m: Ds 20mm	C	100	92	PL(A) = 0.9
	14											
	14.41	Bore discontinued at 14.41m - Target depth reached										

RIG: NDD, hand tools, XC Drill **DRILLER:** Excavac, Terratest **LOGGED:** JS **CASING:** HW to 2.0m, HQ to 5.0m

TYPE OF BORING: Diatube (200mm dia.) to 0.23m, Non-Destructive Digging 0.23-2.0m, Solid Flight Auger (TC-bit) 2.0-4.58m, NMLC Coring 4.58-14.41m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *Field replicate BD2/100321 from 0.23-0.30m and field replicate BD3/100321 from 1.9-2.0m; Groundwater well installed: Blank PVC 0.0-1.7m, screen PVC 1.7-4.0m, bentonite 0.5-1.5m and 4.0-6.0m, sand 1.5-4m, backfill 0-0.5m and 6.0-14.41m, gatic cover

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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Photo D4 - SPT test from Borehole BH1003A, depth interval 2.5-2.95m. Top of test indicated as shown.

Douglas Partners Geotechnics / Environment / Groundwater	**Borehole Photographs** **Proposed Commercial Development** **2-8a Lee Street, Haymarket**	PROJECT: 86884.02 PLATE No: D3 REV: A
	CLIENT: Toga Development and Construction	DATE: 25-Mar-21

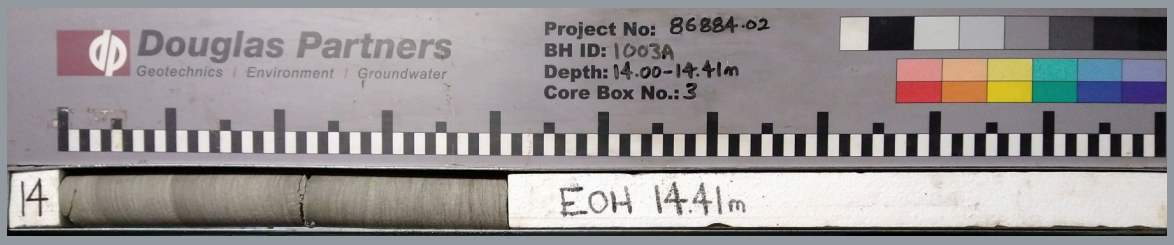
BORE: 1003A PROJECT: HAYMARKET MARCH 2021

4.58 – 9.0m

BORE: 1003A PROJECT: HAYMARKET MARCH 2021

9.0 – 14.0m

BORE: 1003A PROJECT: HAYMARKET MARCH 2021



14.0 – 14.41m

BOREHOLE LOG

CLIENT: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 14.3 m AHD
EASTING: 333900
NORTHING: 6249274
DIP/AZIMUTH: 90°/--

BORE No: BH1003A
PROJECT No: 86884.02
DATE: 10 - 19/3/2021
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
14.3	0.04	STONE TILE							
	0.12	SAND and CEMENT		A/E*	0.23		PID<1		Backfill 0-0.5m
	0.23	CONCRETE SLAB At 0.2m: 8mm steel reinforcement			0.3				
		FILL/Clayey SAND: fine to medium, brown, with sandstone gravel and cobbles, concrete and brick rubble and bricks, trace ash and slag		A/E	0.8 0.9		PID<1		Bentonite 0.5-1.5m
13	1.2	SAND SP: medium, pale brown and pale grey, moist, medium dense, alluvial		A/E	1.4 1.5		PID<1		
12	2			A/E*	1.9 2.0		PID<1		
				S	2.5 2.95		8,15,22 N = 37	19-03-21	Sand filter 1.5-4.0m Slotted PVC pipe 1.7-4.0m
11	3	Below 2.8m: dense							
10	4.0	Silty CLAY CI-CH: medium to high plasticity, pale grey and brown, with ironstone gravel, w<PL, apparently stiff to very stiff, residual soil							End Cap
	4.3			S	4.5 4.58		5/0 refusal		
	4.58	Clayey SAND SC: medium, brown, moist, apparently medium dense to dense, extremely weathered sandstone			4.6		PL(A) = 0.05		
9	4.87 5.0	SANDSTONE: medium grained, brown, pale grey and red-brown, bedded at 0-10°, very low to low strength, highly weathered, fractured, Mittagong Formation		C	5.51		PL(A) = 0.6		Bentonite fill 4.0-6m
		SANDSTONE: medium to coarse grained, brown, pale grey and red-brown, cross-bedded at 0-20°, medium strength with extremely low and very low strength bands, highly weathered, slightly fractured, Hawkesbury Sandstone			6.0				
8	6				6.34		PL(A) = 0.5		
				C					
7	7	Below 6.85m: pale grey, distinct and indistinct bedding at 0-10° with some cross-bedding, medium and medium to high strength, slightly weathered then fresh			7.48 7.53		PL(A) = 1		
6	8			C	8.95		PL(A) = 1		
	9				9.13				
5		Between 9.23-9.35m: grey, fine to medium grained band		C	9.86		PL(A) = 0.9		

RIG: NDD, hand tools, XC Drill **DRILLER:** Excavac, Terratest **LOGGED:** JS **CASING:** HW to 2.0m, HQ to 5.0m

TYPE OF BORING: Diatube (200mm dia.) to 0.23m, Non-Destructive Digging 0.23-2.0m, Solid Flight Auger (TC-bit) 2.0-4.58m, NMLC Coring 4.58-14.41m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *Field replicate BD2/100321 from 0.23-0.30m and field replicate BD3/100321 from 1.9-2.0m; Groundwater well installed: Blank PVC 0.0-1.7m, screen PVC 1.7-4.0m, bentonite 0.5-1.5m and 4.0-6.0m, sand 1.5-4m, backfill 0-0.5m and 6.0-14.41m, gatic cover

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 14.3 m AHD
EASTING: 333900
NORTHING: 6249274
DIP/AZIMUTH: 90°/--

BORE No: BH1003A
PROJECT No: 86884.02
DATE: 10 - 19/3/2021
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
4	11	SANDSTONE: medium to coarse grained, brown, pale grey and red-brown, cross-bedded at 0-20°, medium strength with extremely low and very low strength bands, highly weathered, slightly fractured, Hawkesbury Sandstone *(continued)*		C	10.56 10.66		PL(A) = 0.7		Backfill 6-14.41m
3		Between 10.93-11.14m: extremely weathered seam		C	11.63		PL(A) = 0.8		
2	12				12.19				
1	13			C	12.93		PL(A) = 1		
		Between 13.58-13.84m: grey, fine to medium grained bed, with 10% dark grey siltstone laminations			13.61 13.72		PL(A) = 0.9		
0	14			C					
	14.41	Bore discontinued at 14.41m - Target depth reached			14.41				
-1	15								
-2	16								
-3	17								
-4	18								
-5	19								

RIG: NDD, hand tools, XC Drill **DRILLER:** Excavac, Terratest **LOGGED:** JS **CASING:** HW to 2.0m, HQ to 5.0m

TYPE OF BORING: Diatube (200mm dia.) to 0.23m, Non-Destructive Digging 0.23-2.0m, Solid Flight Auger (TC-bit) 2.0-4.58m, NMLC Coring 4.58- 14.41m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *Field replicate BD2/100321 from 0.23-0.30m and field replicate BD3/100321 from 1.9-2.0m; Groundwater well installed: Blank PVC 0.0-1.7m, screen PVC 1.7-4.0m, bentonite 0.5-1.5m and 4.0-6.0m, sand 1.5-4m, backfill 0-0.5m and 6.0-14.41m, gatic cover

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: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 15.8 m AHD
EASTING: 333920
NORTHING: 6249261
DIP/AZIMUTH: 90°/--

BORE No: BH1004
PROJECT No: 86884.02
DATE: 10/3/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
15	0.04	STONE TILE							
	0.11	SAND and CEMENT							
	0.3	CONCRETE SLAB							
		FILL/Sandy CLAY: low to medium plasticity, brown and grey, with fine to medium sandstone and ironstone gravel, brick rubble, sandstone boulders, and igneous rock cobbles (railway ballast), trace ash and slag		A/E*	0.3 0.4		PID<1ppm		
				A/E	0.6 0.7		PID<1ppm		
	0.8	FILL: building rubble (concrete rubble, bricks, railway ballast and sandstone boulders in a clayey sand matrix)							
14	1.1	Bore discontinued at 1.1m - Refusal in fill							
13									
12									
11									

RIG: NDD and hand tools **DRILLER:** Excavac **LOGGED:** JS **CASING:** Uncased

TYPE OF BORING: Diatube (200mm dia.) to 0.30m, Non-Destructive Digging 0.30-1.1m

WATER OBSERVATIONS: No free ground water observed

REMARKS: *Field replicate BD2/10.03.21 collected from 0.3-0.4m.

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: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 15.8 m AHD
EASTING: 333921
NORTHING: 6249260
DIP/AZIMUTH: 90°/--

BORE No: BH1004A
PROJECT No: 86884.02
DATE: 11 - 18/3/2021
SHEET 1 OF 4

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
	0.04	STONE TILE										
	0.1	SAND and CEMENT										
		CONCRETE SLAB										
	0.3	At 0.26m: 8mm reinforcement steel							A/E*			PID<1ppm
15		FILL/Clayey SAND: fine to medium, brown, with silty clay, sandstone gravel and cobbles, igneous rock cobbles (railway ballast), concrete and brick rubble, bricks and rubbish (plastic bottles), trace ash and slag										
	0.6											
	1	FILL: building rubble (concrete rubble, bricks, railway ballast, sandstone gravel, cobbles and boulders, in a clayey sand matrix)							A/E			PID<1ppm
14	2											
	2.1	FILL/SILT: low to non-plastic, grey, with sandstone gravel and bricks							A/E			PID<1ppm
	2.2	FILL: building rubble (concrete and bricks - possible footing)										
13	2.7	FILL/SAND: medium, brown, moist										
	3 3.0	SAND SP: medium, pale grey, wet, medium dense to dense, alluvial							S/E			7,12,18 N = 30 PID<1ppm REC = 0.3m
12	4 4.0	Silty CLAY CL-CI: low to medium plasticity, grey, trace charcoal, w>PL, very soft to soft, alluvial							S			pp = 50 2,0,0 N = 0 REC = 0.2m
11												

RIG: NDD, hand tools, XC Drill **DRILLER:** Excavac, Terratest **LOGGED:** JS **CASING:** HW to 2.6m

TYPE OF BORING: Diatube (200mm dia.) and Non-Destructive Digging (NDD) to 2.1m, NDD 2.1-2.3m, NMLC coring 2.3-3.1m, washbore 3.1-6.0m, NMLC coring 6.0-18.22m

WATER OBSERVATIONS: No free ground water observed

REMARKS: *Field replicate BD4/110321 collected from 0.3-0.4m.

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: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 15.8 m AHD
EASTING: 333921
NORTHING: 6249260
DIP/AZIMUTH: 90°/--

BORE No: BH1004A
PROJECT No: 86884.02
DATE: 11 - 18/3/2021
SHEET 2 OF 4

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
10		Silty CLAY CL-CI: low to medium plasticity, grey, trace charcoal, w>PL, very soft to soft, alluvial *(continued)*						Unless otherwise stated, rock is fractured along rough, planar bedding dipping 0-5°, with ironstaining or clay infill				
	5.6	SANDSTONE: brown, low to medium strength, Mittagong Formation										
6	6.0	SANDSTONE: medium to coarse grained, brown, pale grey and red-brown, medium strength, highly weathered with 20-40% extremely weathered beds, slightly fractured, Mittagong Formation						6.33-6.83m: Ds 500mm	(S)			10/10 refusal PL(A) = 0.4
9	6.83	SANDSTONE: medium to coarse grained, red-brown, orange and pale grey, medium strength, highly then moderately weathered, slightly fractured, Hawkesbury Sandstone						7.41m: J30°, pl, ro, cly vn 7.50-7.54m: Ds 40mm 7.80-7.83m: Ds 30mm	C	100	60	PL(A) = 0.8
8		Below 7.86m: grading to pale grey, slightly weathered										PL(A) = 0.6
	8.36	SANDSTONE: fine to medium grained, pale grey, indistinct bedding at 0-10°, high strength, fresh, slightly fractured, Hawkesbury Sandstone						8.33-8.36m: Ds 30mm	C	100	93	PL(A) = 1.2
7	8.93	SANDSTONE: medium to coarse grained, pale grey, distinct and indistinct bedding at 0-10°, cross-bedded, medium strength, fresh, slightly fractured to unbroken, Hawkesbury Sandstone						8.93m: B10°, pl, ro, cly co 10mm	C	100	100	PL(A) = 0.8

RIG: NDD, hand tools, XC Drill **DRILLER:** Excavac, Terratest **LOGGED:** JS **CASING:** HW to 2.6m

TYPE OF BORING: Diatube (200mm dia.) and Non-Destructive Digging (NDD) to 2.1m, NDD 2.1-2.3m, NMLC coring 2.3-3.1m, washbore 3.1-6.0m, NMLC coring 6.0-18.22m

WATER OBSERVATIONS: No free ground water observed

REMARKS: *Field replicate BD4/110321 collected from 0.3-0.4m.

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: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 15.8 m AHD
EASTING: 333921
NORTHING: 6249260
DIP/AZIMUTH: 90°/--

BORE No: BH1004A
PROJECT No: 86884.02
DATE: 11 - 18/3/2021
SHEET 3 OF 4

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
		SANDSTONE: medium to coarse grained, pale grey, distinct and indistinct bedding at 0-10°, cross-bedded, medium strength, fresh, slightly fractured to unbroken, Hawkesbury Sandstone *(continued)*							C	100	100	
	11								C	100	95	PL(A) = 0.7
	12								C	100	100	PL(A) = 0.9
	13											PL(A) = 0.9
	14							13.82m: B5°, pl, ro, cly co 5mm 14.31m: B10°, pl, ro, cly vn 14.91m: B10°, pl, ro, cly vn	C	100	99	PL(A) = 0.8 PL(A) = 0.8

RIG: NDD, hand tools, XC Drill **DRILLER:** Excavac, Terratest **LOGGED:** JS **CASING:** HW to 2.6m

TYPE OF BORING: Diatube (200mm dia.) and Non-Destructive Digging (NDD) to 2.1m, NDD 2.1-2.3m, NMLC coring 2.3-3.1m, washbore 3.1-6.0m, NMLC coring 6.0-18.22m

WATER OBSERVATIONS: No free ground water observed

REMARKS: *Field replicate BD4/110321 collected from 0.3-0.4m.

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: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 15.8 m AHD
EASTING: 333921
NORTHING: 6249260
DIP/AZIMUTH: 90°/--

BORE No: BH1004A
PROJECT No: 86884.02
DATE: 11 - 18/3/2021
SHEET 4 OF 4

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
0	16	SANDSTONE: medium to coarse grained, pale grey, distinct and indistinct bedding at 0-10°, cross-bedded, medium strength, fresh, slightly fractured to unbroken, Hawkesbury Sandstone *(continued)* Between 15.15-15.47m: extremely low strength, extremely weathered bed						15.15-15.47m: Ds 320mm 15.52-15.59m: J70°, pl, ro, cly vn, partially healed 15.83m: B10°, pl, ro, cly co 10mm 15.83-16.00m: J80°, ir, ro, cln, partially healed 15.96m: B10°, pl, ro, cly co 10mm	C	100	99	
									C	100	65	PL(A) = 0.9
-1	17	Between 16.72-17.42m: cross-bedded at 0-10°, low strength, with extremely weathered seams, fractured						16.6m: B10°, pl, ro, cly co 5mm 16.72m: B10°, pl, ro, cly co 5mm 16.85m: B10°, pl, ro, cly co 5mm 16.95m: B10°, pl, ro, cly co 10mm 17.18m: B10°, pl, ro, cly co 5mm 17.29-17.42m: Ds 130mm				PL(A) = 0.3
		Between 17.42-18.22m: cross-bedded at 0-10°, high strength, slightly fractured							C	100	86	
-2	18							17.7m: B10°, pl, ro, cly co 10mm 17.81m: B5°, ir, ro, cbs				PL(A) = 1.7
	18.22	Bore discontinued at 18.22m - Target depth reached										
-3	19											
-4												

RIG: NDD, hand tools, XC Drill **DRILLER:** Excavac, Terratest **LOGGED:** JS **CASING:** HW to 2.6m

TYPE OF BORING: Diatube (200mm dia.) and Non-Destructive Digging (NDD) to 2.1m, NDD 2.1-2.3m, NMLC coring 2.3-3.1m, washbore 3.1-6.0m, NMLC coring 6.0-18.22m

WATER OBSERVATIONS: No free ground water observed

REMARKS: *Field replicate BD4/110321 collected from 0.3-0.4m.

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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Photo D5 - SPT test from Borehole BH1004A, depth interval 3.1-3.55m. Top of test indicated as shown.

Photo D6 - SPT test from Borehole BH1004A, depth interval 4.5-4.95m. Top of test indicated as shown.

Douglas Partners Geotechnics / Environment / Groundwater	**Borehole Photographs** **Proposed Commercial Development** **2-8a Lee Street, Haymarket**	PROJECT: 86884.02 PLATE No: D4 REV: A
	CLIENT: Toga Development and Construction	DATE: 25-Mar-21

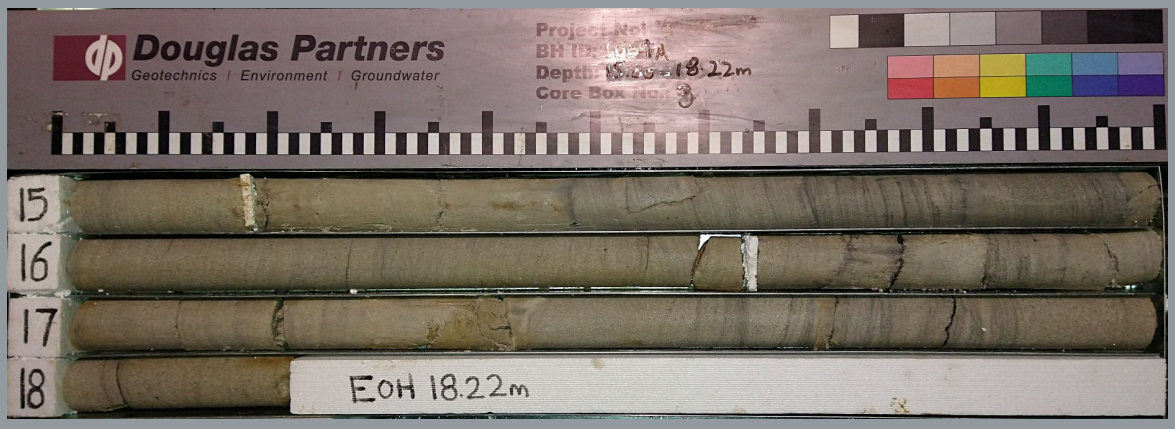
BORE: 1004A PROJECT: HAYMARKET MARCH 2021

6.0 – 10.0m

BORE: 1004A PROJECT: HAYMARKET MARCH 2021

10.0 – 15.0m

BORE: 1004A PROJECT: HAYMARKET MARCH 2021



15.0 – 18.22m

BOREHOLE LOG

CLIENT: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 15.9 m AHD
EASTING: 333920
NORTHING: 6249246
DIP/AZIMUTH: 90°/--

BORE No: BH1005
PROJECT No: 86884.02
DATE: 10 - 16/3/2021
SHEET 1 OF 4

RL	Depth (m)	Description of Strata	Type	Core Rec. %	RQD %	Test Results & Comments
15	0.02	STONE TILE				
	0.07	SAND and CEMENT				
	0.22	CONCRETE SLAB: 3x plastic conduit (empty)	A/E*			PID<1ppm
	0.3	Between 0.17-0.20m: 8mm steel reinforcement				
		FILL/Clayey SAND: fine to medium, brown, with fine to medium gravel and concrete rubble, dry	A/E			PID<1ppm
	1	FILL: building rubble (concrete rubble, bricks, sandstone gravel, cobbles and boulders, railway ballast, ash, slag, in sandy clay matrix)				
	1.3	FILL/Clayey SAND: fine to medium, brown and grey, with sandstone and igneous rock gravel and cobbles and brick rubble, trace ash and slag	A/E			PID<1ppm
14	2					
	2.8	SAND SP: medium, pale grey, wet, medium dense to dense, alluvial	S/E			8,15,15 N = 30 PID<1ppm
13	3		A/E			
12	4					
	4.2	SAND SP: medium, pale brown and red-brown, wet, dense to very dense, alluvial	S			10,25 refusal
11	5.0					

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

RIG: NDD, hand tools, XC Drill **DRILLER:** Excavac, Terratest **LOGGED:** JS **CASING:** HW to 2.3m

TYPE OF BORING: Diatube (200mm dia.) to 0.22m, Non-Destructive Digging 0.22-1.65m, Solid Flight Auger (TC-bit) 1.65-8.74m, NMLC coring 8.74-15.85m

WATER OBSERVATIONS: Groundwater not observed in open hole prior to auger drilling, due to surface water filling hole

REMARKS: *Field replicate BD1/100321 collected from 0.22-0.30m. Sand collapse at 2.5m, possible water table level

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: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 15.9 m AHD
EASTING: 333920
NORTHING: 6249246
DIP/AZIMUTH: 90°/--

BORE No: BH1005
PROJECT No: 86884.02
DATE: 10 - 16/3/2021
SHEET 2 OF 4

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
		SAND SP: refer previous page										
	5.2	Silty CLAY CI-CH: medium to high plasticity, grey, trace fine gravel and charcoal, w=PL, stiff to very stiff, alluvial							S			pp = 400 4,7,12 N = 19
	6.2	Silty CLAY CI-CH: medium to high plasticity, pale grey and pale brown, with fine to medium ironstone gravel, w>=PL, stiff with some soft to firm layers, residual soil							S			pp = 200 5,6,6 N = 12
	8.0	Clayey SAND SC: medium, brown, dry, very dense, extremely weathered sandstone						Unless otherwise stated, rock is fractured along rough, planar bedding dipping 0-5°, with ironstaining or clay infill	S			15/100 refusal
	8.74	SANDSTONE: medium grained, orange-brown, very low strength, highly weathered, fractured, Hawkesbury Sandstone										
	8.9	SANDSTONE: medium to coarse grained, pale grey, bedded at 0-10°, medium to high strength, slightly weathered, slightly fractured to unbroken, Hawkesbury Sandstone							C	100	87	PL(A) = 0.9
									C	100	92	PL(A) = 0.9

RIG: NDD, hand tools, XC Drill **DRILLER:** Excavac, Terratest **LOGGED:** JS **CASING:** HW to 2.3m

TYPE OF BORING: Diatube (200mm dia.) to 0.22m, Non-Destructive Digging 0.22-1.65m, Solid Flight Auger (TC-bit) 1.65-8.74m, NMLC coring 8.74- 15.85m

WATER OBSERVATIONS: Groundwater not observed in open hole prior to auger drilling, due to surface water filling hole

REMARKS: *Field replicate BD1/100321 collected from 0.22-0.30m. Sand collapse at 2.5m, possible water table level

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: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 15.9 m AHD
EASTING: 333920
NORTHING: 6249246
DIP/AZIMUTH: 90°/--

BORE No: BH1005
PROJECT No: 86884.02
DATE: 10 - 16/3/2021
SHEET 3 OF 4

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
5	11	SANDSTONE: medium to coarse grained, pale grey, bedded at 0-10°, medium to high strength, slightly weathered, slightly fractured to unbroken, Hawkesbury Sandstone *(continued)* Between 10.13-13.05m: fresh						10.11-10.13m: Ds 20mm	C	100	92	PL(A) = 0.9
4	12	Between 12.33-12.51m: fine to medium grained, grey							C	100	100	PL(A) = 0.9 PL(A) = 1.1
3	13 13.05	SANDSTONE: medium to coarse grained, pale grey, indistinct bedding at 0-10°, very low then low strength, highly weathered with extremely weathered seams, fractured, Hawkesbury Sandstone						13.05m: B 10°, pl, ro, cly co 13.31-13.33m: Ds 20mm 13.50-13.55m: Ds 50mm 13.60-13.6m: J40° (x2), pl, ro, cly co 10mm 13.84-13.86m: Ds 20mm	C	100	31	PL(A) = 0.1
2	14 14.21	SANDSTONE: medium to coarse grained, pale grey, bedded at 0-10°, low to medium strength, slightly weathered, slightly fractured, Hawkesbury Sandstone Below 14.75m: medium or medium to high strength, fresh						14.04m: B10°, pl, ro, cly co 10mm 14.1m: J60°, ir, ro, cly co 14.17m: J40°, ir, ro, cly co 14.21m: B10°, pl, ro, cly vn 14.62-14.66m: Ds 20mm 14.72-14.75m: Ds 30mm	C	100	84	PL(A) = 0.3 PL(A) = 0.8
1												

RIG: NDD, hand tools, XC Drill **DRILLER:** Excavac, Terratest **LOGGED:** JS **CASING:** HW to 2.3m

TYPE OF BORING: Diatube (200mm dia.) to 0.22m, Non-Destructive Digging 0.22-1.65m, Solid Flight Auger (TC-bit) 1.65-8.74m, NMLC coring 8.74- 15.85m

WATER OBSERVATIONS: Groundwater not observed in open hole prior to auger drilling, due to surface water filling hole

REMARKS: *Field replicate BD1/100321 collected from 0.22-0.30m. Sand collapse at 2.5m, possible water table level

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: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 15.9 m AHD
EASTING: 333920
NORTHING: 6249246
DIP/AZIMUTH: 90°/--

BORE No: BH1005
PROJECT No: 86884.02
DATE: 10 - 16/3/2021
SHEET 4 OF 4

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
		SANDSTONE: medium to coarse grained, pale grey, bedded at 0-10°, low to medium strength, slightly weathered, slightly fractured, Hawkesbury Sandstone *(continued)*							C	100	84	PL(A) = 1
	15.85	Bore discontinued at 15.85m - Target depth reached										

RIG: NDD, hand tools, XC Drill **DRILLER:** Excavac, Terratest **LOGGED:** JS **CASING:** HW to 2.3m

TYPE OF BORING: Diatube (200mm dia.) to 0.22m, Non-Destructive Digging 0.22-1.65m, Solid Flight Auger (TC-bit) 1.65-8.74m, NMLC coring 8.74-15.85m

WATER OBSERVATIONS: Groundwater not observed in open hole prior to auger drilling, due to surface water filling hole

REMARKS: *Field replicate BD1/100321 collected from 0.22-0.30m. Sand collapse at 2.5m, possible water table level

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

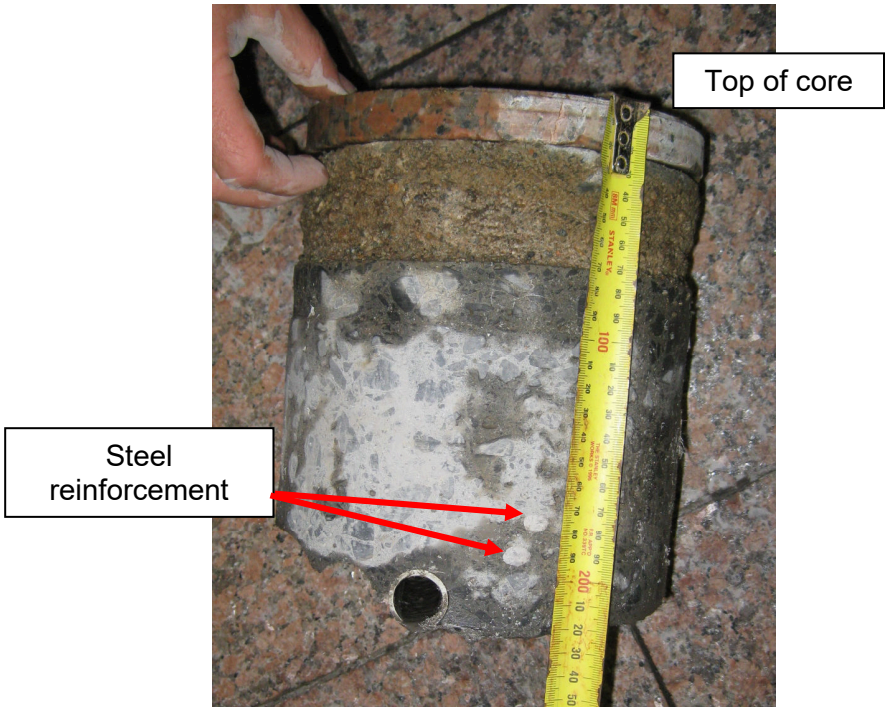


Photo D7 – View of concrete core from Borehole BH1005, showing a cemented coarse sand matrix between 0.02-0.07 m over a concrete slab. Reinforcement steel (8 mm diameter) was encountered in the lower part of the slab at 0.17-0.2 m depth, above an empty plastic conduit.

Photo D8 – View of rubble retrieved from Borehole BH1005 during non-destructive digging through the upper part of the borehole.

Douglas Partners Geotechnics / Environment / Groundwater	**Borehole Photographs** **Proposed Commercial Development** **2-8a Lee Street, Haymarket**	PROJECT:	86884.02
		PLATE No:	D5
		REV:	0
	CLIENT: Toga Development and Construction	DATE:	25-Mar-21

Photo D9 - SPT test from Borehole BH1005, depth interval 5.5-5.95m. Top of test indicated as shown.

Photo D10 - SPT test from Borehole BH1005, depth interval 7.0-7.45m. Top of test indicated as shown.

Douglas Partners Geotechnics / Environment / Groundwater	**Borehole Photographs** **Proposed Commercial Development** **2-8a Lee Street, Haymarket**	PROJECT: 86884.02 PLATE No: D6 REV: A
	CLIENT: Toga Development and Construction	DATE: 25-Mar-21

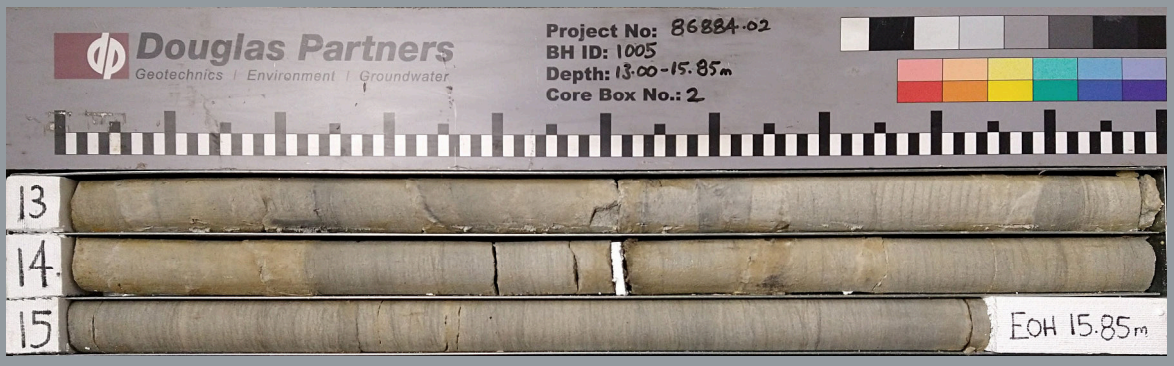
Photo D11 - SPT test from Borehole BH1005, depth interval 8.5-8.6m.

Douglas Partners Geotechnics / Environment / Groundwater	**Borehole Photographs** **Proposed Commercial Development** **2-8a Lee Street, Haymarket**	PROJECT: 86884.02 PLATE No: D7 REV: A
	CLIENT: Toga Development and Construction	DATE: 25-Mar-21

BORE: 1005 PROJECT: HAYMARKET MARCH 2021

8.74 – 13.0m

BORE: 1005 PROJECT: HAYMARKET MARCH 2021



13.0 – 15.85m

BOREHOLE LOG

CLIENT: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 15.7 m AHD
EASTING: 333896
NORTHING: 6249252
DIP/AZIMUTH: 90°/--

BORE No: BH1006
PROJECT No: 86884.02
DATE: 10/3/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
15	0.02	STONE TILE							
	0.06	SAND and CEMENT							
	0.18	CONCRETE SLAB							
		At 0.18m: 20mm copper water pipe							
		FILL: igneous rock cobbles (railway ballast) with fine to medium grained sand and brick rubble							
		At 0.4m: 8mm steel reinforcement fragment							
	0.8	0.80-0.85m: 65mm and 100mm copper pipes (buried services)							
	1	Bore discontinued at 0.8m - Refusal on buried services							
14	2								
13	3								
12	4								
11									

RIG: NDD and hand tools **DRILLER:** Excavac **LOGGED:** JS **CASING:** Uncased

TYPE OF BORING: Diatube (200mm dia.) to 0.18m, Non-Destructive Digging 0.18-0.80m

WATER OBSERVATIONS: No free ground water observed

REMARKS: Terminated on copper pipes

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

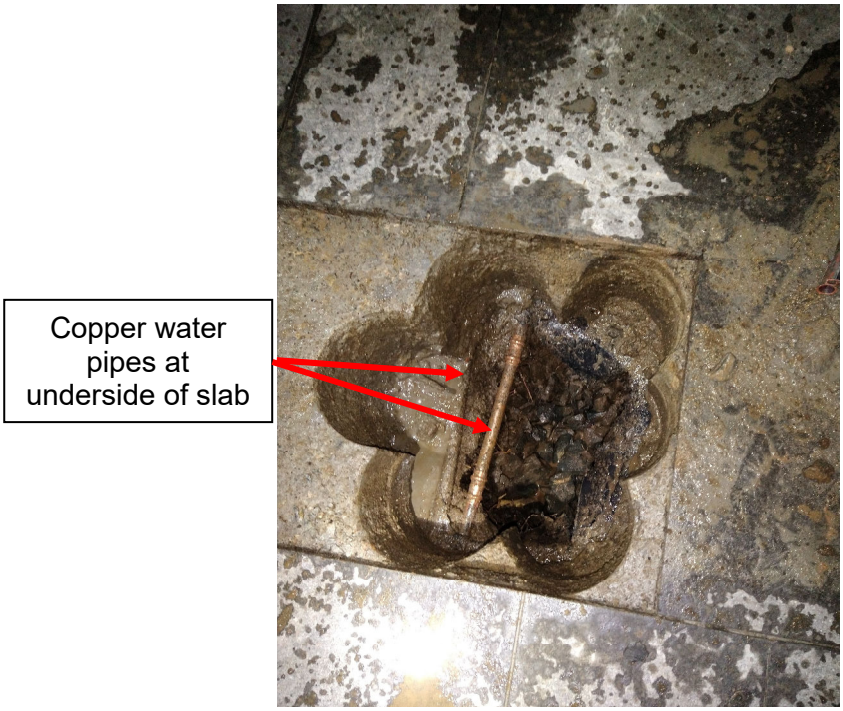


Photo D12 – View of copper water pipes and igneous rail ballast rubble beneath the surface at Borehole BH1006.

Photo D13 – View of two more deeply buried copper pipes within Borehole BH1006, at the termination depth of 0.8m.

Douglas Partners Geotechnics / Environment / Groundwater	**Borehole Photographs** **Proposed Commercial Development** **2-8a Lee Street, Haymarket**	PROJECT:	86884.02
		PLATE No:	D8
		REV:	0
	CLIENT: Toga Development and Construction	DATE:	25-Mar-21

BOREHOLE LOG

CLIENT: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 15.8 m AHD
EASTING: 333896
NORTHING: 6249263
DIP/AZIMUTH: 90°/--

BORE No: BH1007
PROJECT No: 86884.02
DATE: 11 - 17/3/2021
SHEET 1 OF 4

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
	0.02	STONE TILE										
	0.07	SAND and CEMENT										
	0.2	CONCRETE SLAB Between 0.14-0.15m: 8mm steel reinforcement							A/E*			PID<1ppm
15		FILL/Clayey SAND: fine to medium, brown and grey, with sandstone gravel and cobbles, igneous rock cobble (railway ballast), concrete rubble and bricks, trace ash and slag							A/E			PID<1ppm
	1											
									A/E			PID<1ppm
14												
	2								A/E			PID<1ppm
	2.3	FILL/SAND: medium to coarse, pale brown and grey, with pale grey and red-brown silty clay and fine to medium gravel, moist										
13									S/E			4,6,6 N = 12 PID60 ppm
	3											
	3.5	SAND SP: medium, pale grey, wet, dense, alluvial										
12						▼ 16-03-21			S/E*			8,16,25 N = 41 PID16 ppm
	4											
11												

RIG: NDD, hand tools, XC Drill **DRILLER:** Excavac, Terratest **LOGGED:** JS **CASING:** HW to 1.7m, HQ to 9.2m

TYPE OF BORING: Diatube (200mm dia.) to 0.2m, Non-Destructive Digging 0.2-1.6m, Solid Flight Auger (TC-bit) 1.6-8.5m, washbore 8.5-9.5m, NMLC coring 9.5-16.2m

WATER OBSERVATIONS: Free groundwater observed at 4.2m depth whilst augering

REMARKS: *Field replicates BD1/110321 from 0.2-0.3m and BD1/160321 from 4.0-4.45m; 20% water loss below 12.8 and 80% loss below 14.64m; Standpipe installed:- Blank PVC 0.0-10.2m, screen PVC 10.2-16.2m, bentonite 8.5-9.5m, sand 9.5-16.2m, backfill 0-0.5m, gatic

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: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 15.8 m AHD
EASTING: 333896
NORTHING: 6249263
DIP/AZIMUTH: 90°/--

BORE No: BH1007
PROJECT No: 86884.02
DATE: 11 - 17/3/2021
SHEET 2 OF 4

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
		SAND SP: medium, pale grey, wet, dense, alluvial *(continued)* Below 5.0m: grading to loose										
	5.7	Silty CLAY CL-CI: low to medium plasticity, grey, trace fine gravel, w>PL, stiff to very stiff, alluvial							S			pp = 100 3,7,9 N = 16
	6.5	SAND SP: medium, brown, wet, medium dense, alluvial										
	7.2	Silty CLAY CI-CH: medium to high plasticity, pale grey and brown, with ironstone gravel, w>PL, very stiff, residual soil							S			pp = 500 8,15,15 N = 30
	8.0	Clayey SAND SC: medium to coarse, pale grey and brown, with silty clay layers, wet, medium dense, extremely weathered sandstone						Unless otherwise stated, rock is fractured along rough, planar bedding dipping 0-5°, with iron staining or clay coating	S			20,13,8 N = 21
	9.2	SANDSTONE: brown, very low strength, Hawkesbury Sandstone				19-03-21						
	9.5	SANDSTONE: medium to coarse grained, brown, indistinct bedding at 0-10°, very low strength, highly weathered, fractured, Hawkesbury Sandstone							C	100	97	PL(A) = 0.1
	9.83	SANDSTONE: refer following page										PL(A) = 1.2
	10.0											

RIG: NDD, hand tools, XC Drill **DRILLER:** Excavac, Terratest **LOGGED:** JS **CASING:** HW to 1.7m, HQ to 9.2m

TYPE OF BORING: Diatube (200mm dia.) to 0.2m, Non-Destructive Digging 0.2-1.6m, Solid Flight Auger (TC-bit) 1.6-8.5m, washbore 8.5-9.5m, NMLC coring 9.5-16.2m

WATER OBSERVATIONS: Free groundwater observed at 4.2m depth whilst augering

REMARKS: *Field replicates BD1/110321 from 0.2-0.3m and BD1/160321 from 4.0-4.45m; 20% water loss below 12.8 and 80% loss below 14.64m; Standpipe installed:- Blank PVC 0.0-10.2m, screen PVC 10.2-16.2m, bentonite 8.5-9.5m, sand 9.5-16.2m, backfill 0-0.5m, gatic

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: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 15.8 m AHD
EASTING: 333896
NORTHING: 6249263
DIP/AZIMUTH: 90°/--

BORE No: BH1007
PROJECT No: 86884.02
DATE: 11 - 17/3/2021
SHEET 3 OF 4

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
		SANDSTONE: medium to coarse grained, pale grey, distinct bedding at 0-10°, high strength, fresh, slightly fractured, Hawkesbury Sandstone *(continued)*							C	100	97	
	11	Below 10.87m: with 5-10% fine to medium grained beds, and low to medium strength to 10.91m Below 10.98m: medium strength to high strength, unbroken						10.87-10.91m: Ds 40mm 10.98m: B10°, pl, ro, cly co 10mm				PL(A) = 0.3
									C	100	88	PL(A) = 0.4
	12											
	13								C	100	100	PL(A) = 1.1
	14								C	100	97	PL(A) = 0.9
								14.64-14.68m: B5° (x5), pl, ro, cly co				PL(A) = 1.5

RIG: NDD, hand tools, XC Drill **DRILLER:** Excavac, Terratest **LOGGED:** JS **CASING:** HW to 1.7m, HQ to 9.2m

TYPE OF BORING: Diatube (200mm dia.) to 0.2m, Non-Destructive Digging 0.2-1.6m, Solid Flight Auger (TC-bit) 1.6-8.5m, washbore 8.5-9.5m, NMLC coring 9.5-16.2m

WATER OBSERVATIONS: Free groundwater observed at 4.2m depth whilst augering

REMARKS: *Field replicates BD1/110321 from 0.2-0.3m and BD1/160321 from 4.0-4.45m; 20% water loss below 12.8 and 80% loss below 14.64m; Standpipe installed:- Blank PVC 0.0-10.2m, screen PVC 10.2-16.2m, bentonite 8.5-9.5m, sand 9.5-16.2m, backfill 0-0.5m, gatic

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: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 15.8 m AHD
EASTING: 333896
NORTHING: 6249263
DIP/AZIMUTH: 90°/--

BORE No: BH1007
PROJECT No: 86884.02
DATE: 11 - 17/3/2021
SHEET 4 OF 4

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
0	16	SANDSTONE: medium to coarse grained, pale grey, distinct bedding at 0-10°, high strength, fresh, slightly fractured, Hawkesbury Sandstone *(continued)*							C	100	97	PL(A) = 0.8
									C	100	97	PL(A) = 1.3
	16.2	Bore discontinued at 16.2m - Target depth reached										
-1	17											
-2	18											
-3	19											
-4												

RIG: NDD, hand tools, XC Drill **DRILLER:** Excavac, Terratest **LOGGED:** JS **CASING:** HW to 1.7m, HQ to 9.2m

TYPE OF BORING: Diatube (200mm dia.) to 0.2m, Non-Destructive Digging 0.2-1.6m, Solid Flight Auger (TC-bit) 1.6-8.5m, washbore 8.5-9.5m, NMLC coring 9.5-16.2m

WATER OBSERVATIONS: Free groundwater observed at 4.2m depth whilst augering

REMARKS: *Field replicates BD1/110321 from 0.2-0.3m and BD1/160321 from 4.0-4.45m; 20% water loss below 12.8 and 80% loss below 14.64m; Standpipe installed:- Blank PVC 0.0-10.2m, screen PVC 10.2-16.2m, bentonite 8.5-9.5m, sand 9.5-16.2m, backfill 0-0.5m, gatic

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

Photo D14 – View of concrete core obtained from Borehole BH1007. Steel reinforcement was observed within the concrete slab at 0.14-0.15m depth.

Photo D15 - SPT test from Borehole BH1007, depth interval 2.5-2.95m. The top of test indicated as shown.

Douglas Partners Geotechnics / Environment / Groundwater	**Borehole Photographs** **Proposed Commercial Development** **2-8a Lee Street, Haymarket**	PROJECT:	86884.02
		PLATE No:	D9
		REV:	0
	CLIENT: Toga Development and Construction	DATE:	25-Mar-21

Photo D16 – SPT test from Borehole BH1007, depth interval 4.0-4.45m. The top of test indicated as shown.

Photo D17 - SPT test from Borehole BH1007, depth interval 5.5-5.95m. The top of test indicated as shown.

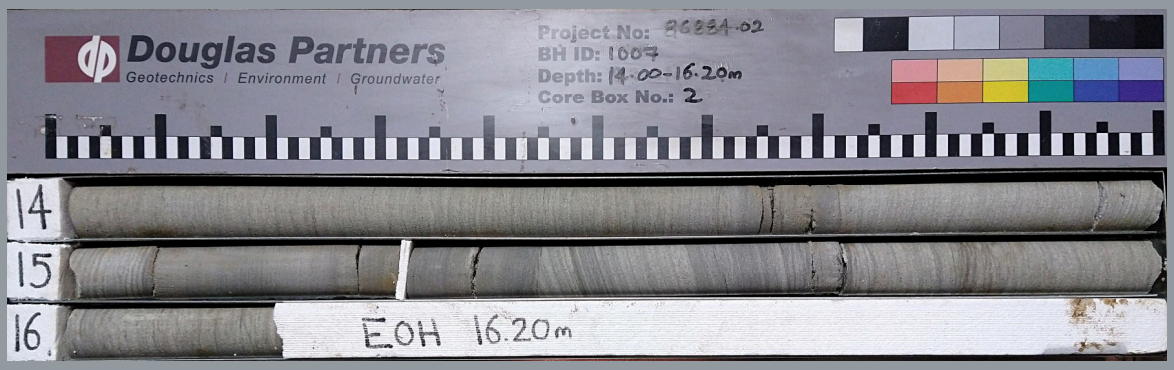
Photo D18 - SPT test from Borehole BH1007, depth interval 7.0-7.45m. The top of test indicated as shown.

Douglas Partners Geotechnics / Environment / Groundwater	**Borehole Photographs** **Proposed Commercial Development** **2-8a Lee Street, Haymarket**	PROJECT: 86884.02 PLATE No: D10 REV: 0
	CLIENT: Toga Development and Construction	DATE: 25-Mar-21

BORE: 1007 PROJECT: HAYMARKET MARCH 2021

9.5 – 14.0m

BORE: 1007 PROJECT: HAYMARKET MARCH 2021



14.0 – 16.2m

BOREHOLE LOG

CLIENT: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 15.8 m AHD
EASTING: 333896
NORTHING: 6249263
DIP/AZIMUTH: 90°/--

BORE No: BH1007
PROJECT No: 86884.02
DATE: 11 - 17/3/2021
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
15	0.02	STONE TILE							
	0.07	SAND and CEMENT		A/E*	0.2 0.3		PID<1ppm		
	0.2	CONCRETE SLAB Between 0.14-0.15m: 8mm steel reinforcement		A/E	0.6 0.7		PID<1ppm		
14	1	FILL/Clayey SAND: fine to medium, brown and grey, with sandstone gravel and cobbles, igneous rock cobble (railway ballast), concrete rubble and bricks, trace ash and slag		A/E	1.5 1.6		PID<1ppm		
	2			A/E	2.0 2.1		PID<1ppm		
13	2.3	FILL/SAND: medium to coarse, pale brown and grey, with pale grey and red-brown silty clay and fine to medium gravel, moist		S/E	2.5 2.95		4,6,6 N = 12 PID60 ppm		
	3								
12	3.5	SAND SP: medium, pale grey, wet, dense, alluvial		S/E*	4.0 4.45		8,16,25 N = 41 PID16 ppm	16-03-21	Backfill 0-0.5m
	4								
11	5	Below 5.0m: grading to loose							
	5.7	Silty CLAY CL-CI: low to medium plasticity, grey, trace fine gravel, w>PL, stiff to very stiff, alluvial		S	5.5 5.95		pp = 100 3,7,9 N = 16		
10	6								
	6.5	SAND SP: medium, brown, wet, medium dense, alluvial							
9	7			S	7.0 7.45		pp = 500 8,15,15 N = 30		
	7.2	Silty CLAY CI-CH: medium to high plasticity, pale grey and brown, with ironstone gravel, w>PL, very stiff, residual soil							
8	8								
	8.0	Clayey SAND SC: medium to coarse, pale grey and brown, with silty clay layers, wet, medium dense, extremely weathered sandstone		S	8.5 8.95		20,13,8 N = 21		
7	9								Bentonite 8.5-9.5m
	9.2	SANDSTONE: brown, very low strength, Hawkesbury Sandstone						19-03-21	
	9.5	SANDSTONE: medium to coarse grained, brown, indistinct bedding at 0-10°, very low strength, highly weathered, fractured, Hawkesbury Sandstone		C	9.5 9.52		PL(A) = 0.1		
6	9.83 10.0								

RIG: NDD, hand tools, XC Drill **DRILLER:** Excavac, Terratest **LOGGED:** JS **CASING:** HW to 1.7m, HQ to 9.2m

TYPE OF BORING: Diatube (200mm dia.) to 0.2m, Non-Destructive Digging 0.2-1.6m, Solid Flight Auger (TC-bit) 1.6-8.5m, washbore 8.5-9.5m, NMLC coring 9.5-16.2m

WATER OBSERVATIONS: Free groundwater observed at 4.2m depth whilst augering

REMARKS: *Field replicates BD1/110321 from 0.2-0.3m and BD1/160321 from 4.0-4.45m; 20% water loss below 12.8 and 80% loss below 14.64m; Standpipe installed:- Blank PVC 0.0-10.2m, screen PVC 10.2-16.2m, bentonite 8.5-9.5m, sand 9.5-16.2m, backfill 0-0.5m, gatic

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: Toga Development and Construction Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 2-8a Lee Street, Haymarket

SURFACE LEVEL: 15.8 m AHD
EASTING: 333896
NORTHING: 6249263
DIP/AZIMUTH: 90°/--

BORE No: BH1007
PROJECT No: 86884.02
DATE: 11 - 17/3/2021
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		SANDSTONE: refer following page			9.96		PL(A) = 1.2		
		SANDSTONE: medium to coarse grained, pale grey, distinct bedding at 0-10°, high strength, fresh, slightly fractured, Hawkesbury Sandstone *(continued)*		C	10.7				
	11	Below 10.87m: with 5-10% fine to medium grained beds, and low to medium strength to 10.91m			10.94		PL(A) = 0.3		11
		Below 10.98m: medium strength to high strength, unbroken		C	11.44		PL(A) = 0.4		
	12				12.28				12
	13			C	12.96		PL(A) = 1.1		13 Sand filter 9.5-16.2m; Slotted PVC pipe 10.2-16.2m
					13.71				
	14				13.94		PL(A) = 0.9		14
				C					
	15				14.95		PL(A) = 1.5		15
					15.27		PL(A) = 0.8		
					15.3				
				C					
	16				15.96		PL(A) = 1.3		16
	16.2	Bore discontinued at 16.2m - Target depth reached			16.2				End Cap
	17								17
	18								18
	19								19

RIG: NDD, hand tools, XC Drill **DRILLER:** Excavac, Terratest **LOGGED:** JS **CASING:** HW to 1.7m, HQ to 9.2m

TYPE OF BORING: Diatube (200mm dia.) to 0.2m, Non-Destructive Digging 0.2-1.6m, Solid Flight Auger (TC-bit) 1.6-8.5m, washbore 8.5-9.5m, NMLC coring 9.5-16.2m

WATER OBSERVATIONS: Free groundwater observed at 4.2m depth whilst augering

REMARKS: *Field replicates BD1/110321 from 0.2-0.3m and BD1/160321 from 4.0-4.45m; 20% water loss below 12.8 and 80% loss below 14.64m; Standpipe installed:- Blank PVC 0.0-10.2m, screen PVC 10.2-16.2m, bentonite 8.5-9.5m, sand 9.5-16.2m, backfill 0-0.5m, gatic

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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Appendix E

Groundwater Monitoring and Permeability Test Results

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Groundwater Field Sheet

Project and Bore Installation Details

Bore / Standpipe ID:	8
Project Name:	
Project Number:	
Site Location:	
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	

Bore Development Details

Date/Time:	19/3/21 14:20.
Purged By:	
GW Level (pre-purge):	1.98 m bgl
Observed Well Depth:	m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Estimated Bore Volume:	L
Total Volume Purged:	(target: no drill mud, min 3 well vol. or dry)
GW Level (post-purge):	m bgl
Equipment:	

Micropurge and Sampling Details

Date/Time:	22/3/21 3.00
Sampled By:	
Weather Conditions:	
GW Level (pre-purge):	1.88 m bgl
Observed Well Depth:	m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Estimated Bore Volume:	L
GW Level (post sample):	m bgl
Total Volume Purged:	L
Equipment:	

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	**0.1° C**	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
Additional Readings Following stabilisation:	DO-% Sat	SPC	TDS			

Sample Details

Sampling Depth (rationale):		m bgl,	
Sample Appearance (e.g. colour, siltiness, odour):			
Sample ID:			
QA/QC Samples:			
Sampling Containers and filtration:			
Comments / Observations:			

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Groundwater Field Sheet

Project and Bore Installation Details

Bore / Standpipe ID:	107A
Project Name:	
Project Number:	
Site Location:	
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	

Bore Development Details

Date/Time:	19/3/21 1:00
Purged By:	JB.
GW Level (pre-purge):	1.86 m bgl
Observed Well Depth:	3.76 m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Estimated Bore Volume:	5 L
Total Volume Purged:	7 (target: no drill mud, min 3 well vol. or dry) DRY (x2).
GW Level (post-purge):	3.73 m bgl
Equipment:	Twister pump + bailer // Water: clear, no sheen, no odour.

Micropurge and Sampling Details

Date/Time:	22/3/21 1:30 pm
Sampled By:	JB
Weather Conditions:	Rainy.
GW Level (pre-purge):	1.63 m bgl
Observed Well Depth:	3.76 m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Estimated Bore Volume:	6 L
GW Level (post sample):	3.75 m bgl (DRY)
Total Volume Purged:	7 L
Equipment:	Peristaltic pump, Bailer.

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	**0.1° C**	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
1:35 // 0-5	21.9	3.71	463	6.06	995	109
1:36 // 1.0	21.8	3.59	436	6.18	205	84
1:37 // 1.5	21.7	3.50	441	6.22	257	67
1:38 // 2.0	21.7	3.47	422	6.25	232	71
1:39 // 2.5	21.7	3.44	41.6	6.26	260	64.
Additional Readings Following stabilisation:	DO % Sat	SPC	TDS			

Sample Details

Sampling Depth (rationale):	3.0 m bgl,
Sample Appearance (e.g. colour, siltiness, odour):	clear / yellow- no silt, no odour, no sheen
Sample ID:	107A.
QA/QC Samples:	none.
Sampling Containers and filtration:	
Comments / Observations:	

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Groundwater Field Sheet

Project and Bore Installation Details	
Bore / Standpipe ID:	107 B R
Project Name:	
Project Number:	
Site Location:	
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	

Bore Development Details	
Date/Time:	19/3/2021 1:30
Purged By:	JB.
GW Level (pre-purge):	2.16. m bgl
Observed Well Depth:	10.90 m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Estimated Bore Volume:	25 L
Total Volume Purged:	50. (target: no drill mud, min 3 well vol. or dry) DRY (x2)
GW Level (post-purge):	10.88 m bgl
Equipment:	Twister pump // Water: dark grey, semi-translucent, sulphurous odour, no sheen.

Micropurge and Sampling Details	
Date/Time:	22/3/21 2:30
Sampled By:	JB
Weather Conditions:	Rainy.
GW Level (pre-purge):	1.85 m bgl
Observed Well Depth:	10.90. m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Estimated Bore Volume:	25 L
GW Level (post sample):	4.88 m bgl
Total Volume Purged:	8 L
Equipment:	Bailer, peristaltic pump.

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	*0.1° C*	+/- 0.3 mg/L	+/- 3%	+/- 0.1	+/- 10%	+/- 10 mV
2:30 / 0.5	21.4	3.38	339	6.13	862	50.7
2:31 / 1.0	21.6	3.71	331	6.22	660	45.8
2:32 / 1.5	21.6	3.66	379	6.29	501	27.5
2:33 / 2.0	21.5	5.61	381.7	6.27	610	31.5
2:34 / 2.5	21.5	3.58	384.1	6.26	594	33.6

Additional Readings Following stabilisation:	DO % Sat	SPC	TDS

Sample Details

Sampling Depth (rationale):	9.0	m bgl,
Sample Appearance (e.g. colour, siltiness, odour):	grey, semi-translucent, no odour, no sheen, low siltyness.	
Sample ID:	107B.	
QA/QC Samples:	None.	
Sampling Containers and filtration:		
Comments / Observations:		

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Groundwater Field Sheet

Project and Bore Installation Details

Bore / Standpipe ID:	202
Project Name:	
Project Number:	86864.02
Site Location:	Lee St, Haymarket
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	

Bore Development Details

Date/Time:	19/3/21 8.30.
Purged By:	JB.
GW Level (pre-purge):	3.32 m bgl
Observed Well Depth:	7.02 m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Estimated Bore Volume:	10 L
Total Volume Purged:	16 (target: no drill mud, min 3 well vol. or dry) DRY.
GW Level (post-purge):	6.98 m bgl
Equipment:	Twister pump + bailer // water: cloudy grey, no sheen, no odour, slightly silty

Micropurge and Sampling Details

Date/Time:	22/3/21 5:20 pm
Sampled By:	JB
Weather Conditions:	Raining.
GW Level (pre-purge):	2.97 m bgl
Observed Well Depth:	7.02 m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Estimated Bore Volume:	11 L
GW Level (post sample):	6.90 m bgl
Total Volume Purged:	7 L
Equipment:	Peristaltic pump + bailer.

Water Quality Parameters

Time / Volume (L).	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	**0.1° C**	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
5:10 // 0.5	22.8	4.64	202	5.29	879	113
5:11 // 1.0	21.0	4.28	171	5.51	590	77
5:12 // 1.5	21.0	3.65	183	5.62	531	56
5:13 // 2.0	21.0	3.58	181	5.65	488	51
5:14 // 2.5	21.0	3.50	178	5.66	489	50

Additional Readings Following stabilisation:	DO % Sat	SPC	TDS			

Sample Details

Sampling Depth (rationale):	6.0 m bgl,
Sample Appearance (e.g. colour, siltiness, odour):	pale brown/ translucent, low siltiness, no odour, no sheen.
Sample ID:	202
QA/QC Samples:	
Sampling Containers and filtration:	
Comments / Observations:	Rising head test performed

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Groundwater Field Sheet

Project and Bore Installation Details

Bore / Standpipe ID:	1002
Project Name:	
Project Number:	86884.02
Site Location:	Lee Street, Maynard.
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	

Bore Development Details

Date/Time:	19/3/21 7.00.
Purged By:	JB.
GW Level (pre-purge):	16.42 m bgl
Observed Well Depth:	18.00 m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Estimated Bore Volume:	4.5 L
Total Volume Purged:	18 (target: no drill mud, min 3 well vol. or dry)
GW Level (post-purge):	16.71 m bgl
Equipment:	Twister pump // water: pale brown, low turbidity, no sheen, no odour.

Micropurge and Sampling Details

Date/Time:	22/3/21 12:00pm Rainy.
Sampled By:	JB.
Weather Conditions:	Rainy.
GW Level (pre-purge):	16.27 m bgl
Observed Well Depth:	18.00 m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Estimated Bore Volume:	5 L
GW Level (post sample):	16.36 m bgl
Total Volume Purged:	6 L
Equipment:	Peristaltic pump (QPS13) + Bailer.

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	***0.1° C***	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
12.00 / 0.5	21.1	3.94	410.8	5.59	537	135
12.01 / 1.0	21.2	3.38	341.5	5.64	614	121
12.02 / 1.5	21.2	3.37	342.3	5.71	577	109
12.03 / 2.0	21.2	3.10	348.9	5.79	532	105

Additional Readings Following stabilisation:	DO % Sat	SPC	TDS

Sample Details

Sampling Depth (rationale):	17.00 m bgl,
Sample Appearance (e.g. colour, siltiness, odour):	pale brown, low siltyness, no odour, no sheen.
Sample ID:	1002
QA/QC Samples:	BD1/20210321
Sampling Containers and filtration:	
Comments / Observations:	22/3/21: water: semi-translucent, pale brown, no sheen, no odour.

EC is in µS/cm.

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Groundwater Field Sheet

Project and Bore Installation Details

Bore / Standpipe ID:	1003A.
Project Name:	
Project Number:	
Site Location:	
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	

Bore Development Details

Date/Time:	19/3/2021 11:00 AM
Purged By:	JB
GW Level (pre-purge):	2.79 m bgl
Observed Well Depth:	3.93 m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Estimated Bore Volume:	6 L
Total Volume Purged:	30 (target: no drill mud, min 3 well vol. or dry)
GW Level (post-purge):	2.85 m bgl
Equipment:	Twister pump // Water : 0-10L: brown, silty. 10-25L: translucent, pale brown. — no odour or sheen

Micropurge and Sampling Details

Date/Time:	22/3/21 3:00
Sampled By:	JB
Weather Conditions:	Raining
GW Level (pre-purge):	2.78 m bgl
Observed Well Depth:	3.93 m bgl 3.93
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Estimated Bore Volume:	6 L
GW Level (post sample):	2.81 m bgl
Total Volume Purged:	10 L
Equipment:	Peristaltic pump + Lailer **

Water Quality Parameters

Time / Volume (L)	Temp (°C)	DO (mg/L)	EC (~~µS or mS/cm~~) mS/cm.	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	***0.1° C***	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
3:10 / 0.5	22.0	3.75	232	5.96	636	128
3:11 / 1.0	22.1	4.21	232	6.19	647	102
3:12 / 1.5	22.1	4.28	233	6.33	721	88
3:13 / 2.0	22.1	4.33	237	6.57	706	78
3:14 / 2.5	22.1	4.36	241	6.35	712	74
Additional Readings Following stabilisation:	DO % Sat	SPC	TDS			

Sample Details

Sampling Depth (rationale):	3.5 m bgl,
Sample Appearance (e.g. colour, siltiness, odour):	brown, silty, no sheen, no odour.
Sample ID:	1003A.
QA/QC Samples:	
Sampling Containers and filtration:	
Comments / Observations:	** additional 20L pumped out using twister pump for rising head test.

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Groundwater Field Sheet

Project and Bore Installation Details

Bore / Standpipe ID:	1007
Project Name:	
Project Number:	86584.02
Site Location:	Lee St, Haymarket
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	

Bore Development Details

Date/Time:	19/3/2021 11:30
Purged By:	
GW Level (pre-purge):	9.22 m bgl
Observed Well Depth:	14.40 m bgl depth measured at 15.81 post development
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Estimated Bore Volume:	15 L
Total Volume Purged:	95 (target: no drill mud, min 3 well vol. or dry)
GW Level (post-purge):	15.21 m bgl
Equipment:	Twister pump // Water: brown, silty, no odour, no sheen. * 80L+: semi-translucent, low silty.

Micropurge and Sampling Details

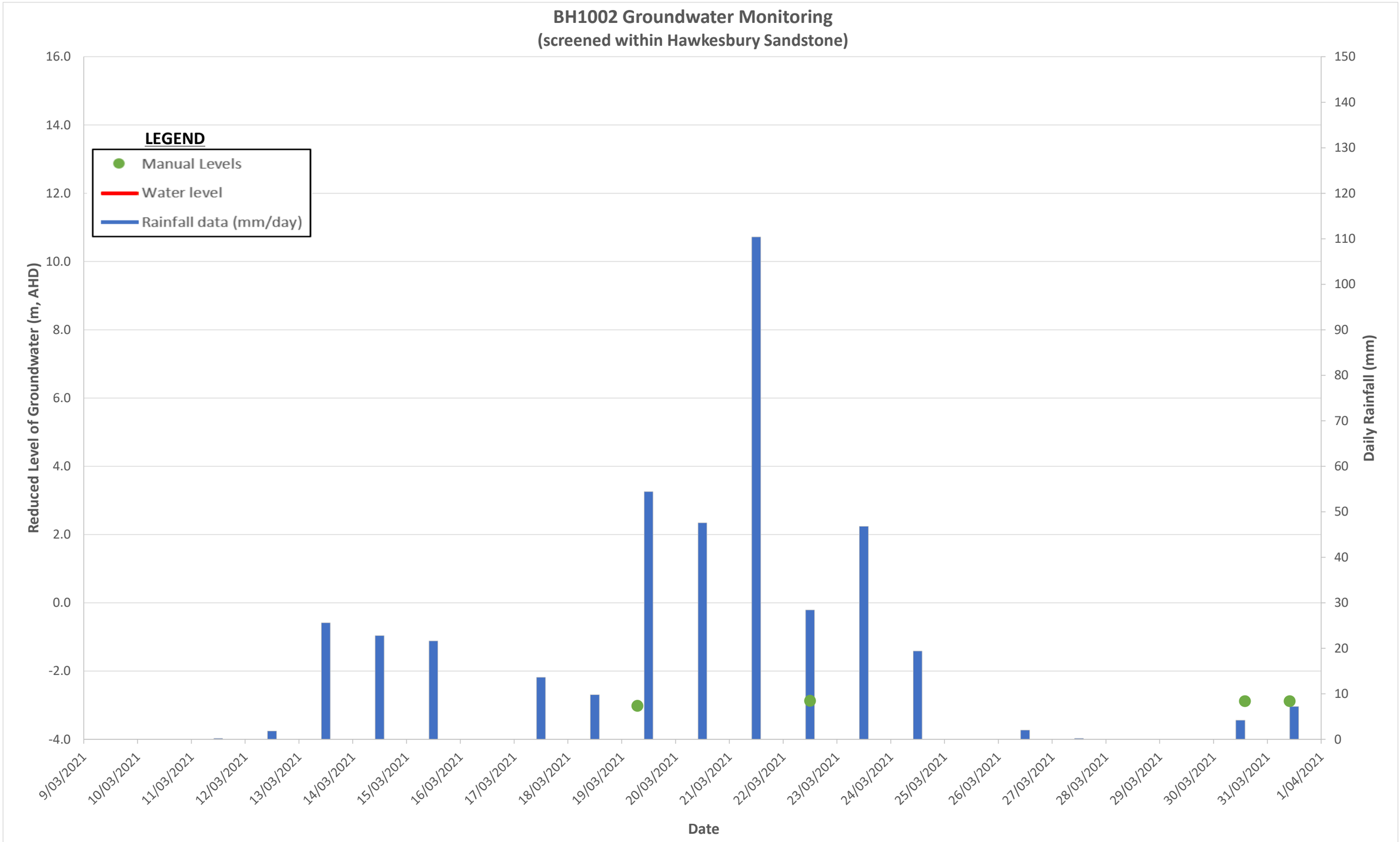
Date/Time:	22/3/2021 4:00
Sampled By:	JB
Weather Conditions:	Raining
GW Level (pre-purge):	9.30 m bgl
Observed Well Depth:	15.81 m bgl (15.87m post purge).
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Estimated Bore Volume:	20 L
GW Level (post sample):	13.71 m bgl
Total Volume Purged:	10 L
Equipment:	Peristaltic pump + Lailer. **

Water Quality Parameters (EC in µS/cm.)

Time / Volume	Temp (°C)	DO (mg/L)	EC (~~µS or mS/m~~)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	**0.1° C**	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
0.5	20.3	4.35	524	6.07	2524	122.6
1.0	20.6	4.26	445	6.12	1566	87.4
1.5	20.7	3.28	477	6.11	1204	83.2
2.0	20.7	3.17	451	6.13	981	78.9
2.5	20.7	3.21	462	6.15	970	76.0
3.0	20.7	3.20	467	6.17	946	77.1
3.5	20.7	3.23	461	6.15	941	78.2
Additional Readings Following stabilisation:	DO % Sat	SPC	TDS			

Sample Details

Sampling Depth (rationale):	15.0 m bgl,
Sample Appearance (e.g. colour, siltiness, odour):	brown, silty, no odour, no sheen
Sample ID:	1007
QA/QC Samples:	
Sampling Containers and filtration:	
Comments / Observations:	* Sheen on top of water ponding inside gate. ** Twister pump used to pump ~120L post sampling for rising head test


BH1002 Groundwater Monitoring
(screened within Hawkesbury Sandstone)
LEGEND
Manual Levels
Water level
Rainfall data (mm/day)
Reduced Level of Groundwater (m, AHD)
Daily Rainfall (mm)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
9/03/2021
10/03/2021
11/03/2021
12/03/2021
13/03/2021
14/03/2021
15/03/2021
16/03/2021
17/03/2021
18/03/2021
19/03/2021
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21/03/2021
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25/03/2021
26/03/2021
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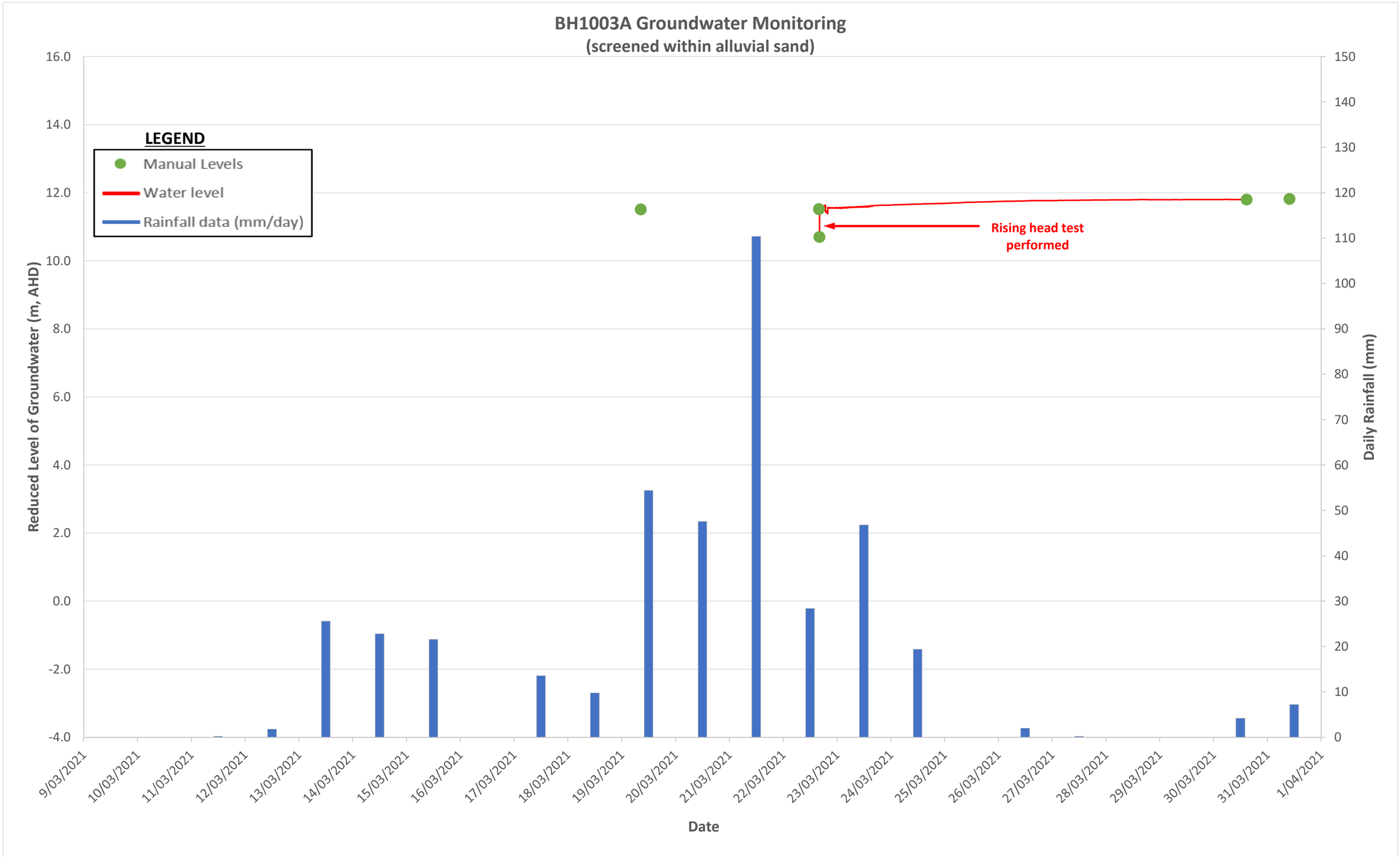
28/03/2021
29/03/2021
30/03/2021
31/03/2021
1/04/2021
Date


BH1003A Groundwater Monitoring
(screened within alluvial sand)
LEGEND
Manual Levels
Water level
Rainfall data (mm/day)
Rising head test performed
Reduced Level of Groundwater (m, AHD)
Daily Rainfall (mm)
Date
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
9/03/2021
10/03/2021
11/03/2021
12/03/2021
13/03/2021
14/03/2021
15/03/2021
16/03/2021
17/03/2021
18/03/2021
19/03/2021
20/03/2021
21/03/2021
22/03/2021
23/03/2021
24/03/2021
25/03/2021
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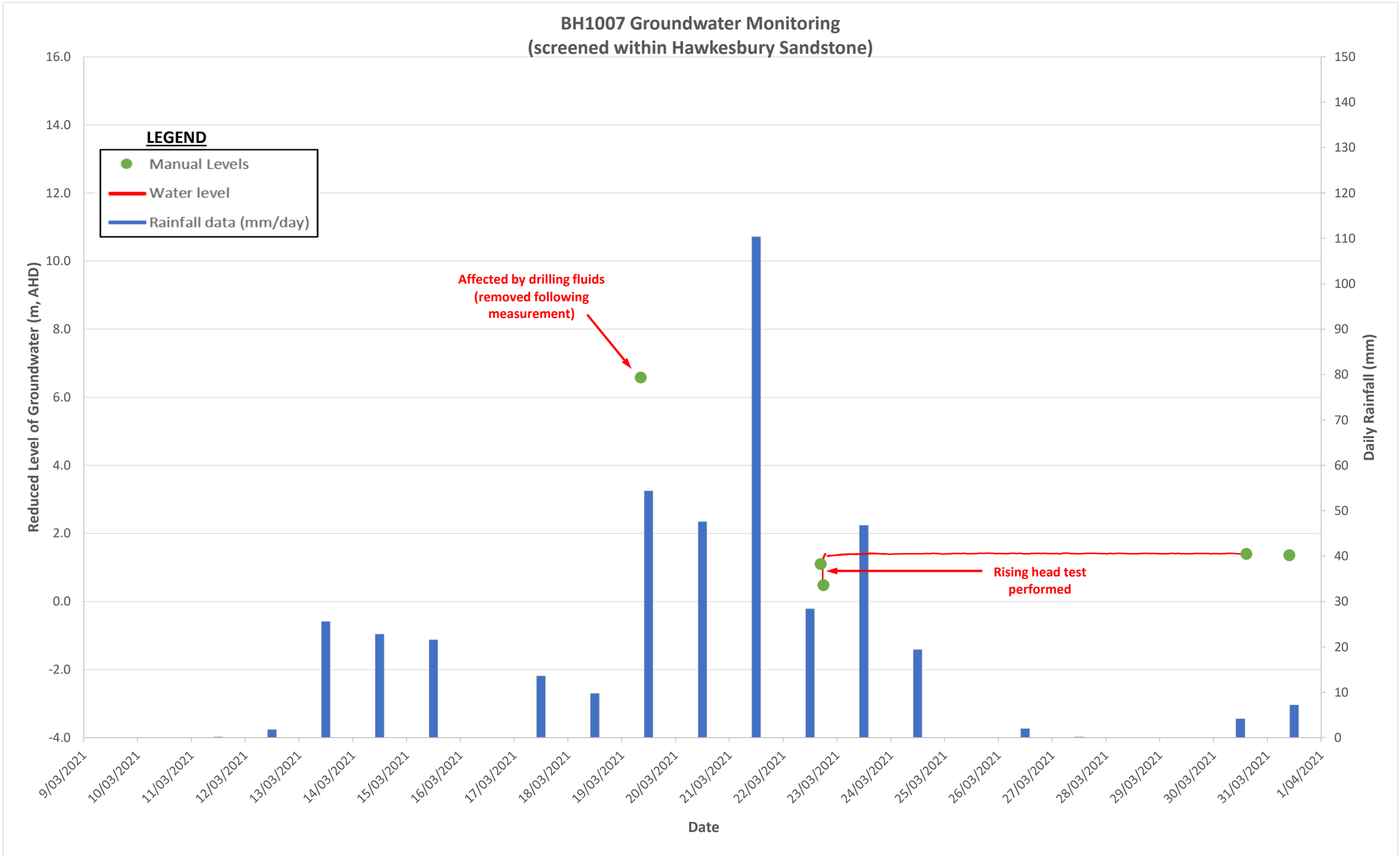
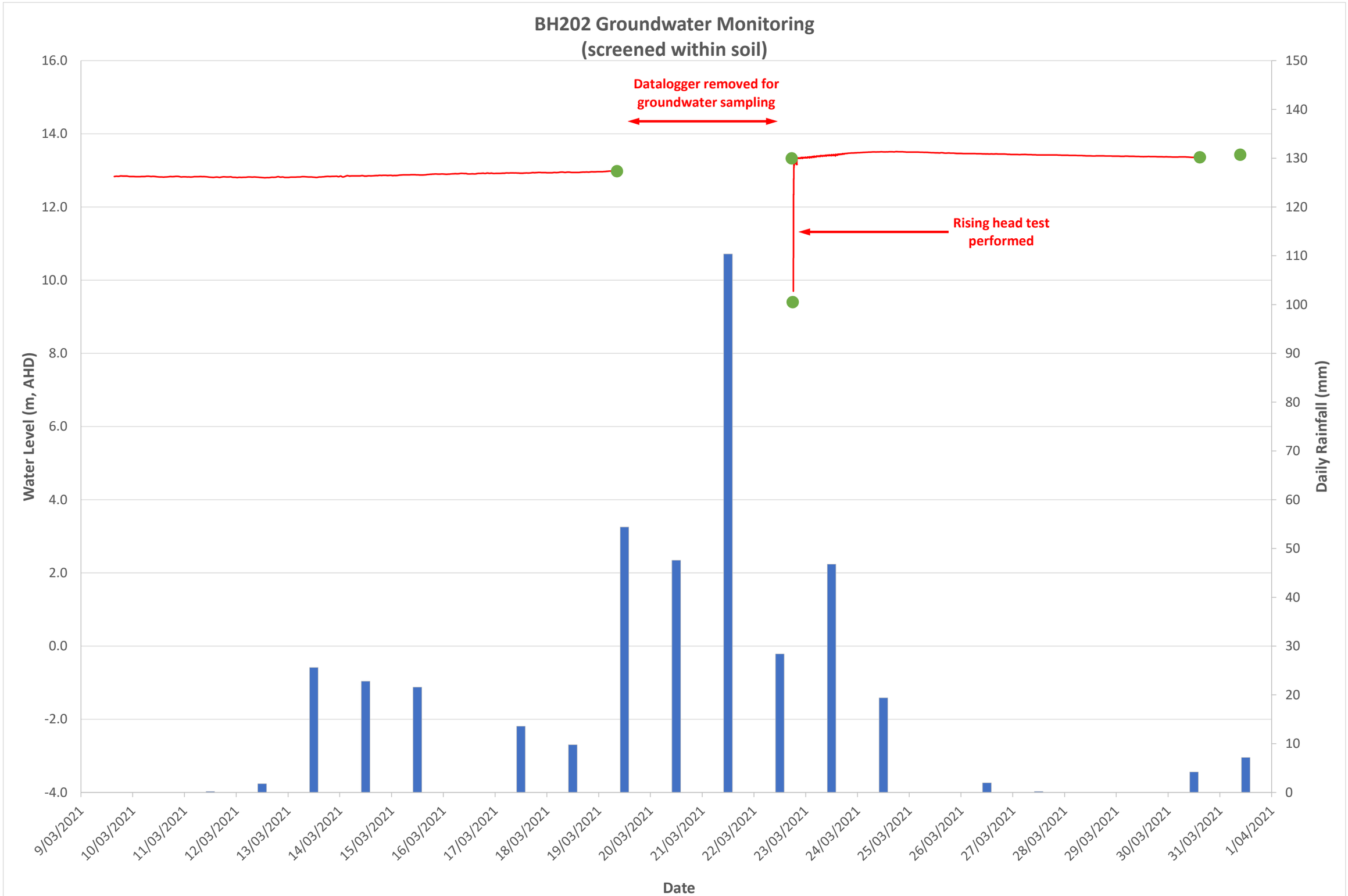
27/03/2021
28/03/2021
29/03/2021
30/03/2021
31/03/2021
1/04/2021


BH1007 Groundwater Monitoring
(screened within Hawkesbury Sandstone)
LEGEND
Manual Levels
Water level
Rainfall data (mm/day)
Affected by drilling fluids
(removed following
measurement)
Rising head test
performed
Reduced Level of Groundwater (m, AHD)
Daily Rainfall (mm)
Date
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
9/03/2021
10/03/2021
11/03/2021
12/03/2021
13/03/2021
14/03/2021
15/03/2021
16/03/2021
17/03/2021
18/03/2021
19/03/2021
20/03/2021
21/03/2021
22/03/2021
23/03/2021
24/03/2021
25/03/2021
26/03/2021
27/03/2021
28/03/2021
29/03/2021
30/03/2021
31/03/2021
1/04/2021


BH202 Groundwater Monitoring
(screened within soil)
Datalogger removed for groundwater sampling
Rising head test performed
Water Level (m, AHD)
Daily Rainfall (mm)
Date
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
9/03/2021
10/03/2021
11/03/2021
12/03/2021
13/03/2021
14/03/2021
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26/03/2021
27/03/2021
28/03/2021
29/03/2021
30/03/2021
31/03/2021
1/04/2021

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Constant Head Permeameter Test Report [AS1547-2012 App G]

Client:	Toga Development and Construction Pty Ltd	Project No:	86884.02
Project:	Proposed Commercial Development	Date:	30-Mar-21
Location:	2-8A Lee Street, Haymarket	Tested by:	JB

Test Location

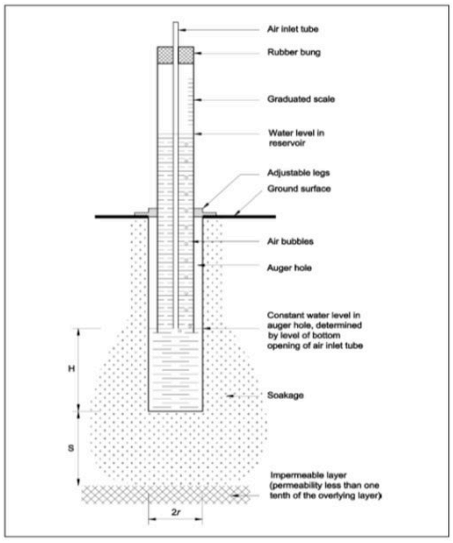
Description:	Adina Hotel Basement, Standpipe piezometer	**Test No.**	BH1002	
Material type:	Sandstone	Easting:	333935	m
Condition of ground surface before test: Saturated		Northing	6249290	m
Weather during test: Sunny		Surface Level:	13.4	m AHD

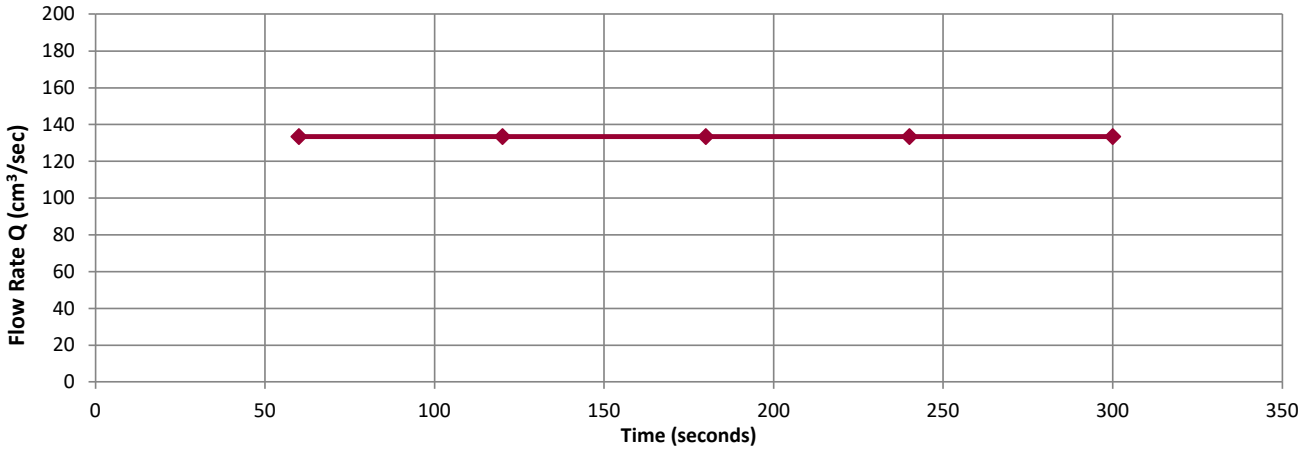
Details of Bore Installation

Depth of augered hole	18000	mm	Depth to impermeable layer	18000	m
Depth of constant water below permeameter	1720	mm	Time from filling to start	0	minutes
Diameter of hole	76	mm			

Test Results

Time (Seconds)	Level below top (mm)	Flow Volume (cm^3)	Rate of Loss [Q] (cm^3/sec)
0		0	-
60		8000	133
120		16000	133
180		24000	133
240		32000	133
300		40000	133
Totals	0	40000	133





Saturated Hydraulic Conductivity - Over total duration of test

k =	**4.51E-03**	cm/sec
=	**4.51E-05**	m/sec
=	**3.89**	m/day

where: $$K_{sat} = \frac{4.4Q\left[0.5\sinh^{-1}\left(\frac{H}{2r}\right) - \sqrt{\left\{\left(\frac{r}{H}\right)^2 + 0.25\right\}} + \frac{r}{H}\right]}{2\pi H^2}$$

(ref. AS1547-2012 App G)

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Permeability Testing - Rising or Falling Head Test Report

Client:	Toga Development and Construction Pty Ltd	Project No:	86884.02
Project:	Proposed Commercial Development	Test date:	22/3/2021
Location:	2-8A Lee Street, Haymarket	Tested by:	JDB

Test Location

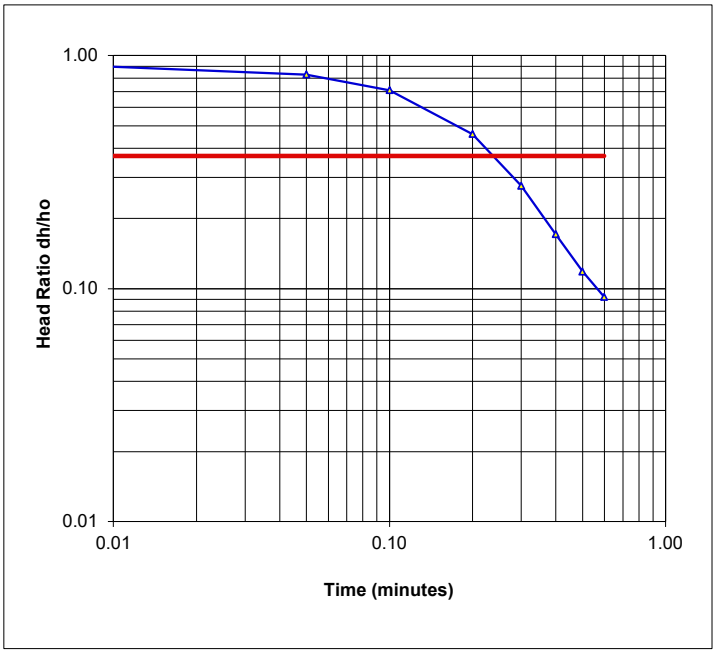
Description:	Standpipe in borehole	**Test No.**	1003A	
Material type:	Alluvial Sand	Easting:	333900	m
		Northing	6249274	m
		Surface Level:	14.3	m AHD

Details of Well Installation

Well casing diameter (2r)	110	mm	Depth to water before test	2.77	m
Well screen diameter (2R)	110	mm	Depth to water at start of test	3.53	m
Length of well screen (Le)	1.23	m			

Test Results

Time (min)	Depth (m)	Change in Head: δH (m)	δH/Ho
0	3.53	0.76	1.000
0.05	3.40	0.63	0.829
0.10	3.31	0.54	0.711
0.20	3.12	0.35	0.461
0.30	2.98	0.21	0.276
0.40	2.9	0.13	0.171
0.50	2.86	0.09	0.118
0.60	2.84	0.07	0.092



To = 0.25 mins
15 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 =**	**2.5E-04**	m/sec
	=	**91.707**	cm/hour

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Permeability Testing - Rising or Falling Head Test Report

Client:	Toga Development and Construction Pty Ltd	Project No:	86884.02
Project:	Proposed Commercial Development	Test date:	22/3/2021
Location:	2-8A Lee Street, Haymarket	Tested by:	JDB

Test Location

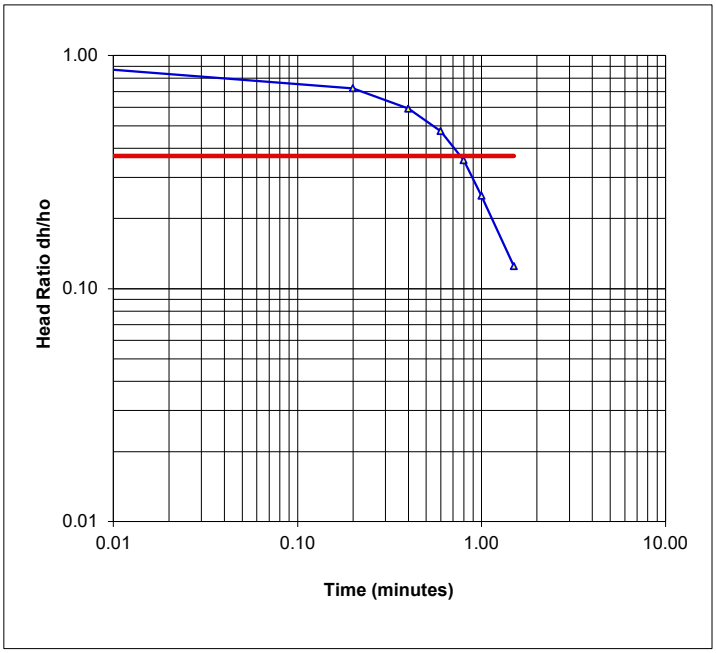
Description:	Standpipe in borehole	**Test No.**	1007	
Material type:	Sandstone	Easting:	333896	m
		Northing	6249263	m
		Surface Level:	15.8	m AHD

Details of Well Installation

Well casing diameter (2r)	76	mm	Depth to water before test	14.56	m
Well screen diameter (2R)	76	mm	Depth to water at start of test	15.32	m
Length of well screen (Le)	1.64	m			

Test Results

Time (min)	Depth (m)	Change in Head: δH (m)	δH/Ho
0	15.32	0.76	1.000
0.20	15.11	0.55	0.724
0.40	15.01	0.45	0.592
0.60	14.92	0.36	0.474
0.80	14.83	0.27	0.355
1.00	14.75	0.19	0.250
1.50	14.66	0.09	0.125



To = 0.78 mins
46.8 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 =**	**3.5E-05**	m/sec
	=	**12.750**	cm/hour

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Permeability Testing - Rising or Falling Head Test Report

Client:	Toga Development and Construction Pty Ltd	Project No:	86884.02
Project:	Proposed Commercial Development	Test date:	22/3/2021
Location:	2-8A Lee Street, Haymarket	Tested by:	JDB

Test Location

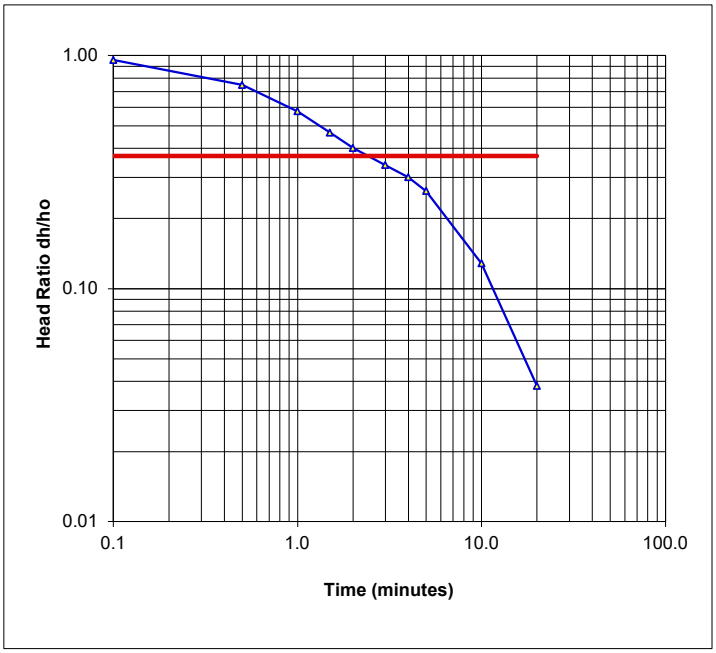
Description:	Standpipe in borehole	**Test No.**	202	
Material type:	Alluvial Sands and Clays	Easting:	333941	m
		Northing	6249253	m
		Surface Level:	16.3	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	2.94	m
Well screen diameter (2R)	114	mm	Depth to water at start of test	6.6	m
Length of well screen (Le)	3.5	m			

Test Results

Time (min)	Depth (m)	Change in Head: δH (m)	δH/Ho
0	6.60	3.66	1.000
0.1	6.44	3.50	0.956
0.5	5.68	2.74	0.749
1	5.05	2.11	0.577
1.5	4.65	1.71	0.467
2	4.41	1.47	0.402
3	4.18	1.24	0.339
4	4.04	1.10	0.301
5	3.9	0.96	0.262
10	3.41	0.47	0.128
20	3.08	0.14	0.038



To = 2.4 mins
144 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 =**	**2.6E-06**	m/sec
	=	**0.919**	cm/hour

Appendix F

Previous Field Work Results and Permeability Test Results

Sampling Methods

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Sampling

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

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

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

Test Pits

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

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

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

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

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

The test results are reported in the following form.

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

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

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

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

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

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are generally based on Australian Standard AS1726:2017, Geotechnical Site Investigations. 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	19 - 63
Medium gravel	6.7 - 19
Fine gravel	2.36 – 6.7
Coarse sand	0.6 - 2.36
Medium sand	0.21 - 0.6
Fine sand	0.075 - 0.21

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

The proportions of secondary constituents of soils are described as follows:

In fine grained soils (>35% fines)

Term	Proportion of sand or gravel	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	>30%	Sandy Clay
With	15 – 30%	Clay with sand
Trace	0 - 15%	Clay with trace sand

In coarse grained soils (>65% coarse)
- with clays or silts

Term	Proportion of fines	Example
And	Specify	Sand (70%) and Clay (30%)
Adjective	>12%	Clayey Sand
With	5 - 12%	Sand with clay
Trace	0 - 5%	Sand with trace clay

In coarse grained soils (>65% coarse)
- with coarser fraction

Term	Proportion of coarser fraction	Example
And	Specify	Sand (60%) and Gravel (40%)
Adjective	>30%	Gravelly Sand
With	15 - 30%	Sand with gravel
Trace	0 - 15%	Sand with trace gravel

The presence of cobbles and boulders shall be specifically noted by beginning the description with ‘Mix of Soil and Cobbles/Boulders’ with the word order indicating the dominant first and the proportion of cobbles and boulders described together.

Soil Descriptions

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
Friable	Fr	-

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	Density Index (%)
Very loose	VL	<15
Loose	L	15-35
Medium dense	MD	35-65
Dense	D	65-85
Very dense	VD	>85

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;
- Extremely weathered material – formed from in-situ weathering of geological formations. Has soil strength but retains the structure or fabric of the parent rock;
- Alluvial soil – deposited by streams and rivers;
- Estuarine soil – deposited in coastal estuaries;
- Marine soil – deposited in a marine environment;
- Lacustrine soil – deposited in freshwater lakes;
- Aeolian soil – carried and deposited by wind;
- Colluvial soil – soil and rock debris transported down slopes by gravity;
- Topsoil – mantle of surface soil, often with high levels of organic material.
- Fill – any material which has been moved by man.

Moisture Condition – Coarse Grained Soils

For coarse grained soils the moisture condition should be described by appearance and feel using the following terms:

- Dry (D) Non-cohesive and free-running.
- Moist (M) Soil feels cool, darkened in colour.
  Soil tends to stick together.
  Sand forms weak ball but breaks easily.
- Wet (W) Soil feels cool, darkened in colour.
  Soil tends to stick together, free water forms when handling.

Moisture Condition – Fine Grained Soils

For fine grained soils the assessment of moisture content is relative to their plastic limit or liquid limit, as follows:

- ‘Moist, dry of plastic limit’ or ‘w <PL’ (i.e. hard and friable or powdery).
- ‘Moist, near plastic limit’ or ‘w ≈ PL (i.e. soil can be moulded at moisture content approximately equal to the plastic limit).
- ‘Moist, wet of plastic limit’ or ‘w >PL’ (i.e. soils usually weakened and free water forms on the hands when handling).
- ‘Wet’ or ‘w ≈LL’ (i.e. near the liquid limit).
- ‘Wet’ or ‘w >LL’ (i.e. wet of the liquid limit).

Rock Strength

Rock strength is defined by the Unconfined Compressive Strength and it 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 Point Load Strength Index $Is_{(50)}$ is commonly used to provide an estimate of the rock strength and site specific correlations should be developed to allow UCS values to be determined. The point load strength test procedure is described by Australian Standard AS4133.4.1-2007. The terms used to describe rock strength are as follows:

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

* 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
Residual Soil	RS	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely weathered	XW	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible
Highly weathered	HW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Moderately weathered	MW	The whole of the rock material is discoloured , usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.
Slightly weathered	SW	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh	FR	No signs of decomposition or staining.
Note: If HW and MW cannot be differentiated use DW (see below)		
Distinctly weathered	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching or may be decreased due to deposition of weathered products in pores.

Rock Descriptions

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 occasional fragments
Fractured	Core lengths of 30-100 mm with occasional shorter and longer sections
Slightly Fractured	Core lengths of 300 mm or longer with occasional sections of 100-300 mm
Unbroken	Core contains very few fractures

Rock Quality Designation

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

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

where 'sound' rock is assessed to be rock of low strength or stronger. 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

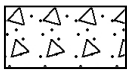
Symbols & Abbreviations

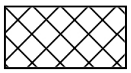
Graphic Symbols for Soil and Rock

General

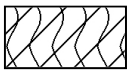

Asphalt

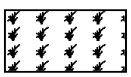

Road base

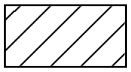

Concrete

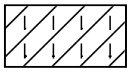

Filling

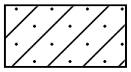
Soils


Topsoil

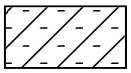

Peat

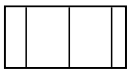

Clay

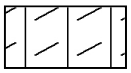

Silty clay

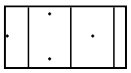

Sandy clay

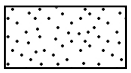

Gravelly clay

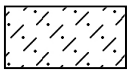

Shaly clay

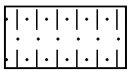

Silt


Clayey silt


Sandy silt

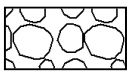

Sand

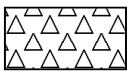

Clayey sand


Silty sand


Gravel

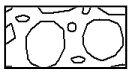

Sandy gravel


Cobbles, boulders

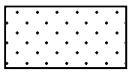

Talus

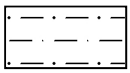
Sedimentary Rocks

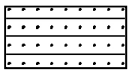

Boulder conglomerate

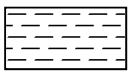

Conglomerate


Conglomeratic sandstone

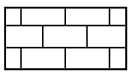

Sandstone


Siltstone

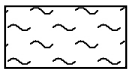

Laminite

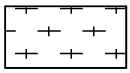

Mudstone, claystone, shale

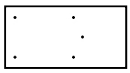

Coal


Limestone

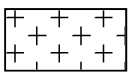
Metamorphic Rocks

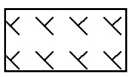

Slate, phyllite, schist

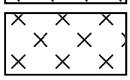

Gneiss

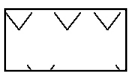

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

BOREHOLE LOG

CLIENT: Atlassian Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 15.5 AHD
EASTING: 333954
NORTHING: 6249289
DIP/AZIMUTH: 90°/--

BORE No: BH8
PROJECT No: 86767.00
DATE: 14/7/2019
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	0.28	CONCRETE SLAB: angular to subangular aggregate to 15mm, negligible voids, 10mm diameter steel reinforcement at 0.09m and 0.10m, plastic at lower interface							A/E			PID<1
	0.6	Fill/Clayey SAND: fine to coarse grained sand, brown and yellow, 15% plastic fines, with fine gravel, apparently moderately compacted, moist										
	1.9	SAND SW: fine to medium grained sand, yellow, with clay, trace gravel, moist, alluvial soil						Unless otherwise specified, defects are B 0°, pl, ro				
	2.12	SANDSTONE: medium grained, orange-red and grey, low to medium strength, with some very low strength bands, highly weathered, fractured, Mittagong Formation						1.9m: CORE LOSS: 220mm 2.12m: Ds 270mm 2.49m: B 4°, st, ro 2.6m: B 0°, st, ro 2.61m: B 0°, st, sm 2.83m: B 0°, st, ro 2.93m: Ds 140mm	C	82	20	PL(A) = 1.5
	3.07	SANDSTONE: medium grained, orange and red, medium strength with some very low strength bands, highly weathered, fractured, Mittagong Formation						3.07m: CORE LOSS: 480mm 3.8m: Ds 60mm 3.92m: Cs 20mm	C	66	33	PL(A) = 0.15
	4.13	SANDSTONE: medium grained, yellow-grey, medium then high strength, moderately weathered, slightly fractured, Hawkesbury Sandstone						4.29m: J 30°, pl, ro, open 4.37m: J 30°, pl, ro, open 4.79m: J 15°, pl, ro, clay 1mm 4.82m: B 10°, pl, ro, fe stn 4.84m: B 5°, un, ro	C	100	100	PL(A) = 0.66 PL(A) = 1.2 PL(A) = 1.3
	4.85	SANDSTONE: medium grained, grey, high strength, fresh, unbroken, Hawkesbury Sandstone						7.45m: B 0°, pl, sm 7.46m: B 0°, pl, sm 7.88m: B 0°, pl, sm 7.89m: B 0°, pl, sm	C	100	100	PL(A) = 1.9 PL(A) = 1.2
								9.1m: Ds 20mm				PL(A) = 1.4

RIG: XC **DRILLER:** Terratest **LOGGED:** NB **CASING:** HQ to 1.9m

TYPE OF BORING: Diacore 0-0.28m; Hand auger 0.28-1.0m; solid flight auger (TC Bit) 1.0-1.9m; NMLC coring 1.9-15.0m

WATER OBSERVATIONS: No groundwater observed during auger drilling

REMARKS: Groundwater well installed: 15.0-2.9m screened PVC with sand backfill, 2.9-2.4m blank PVC with sand backfill, 2.4-0m blank PVC, 2.4-0m bentonite backfill, gatic cover at surface.

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: Atlassian Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 15.5 AHD
EASTING: 333954
NORTHING: 6249289
DIP/AZIMUTH: 90°/--

BORE No: BH8
PROJECT No: 86767.00
DATE: 14/7/2019
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
		SANDSTONE: medium grained, grey, high strength, fresh, unbroken, Hawkesbury Sandstone *(continued)*							C	100	100	
		Between 10.2-10.9m: dark grey, fine grained sandstone										PL(A) = 2.5
	11							>>				
									C	100	100	
	12											PL(A) = 1.5
		Between 12.4-12.55m: carbonaceous laminations										
	13											PL(A) = 1.1
								13.48m: Ds 20mm				
								13.77m: B 20°, pl, sm, cbs				PL(A) = 1.3
	14								C	100	100	
								14.55m: B 0°, pl, sm, clay co 2mm				
	15 15.0	Bore discontinued at 15.0m										PL(A) = 1.3
	16											
	17											
	18											
	19											

RIG: XC **DRILLER:** Terratest **LOGGED:** NB **CASING:** HQ to 1.9m

TYPE OF BORING: Diacore 0-0.28m; Hand auger 0.28-1.0m; solid flight auger (TC Bit) 1.0-1.9m; NMLC coring 1.9-15.0m

WATER OBSERVATIONS: No groundwater observed during auger drilling

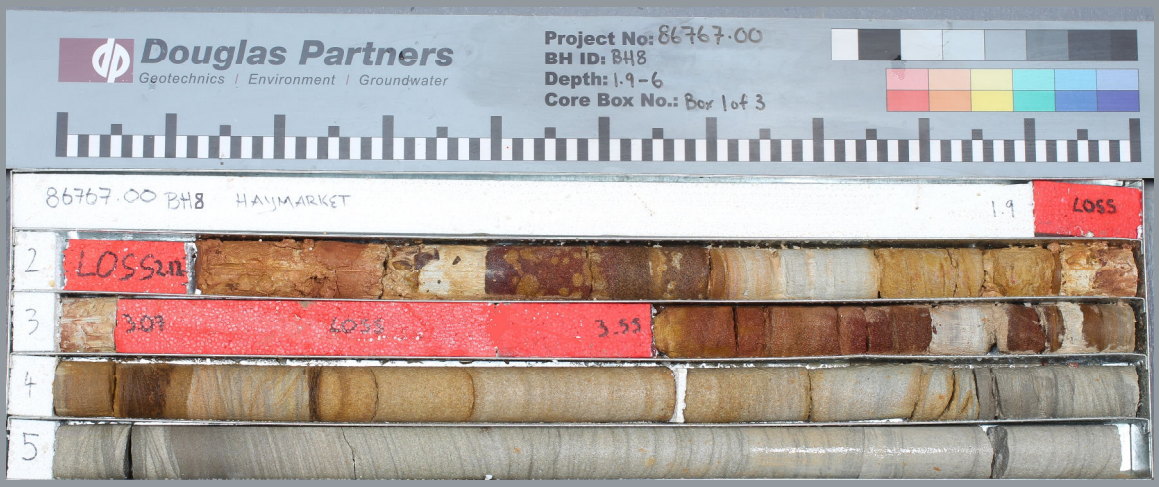
REMARKS: Groundwater well installed: 15.0-2.9m screened PVC with sand backfill, 2.9-2.4m blank PVC with sand backfill, 2.4-0m blank PVC, 2.4-0m bentonite backfill, gatic cover at surface.

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: BH8 PROJECT: HAYMARKET AUGUST 2019



1.9 – 6m

BORE: BH8 PROJECT: HAYMARKET AUGUST 2019

6m – 11m

BORE: BH8 PROJECT: HAYMARKET AUGUST 2019

11m – 15.19m

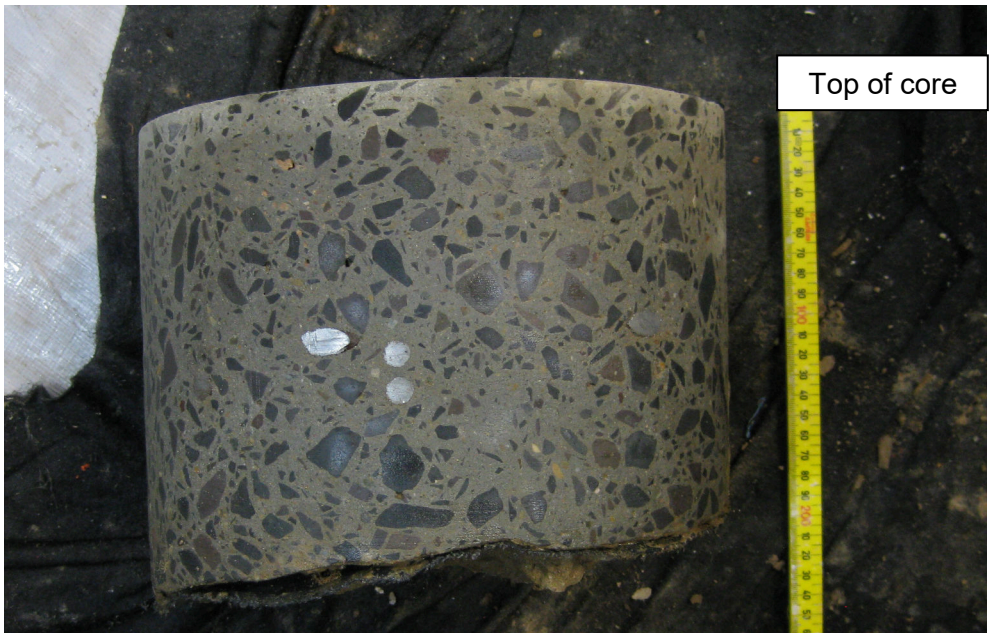


Photo D2 – View of concrete core from Borehole BH8. Two layers of reinforcement steel (10 mm diameter) were encountered at 0.09 m and 0.10 m depth, with a layer of plastic at the underside of the slab.

Douglas Partners Geotechnics / Environment / Groundwater	**Borehole Photographs** **Proposed Commercial Development** **8-10 Lee Street, Haymarket**	PROJECT: 86867.00 PLATE No: D2 REV: 0
	CLIENT: Atlassian Pty Ltd	DATE: 15/08/2019

BOREHOLE LOG

CLIENT: Atlassian Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 15.5 AHD
EASTING: 333954
NORTHING: 6249289
DIP/AZIMUTH: 90°/--

BORE No: BH8
PROJECT No: 86767.00
DATE: 14/7/2019
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.28	CONCRETE SLAB: angular to subangular aggregate to 15mm, negligible voids, 10mm diameter steel reinforcement at 0.09m and 0.10m, plastic at lower interface		A/E	0.2 0.3		PID<1		Gatic Cover and cap
	0.6	Fill/Clayey SAND: fine to coarse grained sand, brown and yellow, 15% plastic fines, with fine gravel, apparently moderately compacted, moist							
		SAND SW: fine to medium grained sand, yellow, with clay, trace gravel, moist, alluvial soil							Bentonite Seal and Blank PVC pipe
	1.9				1.9				
	2.12	SANDSTONE: medium grained, orange-red and grey, low to medium strength, with some very low strength bands, highly weathered, fractured, Mittagong Formation		C	2.47		PL(A) = 1.5		Sand filter
	3.07				3.07				
	3.55	SANDSTONE: medium grained, orange and red, medium strength with some very low strength bands, highly weathered, fractured, Mittagong Formation		C	3.66		PL(A) = 0.15		
	4.13	SANDSTONE: medium grained, yellow-grey, medium then high strength, moderately weathered, slightly fractured, Hawkesbury Sandstone			4.57 4.66		PL(A) = 0.66		
	4.85	SANDSTONE: medium grained, grey, high strength, fresh, unbroken, Hawkesbury Sandstone		C	5.95		PL(A) = 1.2		
					6.95		PL(A) = 1.3		
					7.2				
					7.89		PL(A) = 1.9		
				C					
					8.95		PL(A) = 1.2		Slotted PVC pipe
					9.95		PL(A) = 1.4		

RIG: XC **DRILLER:** Terratest **LOGGED:** NB **CASING:** HQ to 1.9m

TYPE OF BORING: Diacore 0-0.28m; Hand auger 0.28-1.0m; solid flight auger (TC Bit) 1.0-1.9m; NMLC coring 1.9-15.0m

WATER OBSERVATIONS: No groundwater observed during auger drilling

REMARKS: Groundwater well installed: 15.0-2.9m screened PVC with sand backfill, 2.9-2.4m blank PVC with sand backfill, 2.4-0m blank PVC, 2.4-0m bentonite backfill, gatic cover at surface.

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: Atlassian Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 15.5 AHD
EASTING: 333954
NORTHING: 6249289
DIP/AZIMUTH: 90°/--

BORE No: BH8
PROJECT No: 86767.00
DATE: 14/7/2019
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		SANDSTONE: medium grained, grey, high strength, fresh, unbroken, Hawkesbury Sandstone *(continued)*		C	10.22				
		Between 10.2-10.9m: dark grey, fine grained sandstone							
	11				10.95		PL(A) = 2.5		
				C					
	12				11.95		PL(A) = 1.5		
		Between 12.4-12.55m: carbonaceous laminations							
	13				12.95		PL(A) = 1.1		
					13.25				
	14			C	13.95		PL(A) = 1.3		
	15 15.0	Bore discontinued at 15.0m			14.99 15.0		PL(A) = 1.3		End Cap
	16								
	17								
	18								
	19								

RIG: XC **DRILLER:** Terratest **LOGGED:** NB **CASING:** HQ to 1.9m

TYPE OF BORING: Diacore 0-0.28m; Hand auger 0.28-1.0m; solid flight auger (TC Bit) 1.0-1.9m; NMLC coring 1.9-15.0m

WATER OBSERVATIONS: No groundwater observed during auger drilling

REMARKS: Groundwater well installed: 15.0-2.9m screened PVC with sand backfill, 2.9-2.4m blank PVC with sand backfill, 2.4-0m blank PVC, 2.4-0m bentonite backfill, gatic cover at surface.

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: Vertical First Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 15.5 AHD
EASTING: 333945
NORTHING: 6249270
DIP/AZIMUTH: 90°/--

BORE No: BH107A
PROJECT No: 86767.00
DATE: 17/5/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
15	0.14	CONCRETE: grey, angular to subangular aggregate to 15mm, negligible voids, 9 mm steel reinforcement at 0.08 m depth							Gatic Cover and cap
		FILL/ Sandy CLAY: low to medium plasticity, dark red and brown, fine to medium, with angular igneous and sandstone gravel, trace silt, w<PL, generally in a stiff condition							Backfill and Blank PVC pipe
14	1	Below 1.0m: grading to medium plasticity, dark grey, trace sandstone gravel, w~PL							
	1.6	FILL/ Silty CLAY: medium to high plasticity, pale grey-yellow, with fine to medium sand, w~PL, generally in a stiff condition						05-06-20	
13	2								Bentonite Seal
	2.2	Sandy CLAY CL: low to medium plasticity, pale yellow, fine to medium, w~PL, apparently stiff to very stiff, residual							
12	2.81	Below 2.6m: yellow-brown							Sand filter
	3	SANDSTONE: fine to medium grained, pale grey and red-brown, high strength with very low then low strength bands, highly weathered, fractured, Mittagong Formation							Slotted PVC pipe
11	3.9	Bore discontinued at 3.9m - Target depth reached							End Cap
10	4								
	5								
9	6								
8	7								
7	8								
6	9								

RIG: Miniprobe **DRILLER:** Terratest **LOGGED:** NB **CASING:** NA

TYPE OF BORING: SFA (TC-bit) to 3.9m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Standpipe installed: 0-3.4m Blank PVC pipe, 3.4-3.9m Slotted PVC pipe, End cap at 3.9m, Sand backfill 0-1.5m, Bentonite 1.5-3.2m, Sand filter 3.2-3.9m, Gatic cover at surface.

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: Vertical First Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 15.5 AHD
EASTING: 333945
NORTHING: 6249272
DIP/AZIMUTH: 90°/--

BORE No: BH107B
PROJECT No: 86767.00
DATE: 16/5/2020
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)	Type	Core Rec. %	RQD %	Test Results & Comments
15	0.14	CONCRETE: grey, angular to subangular aggregate to 15mm, negligible voids, 9 mm steel reinforcement at 0.08 m depth							A			PID=4
									A/E*			PID=5
14	1	FILL/ Sandy CLAY: low to medium plasticity, dark red and brown, fine to medium, with angular igneous and sandstone gravel, trace silt, w<PL, generally in a stiff condition							A/E			PID=2
	1.6	Below 1.0m: grading to medium plasticity, dark grey, trace sandstone gravel, w~PL							A/E			PID=2
13	2	FILL/ Silty CLAY: medium to high plasticity, pale grey-yellow, with fine to medium sand, w~PL, generally in a stiff condition				05-06-20			A/E			PID=2
	2.2	Sandy CLAY CL-CI: low to medium plasticity, pale yellow, fine to medium, w~PL, apparently stiff to very stiff, residual							A/E			PID=1
	2.81	Below 2.6m: yellow-brown							A/E			PID=2
12	3	SANDSTONE: fine to medium grained, pale grey and red-brown, high strength with very low then low strength bands, highly weathered, fractured, Mittagong Formation							C	100	10	PL(A) = 1.1
	3.92											PL(A) = 0.1
11	4	SANDSTONE: fine to medium grained, pale grey and red-brown, medium then high strength, moderately weathered, fractured, Hawkesbury Sandstone						3.81m: CORE LOSS: 110mm 3.92m: Ds 80mm 4m: Cs 30mm 4.44m: J40°, pl, ro, fe stn 4.6m: B5°, pl, ro, cly co 5mm 4.78m: B0°, pl, ro, cly co 5mm 4.83m: Ds 10mm 4.86m: B0°, ir, ro, cly co 5mm	C	93	75	PL(A) = 0.9
	4.03											
	4.94	SANDSTONE: fine to medium grained, pale grey, high strength, fresh, slightly fractured to unbroken, cross-bedding 5°-10°, Hawkesbury Sandstone										
10	5								C	100	100	PL(A) = 1.1
9	6											
	7								C	100	99	PL(A) = 1.3
8	8	Between 7.66m-8.10m: band of fine grained sandstone						7.66m: Cz 10mm				PL(A) = 1.6
7	9							>>	C	100	100	PL(A) = 1.1
6												

RIG: XC **DRILLER:** Terratest **LOGGED:** KR **CASING:** HWT to 2.8m

TYPE OF BORING: Diatube (200 mm) to 0.14m, SFA (TC-bit) to 2.81m, NMLC coring to 15.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *BD1/20200516 taken at 0.4-0.5m. Standpipe installed: 0-5.5m Blank PVC pipe, 5.5-11.0m Slotted PVC pipe, End cap at 11.0m, Sand backfill 0-2.3m, Bentonite 2.3-5.0m, Sand filter 5.0-11.0m, Bentonite 11.0-12.0m, Backfill 12.0-15.0m, Gatic cover at surface.

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: Vertical First Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 15.5 AHD
EASTING: 333945
NORTHING: 6249272
DIP/AZIMUTH: 90°/--

BORE No: BH107B
PROJECT No: 86767.00
DATE: 16/5/2020
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
-5	11	SANDSTONE: fine to medium grained, pale grey, high strength, fresh, slightly fractured to unbroken, cross-bedding 5°-10°, Hawkesbury Sandstone *(continued)*							C	100	100	PL(A) = 1.3 PL(A) = 1.1
-4	12							11.3m: B0°, pl, ro, cbs co				PL(A) = 1.1
-3	13	Between 12.60m-13.78m: band of fine grained sandstone							C	100	100	PL(A) = 1
-2	14							13.74m: B5°, pl, ro, cly co 5mm				PL(A) = 1.2
-1	15 15.0								C	100	100	
0		Bore discontinued at 15.0m - Target depth reached										
1	16											
-1	17											
-2	18											
-3	19											
-4												

RIG: XC **DRILLER:** Terratest **LOGGED:** KR **CASING:** HWT to 2.8m

TYPE OF BORING: Diatube (200 mm) to 0.14m, SFA (TC-bit) to 2.81m, NMLC coring to 15.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *BD1/20200516 taken at 0.4-0.5m. Standpipe installed: 0-5.5m Blank PVC pipe, 5.5-11.0m Slotted PVC pipe, End cap at 11.0m, Sand backfill 0-2.3m, Bentonite 2.3-5.0m, Sand filter 5.0-11.0m, Bentonite 11.0-12.0m, Backfill 12.0-15.0m, Gatic cover at surface.

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: 107B PROJECT: HAYMARKET MAY 2020

2.81 – 7.0 m

BORE: 107B PROJECT: HAYMARKET MAY 2020

7.0 – 12.0 m

BORE: 107B PROJECT: HAYMARKET MAY 2020

12.0 – 15.0 m

BOREHOLE LOG

CLIENT: Vertical First Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 15.5 AHD
EASTING: 333945
NORTHING: 6249272
DIP/AZIMUTH: 90°/--

BORE No: BH107B
PROJECT No: 86767.00
DATE: 16/5/2020
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
15	0.14	CONCRETE: grey, angular to subangular aggregate to 15mm, negligible voids, 9 mm steel reinforcement at 0.08 m depth		A	0.15 0.2		PID=4		Gatic Cover and cap
		FILL/ Sandy CLAY: low to medium plasticity, dark red and brown, fine to medium, with angular igneous and sandstone gravel, trace silt, w<PL, generally in a stiff condition		A/E*	0.4 0.5		PID=5		
1		Below 1.0m: grading to medium plasticity, dark grey, trace sandstone gravel, w~PL		A/E	0.9 1.0		PID=2		Backfill and Blank PVC pipe
14	1.6			A/E	1.4 1.5		PID=2		
		FILL/ Silty CLAY: medium to high plasticity, pale grey-yellow, with fine to medium sand, w~PL, generally in a stiff condition		A/E	1.9 2.0		PID=2	05-06-20	
2	2.2			A/E	2.4 2.5		PID=1		
13		Sandy CLAY CL-CI: low to medium plasticity, pale yellow, fine to medium, w~PL, apparently stiff to very stiff, residual		A/E	2.65 2.8		PID=2		
		Below 2.6m: yellow-brown							
	2.81	SANDSTONE: fine to medium grained, pale grey and red-brown, high strength with very low then low strength bands, highly weathered, fractured, Mittagong Formation		C	2.81 2.94		PL(A) = 1.1		
12					3.57 3.62		PL(A) = 0.1		Bentonite Seal
	3.92 4.03	SANDSTONE: fine to medium grained, pale grey and red-brown, medium then high strength, moderately weathered, fractured, Hawkesbury Sandstone		C	4.25		PL(A) = 0.9		
11	4.94	SANDSTONE: fine to medium grained, pale grey, high strength, fresh, slightly fractured to unbroken, cross-bedding 5°-10°, Hawkesbury Sandstone		C	5.0 5.12		PL(A) = 1.5		Sand filter
10				C	6.0		PL(A) = 1.1		
					6.59				
9				C	7.0		PL(A) = 1.3		
		Between 7.66m-8.10m: band of fine grained sandstone							
8					8.0 8.12		PL(A) = 1.6		Slotted PVC pipe
7				C	9.0		PL(A) = 1.1		
6					10.0		PL(A) = 1.3		

RIG: XC **DRILLER:** Terratest **LOGGED:** KR **CASING:** HWT to 2.8m

TYPE OF BORING: Diatube (200 mm) to 0.14m, SFA (TC-bit) to 2.81m, NMLC coring to 15.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *BD1/20200516 taken at 0.4-0.5m. Standpipe installed: 0-5.5m Blank PVC pipe, 5.5-11.0m Slotted PVC pipe, End cap at 11.0m, Sand backfill 0-2.3m, Bentonite 2.3-5.0m, Sand filter 5.0-11.0m, Bentonite 11.0-12.0m, Backfill 12.0-15.0m, Gatic cover at surface.

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: Vertical First Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 15.5 AHD
EASTING: 333945
NORTHING: 6249272
DIP/AZIMUTH: 90°/--

BORE No: BH107B
PROJECT No: 86767.00
DATE: 16/5/2020
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
5		SANDSTONE: fine to medium grained, pale grey, high strength, fresh, slightly fractured to unbroken, cross-bedding 5°-10°, Hawkesbury Sandstone *(continued)*		C					
	11				11.02 11.07		PL(A) = 1.1		11 End Cap Bentonite Seal
4	12				12.0		PL(A) = 1.1		12
3		Between 12.60m-13.78m: band of fine grained sandstone		C					
	13				13.03		PL(A) = 1		13 Sand Back Fill
2	14				14.0 14.08		PL(A) = 1.2		14
1				C					
	15 15.0	Bore discontinued at 15.0m - Target depth reached			15.0				15
0	16								16
-1	17								17
-2	18								18
-3	19								19
-4									

RIG: XC **DRILLER:** Terratest **LOGGED:** KR **CASING:** HWT to 2.8m

TYPE OF BORING: Diatube (200 mm) to 0.14m, SFA (TC-bit) to 2.81m, NMLC coring to 15.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *BD1/20200516 taken at 0.4-0.5m. Standpipe installed: 0-5.5m Blank PVC pipe, 5.5-11.0m Slotted PVC pipe, End cap at 11.0m, Sand backfill 0-2.3m, Bentonite 2.3-5.0m, Sand filter 5.0-11.0m, Bentonite 11.0-12.0m, Backfill 12.0-15.0m, Gatic cover at surface.

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: Vertical First Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 15.3 AHD
EASTING: 333970
NORTHING: 6249311
DIP/AZIMUTH: 90°/--

BORE No: BH109B
PROJECT No: 86767.00
DATE: 17/5/2020
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
15	0.2	CONCRETE: grey, angular to subangular aggregate to 15mm, negligible voids, no reinforcement steel observed							A/E			PID<1
	0.3	FILL/ GRAVEL: coarse, black, angular igneous gravel bonded by bitumen, dry, generally in a dense condition							A/E			PID<1
14	1.05	Silty CLAY CI: medium plasticity, pale orange, w<PL, apparently stiff to very stiff, residual (possibly extremely weathered Mittagong Formation)						1.05m: Ds 50mm 1.17m: B0°, un, ro, fe co 1.23m-1.25m: B0° (x3), pl, ro, fe stn 1.29m & 1.37m: B0°, pl, ro, fe stn 1.54m: Ds 10mm 1.55m: J80°, pl, ro, op 1.73m & 1.81m: B0°, pl, ro, fe co 1.92m: Cs 5mm 2.02m & 2.25m: J60°, pl, he 2.3m: Cs 10mm 2.4m-2.45m: B0° (x3), un, ro, fe co 2.56m: Ds 20mm 2.61m: B2°, un, ro, fe co 2.64m: B0°, un, ro, fe co 2.72m: Ds 10mm 2.79m: Ds 5mm 2.84m: Ds 2mm 2.9m: B2°, pl, ro, fe co 3.1m: Cs 2mm 3.16m: B0°, pl, ro, fe co 3.96m: Ds 20mm 4.02m: J45°, pl, ro, fe co 4.2m: Ds 20mm	C	100	20	PL(A) = 1.8
13	2	SANDSTONE: fine to medium grained, pale grey and dark orange, highly weathered, medium strength, fractured, Hawkesbury Sandstone				09-06-20			C	100	40	PL(A) = 0.7
12	2.93	SANDSTONE: fine to coarse grained, pale grey and pale yellow, moderately weathered then slightly weathered, medium strength, slightly fractured, cross-bedding 5°-10°, Hawkesbury Sandstone							C	100	90	PL(A) = 0.5 PL(A) = 0.7
11	4.9	SANDSTONE: fine to coarse grained, pale grey, fresh, medium then high strength, slightly fractured then unbroken, cross-bedding 5°-10°, Hawkesbury Sandstone						>>	C	100	100	PL(A) = 0.9 PL(A) = 1
10	6								C	100	100	PL(A) = 0.7
9	7								C	100	100	PL(A) = 1.2
8	8							7.86m - 7.89m: Cs 2mm (x2)	C	100	100	PL(A) = 1.8
7	9								C	100	100	PL(A) = 1.9
6									C	100	100	

RIG: XC **DRILLER:** Terratest **LOGGED:** NB **CASING:** HWT to 1.05m

TYPE OF BORING: Diatube (200mm) to 0.2m, SFA (TC-bit) to 1.05m, NMLC coring to 15m

WATER OBSERVATIONS: No free groundwater observed whilst drilling

REMARKS: Standpipe installed: 0-6.0m Blank PVC pipe, 6.0-11.6m Slotted PVC pipe, End cap at 11.6m, Sand backfill 0-1.05m, Bentonite 1.05-5.2m, Sand filter 5.2-11.6m, Bentonite 11.6-13.0m, Backfill 13.0-15.0m, Gatic cover at surface. Surface level taken from survey

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: Vertical First Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 15.3 AHD
EASTING: 333970
NORTHING: 6249311
DIP/AZIMUTH: 90°/--

BORE No: BH109B
PROJECT No: 86767.00
DATE: 17/5/2020
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
		SANDSTONE: fine to coarse grained, pale grey, fresh, medium then high strength, slightly fractured then unbroken, cross-bedding 5°-10°, Hawkesbury Sandstone *(continued)*										PL(A) = 1.4
5									C	100	100	
4	11							>>				PL(A) = 1.8
									C	100	100	
	12											PL(A) = 1.2
3												
	13								C	100	100	PL(A) = 1.4
2												
	14											PL(A) = 1.3
1									C	100	100	
	15	15.0						14.6m: Ds 10mm 14.62m: J45°, st, he				
0		Bore discontinued at 15.0m - Target depth reached										
	16											
-1												
	17											
-2												
	18											
-3												
	19											
-4												

RIG: XC **DRILLER:** Terratest **LOGGED:** NB **CASING:** HWT to 1.05m

TYPE OF BORING: Diatube (200mm) to 0.2m, SFA (TC-bit) to 1.05m, NMLC coring to 15m

WATER OBSERVATIONS: No free groundwater observed whilst drilling

REMARKS: Standpipe installed: 0-6.0m Blank PVC pipe, 6.0-11.6m Slotted PVC pipe, End cap at 11.6m, Sand backfill 0-1.05m, Bentonite 1.05-5.2m, Sand filter 5.2-11.6m, Bentonite 11.6-13.0m, Backfill 13.0-15.0m, Gatic cover at surface. Surface level taken from survey

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: 109B PROJECT: HAYMARKET MAY 2020

1.05 – 5.0 m

BORE: 109B PROJECT: HAYMARKET MAY 2020

5.0 – 10.0 m

BORE: 109B PROJECT: HAYMARKET MAY 2020

10.0 – 15.0 m

BOREHOLE LOG

CLIENT: Vertical First Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 15.3 AHD
EASTING: 333970
NORTHING: 6249311
DIP/AZIMUTH: 90°/--

BORE No: BH109B
PROJECT No: 86767.00
DATE: 17/5/2020
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
15	0.2	CONCRETE: grey, angular to subangular aggregate to 15mm, negligible voids, no reinforcement steel observed							Gatic Cover and cap
	0.3	FILL/ GRAVEL: coarse, black, angular igneous gravel bonded by bitumen, dry, generally in a dense condition		A/E	0.4 0.5		PID<1		Backfill and Blank PVC pipe
		Silty CLAY CI: medium plasticity, pale orange, w<PL, apparently stiff to very stiff, residual (possibly extremely weathered Mittagong Formation)		A/E	0.9 1.05		PID<1		
14	1.05	SANDSTONE: fine to medium grained, pale grey and dark orange, highly weathered, medium strength, fractured, Hawkesbury Sandstone		C	1.16 1.65		PL(A) = 1.8		
13	2			C	2.11		PL(A) = 0.7	09-06-20	
12	2.93	SANDSTONE: fine to coarse grained, pale grey and pale yellow, moderately weathered then slightly weathered, medium strength, slightly fractured, cross-bedding 5°-10°, Hawkesbury Sandstone		C	3.1 3.11		PL(A) = 0.5		Bentonite Seal
11	4			C	3.92		PL(A) = 0.7		
10	4.9	SANDSTONE: fine to coarse grained, pale grey, fresh, medium then high strength, slightly fractured then unbroken, cross-bedding 5°-10°, Hawkesbury Sandstone		C	4.65 4.93 5.04		PL(A) = 0.9 PL(A) = 1		Sand filter
9	6			C	6.0		PL(A) = 0.7		
8	7			C	7.0		PL(A) = 1.2		
				C	7.4 7.75				
7	8			C	8.0		PL(A) = 1.8		Slotted PVC pipe
6	9			C	9.0 9.25		PL(A) = 1.9		
	10.0						PL(A) = 1.4		

RIG: XC **DRILLER:** Terratest **LOGGED:** NB **CASING:** HWT to 1.05m

TYPE OF BORING: Diatube (200mm) to 0.2m, SFA (TC-bit) to 1.05m, NMLC coring to 15m

WATER OBSERVATIONS: No free groundwater observed whilst drilling

REMARKS: Standpipe installed: 0-6.0m Blank PVC pipe, 6.0-11.6m Slotted PVC pipe, End cap at 11.6m, Sand backfill 0-1.05m, Bentonite 1.05-5.2m, Sand filter 5.2-11.6m, Bentonite 11.6-13.0m, Backfill 13.0-15.0m, Gatic cover at surface. Surface level taken from survey

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: Vertical First Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 15.3 AHD
EASTING: 333970
NORTHING: 6249311
DIP/AZIMUTH: 90°/--

BORE No: BH109B
PROJECT No: 86767.00
DATE: 17/5/2020
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		SANDSTONE: fine to coarse grained, pale grey, fresh, medium then high strength, slightly fractured then unbroken, cross-bedding 5°-10°, Hawkesbury Sandstone *(continued)*		C	10.73				
11				C	11.0		PL(A) = 1.8		End Cap
12					12.0		PL(A) = 1.2		Bentonite Seal
					12.38				
13				C	13.0		PL(A) = 1.4		
					13.88				
14				C	14.0		PL(A) = 1.3		Sand Back Fill
15	15.0	Bore discontinued at 15.0m - Target depth reached			15.0				
16									
17									
18									
19									

RIG: XC **DRILLER:** Terratest **LOGGED:** NB **CASING:** HWT to 1.05m

TYPE OF BORING: Diatube (200mm) to 0.2m, SFA (TC-bit) to 1.05m, NMLC coring to 15m

WATER OBSERVATIONS: No free groundwater observed whilst drilling

REMARKS: Standpipe installed: 0-6.0m Blank PVC pipe, 6.0-11.6m Slotted PVC pipe, End cap at 11.6m, Sand backfill 0-1.05m, Bentonite 1.05-5.2m, Sand filter 5.2-11.6m, Bentonite 11.6-13.0m, Backfill 13.0-15.0m, Gatic cover at surface. Surface level taken from survey

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: Vertical First Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 15.3 AHD
EASTING: 333960
NORTHING: 6249314
DIP/AZIMUTH: 90°/--

BORE No: BH110
PROJECT No: 86767.00
DATE: 20/5/2020
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
15	0.2	CONCRETE: grey, angular to subangular aggregate to 15mm, negligible voids, no reinforcement			0.2				
	0.3	FILL/ SAND: fine to coarse, pale orange, moist, generally in a medium dense condition		A	0.3		PID<1		
	0.6	FILL/ Silty CLAY: medium to high plasticity, pale grey mottled orange, with fine to coarse sand and brick, concrete and asphalt fragments, w<PL, generally in a stiff condition		A	0.5		PID<1		
		Bore discontinued at 0.6m - Termination on brick and concrete fragments			0.6				
14	1								1
13	2								2
12	3								3
11	4								4

RIG: Hand tools **DRILLER:** Nick Ruha/NB **LOGGED:** NB **CASING:** NA

TYPE OF BORING: Diatube (100mm) to 0.2m, then hand auger

WATER OBSERVATIONS: No free groundwater observed whilst drilling

REMARKS: Surface level taken from survey drawing provided

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: Vertical First Pty Ltd
PROJECT: Link Tunnel
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 16.4 AHD
EASTING: 333944.3
NORTHING: 6249251.2
DIP/AZIMUTH: 90°/--

BORE No: BH201
PROJECT No: 86767.07
DATE: 29/10 - 5/11/2020
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (XW 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
16	0.02	TILE: 20mm thick, stone										
	0.25	CONCRETE SLAB: sub-angular fine sandstone and igneous aggregate within coarse sand matrix (0.02-0.10m), sub-angular fine igneous aggregate, trace voids (0.10-0.25m)							A			
15	1	FILL/Gravelly SAND: fine to medium sand, brown and dark grey, sub-angular to sub-rounded fine to coarse sandstone gravel, with thin clay bands (0.15-0.2m thick), trace sandstone cobbles and silt, moist, generally in a loose to medium dense condition										
14	2								S			2,2,1 N = 3
	2.3	SAND SP: fine to medium, pale gey, moist, very loose to loose, alluvial										
13	3	Below 3.4m: grading to medium dense										
	4	Below 4.0m: grading to wet and dense										
12		Between 4.4-4.7m: grading to very dense, possibly cemented layer				05-11-20						
	4.7	Silty CLAY CH: high plasticity, grey, w>PL, firm to stiff, residual							S			pp = 90-105 5,6,6 N = 12
11	5											
10	6											
	7	Below 6.8m: pale grey, with fine sand, inferred stiff to very stiff										
9	7.17	SANDSTONE: medium to coarse grained, brown, high strength, moderately weathered, unbroken, Hawkesbury Sandstone							C	100	100	PL(A) = 1.6
	7.97	SANDSTONE: medium to coarse grained, pale grey, 10%-30% fine grained laminations, high strength, fresh, slightly fractured to unbroken, Hawkesbury Sandstone							C	100	100	PL(A) = 1.2
8	8											
	9											
7									C	100	97	PL(A) = 1
	9.86							9.71m: Cs, 20mm 9.75m: B5°, cly co 2mm, pl, ro				

RIG: Diatube, XC **DRILLER:** TJ Core Cutting, Terrates **LOGGED:** KR **CASING:** HQ to 5.4m

TYPE OF BORING: Diatube (300mm) to 0.25m, hand-auger to 1.37m, SFA (TC-bit) to 7.17m, NMLC to 13.84m

WATER OBSERVATIONS: Groundwater observed at 4.5m

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Vertical First Pty Ltd
PROJECT: Link Tunnel
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 16.4 AHD
EASTING: 333944.3
NORTHING: 6249251.2
DIP/AZIMUTH: 90°/--

BORE No: BH201
PROJECT No: 86767.07
DATE: 29/10 - 5/11/2020
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (XW 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
		SANDSTONE: fine to medium grained, pale grey, 40%-50% fine grained lamination, high strength, fresh, slightly fractured to unbroken, Hawkesbury Sandstone *(continued)*							C	100	97	PL(A) = 1.1
	11							10.92m: B0°, pl, ro, fg 10mm				
									C	100	99	PL(A) = 1.6
	12											
												PL(A) = 1.1
	13								C	100	97	
								13.25m: Cs, 40mm				PL(A) = 1
		13.51-13.54m: low strength seam										
	13.84	Bore discontinued at 13.84m - Target depth reached										
	14											
	15											
	16											
	17											
	18											
	19											

RIG: Diatube, XC **DRILLER:** TJ Core Cutting, Terrates **LOGGED:** KR **CASING:** HQ to 5.4m

TYPE OF BORING: Diatube (300mm) to 0.25m, hand-auger to 1.37m, SFA (TC-bit) to 7.17m, NMLC to 13.84m

WATER OBSERVATIONS: Groundwater observed at 4.5m

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: BH201 PROJECT: HAYMARKET NOVEMBER 2020

7.17 – 11.00m

BORE: BH201 PROJECT: HAYMARKET NOVEMBER 2020

11.00m – 13.84m

BOREHOLE LOG

CLIENT: Vertical First Pty Ltd
PROJECT: Link Tunnel
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 16.3 AHD
EASTING: 333940.8
NORTHING: 6249253.1
DIP/AZIMUTH: 90°/--

BORE No: BH202
PROJECT No: 86767.07
DATE: 29/10 - 6/11/2020
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (XW 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
16	0.02	TILE: 20mm thick, stone										
	0.26	CONCRETE SLAB: sub-angular fine sandstone and igneous aggregate within a coarse sand matrix (0.02-0.11m), sub-angular, fine igneous aggregate, trace voids (0.11-0.26m)							A/E			
	0.7	FILL/Silty CLAY: medium plasticity, brown, with sub-angular to sub-rounded igneous and sandstone gravel, trace brick fragments, w~PL, generally in a stiff condition							A/E			
15	1											
	1.3	FILL/SAND: fine to medium, brown, with clay, moist, generally in a medium dense condition							A/E			
14	2	SAND SP: fine to medium, pale grey, moist, apparently loose, alluvial										
		Below 2.7m: grading to medium dense to dense										
13	3	Below 3.3m: grading to dense				09-11-20						
		Below 3.7m: grading to pale yellow-brown, moist to wet										
12	4											
	4.5	Silty CLAY CH: high plasticity, grey, w>PL, apparently stiff to very stiff, alluvial				06-11-20						
	4.8	SAND SP: fine to medium, orange, wet, apparently medium dense, alluvial										
11	5											
10	6											
	6.7	Silty CLAY CH: high plasticity, pale grey, trace fine sand, w>PL, apparently stiff to very stiff, residual										
9	7											
	7.24	SANDSTONE: medium to coarse grained, brown, medium strength, moderately weathered, unbroken, Hawkesbury Sandstone							C	100	100	PL(A) = 1.7
	8											PL(A) = 1.4
	8.12	SANDSTONE: medium to coarse grained, pale grey, 10%-30% fine grained laminations, medium to high strength, fresh, slightly fractured to unbroken, Hawkesbury Sandstone						8.19m: B0°, cly vn, ir, ro	C	100	100	PL(A) = 1.2
8	9											
	9.32	9.31-9.33m: low strength seam						9.31m: B0°, cly co 5mm, pl, ro				PL(A) = 1.1
7		SANDSTONE: refer following page						9.61m: B0°, cly co 1mm, pl, ro	C	100	97	PL(A) = 1.1
	10.0							9.63m: B0°, cly co 1mm,				

RIG: Diatube, Vacuum truck, XC **DRILLER:** TJ Cutting, Excavac, Terratec **LOGGED:** KR **CASING:** HWT to 7.2m

TYPE OF BORING: Diatube 0-0.04m (300mm diam.) and 0.04-0.26m (200mm diam.), NDD to 3.0m, SFA (TC-bit) to 7.24m, NMLC to 13.77m

WATER OBSERVATIONS: Groundwater observed at 4.5m

REMARKS: Standpipe details: backfill 13.77-8.24m, bentonite 8.24-7.34m, fine sand 7.34-3.74m, bentonite 3.74-2.88m, backfill 2.88-0.2m, gatic cover 0.2-0.0m, Screen 7.24-4.24m, blank 4.24-0.1m

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: Vertical First Pty Ltd
PROJECT: Link Tunnel
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 16.3 AHD
EASTING: 333940.8
NORTHING: 6249253.1
DIP/AZIMUTH: 90°/--

BORE No: BH202
PROJECT No: 86767.07
DATE: 29/10 - 6/11/2020
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (XW 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
		SANDSTONE: medium grained, pale grey, 40%-50% fine grained laminations, medium to high strength, fresh, slightly fractured to unbroken, Hawkesbury Sandstone						pl, ro 9.92m: Cs, 20mm	C	100	97	PL(A) = 1.2
	11							10.78m: B0°, cly co 5mm, pl, ro	C	100	100	PL(A) = 1
	12											
	13							13.28m: Ds, 20mm	C	100	97	PL(A) = 1 PL(A) = 1
		13.52-13.55m: low strength seam						13.5m: B5°, cly co 3mm, pl, ro				
	13.77	Bore discontinued at 13.77m - Target depth reached						13.52m: B5°, cly co 3mm, pl, ro				
	14											
	15											
	16											
	17											
	18											
	19											

RIG: Diatube, Vacuum truck, XC **DRILLER:** TJ Cutting, Excavac, Terratec **LOGGED:** KR **CASING:** HWT to 7.2m

TYPE OF BORING: Diatube 0-0.04m (300mm diam.) and 0.04-0.26m (200mm diam.), NDD to 3.0m, SFA (TC-bit) to 7.24m, NMLC to 13.77m

WATER OBSERVATIONS: Groundwater observed at 4.5m

REMARKS: Standpipe details: backfill 13.77-8.24m, bentonite 8.24-7.34m, fine sand 7.34-3.74m, bentonite 3.74-2.88m, backfill 2.88-0.2m, gatic cover 0.2-0.0m, Screen 7.24-4.24m, blank 4.24-0.1m

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: BH202 PROJECT: HAYMARKET NOVEMBER 2020

7.24 – 11.00m

BORE: BH201 PROJECT: HAYMARKET NOVEMBER 2020

11.00m – 13.77m

BOREHOLE LOG

CLIENT: Vertical First Pty Ltd
PROJECT: Link Tunnel
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 16.3 AHD
EASTING: 333940.8
NORTHING: 6249253.1
DIP/AZIMUTH: 90°/--

BORE No: BH202
PROJECT No: 86767.07
DATE: 29/10 - 6/11/2020
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
16	0.02	TILE: 20mm thick, stone							Gatic Cover and cap
	0.26	CONCRETE SLAB: sub-angular fine sandstone and igneous aggregate within a coarse sand matrix (0.02-0.11m), sub-angular, fine igneous aggregate, trace voids (0.11-0.26m)		A/E	0.25 0.35				
	0.7	FILL/Silty CLAY: medium plasticity, brown, with sub-angular to sub-rounded igneous and sandstone gravel, trace brick fragments, w~PL, generally in a stiff condition		A/E	0.9 1.0				
15	1.3	FILL/SAND: fine to medium, brown, with clay, moist, generally in a medium dense condition		A/E	1.4 1.5				Backfill and Blank PVC pipe
14		SAND SP: fine to medium, pale grey, moist, apparently loose, alluvial							
		Below 2.7m: grading to medium dense to dense							
13		Below 3.3m: grading to dense						09-11-20	Bentonite Seal
		Below 3.7m: grading to pale yellow-brown, moist to wet							
12	4.5	Silty CLAY CH: high plasticity, grey, w>PL, apparently stiff to very stiff, alluvial						06-11-20	
	4.8	SAND SP: fine to medium, orange, wet, apparently medium dense, alluvial							Sand filter Slotted PVC pipe
11									
10	6.7	Silty CLAY CH: high plasticity, pale grey, trace fine sand, w>PL, apparently stiff to very stiff, residual							
9	7.24	SANDSTONE: medium to coarse grained, brown, medium strength, moderately weathered, unbroken, Hawkesbury Sandstone		C	7.24 7.63 7.69 8.0		PL(A) = 1.7 PL(A) = 1.4		End Cap Bentonite Seal
8	8.12	SANDSTONE: medium to coarse grained, pale grey, 10%-30% fine grained laminations, medium to high strength, fresh, slightly fractured to unbroken, Hawkesbury Sandstone		C	8.34		PL(A) = 1.2		
7	9.32	9.31-9.33m: low strength seam		C	9.19 9.21 9.46		PL(A) = 1.1 PL(A) = 1.1		
	10.0	SANDSTONE: refer following page							

RIG: Diatube, Vacuum truck, XC **DRILLER:** TJ Cutting, Excavac, Terratec **LOGGED:** KR **CASING:** HWT to 7.2m

TYPE OF BORING: Diatube 0-0.04m (300mm diam.) and 0.04-0.26m (200mm diam.), NDD to 3.0m, SFA (TC-bit) to 7.24m, NMLC to 13.77m

WATER OBSERVATIONS: Groundwater observed at 4.5m

REMARKS: Standpipe details: backfill 13.77-8.24m, bentonite 8.24-7.34m, fine sand 7.34-3.74m, bentonite 3.74-2.88m, backfill 2.88-0.2m, gatic cover 0.2-0.0m, Screen 7.24-4.24m, blank 4.24-0.1m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: Vertical First Pty Ltd
PROJECT: Link Tunnel
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 16.3 AHD
EASTING: 333940.8
NORTHING: 6249253.1
DIP/AZIMUTH: 90°/--

BORE No: BH202
PROJECT No: 86767.07
DATE: 29/10 - 6/11/2020
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
5.3	11	SANDSTONE: medium grained, pale grey, 40%-50% fine grained laminations, medium to high strength, fresh, slightly fractured to unbroken, Hawkesbury Sandstone		C	10.34		PL(A) = 1.2		11 Sand Backfill
					10.61				
4.3	12			C	11.2		PL(A) = 1		12
					12.22				
3.3	13			C	12.4		PL(A) = 1		13
		13.52-13.55m: low strength seam			13.33		PL(A) = 1		
2.53	13.77	Bore discontinued at 13.77m - Target depth reached			13.77				
2.3	14								14
1.3	15								15
0.3	16								16
-0.7	17								17
-1.7	18								18
-2.7	19								19

RIG: Diatube, Vacuum truck, XC **DRILLER:** TJ Cutting, Excavac, Terratec **LOGGED:** KR **CASING:** HWT to 7.2m

TYPE OF BORING: Diatube 0-0.04m (300mm diam.) and 0.04-0.26m (200mm diam.), NDD to 3.0m, SFA (TC-bit) to 7.24m, NMLC to 13.77m

WATER OBSERVATIONS: Groundwater observed at 4.5m

REMARKS: Standpipe details: backfill 13.77-8.24m, bentonite 8.24-7.34m, fine sand 7.34-3.74m, bentonite 3.74-2.88m, backfill 2.88-0.2m, gatic cover 0.2-0.0m, Screen 7.24-4.24m, blank 4.24-0.1m

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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Results of Dynamic Penetrometer Tests

Client Vertical First Pty Ltd
Project Link Tunnel
Location 8-10 Lee Street, Haymarket

Project No. 86767.07
Date 03-05/11/2020
Page No. 1 of 2

Test Locations	BH201	BH202							
RL of Test (AHD)	16.4	16.3							
Depth (m)	**Penetration Resistance** Blows/150 mm								
0.00 – 0.15	E	E							
0.15 – 0.30	E	E							
0.30 – 0.45	E	E							
0.45 – 0.60	E	E							
0.60 – 0.75	E	E							
0.75 – 0.90	E	E							
0.90 – 1.05	7	E							
1.05 – 1.20	5	E							
1.20 – 1.35	5	E							
1.35 – 1.50	4	E							
1.50 – 1.65	8	E							
1.65 – 1.80	7	E							
1.80 – 1.95	8	E							
1.95 – 2.10	3	E							
2.10 – 2.25	8	E							
2.25 – 2.40	7	E							
2.40 – 2.55	4	E							
2.55 – 2.70	4	E							
2.70 – 2.85	3	5/100							
2.85 – 3.00	3	13							
3.00 – 3.15	2	14							
3.15 – 3.30	3	16							
3.30 – 3.45	3	19							

Test Method AS 12829.6.3.2, Cone Penetrometer ☑
Remarks E = Excavated, HB = Bouncing, Ref = Refusal
5 / 100 indicates 5 blows for 100 mm penetration,

Tested By KR
Checked By HDS

BOREHOLE LOG

CLIENT: Vertical First Pty Ltd
PROJECT: Link Tunnel
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 16.3 AHD
EASTING: 333937
NORTHING: 6249257.8
DIP/AZIMUTH: 90°/--

BORE No: BH203
PROJECT No: 86767.07
DATE: 29/10 - 4/11/2020
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (XW 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
16	0.02	TILE: 20mm thick, stone										
	0.25	CONCRETE SLAB: sub-angular, fine sandstone and igneous aggregate within a coarse sand matrix (0.02-0.09m), sub-angular, fine igneous aggregate with 9mm diameter steel reinforcement at 0.22m depth (0.09-0.25m)										
	0.32											
15	1	FILL/Gravelly CLAY: low plasticity, grey-brown, sub-angular, fine igneous gravel, with fine sand and silt, w<PL, generally in a stiff condition										
	1.74								A/E			
14	2	CONCRETE: sub-rounded to sub-angular, medium sandstone aggregate, possible former footing										
	2.2	FILL/SAND: fine to medium, brown, with clay nodules, trace igneous gravel, moist, generally in a medium dense condition							A/E			
13	3	SAND SP: fine to medium, pale brown, moist, apparently loose, alluvial										
		Below 2.8m: pale grey							A/E			
12	4											
11	5					04-11-20						
	5.0	Silty CLAY CH: high plasticity, grey, w>PL, apparently firm to stiff, residual							A			
10	6	Below 5.8m: pale grey, with fine sand, apparently stiff to very stiff							A			
	6.4	SANDSTONE: fine to medium grained, pale grey and orange-brown, very low and low strength with medium strength bands and clay seams, highly weathered, fractured, Mittagong formation						6.42m: Cs, 100mm	C	100	73	PL(A) = 0.3
	7							6.98m: Cs, 50mm				PL(A) = 0.3
9								7.2m: Cs, 50mm				PL(A) = 0.07
	7.55	SANDSTONE: medium grained, pale grey and orange-brown, trace dark grey siltstone laminations, high then medium strength, highly weathered, slightly fractured, cross-bedded at 0-10°, Hawkesbury Sandstone						7.46m: Cs, 60mm 7.53m: B5°, cly co 3mm, cu, ro 7.55m: B0°, cln, pl, ro	C	100	47	PL(A) = 1.5
	8											PL(A) = 0.6
8	8.65	Below 8.12m: grading to slightly weathered										PL(A) = 0.8
	9	SANDSTONE: medium grained, pale grey, medium strength with very low strength bands, slightly weathered with highly weathered bands, slightly fractured, Hawkesbury Sandstone						8.88m: B0°, cly vn, pl, ro 8.9m: J75°, cln, pl, ro 9m: Ds, 90mm	C	100	75	PL(A) = 1.1
7	9.86							9.82m: Ds, 40mm				

RIG: Diatube, Vacuum truck, XC **DRILLER:** TJ Cutting, Excavac, Terratec **LOGGED:** KR **CASING:** HQ to 6.4m

TYPE OF BORING: Diatube 0-0.04m (300mm diam.) and 0.04-0.25m (200mm diam.), NDD to 4.0m, SFA (TC-bit) to 6.4m, NMLC to 13.43m

WATER OBSERVATIONS: Groundwater observed at 5.0m

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Vertical First Pty Ltd
PROJECT: Link Tunnel
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 16.3 AHD
EASTING: 333937
NORTHING: 6249257.8
DIP/AZIMUTH: 90°/--

BORE No: BH203
PROJECT No: 86767.07
DATE: 29/10 - 4/11/2020
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (XW 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
		SANDSTONE: medium grained, pale grey, medium to high strength, fresh, slightly fractured, Hawkesbury Sandstone *(continued)*							C	100	93	PL(A) = 1.4
								10.58m: Ds, 30mm	C	100	93	
	11							11.22m: B0°, cly vn, pl, ro				PL(A) = 1.3
								11.3m: B0°, cly co 5mm, pl, ro				
								11.58m: Cs, 50mm				
	12							11.75m: B0°, cly co 10mm, pl, ro	C	100	96	PL(A) = 1.2
	13											
	13.43	Bore discontinued at 13.43m - Target depth reached						13.24m: B0°, cly co 10mm, pl, ro	C	100	97	PL(A) = 1.5
	14											
	15											
	16											
	17											
	18											
	19											

RIG: Diatube, Vacuum truck, XC **DRILLER:** TJ Cutting, Excavac, Terratec **LOGGED:** KR **CASING:** HQ to 6.4m
TYPE OF BORING: Diatube 0-0.04m (300mm diam.) and 0.04-0.25m (200mm diam.), NDD to 4.0m, SFA (TC-bit) to 6.4m, NMLC to 13.43m
WATER OBSERVATIONS: Groundwater observed at 5.0m
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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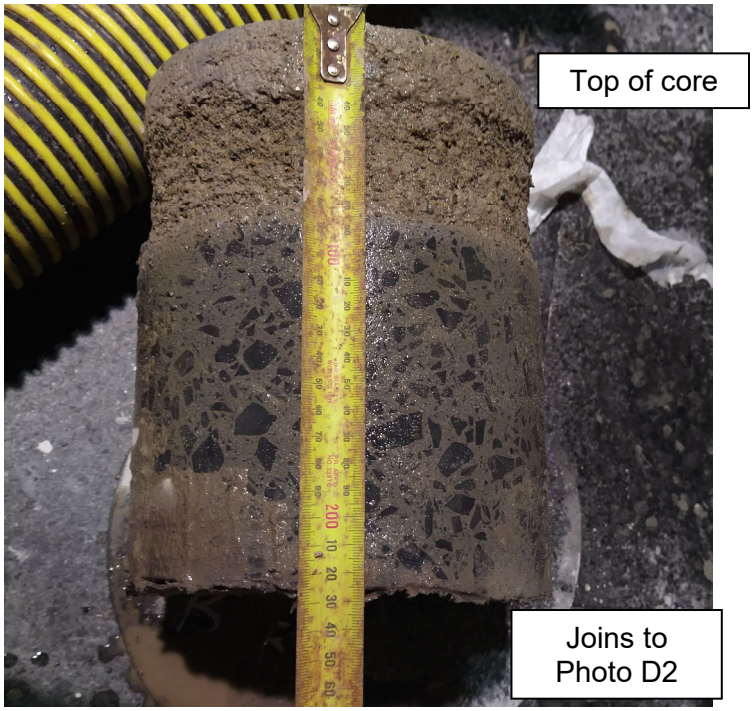


Photo D1 – View of top part of concrete core from Borehole BH203, showing a cemented coarse sand matrix between 0.02-0.09 m over a concrete slab. Reinforcement steel (9 mm diameter) was encountered in the lower part of the slab at 0.22 m depth.

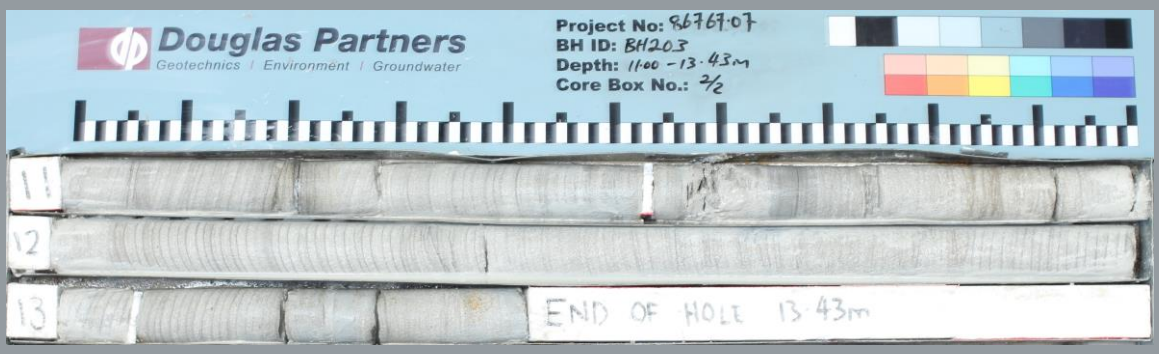
Photo D2 – View of lower part of concrete core from Borehole BH203, with sub-rounded sandstone aggregate.

Douglas Partners Geotechnics / Environment / Groundwater	**Borehole Photographs** **Link Tunnel** **Devonshire Street Pedestrian Tunnel, Haymarket**	PROJECT: 86867.07 PLATE No: D1 REV: 0
	CLIENT: Vertical First Pty Ltd	DATE: 17/11/2020

BORE: BH203 PROJECT: HAYMARKET NOVEMBER 2020

6.40 – 11.00m

BORE: BH203 PROJECT: HAYMARKET NOVEMBER 2020



11.00m – 13.43m

BOREHOLE LOG

CLIENT: Vertical First Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 15.4 AHD
EASTING: 333963
NORTHING: 6249315
DIP/AZIMUTH: 90°/--

BORE No: W2
PROJECT No: 86767.00
DATE: 20/5/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	ASPHALTIC CONCRETE			0.0				
	0.15	FILL/ ROADBASE: fine to coarse, dark grey, angular igneous gravel, fine to coarse sand, dry, generally in a dense condition		C					
15		CONCRETE: grey, with medium to coarse sub-rounded fragments of high strength sandstone, trace voids			0.35				
				C	0.55		PL(A) = 1.6		
					0.8				
1	1.03			C					1
	1.12	Silty CLAY CI: medium plasticity, pale grey mottled dark red, w<PL, apparently stiff to very stiff, residual (possibly extremely weathered Ashfield Shale)			1.15		PL(A) = 1.5		
14	1.33	SANDSTONE: fine grained, orange-brown and pale grey, iron-cemented and with thin clay bands, highly weathered, high strength, fractured, Mittagong formation			1.33				
		Bore discontinued at 1.33m - Target depth reached							
2									2
13									
3									3
12									
4									4
11									

RIG: Hand Drill **DRILLER:** Nick Ruha **LOGGED:** NB **CASING:** NA

TYPE OF BORING: Diatube (50mm) to 1.33m

WATER OBSERVATIONS: No free groundwater observed whilst drilling

REMARKS: Surface level taken from survey drawing provided

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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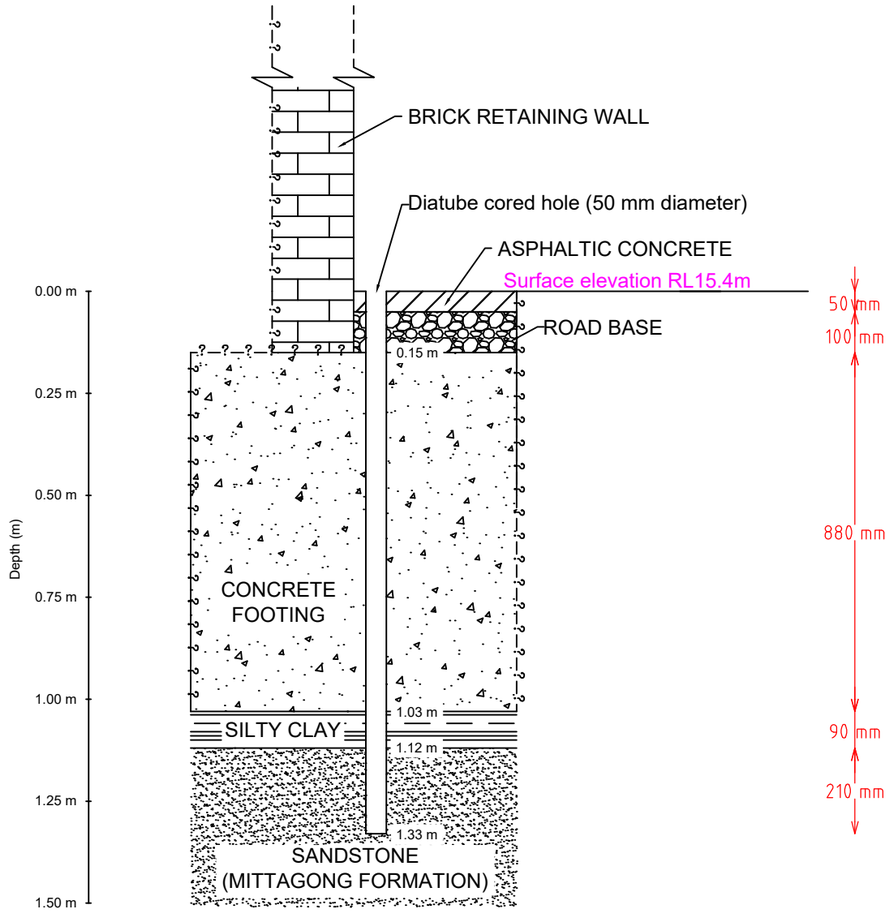
Photo W2 – View of core obtained from Borehole W2.

Douglas Partners Geotechnics / Environment / Groundwater	**Borehole Photographs** **Proposed Commercial Development** **8-10 Lee Street, Haymarket**	PROJECT: 86867.00 PLATE No: W2 REV: 0
	CLIENT: Vertical First Pty Ltd	DATE: 15/06/2020

SECTION W2-W2'



Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Vertical First Pty Ltd	TITLE: **W1 Cross Section** **Proposed Commercial Development** **8-10 Lee Street, Haymarket**	PROJECT No: 86767.00
	OFFICE: Sydney DRAWN BY: JDB		DRAWING No: W2
	SCALE: 1:15 @ A3 DATE: 15.6.2020		REVISION: 0

BOREHOLE LOG

CLIENT: Vertical First Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 13.4 AHD
EASTING: 333954
NORTHING: 6249290
DIP/AZIMUTH: 70°/135°

BORE No: W3
PROJECT No: 86767.00
DATE: 20/5/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
13	0.0	SANDSTONE: fine grained, orange-brown and pale grey, iron-cemented and with thin clay bands, highly weathered, medium to high strength, fragmented, Mittagong formation		C	0.0				
	0.46			C	0.46				
12	1.2	Bore discontinued at 1.2m - Target depth reached			1.2				
11									
10									
9									

RIG: Hand Drill **DRILLER:** Nick Ruha **LOGGED:** NB **CASING:** NA

TYPE OF BORING: Diatube (50mm) to 1.2m

WATER OBSERVATIONS: No free groundwater observed whilst drilling

REMARKS: Surface level taken from architectural drawing provided, Synman Justin Bialek Architects Pty Ltd, Lower Ground Floor plan, Drawing WD05 (Rev E) dated 21 May 1998. Borehole azimuth relative to Grid North

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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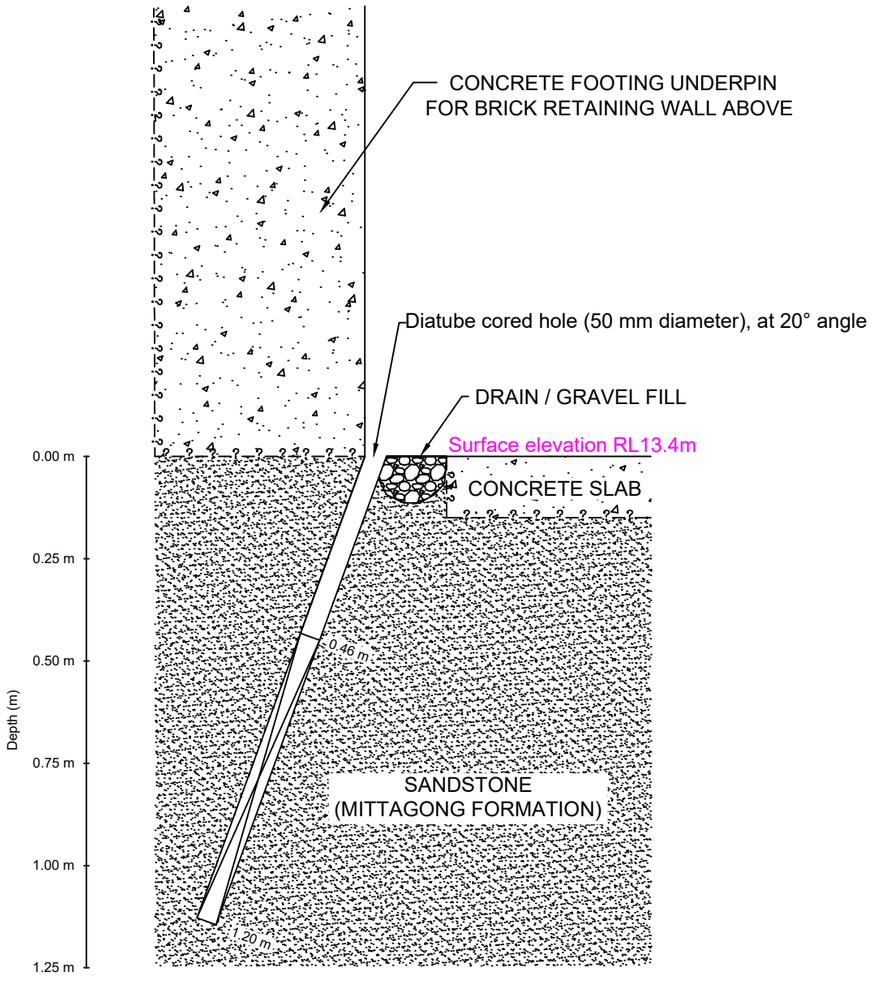
Photo W3 – View of core obtained from Borehole W3. Weathered sandstone was encountered from the start of the borehole.

Douglas Partners Geotechnics / Environment / Groundwater	**Borehole Photographs** **Proposed Commercial Development** **8-10 Lee Street, Haymarket**	PROJECT: 86867.00 PLATE No: W3 REV: 0
	CLIENT: Vertical First Pty Ltd	DATE: 15/06/2020

SECTION W3-W3'



Note: Depth measurements are along the length of the hole.

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Vertical First Pty Ltd	TITLE: **W3 Cross Section** **Proposed Commercial Development** **8-10 Lee Street, Haymarket**	PROJECT No: 86767.00
	OFFICE: Sydney / DRAWN BY: JDB		DRAWING No: W3
	SCALE: 1:15 @ A3 / DATE: 15.6.2020		REVISION: 0

BOREHOLE LOG

CLIENT: Vertical First Pty Ltd
PROJECT: Proposed Commercial Development
LOCATION: 8-10 Lee Street, Haymarket

SURFACE LEVEL: 13.4 AHD
EASTING: 333948
NORTHING: 6249282
DIP/AZIMUTH: 60°/135°

BORE No: W4
PROJECT No: 86767.00
DATE: 20/5/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
13	0.0	CONCRETE: grey, with fine to coarse sub-rounded and sub-angular fragments of high strength sandstone, trace voids		C	0.0 – 0.22		PL(A) = 1.5		
				C	0.4				
	0.86	SANDSTONE: fine grained, orange-brown, highly weathered, medium to high strength, fractured, Mittagong formation		C	0.9				
12	1.57			C	1.5 – 1.7		PL(A) = 0.29		
	2.12				2.0				
	2.19	SANDSTONE: fine to coarse grained, pale orange, highly weathered, medium to high strength, fractured, Hawkesbury sandstone		C	2.2		PL(A) = 0.99		
11	2.4	Bore discontinued at 2.4m - Target depth reached			2.4				
10									

RIG: Hand Drill **DRILLER:** Nick Ruha **LOGGED:** NB **CASING:** NA

TYPE OF BORING: Diatube (50mm) to 2.4m

WATER OBSERVATIONS: No free groundwater observed whilst drilling

REMARKS: Surface level taken from architectural drawing provided, Synman Justin Bialek Architects Pty Ltd, Lower Ground Floor plan, Drawing WD05 (Rev E) dated 21 May 1998. Borehole azimuth relative to Grid North

SAMPLING & IN SITU TESTING LEGEND

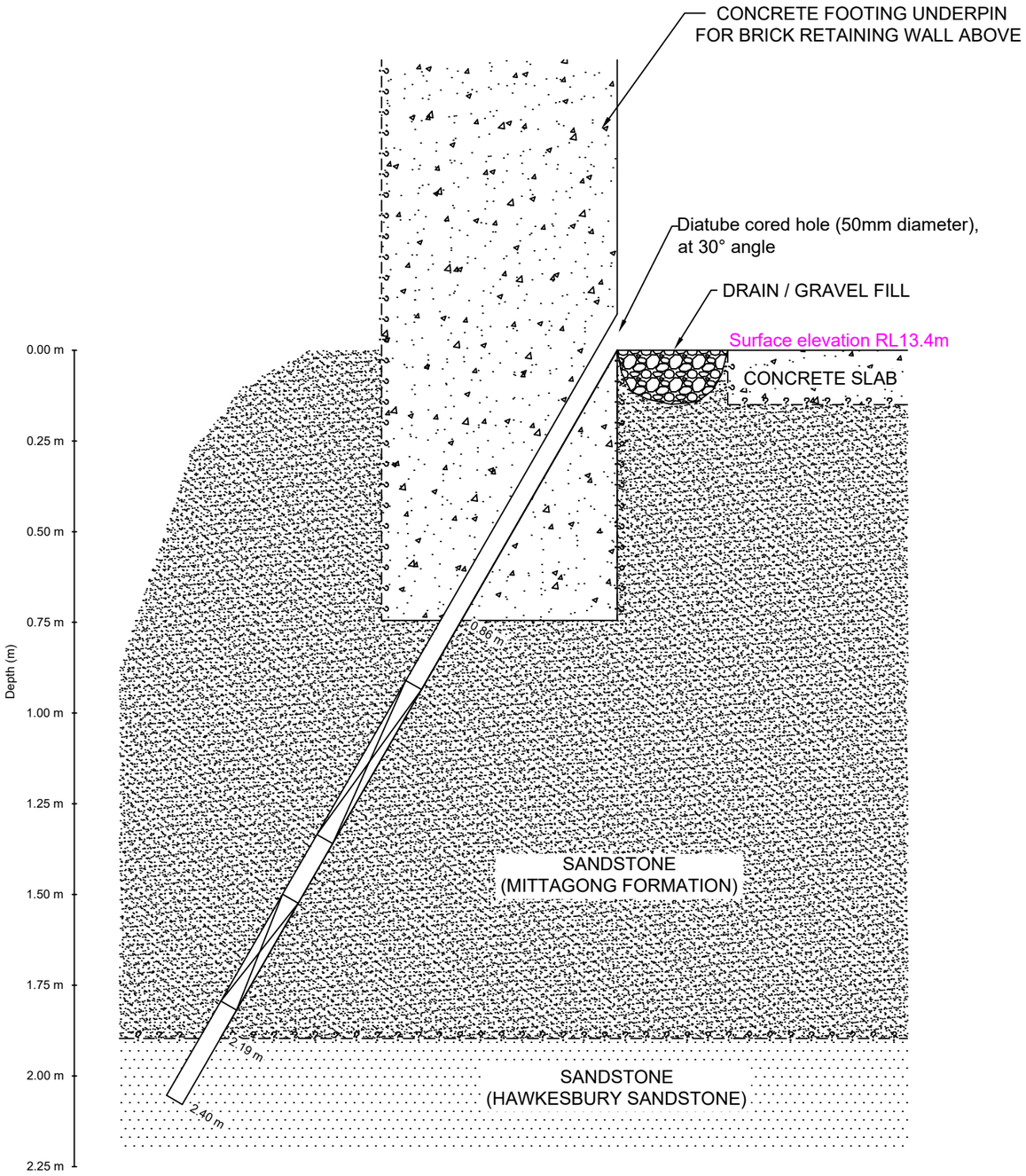
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample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

Douglas Partners
Geotechnics / Environment / Groundwater

Photo W4 – View of core obtained from Borehole W4.

Douglas Partners Geotechnics / Environment / Groundwater	**Borehole Photographs** **Proposed Commercial Development** **8-10 Lee Street, Haymarket**	PROJECT: 86867.00 PLATE No: W4 REV: 0
	CLIENT: Vertical First Pty Ltd	DATE: 15/06/2020

SECTION W4-W4'



Note: Depth measurements are along the length of the hole.

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Vertical First Pty Ltd	TITLE: **W4 Cross Section** **Proposed Commercial Development** **8-10 Lee Street, Haymarket**	PROJECT No: 86767.00
	OFFICE: Sydney / DRAWN BY: JDB		DRAWING No: W4
	SCALE: 1:15 @ A3 / DATE: 15.6.2020		REVISION: 0

BH8

Douglas Partners
Geotechnics / Environment / Groundwater

Groundwater Field Sheet

Bore Volume = casing volume + filter pack volume
$= \pi h_1 d_1^2/4 + n(\pi h_2 d_2^2/4 - \pi h_2 d_1^2/4)$
Where: $\pi = 3.14$
n = porosity (0.3 for most filter pack material)
h_1 = height of water column
d_1 = diameter of annulus
h_2 = length of filter pack
d_2 = diameter of casing
Bore Vol Normally: 7.2*h

Project and Bore Installation Details	
Bore / Standpipe ID:	BH8 (TOGA)
Project Name:	HAYMARKET DSI
Project Number:	86767.01
Site Location:	
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	- m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	-

Bore Development Details	
Date/Time:	23/07/19 15:00
Purged By:	AS
GW Level (pre-purge):	9.3 m bgl
GW Level (post-purge):	8.9 m bgl
PSH observed:	Yes / (No) (interface / visual). Thickness if observed:
Observed Well Depth:	15.2 m bgl
Estimated Bore Volume:	93 L *actual bore volume ~40L (dry/slow recha
Total Volume Purged:	(target: no drill mud, min 3 well vol. or (dry)) 100L
Equipment:	pump, battery, interface meter, bailer line, water cubes

Micropurge and Sampling Details	
Date/Time:	
Sampled By:	
Weather Conditions:	
GW Level (pre-purge):	m bgl
GW Level (post sample):	m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Observed Well Depth:	m bgl
Estimated Bore Volume:	L
Total Volume Purged:	L
Equipment:	

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	**0.1° C**	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
Additional Readings Following stabilisation:	DO % Sat	SPC	TDS			

Sample Details

Sampling Depth (rationale):	m bgl,
Sample Appearance (e.g. colour, siltiness, odour):	yellow-brown, still, odourless
Sample ID:	
QA/QC Samples:	
Sampling Containers and filtration:	
Comments / Observations:	actual well V ≈ 40 (?) L - slow pumping, water coming out on/off

BH8

Douglas Partners
Geotechnics / Environment / Groundwater

Groundwater Field Sheet

Bore Volume = casing volume + filter pack volume
$= \pi h_c d_c^2/4 + n(\pi h_f d_f^2/4 - \pi h_f d_c^2/4)$
Where: $\pi = 3.14$
n = porosity (0.3 for most filter pack material)
h_c = height of water column
d_c = diameter of annulus
h_f = length of filter pack
d_c = diameter of casing
Bore Vol Normally: 7.2*h

Project and Bore Installation Details	
Bore / Standpipe ID:	BH8 (TOGA)
Project Name:	HAYMARKET DSI
Project Number:	86767.01
Site Location:	
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	- m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	-

Bore Development Details	
Date/Time:	23/07/19 15:00
Purged By:	AS
GW Level (pre-purge):	2.3 m bgl
GW Level (post-purge):	8.9 m bgl
PSH observed:	Yes / (No) (interface / visual). Thickness if observed:
Observed Well Depth:	15.2 m bgl
Estimated Bore Volume:	93 L * actual bore volume ~40L (dry/slow recharge
Total Volume Purged:	(target: no drill mud, min 3 well vol. or (dry)) 100L
Equipment:	pump, battery, interface metre, bailer/line, water cubes

Micropurge and Sampling Details	
Date/Time:	1500 30.7.19
Sampled By:	JSH
Weather Conditions:	overcast (indoors)
GW Level (pre-purge):	2.3 m bgl
GW Level (post sample):	2.3 m bgl
PSH observed:	Yes / (No) (interface / (visual)). Thickness if observed:
Observed Well Depth:	15.2 m bgl
Estimated Bore Volume:	93 L
Total Volume Purged:	3 L
Equipment:	Peripump, WQM, interface meter, Bailer

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	**0.1° C**	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
1515	18.0	3.51	329	5.4	41	189
1516	18.8	2.97	327	5.4	28	184
1517	19.1	2.53	315	5.4	28	160
1518	19.2	2.28	313	5.4	28	157
1519	19.2	1.94	311	5.4	29	154
1520	19.3	1.62	313	5.4	24	151
1521	19.3	1.43	312	5.4	26	150
1522	19.3	1.36	310	5.4	20	148
Additional Readings Following stabilisation:	DO % Sat	SPC	TDS			

Sample Details

Sampling Depth (rationale):	m bgl,
Sample Appearance (e.g. colour, siltiness, odour):	yellow-brown, still, odourless
Sample ID:	
QA/QC Samples:	
Sampling Containers and filtration:	
Comments / Observations:	actual well V ≈ 40 (?) L - slow pumping, water coming out on/off

Post sample purge ~ 100 L ; depth 11.9m to water (dipped)
Installed level logger at 11.8m (SW) at approx 1420

Groundwater Field Sheet

Bore Volume = casing volume + filter pack volume
= πh$_1$d$_1^2$/4 + n(πh$_2$d$_2^2$/4-πh$_2$d$_3^2$/4)
Where: π = 3.14
n = porosity (0.3 for most filter pack material)
h$_1$ = height of water column
d$_1$ = diameter of annulus
h$_2$ = length of filter pack
d$_3$ = diameter of casing
Bore Vol Normally: 7.2*h

Project and Bore Installation Details	
Bore / Standpipe ID:	BH107a
Project Name:	Haymarket SSI
Project Number:	86767.03
Site Location:	
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	- m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	-

Bore Development Details	
Date/Time:	
Purged By:	
GW Level (pre-purge):	m bgl
GW Level (post-purge):	m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Observed Well Depth:	m bgl
Estimated Bore Volume:	L
Total Volume Purged:	(target: no drill mud, min 3 well vol. or dry)
Equipment:	

Micropurge and Sampling Details	
Date/Time:	26/05/20
Sampled By:	AS
Weather Conditions:	rainy
GW Level (pre-purge):	2.1 m bgl data logger retrieved 10.30am
GW Level (post sample):	3.85 m bgl data logger put in 11.01am
PSH observed:	Yes / (No) (interface / visual). Thickness if observed:
Observed Well Depth:	3.95 m bgl
Estimated Bore Volume:	12.6 L
Total Volume Purged:	~5 L
Equipment:	geopump · WQM. int meter

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	***0.1° C***	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
13:07	18.8	3.23	494	7.16	137.3	74
13:08	21.3	2.06	462	6.84	127.1	72
13:09	22.1	1.68	125	6.78	–	67
Additional Readings Following stabilisation:	DO % Sat	SPC	TDS			

Sample Details

Sampling Depth (rationale):	3.2 m bgl,
Sample Appearance (e.g. colour, siltiness, odour):	grey, odourless
Sample ID:	BH107A
QA/QC Samples:	–
Sampling Containers and filtration:	see COC
Comments / Observations:	note - samples taken prior to WQM readings due to low vol, slow recharge

well dry after 3 readings

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PROJECT Haymarket SSI	Job No 86767.03	Page 1 of 1

BH107b 17105120

depth: 11m AS

WL: pre purge 1.85m (volume = 9.15 × 7.2 = 65.8L)
~131L or dry

WL: post purge 10.6m

data logger installed to 10.5m post purge at 10:51am

v purged: ~30L → well dry

equipment: twister pump

BH107a

depth: 4m

WL prepurge 3.2m (volume = 5.76L)
~15L or dry

WL post purge 4m (dry)

data logger installed to 3.5m post purge (11:30am)

v purged: ~3L

equipment: bailer

Comps By / /	Checked By / /	Approved By / /

Groundwater Field Sheet

Bore Volume = casing volume + filter pack volume
= $\pi h_1 d_1^2/4 + n(\pi h_2 d_2^2/4 - \pi h_2 d_3^2/4)$

Where: $\pi = 3.14$
n = porosity (0.3 for most filter pack material)
h_1 = height of water column
d_1 = diameter of annulus
h_2 = length of filter pack
d_2 = diameter of casing

Bore Vol Normally: 7.2*h

Project and Bore Installation Details	
Bore / Standpipe ID:	BH107B
Project Name:	Haymarket SSI
Project Number:	86767.03
Site Location:	
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	- m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	-

Bore Development Details	
Date/Time:	
Purged By:	
GW Level (pre-purge):	m bgl
GW Level (post-purge):	m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Observed Well Depth:	m bgl
Estimated Bore Volume:	L
Total Volume Purged:	(target: no drill mud, min 3 well vol. or dry)
Equipment:	

Micropurge and Sampling Details	
Date/Time:	26/05/20
Sampled By:	AS
Weather Conditions:	rainy
GW Level (pre-purge):	2.6 m bgl data logger retrieved 11:11
GW Level (post sample):	5.3 m bgl data logger put in, 30s int, 11:28
PSH observed:	Yes / (No) (interface / visual). Thickness if observed:
Observed Well Depth:	11.15 m bgl
Estimated Bore Volume:	61 L
Total Volume Purged:	~15 L
Equipment:	geopump, WQM, int. meter

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	**0.1°C**	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
13:27	19.3	3.47	501	7.04	—	12
13:28	21.3	1.09	499	7.22	—	-28
13:29	22.1	0.62	494	7.19	82.2	-56
13:30	22.3	0.33	492	7.18	35.5	-68
13:31	22.4	0.24	474	7.23	24.0	-75
13:32	22.5	0.18	474	7.27	19.6	-77
13:33	22.5	0.14	472	7.24	16.8	-76
Additional Readings Following stabilisation:	DO % Sat	SPC	TDS			

Sample Details

Sampling Depth (rationale):	8.0 m bgl,
Sample Appearance (e.g. colour, siltiness, odour):	clear - grey, odourless
Sample ID:	BH107B
QA/QC Samples:	—
Sampling Containers and filtration:	see COC
Comments / Observations:	—

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Groundwater Field Sheet

Bore Volume = casing volume + filter pack volume
= $\pi h_c d_c^2/4 + n\pi h_f d^2/4 - \pi h_f d_c^2/4$
Where: $\pi = 3.14$
n = porosity (0.3 for most filter pack material)
h_c = height of water column
d = diameter of annulus
h_f = length of filter pack
d_c = diameter of casing
Bore Vol Normally: 7.2*h

Project and Bore Installation Details	
Bore / Standpipe ID:	BH109B.
Project Name:	
Project Number:	
Site Location:	
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	NA - - m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	-

Bore Development Details	
Date/Time:	21.05.2020 80 Litres emplieed.
Purged By:	Slow Recharge.
GW Level (pre-purge):	7.78 m bgl
GW Level (post-purge):	11.4m. m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Observed Well Depth:	m bgl
Estimated Bore Volume:	L Data logger set @
Total Volume Purged:	(target: no drill mud, min 3 well vol. or dry)
Equipment:	11m.

Micropurge and Sampling Details	
Date/Time:	
Sampled By:	
Weather Conditions:	
GW Level (pre-purge):	m bgl
GW Level (post sample):	m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Observed Well Depth:	m bgl
Estimated Bore Volume:	L
Total Volume Purged:	L
Equipment:	

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	***0.1° C***	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
Additional Readings Following stabilisation:	DO % Sat	SPC	TDS			

Sample Details

Sampling Depth (rationale):	m bgl,
Sample Appearance (e.g. colour, siltiness, odour):	
Sample ID:	
QA/QC Samples:	
Sampling Containers and filtration:	
Comments / Observations:	

Groundwater Field Sheet

Bore Volume = casing volume + filter pack volume
= πh$_1$d$_1^2$/4 + n(πh$_2$d$_2^2$/4-πh$_2$d$_3^2$/4)
Where: π = 3.14
n = porosity (0.3 for most filter pack material)
h$_1$ = height of water column
d$_1$ = diameter of annulus
h$_2$ = length of filter pack
d$_2$ = diameter of casing
Bore Vol Normally: 7.2*h

Project and Bore Installation Details	
Bore / Standpipe ID:	BH109B
Project Name:	Haymarket SSI
Project Number:	26767.03
Site Location:	
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	- m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	-

Bore Development Details	
Date/Time:	
Purged By:	
GW Level (pre-purge):	m bgl
GW Level (post-purge):	m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Observed Well Depth:	m bgl
Estimated Bore Volume:	L
Total Volume Purged:	(target: no drill mud, min 3 well vol. or dry)
Equipment:	

Micropurge and Sampling Details	
Date/Time:	26/05/20
Sampled By:	AS
Weather Conditions:	cloudy
GW Level (pre-purge):	3.2 m bgl data logger retrieved, 12:17pm
GW Level (post sample):	10.9 m bgl data logger put in (30s), 12:59pm
PSH observed:	Yes / (No) (interface / visual). Thickness if observed:
Observed Well Depth:	12.0 m bgl
Estimated Bore Volume:	27 L
Total Volume Purged:	~15 L
Equipment:	geopump, int meter, WQM, bailer

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	***0.1°C***	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
14:39	19.9	3.16	760	7.42	—	-1
14:40	20.9	2.10	764	7.38	—	-10
14:41	22.2	1.25	735	7.39	3.2	-24
14:41	22.8	0.71	719	7.36	99.2	-33
14:42	23.0	0.53	711	7.42	110.5	-36
14:43	23.1	0.60	735	7.31	114.1	-41
14:44	23.1	0.55	731	7.31	91.0	-42

Additional Readings Following stabilisation:	DO % Sat	SPC	TDS

Sample Details

Sampling Depth (rationale):	10.5 m bgl,
Sample Appearance (e.g. colour, siltiness, odour):	brown - grey, slightly silty, odourless
Sample ID:	BH109B
QA/QC Samples:	—
Sampling Containers and filtration:	see COC
Comments / Observations:	—

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Permeability Testing - Rising Head Test Report

Client:	Atlassian Pty Ltd	Project No:	86767.00
Project:	Proposed Commercial Development	Test date:	30-Jul-19
Location:	8-10 Lee Street, Haymarket	Tested by:	JJH

Test Location

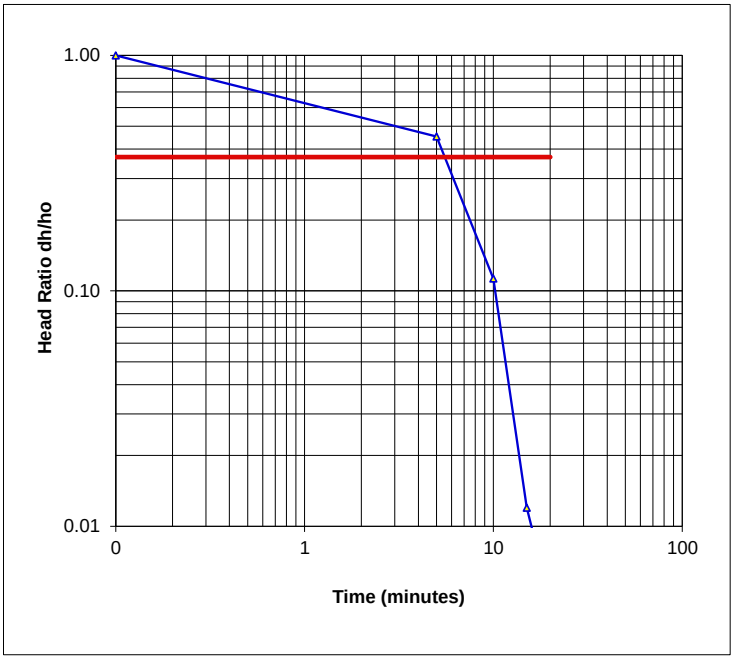
Description:	Standpipe in borehole	**Test No.**	BH8	
Material type:	Sandstone	Easting:	333954	m
		Northing	6249289	m
		Surface Level:	15.5	m AHD

Details of Well Installation

Well casing diameter (2r)	76	mm	Depth to water before test	2.3	m
Well screen diameter (2R)	76	mm	Depth to water at start of test	14.8	m
Length of well screen (Le)	12.1	m			

Test Results

Time (min)	Depth (m)	Change in Head: dH (m)	dH/Ho
0	14.80	12.50	1.000
5	7.95	5.65	0.452
10	3.71	1.41	0.113
15	2.45	0.15	0.012
20	2.36	0.06	0.005



To = 5.5 mins
330 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 =**	**1.0E-06**	m/sec
	=	**0.375**	cm/hour

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Permeability Testing - Rising or Falling Head Test Report

Client:	Vertical First Pty Ltd	Project No:	86767.00
Project:	Proposed Commercial Development	Test date:	17-May-20
Location:	8-10 Lee Street, Haymarket	Tested by:	NB

Test Location

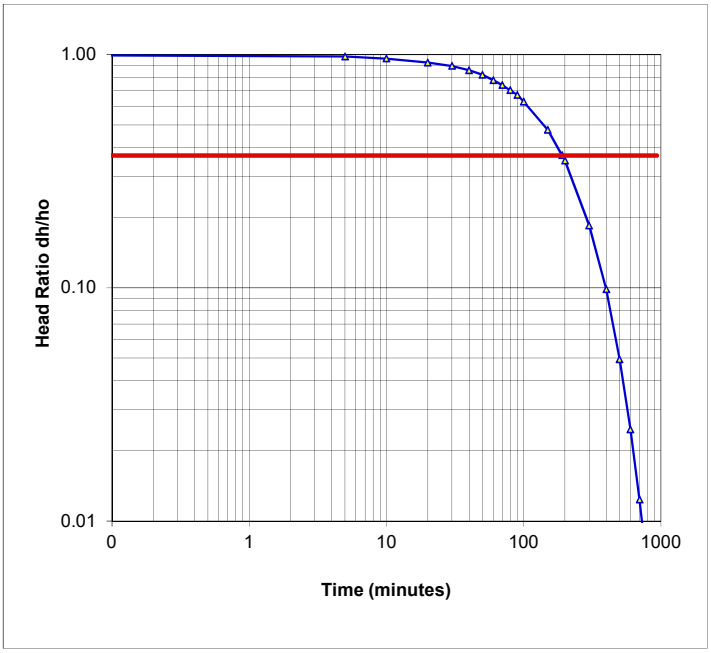
Description:	Standpipe in borehole	**Test No.**	BH107A	
Material type:	Sandstone	Easting:	333945	m
		Northing	6249270	m
		Surface Level:	15.5	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	2.13	m
Well screen diameter (2R)	76	mm	Depth to water at start of test	3.75	m
Length of well screen (Le)	0.5	m			

Test Results

Time (min)	Depth (m)	Change in Head: δH (m)	δH/Ho
0	3.75	1.62	1.000
5	3.72	1.59	0.981
10	3.69	1.56	0.963
20	3.63	1.50	0.926
30	3.58	1.45	0.895
40	3.52	1.39	0.858
50	3.46	1.33	0.821
60	3.39	1.26	0.778
70	3.33	1.20	0.741
80	3.27	1.14	0.704
90	3.22	1.09	0.673
100	3.15	1.02	0.630
150	2.9	0.77	0.475
190.5	2.73	0.6	0.370
200	2.7	0.57	0.352
300	2.43	0.3	0.185
400	2.29	0.16	0.099
500	2.21	0.08	0.049
600	2.17	0.04	0.025
700	2.15	0.02	0.012
800	2.14	0.01	0.006
936	2.13	0	0.000



To = 190.5 mins
11430 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 =**	**1.4E-07**	m/sec
	=	**0.051**	cm/hour

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Permeability Testing - Rising Head Test Report

Client:	Vertical First Pty Ltd	Project No:	86767.00
Project:	Proposed Commercial Development	Test date:	26-May-20
Location:	8-10 Lee Street, Haymarket	Tested by:	AS

Test Location

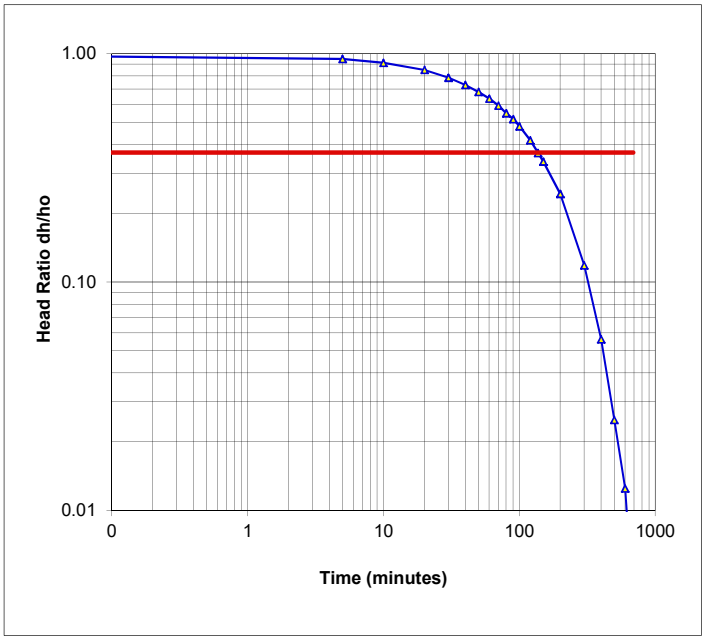
Description:	Standpipe in borehole	**Test No.**	BH107A	
Material type:	Sandstone	Easting:	333945	m
		Northing	6249270	m
		Surface Level:	15.5	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	2.2	m
Well screen diameter (2R)	76	mm	Depth to water at start of test	3.8	m
Length of well screen (Le)	0.5	m			

Test Results

Time (min)	Depth (m)	Change in Head: δH (m)	δH/Ho
0	3.8	1.60	1.000
5	3.72	1.52	0.950
10	3.66	1.46	0.913
20	3.56	1.36	0.850
30	3.46	1.26	0.788
40	3.37	1.17	0.731
50	3.29	1.09	0.681
60	3.22	1.02	0.638
70	3.15	0.95	0.594
80	3.08	0.88	0.550
90	3.03	0.83	0.519
100	2.97	0.77	0.481
120	2.87	0.67	0.419
137	2.79	0.59	0.369
150	2.74	0.54	0.338
200	2.59	0.39	0.244
300	2.39	0.19	0.119
400	2.29	0.09	0.056
500	2.24	0.04	0.025
600	2.22	0.02	0.013
650	2.21	0.01	0.006
687	2.2	0	0.000



To = 137 mins
8220 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 =**	**2.0E-07**	m/sec
	=	**0.071**	cm/hour

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Permeability Testing - Rising or Falling Head Test Report

Client:	Vertical First Pty Ltd	Project No:	86767.00
Project:	Proposed Commercial Development	Test date:	17-May-20
Location:	8-10 Lee Street, Haymarket	Tested by:	NB

Test Location

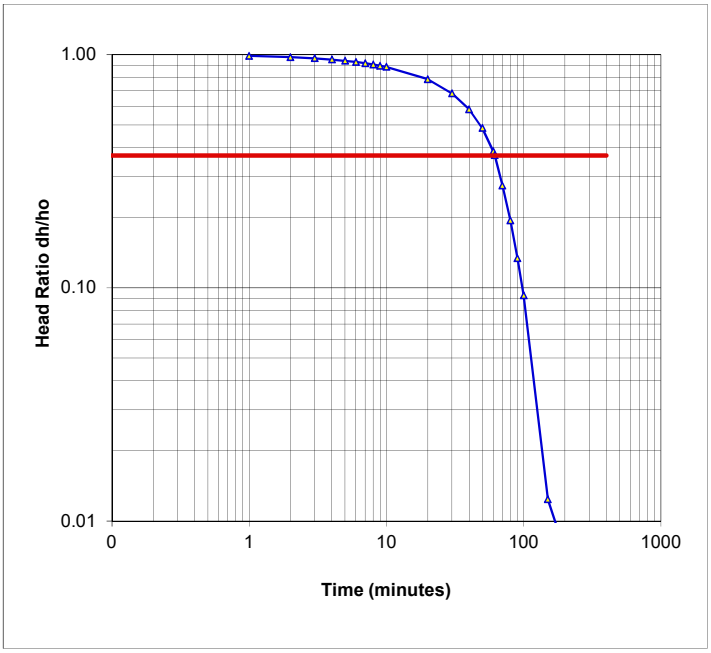
Description:	Standpipe in borehole	**Test No.**	BH107B	
Material type:	Sandstone	Easting:	333945	m
		Northing	6249272	m
		Surface Level:	15.5	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	2.65	m
Well screen diameter (2R)	76	mm	Depth to water at start of test	10.72	m
Length of well screen (Le)	5.5	m			

Test Results

Time (min)	Depth (m)	Change in Head: δH (m)	δH/Ho
0	10.72	8.07	1.000
1	10.63	7.98	0.989
2	10.53	7.88	0.976
3	10.44	7.79	0.965
4	10.34	7.69	0.953
5	10.25	7.60	0.942
6	10.16	7.51	0.931
7	10.07	7.42	0.919
8	9.98	7.33	0.908
9	9.89	7.24	0.897
10	9.8	7.15	0.886
20	8.98	6.33	0.784
30	8.16	5.51	0.683
40	7.36	4.71	0.584
50	6.56	3.91	0.485
60	5.76	3.11	0.385
61.5	5.64	2.99	0.371
70	4.87	2.22	0.275
80	4.22	1.57	0.195
90	3.73	1.08	0.134
100	3.4	0.75	0.093
150	2.75	0.1	0.012
200	2.71	0.06	0.007
300	2.69	0.04	0.005
400	2.68	0.03	0.004
500	2.66	0.01	0.001
636	2.65	0	0.000



To = 61.5 mins
3690 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 =**	**7.7E-08**	m/sec
	=	**0.028**	cm/hour

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Permeability Testing - Rising Head Test Report

Client:	Vertical First Pty Ltd	Project No:	86767.00
Project:	Proposed Commercial Development	Test date:	26-May-20
Location:	8-10 Lee Street, Haymarket	Tested by:	AS

Test Location

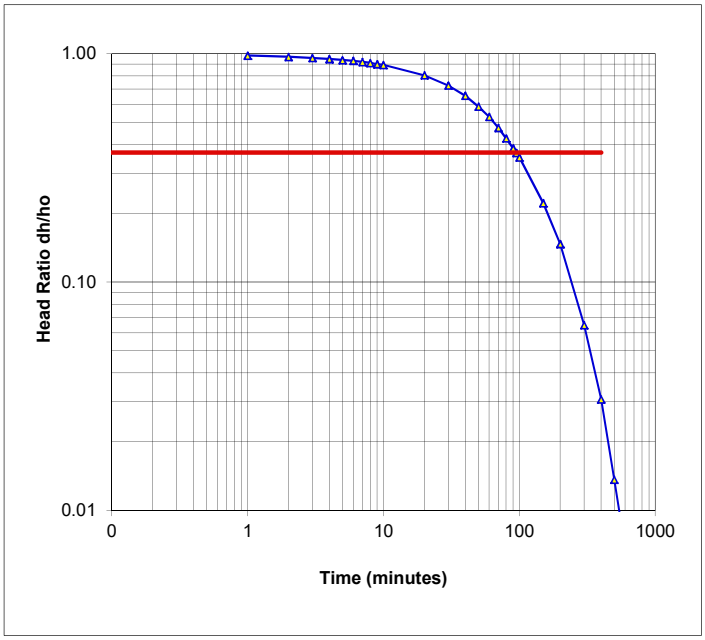
Description:	Standpipe in borehole	**Test No.**	BH107B	
Material type:	Sandstone	Easting:	333945	m
		Northing	6249272	m
		Surface Level:	15.5	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	2.22	m
Well screen diameter (2R)	76	mm	Depth to water at start of test	5.15	m
Length of well screen (Le)	5.5	m			

Test Results

Time (min)	Depth (m)	Change in Head: δH (m)	δH/Ho
0	5.15	2.93	1.000
1	5.10	2.88	0.983
2	5.06	2.84	0.969
3	5.03	2.81	0.959
4	5.00	2.78	0.949
5	4.97	2.75	0.939
6	4.95	2.73	0.932
7	4.92	2.70	0.922
8	4.89	2.67	0.911
9	4.86	2.64	0.901
10	4.84	2.62	0.894
20	4.58	2.36	0.805
30	4.35	2.13	0.727
40	4.14	1.92	0.655
50	3.94	1.72	0.587
60	3.77	1.55	0.529
70	3.61	1.39	0.474
80	3.47	1.25	0.427
90	3.35	1.13	0.386
95	3.30	1.08	0.369
100	3.25	1.03	0.352
150	2.87	0.65	0.222
200	2.65	0.43	0.147
300	2.41	0.19	0.065
400	2.31	0.09	0.031
500	2.26	0.04	0.014
600	2.24	0.02	0.007



To = 95 mins
5700 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 =**	**5.0E-08**	m/sec
	=	**0.018**	cm/hour

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Permeability Testing - Falling Head Test Report

Client:	Vertical First Pty Ltd	Project No:	86767.00
Project:	Proposed Commercial Development	Test date:	5-Jun-20
Location:	8-10 Lee Street, Haymarket	Tested by:	NB

Test Location

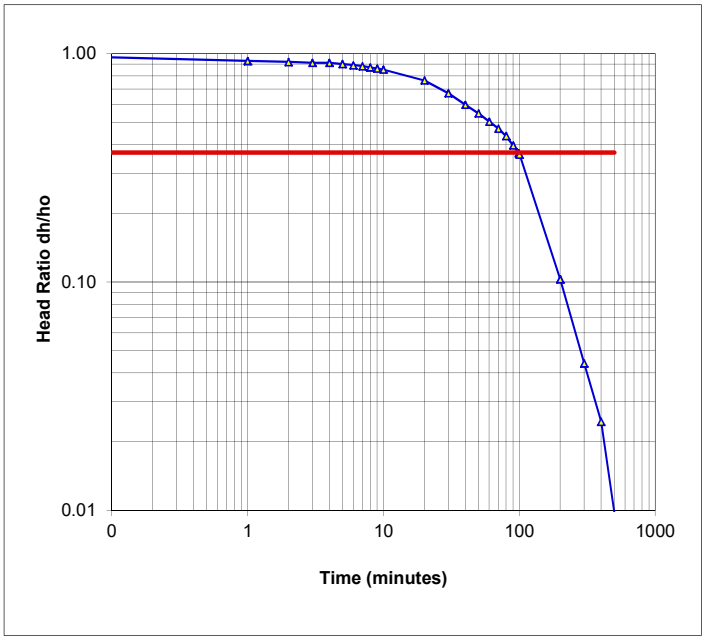
Description:	Standpipe in borehole	**Test No.**	BH109B	
Material type:	Sandstone	Easting:	333970	m
		Northing	6249311	m
		Surface Level:	15.3	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water at end of test	2.17	m
Well screen diameter (2R)	76	mm	Depth to water at start of test	0.13	m
Length of well screen (Le)	5.6	m			

Test Results

Time (min)	Depth (m)	Change in Head: δH (m)	δH/Ho
0	0.13	2.04	1.000
1	0.27	1.90	0.931
2	0.29	1.88	0.922
3	0.31	1.86	0.912
4	0.31	1.86	0.912
5	0.33	1.84	0.902
6	0.35	1.82	0.892
7	0.37	1.80	0.882
8	0.39	1.78	0.873
9	0.41	1.76	0.863
10	0.43	1.74	0.853
20	0.61	1.56	0.765
30	0.8	1.37	0.672
40	0.95	1.22	0.598
50	1.05	1.12	0.549
60	1.14	1.03	0.505
70	1.21	0.96	0.471
80	1.28	0.89	0.436
90	1.36	0.81	0.397
98.5	1.42	0.75	0.368
100	1.43	0.74	0.363
200	1.96	0.21	0.103
300	2.08	0.09	0.044
400	2.12	0.05	0.025
500	2.15	0.02	0.010
600	2.17	0	0.000



To = 98.5 mins
5910 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 =**	**4.7E-08**	m/sec
	=	**0.017**	cm/hour

Douglas Partners
Geotechnics / Environment / Groundwater

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

Permeability Testing - Rising Head Test Report

Client:	Vertical First Pty Ltd	Project No:	86767.07
Project:	Link Tunnel	Test date:	10-Nov-20
Location:	8-10 Lee Street, Haymarket	Tested by:	KR

Test Location

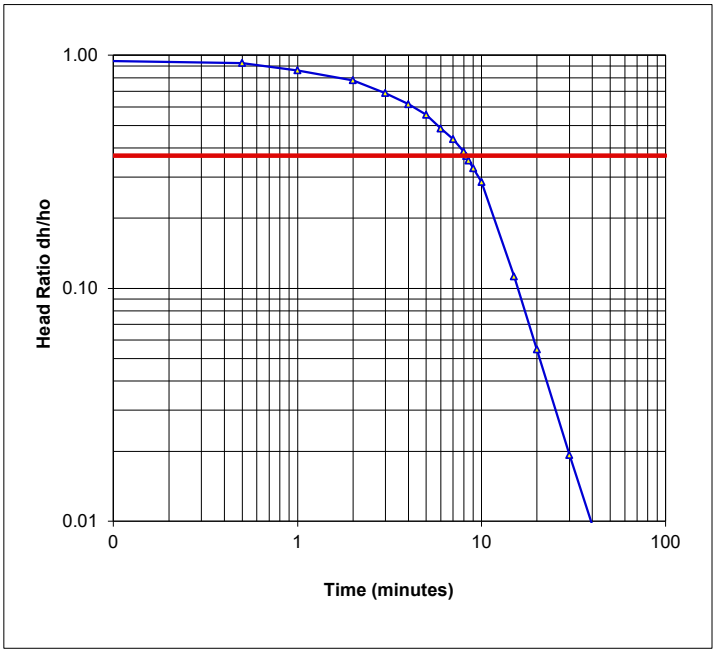
Description:	Standpipe in borehole	**Test No.**	BH202	
Material type:	Alluvial clay and sand underlain by residual clay	Easting:	333941	m
		Northing	6249253	m
		Surface Level:	16.3	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	3.46	m
Well screen diameter (2R)	114.3	mm	Depth to water at start of test	6.57	m
Length of well screen (Le)	3	m			

Test Results

Time (min)	Depth (m)	Change in Head: δH (m)	δH/Ho
0	6.57	3.11	1.000
0.5	6.34	2.88	0.926
1	6.14	2.68	0.862
2	5.89	2.43	0.781
3	5.6	2.14	0.688
4	5.38	1.92	0.617
5	5.19	1.73	0.556
6	4.97	1.51	0.486
7	4.82	1.36	0.437
8	4.66	1.20	0.386
8.25	4.61	1.15	0.370
8.5	4.56	1.10	0.354
9	4.48	1.02	0.328
10	4.35	0.89	0.286
15	3.81	0.35	0.113
20	3.63	0.17	0.055
30	3.52	0.06	0.019
40	3.49	0.03	0.010
50	3.47	0.01	0.003



To = 8.25 mins
495 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 =**	**8.3E-07**	m/sec
	=	**0.300**	cm/hour

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Geotechnics / Environment / Groundwater

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www.douglaspartners.com.au

Permeability Testing - Rising Head Test Report

Client:	Vertical First Pty Ltd	Project No:	86767.07
Project:	Link Tunnel	Test date:	10-Nov-20
Location:	8-10 Lee Street, Haymarket	Tested by:	KR

Test Location

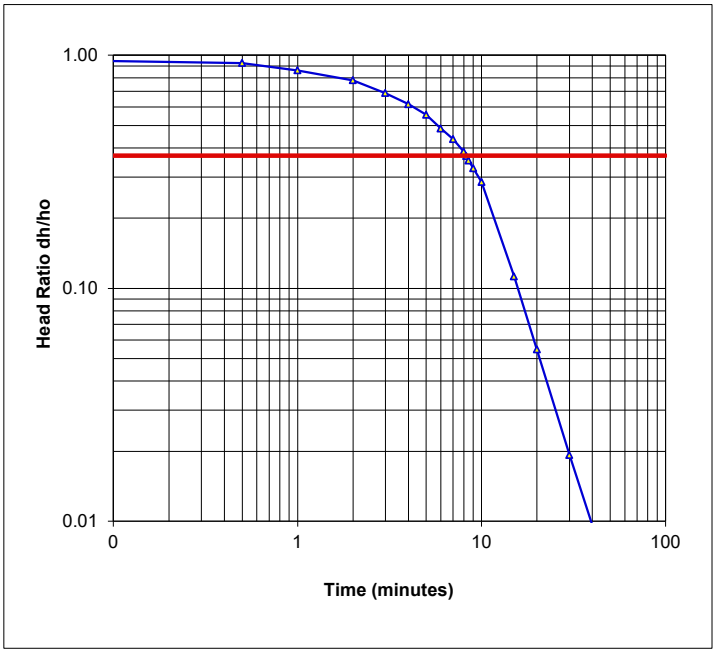
Description:	Standpipe in borehole	**Test No.**	BH202	
Material type:	Alluvial clay and sand underlain by residual clay	Easting:	333941	m
		Northing	6249253	m
		Surface Level:	16.3	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	3.46	m
Well screen diameter (2R)	114.3	mm	Depth to water at start of test	6.57	m
Length of well screen (Le)	3.5	m			

Test Results

Time (min)	Depth (m)	Change in Head: δH (m)	δH/Ho
0	6.57	3.11	1.000
0.5	6.34	2.88	0.926
1	6.14	2.68	0.862
2	5.89	2.43	0.781
3	5.6	2.14	0.688
4	5.38	1.92	0.617
5	5.19	1.73	0.556
6	4.97	1.51	0.486
7	4.82	1.36	0.437
8	4.66	1.20	0.386
8.25	4.61	1.15	0.370
8.5	4.56	1.10	0.354
9	4.48	1.02	0.328
10	4.35	0.89	0.286
15	3.81	0.35	0.113
20	3.63	0.17	0.055
30	3.52	0.06	0.019
40	3.49	0.03	0.010
50	3.47	0.01	0.003



To = 8.25 mins
495 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 =**	**7.4E-07**	m/sec
	=	**0.267**	cm/hour

Douglas Partners
Geotechnics / Environment / Groundwater

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ABN 75 053 980 117
www.douglaspartners.com.au

Permeability Testing - Rising Head Test Report

Client:	Vertical First Pty Ltd	Project No:	86767.07
Project:	Link Tunnel	Test date:	12-Nov-20
Location:	8-10 Lee Street, Haymarket	Tested by:	KR

Test Location

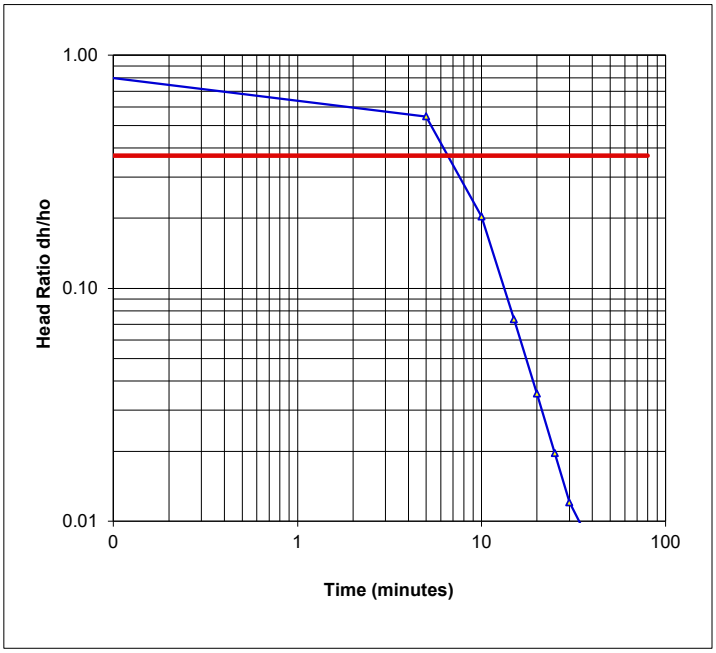
Description:	Standpipe in borehole	**Test No.**	BH202	
Material type:	Alluvial clay and sand underlain by residual clay	Easting:	333941	m
		Northing	6249253	m
		Surface Level:	16.3	m AHD

Details of Well Installation

Well casing diameter (2r)	50	mm	Depth to water before test	3.44	m
Well screen diameter (2R)	114	mm	Depth to water at start of test	6.06	m
Length of well screen (Le)	3.5	m			

Test Results

Time (min)	Depth (m)	Change in Head: δH (m)	δH/Ho
0	6.06	2.62	0.998
5	4.87	1.43	0.546
10	3.97	0.53	0.203
15	3.63	0.19	0.074
20	3.53	0.09	0.035
25	3.49	0.05	0.020
30	3.47	0.03	0.012
35	3.47	0.02	0.010
40	3.46	0.02	0.007
45	3.45	0.01	0.005
50	3.45	0.01	0.004
55	3.45	0.01	0.003
60	3.45	0.01	0.003
65	3.45	0.0064	0.002
70	3.45	0.0061	0.002
75	3.45	0.0054	0.002
80	3.44	0.0046	0.002



To = 6 mins
360 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 =**	**1.0E-06**	m/sec
	=	**0.368**	cm/hour

Appendix G

Laboratory Test Results

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

CERTIFICATE OF ANALYSIS 264169-A

Client Details

Client	Douglas Partners Pty Ltd
Attention	Huw Smith
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**86884.02, Haymarket**
Number of Samples	12 Soil
Date samples received	12/03/2021
Date completed instructions received	12/03/2021

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	19/03/2021
Date of Issue	19/03/2021

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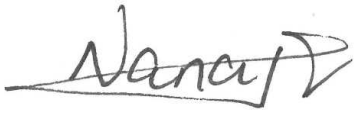
Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Diego Bigolin, Team Leader, Inorganics

Authorised By



Nancy Zhang, Laboratory Manager

Soil Aggressivity				
Our Reference		264169-A-2	264169-A-3	264169-A-8
Your Reference	UNITS	BH1003A/0.8-0.9	BH1003A/1.9-2.0	BH1005/1.55-1.65
Date Sampled		10/03/2021	10/03/2021	11/03/2021
Type of sample		Soil	Soil	Soil
pH 1:5 soil:water	pH Units	8.9	8.2	9.5
Electrical Conductivity 1:5 soil:water	µS/cm	77	8	1
Chloride, Cl 1:5 soil:water	mg/kg	<10	<10	20
Sulphate, SO4 1:5 soil:water	mg/kg	20	<10	51

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

QUALITY CONTROL: Soil Aggressivity						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	101	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	103	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	104	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	104	[NT]

Result Definitions

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

Quality Control Definitions

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

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

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

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

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

Spikes for Physical and Aggregate Tests are not applicable.

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

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

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

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

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

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Douglas Partners
Geotechnics | Environment | Groundwater

CHAIN OF CUSTODY DESPATCH SHEET

Project No:	86884.02	**Suburb:**	Haymarket	**To:**	EnviroLab
Project Name:	Haymarket Contamination Assessment	**Order Number**			12 Ashley Street, Chatswood 2067
Project Manager:	Huw Smith	**Sampler:**	Alyssa Spencer	**Attn:**	Aileen Hie
Emails:	Huw.Smith@douglaspartners.com.au	Alyssa.Spencer@douglaspartners.com.au		**Phone:**	(02) 9910 6200
Date Required:	Same day ☐ 24 hours ☐ 48 hours ☐ 72 hours ☐ Standard ☒			**Email:**	Ahie@envirolab.com.au
Prior Storage:	☒ Esky ☒ Fridge ☐ Shelved	Do samples contain 'potential' HBM?	Yes ☒ No ☐ (If YES, then handle, transport and store in accordance with FPM HAZID)		

Sample ID	Lab ID	Date Sampled	Sample Type (S - soil, W - water)	Container Type (G - glass, P - plastic)	Analytes: pH	EC	Sulphate	Chloride						Notes/preservation
BH1003A/0.8-0.9	2	11/03/21	S	G/P	X	X	X	X						*aggressivity testing
BH1003A/1.9-2.0	3	11/03/21	S	G/P	X	X	X	X						
BH1005/1.5-1.6	8	10/03/21	S	G/P	X	X	X	X						
PQL (S) mg/kg														**ANZECC PQLs req'd for all water analytes** ☐

ENVIROLAB GROUP

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 264169-A
Date Received: 12/03/21
Time Received: 14:57
Received By: M
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

PQL = practical quantitation limit. If none given, default to Laboratory Method Detection Limit
Metals to Analyse: 8HM unless specified here:

Lab Report/Reference No: 264169-A

Total number of samples in container: 3 **Relinquished by:** AS **Transported to laboratory by:** Courier

Send Results to: Douglas Partners Pty Ltd **Address** **Phone:** **Fax:**

Signed: MA **Received by:** Envirolab **Date & Time:** 12/03/21 14:57

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

CERTIFICATE OF ANALYSIS 264455-A

Client Details

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

Sample Details

Your Reference	**86884.02, Haymarket**
Number of Samples	5 SOIL
Date samples received	17/03/2021
Date completed instructions received	23/03/2021

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	30/03/2021
Date of Issue	29/03/2021

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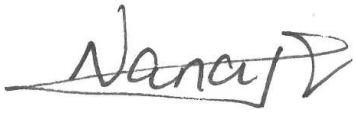
Results Approved By
Diego Bigolin, Team Leader, Inorganics

Authorised By



Nancy Zhang, Laboratory Manager

Soil Aggressivity		
Our Reference		264455-A-3
Your Reference	UNITS	1001/0.9-1.0
Date Sampled		12/03/2021
Type of sample		SOIL
pH 1:5 soil:water	pH Units	5.4
Electrical Conductivity 1:5 soil:water	µS/cm	29
Chloride, Cl 1:5 soil:water	mg/kg	<10
Sulphate, SO4 1:5 soil:water	mg/kg	32
Resistivity in soil*	ohm m	350

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA 22nd ED 2510 and Rayment & Lyons. Resistivity is calculated from Conductivity (non NATA). Resistivity (calculated) may not correlate with results otherwise obtained using Resistivity-Current method, depending on the nature of the soil being analysed.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.

QUALITY CONTROL: Soil Aggressivity					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	101	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	99	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	111	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	111	[NT]
Resistivity in soil*	ohm m	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]

Result Definitions

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

Quality Control Definitions

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

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

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

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

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Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Ming To

From: David Holden <David.Holden@douglaspartners.com.au>
Sent: Tuesday, 23 March 2021 1:06 PM
To: Ming To
Subject: RE: 264455 86884.02, Haymarket- Additional Analysis

Ref: 264455-A.
TAT: Standard.
Due: 30/03/2021 MT

Sorry Ming,

Please go with (3) 1001/0.9-1.0 is 264455-3.

Thanks

Dave

David Holden | Environmental Scientist
Douglas Partners Pty Ltd | ABN 75 053 980 117 | www.douglaspartners.com.au
96 Hermitage Road West Ryde NSW 2114 | PO Box 472 West Ryde NSW 1685
P: 02 8878 0652 | M: 0414 768 997 | E: David.Holden@douglaspartners.com.au

From: Ming To [mailto:MTo@envirolab.com.au]
Sent: Tuesday, 23 March 2021 1:05 PM
To: David Holden
Subject: FW: 264455 86884.02, Haymarket- Additional Analysis

Hi David,

The sample 264455-1 is 1001/0.25-0.3 and 1001/0.9-1.0 is 264455-3.
Can you please confirm which sample you would need the aggressivity suite on?

Thanks,

From: David Holden <David.Holden@douglaspartners.com.au>
Sent: Tuesday, 23 March 2021 11:44 AM
To: Aileen Hie <AHie@envirolab.com.au>
Subject: 264455 86884.02, Haymarket- Additional Analysis

Ming To

From: Aileen Hie
Sent: Tuesday, 23 March 2021 12:30 PM
To: Ming To
Subject: FW: 264455 86884.02, Haymarket- Additional Analysis
Attachments: 264455-COC.pdf

264455-A

Follow Up Flag: Follow up
Flag Status: Flagged

From: David Holden <David.Holden@douglaspartners.com.au>
Sent: Tuesday, 23 March 2021 11:44 AM
To: Aileen Hie <AHie@envirolab.com.au>
Subject: 264455 86884.02, Haymarket- Additional Analysis

Hi Aileen,

Could you please undertake aggresivity testing on sample 264455-1 (BH1001/0.9-1.0)

Please run this as an 'A' job. Standard TAT is fine.

Thanks

Dave

David Holden | Environmental Scientist
Douglas Partners Pty Ltd | ABN 75 053 980 117 | www.douglaspartners.com.au
96 Hermitage Road West Ryde NSW 2114 | PO Box 472 West Ryde NSW 1685
P: 02 8878 0652 | M: 0414 768 997 | E: David.Holden@douglaspartners.com.au

From: Aileen Hie [mailto:AHie@envirolab.com.au]
Sent: Wednesday, 17 March 2021 4:18 PM
To: David Holden; Alyssa Spencer
Subject: Sample Receipt for 264455 86884.02, Haymarket

Please refer to attached for:
a copy of the COC/paperwork received from you
a copy of our Sample Receipt Advice (SRA)
Please open and read the SRA as it contains important information.

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

CERTIFICATE OF ANALYSIS 264957-A

Client Details

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

Sample Details

Your Reference	**86884.02, Haymarket Contamination Investigation**
Number of Samples	9 soil
Date samples received	23/03/2021
Date completed instructions received	23/03/2021

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	30/03/2021
Date of Issue	29/03/2021

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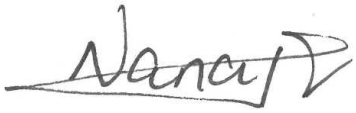
Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Diego Bigolin, Team Leader, Inorganics

Authorised By



Nancy Zhang, Laboratory Manager

Soil Aggressivity				
Our Reference		264957-A-7	264957-A-8	264957-A-9
Your Reference	UNITS	BH1004A	BH1005	BH1007
Depth		4.5-4.95	7.0-7.45	8.5-8.95
Date Sampled		17/03/2021	15/03/2021	16/03/2021
Type of sample		soil	soil	soil
pH 1:5 soil:water	pH Units	6.1	6.4	6.3
Electrical Conductivity 1:5 soil:water	µS/cm	40	27	14
Chloride, Cl 1:5 soil:water	mg/kg	<10	10	<10
Sulphate, SO4 1:5 soil:water	mg/kg	20	<10	<10

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

QUALITY CONTROL: Soil Aggressivity						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	7	6.1	6.0	2	101	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	7	40	42	5	99	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	7	<10	<10	0	111	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	7	20	22	10	108	[NT]

Result Definitions

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

Quality Control Definitions

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

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

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

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

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

Spikes for Physical and Aggregate Tests are not applicable.

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

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

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