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# Geotechnical Investigation Report

For

## Mills Oakley Pty Ltd

At

## 28 Lockwood Ave

## Belrose NSW 2085

Report G10132-1

4th June 2021

## Document Control

Proposed Mixed-Use Development

28 Lockwood Ave, Belrose NSW 2085

**Prepared for:** Mills Oakley Pty Ltd

| Revision | Date | Author | Reviewer |
|---|---|---|---|
| Rev 0 | 27/03/2021 | XDC | MH |
| Rev A | 4/06/2021 | XDC | MH |

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**Disclaimer:** This Document is subjected to Limitations Notes

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# 1. Introduction

## 1.1. Overview

Atlas Geotechnical Service Pty Ltd (AGS) was engaged by Mills Oakley Pty Ltd (client), to conduct a geotechnical investigation works for a proposed mixed-use development at 28 Lockwood Ave, Belrose NSW 2085, herein referred to as 'the site'. This geotechnical investigation report is prepared for Development Application (DA) submission and also provides geotechnical design parameters and recommendations regarding the proposed development.

To assist in the preparation of this Site Geotechnical Investigation Report AGS was supplied with the following documents and design specifications:

- Existing Survey Plan, issued by ECS Surveying Pty Ltd, ref: 11574, dated Aug 2019.
- Architectural Set for Development Application, issued by DKO Architecture (NSW) Pty Ltd, ref: 11574 - Rev F, dated 16th April 2021 (Amended).

It is understood that the proposed development comprises the demolition of the existing site structures and the construction of a two (2) multi-leveled structure with underground basement facilities, located within the internal confines of the site boundary (Image 2).

## 1.2. Objectives

The objectives of this geotechnical investigation are to assess the subsurface conditions and provide geotechnical engineering comments and recommendations relating to the following:

- Geotechnical subsurface conditions and groundwater;
- Geotechnical design parameters including bearing capacity and lateral earth pressure for retaining structures;
- Excavations and temporary/permanent shoring system;
- Vibration;
- Groundwater monitoring.

## 1.3. Scope of Work

To achieve the project objectives, the following scope of work was carried out for the geotechnical investigation:

- Review of the relevant geological map;
- Obtain Dial Before You Dig (DBYD) plans;
- Site walkover inspection during the fieldwork to gain an appreciation of the existing conditions and features;
- Drilling of five (5) boreholes across the site to a maximum depth of 15m;
- Carry out Standard Penetration Tests (SPTs) at varied depths to evaluate shallow soil strength;

- Install one (1) monitoring well within the drilled borehole to record static groundwater level;
- Carry out Point Load tests on the recovered rock core samples;
- Prepare a geotechnical investigation report summarising the findings of the geotechnical investigation and provide recommendations for the proposed development.

# 2. Site Condition and Description

## 2.1. Regional Geology

The 1:100,000 scale Geological Series Map of the Sydney region indicates that the subject site is underlain by a Middle Triassic Hawkesbury Sandstone (Rh/Rhs) of the Mesozoic Era, described as *'Medium to coarse-grained quartz sandstone, very minor shale and laminite lenses/Shale, laminite'.*


**Image 1 - 1:100,000 Geological Map of the Sydney Region**

## 2.2. Site Details

Based on the provided drawings, it is understood that the proposed four (4) storey mixed-use development includes three (3) basement levels. The lower basement finished floor level is at RL 144.8m AHD and the excavation depth is approximately 13.85m from the existing ground surface (towards Lockwood Av). A service station (Caltex Woolworths) was observed at the eastern perimeter of the site, situated within the anticipated excavation zone of influence.

The approximate set back distance of the site boundary from the proposed basement excavations varies across the site, the majority of external basement walls extend to the full site boundary with the exception of two localised sections located on the north-west corner and southeast corner of the site. It is envisaged overlying landscaping has been proposed within these two localised areas.

## 2.3. Site Description

The site is located within The Northern Beaches Council governing area, with site access from Lockwood Ave located on the southern perimeter of the site location/boundary. The site maintains

an approximate area of 5,444 $m^2$ and is located approximately 0.50 km west of Lionel Watts Reserve. Topographically, the site was observed to be of a sloping terrain during AGS's site visit. It has been proposed that further earthwork will be undertaken on the existing terrain. From south to north, an approximate descending gradient of 4.39° was estimated, with contour levels derived from the aforementioned survey plan.


**Image 2 - General Site Location**

As indicated in Image 2, the site is bounded by:

- Residential dwellings (to west);
- Lockwood Av (to south);
- Service Station (to east); and
- Glenrose Place (to north).

The proposed mixed-use development will be constructed in close proximity to the neighbouring service station and residential dwellings.

# 3. Fieldwork

## 3.1. Drilling Investigation

AGS undertook the site investigation fieldwork on multiple dates between 15th to 17th March 2021. The site photos taken during the fieldwork are enclosed in Appendix A. Prior to the commencement of the site investigation, the borehole locations were confirmed by the client on site. AGS supervised the geotechnical site investigation including:

- Drilling of 5 boreholes (BH01 to BH05) to a maximum depth up to 15m.
- Undertaking SPT tests in selected boreholes;
- Installing one (1) monitoring well (BH02).

The location of boreholes is shown on the Borehole Location Plan (Figure 1) enclosed in Appendix A. The approximate borehole locations were determined by measuring from the existing site features.

The boreholes were drilled using a Hanjin D&B 8D drilling rig operated by BG Drilling. The boreholes were advanced by solid flight 100 mm diameter auger with a TC (Tungsten Carbide) drill bit. A combination of augering with a TC drill bit and core drilling with NMLC core barrel was used to advance each borehole and were terminated upon reaching the target depth.

During the site investigation, the subsurface strata encountered was logged by an AGS's geotechnical engineer and SPTs were undertaken at selected intervals to assess shallow soil consistency. The borehole logs and the core box photos are enclosed in Appendix B and A respectively.

Rock core samples were collected for geotechnical laboratory testing of Point Load Tests ($Is_{50}$) for Axial and Diametral at 1.0m intervals.

One (1) monitoring well was installed in BH2 to determine the stabilised groundwater level. The screen in BH2 extends to an approximate depth of 14.6m to measure the groundwater seepage through the bedrock joints, passing the level of the proposed basement excavation. The monitoring well was installed on the 15th March 2021 and the final recording of static water level was undertaken on 17th March 2021.

## 3.2. Soil Profiles

The inferred subsurface condition of the boreholes is summarised in Table 1. Detailed borehole logs (BH01 to BH05) are enclosed in Appendix B.

**Table 1- Subsurface Condition**

| Boreholes | Ground Surface Level | Unit 1 | Unit 2 | Unit 3 | Unit 4 | Unit 5 | Termination depth |
|---|---|---|---|---|---|---|---|
| | | Topsoil/ Fill Silty Gravelly Sand | Residual Soil Loose to Very Dense Silty Sand | EL St – VL St Sandstone (EW – HW) | VL St – M St Sandstone (HW – MW) | M St – H St Sandstone (MW – SW) | |
| | (m) | (m) | (m) | (m) | (m) | (m) | (m) |
| **BH01** | 156.0 | 0.0 – 0.8 | 0.8 – 2.5 | 2.5 – 8.9 | 8.9 – 10.9 | 10.9 – 15.73 | 15.73 |
| **BH02** | 157.6 | 0.0 – 0.5 | 0.5 – 2.5 | 2.5 – 8.8* | 8.8 – 9.6 | 9.6 – 14.60 | 14.60 |
| **BH03** | 155.7 | 0.0 – 0.5 | 0.8 – 2.8 | 2.8 – 7.4 | 7.4 – 8.8 | 8.8 – 14.74 | 14.74 |
| **BH04** | 153.5 | 0.0 – 0.2 | 0.2 – 2.5 | 2.5 – 8.6 | 8.6 – 10.5 | 10.5 – 14.70 | 14.70 |
| **BH05** | 154.2 | 0.0 – 0.2 | 0.2 – 2.5 | 2.5 – 4.6 | 4.6 – 7.4 | 7.4 – 14.65 | 14.65 |
| *Core loss from an approximate depth of 8.0m to 8.7m which is expected to be a clay band. | | | | | | | |
| **Legend:**<br>VL St.: Very Low Strength<br>L. St.: Low Strength<br>M St.: Medium Strength<br>H St. : High Strength | | | | | | EW: Extremely weathered<br>HW: highly weathered<br>MW: Moderately weathered<br>SW: Slightly weathered | |

Based on the soil and rock material recovered during auger drilling and SPT results (presented in the attached borehole logs, in Appendix B), the generalised subsurface condition is summarised as follows:

*Topsoil & Fill*

The topsoil was encountered in BH01 and BH05 consisted of Silty Sand to a maximum depth of 0.8m. underlying fill material encountered in BH02 and BH04. The fill consisted of well compacted gravelly clay with an approximate thickness of 0.2m.

*Residual Soil*

The residual soils comprise low plasticity, firm to stiff sandy clay, loose to very dense clayey sand and silty sand. The depth of the residual soil encountered, extends to an approximate depth of 2.2m to 2.5m across the site.

*Bedrock*

The site is underlain by extremely to slightly weathered, extremely low to high strength sandstone bedrock extending to an approximate depth of 15.75m, across the site. Frequent clay seams were observed across all cored boreholes, varying between 4m, 8m, 11m and 14 below ground levels across selected boreholes.

The bedrock profile at BH02 exhibited 0.7m core loss with has several joints with a maximum dip angle of 30 degrees, indicating a reduced level of bedrock quality in conjunction with clayey seams

with a thickness of 100mm at an approximate depth of 6.9m and a few clayey seams with an average thickness of 20mm between an approximate depth of 13.3m and 13.6m below the ground surface.

### 3.3. Groundwater Seepage

Groundwater seepage was not observed during the auger drilling of each borehole. It should be noted that the groundwater seepage was not observed to the depth of auger drilling and could not be detected accurately upon coring into bedrock due to the use of drilling fluids.

Groundwater level was measured in the installed monitoring well two (2) days upon completion of borehole drilling of BH02 on 17th March 2021 at an approximate depth of 14.6m below the existing ground surface in BH02. The recorded groundwater level is presented in Table 2.

**Table 2- Groundwater Water Levels**

| Monitoring Well | Well Elevation (m) | Well Depth (m) | Water depth (m) | Solid well length (m) | Screen depth (m) |
|---|---|---|---|---|---|
| BH02 | RL ~ 157.6 | 14.6 | 5.3 (RL ~ 152.3m) | 0 – 8.6 | 8.6 – 14.6 |

# 4. Recommendations

## 4.1. Groundwater Considerations

As described in Section 3.3, the monitoring wells were installed to an approximate depth of 14.6m below the existing ground surface to the base of the cored borehole. The stabilised groundwater level was measured at an approximate depth of 5.3m (RL 152.3m) in BH02.

Considering the groundwater seepage level fluctuation following the seasonal rainfall changes and water level observations, a design groundwater level of RL 153m AHD is recommended for the groundwater dewatering and basement excavation support (temporary shoring system and permanent retaining wall).

*Dewatering during construction*

Groundwater dewatering during the construction can be carried out using the pump-sump method. Groundwater inflow is expected during pile boring. Therefore, pumps may be required to remove seepage from bored pile holes prior to the placement of concrete, if bored piles are adopted. Alternatively, the tremie concrete placement method could be adopted for the concrete placement.

*Drainage during the building lifetime*

Generally, groundwater seepage during the building lifetime can be controlled by a properly designed drainage system. It will be required to design a sub-floor drainage system to create a free drain layer below the base of the concrete slab to release the uplift pressure. As such, this sub-floor drainage system should be designed properly to avoid any water accumulation below the lower basement concrete slab.

## 4.2. Excavation Considerations

As described in Section 2.2, the proposed basement finished floor level is at RL 144.8m (AHD) and the maximum excavation depth is approximately 13.85m towards Lockwood Ave.

The excavation for the proposed basement is expected to encounter fill material comprising silty clay, firm to stiff residual silty clay, loose to dense silty sand and sandstone bedrock with varied strength and classification ranging from extremely low to high strength across the site. In accordance with point load test results, it is expected the base of the proposed bulk excavation will be founded on medium to high strength sandstone with the exception of BH05 (RL144.8m founded within low to medium strength sandstone).

Excavations through the overlying residual soils and extremely weathered sandstone bedrock to the approximately 2.5m are expected to be readily achieved using conventional earthworks excavation equipment including excavator and backhoe. Excavation works from 2.5m will be required to advance with appropriate rock breaking equipment, retention pile excavation and basement bulk excavation should be undertaken while maintaining the ground vibration peak particle velocity below 5mm/sec.

A dilapidation survey on nearby structures and infrastructures must be undertaken prior to the commencement of any site excavations. The report should include precise measurements of the existing defects and cracks presented with relevant photos.

Temporary batter slopes are not feasible for the proposed deep excavation along all perimeters of the site as unsupported temporary excavations in soil and bedrock are anticipated to extend below the 'zone of influence' of the adjacent structures, road and infrastructures (the service station in particular).

### 4.3. Excavation Support

The proposed basement excavation should be supported by a properly designed shoring system along the site perimeter. The shoring system could take the form of a soldier piled wall with reinforced shotcrete infill panels and drainage provided behind the shotcrete panels. The soldier piles are usually spaced at approximately 2 m to 2.5 m centres, however, more closely spaced piles may be required to reduce wall movements, or prevent the collapse of infill materials, particularly where pavements, structures or services are located in close proximity to the excavation.

The shoring system piles must extend below the proposed lowest level basement slab level at RL144.8m AHD. The socket depth of the shoring system should be indicated by the design engineer following undertaking analysis to assess the lateral pressures exerted and stability of the excavation. A minimum socket depth of 0.5m into the medium to high strength sandstone is recommended for the shoring system piles.

The lateral pressures exerted, and stability of the temporary shoring system could be achieved by bracing the excavation with struts/temporary tilt struts or temporary anchors. Alternatively, a cantilevered braced piled wall could be adopted. Temporary anchors will be required to support the soldier piled walls until the wall can be braced by the basement slabs. Anchors will need to be installed progressively as the excavation proceeds below the existing ground surface level and should be inclined sufficiently to allow for penetration through the residual clay soils to anchor into the sandstone bedrock.

The temporary ground anchors may be designed with maximum ultimate bond stress as provided in Table 3

**Table 3 - Recommended Ultimate Bond Stress for Temporary Anchors**

| Description | Ultimate Bond Stress (kPa) |
|---|---|
| Very low strength sandstone | 70 |
| Low to medium strength sandstone | 150 |
| Medium to high strength sandstone | 350 |

The parameters outlined in Table 3 is provided on the assumption that all drilled holes are clean and adequately flushed. Anchor designs should be based on bonding to be developed behind an active zone. Anchor bond lengths should be minimum of 3m and not exceeding 7m in length to reduce the potential for progressive debonding failure. The specific requirements for excavation support are to be assessed by an experienced geotechnical engineer as the excavation proceeds. It is recommended that every 2m depth of the excavation be inspected by an experienced geotechnical engineer.

Periodic checks of installed anchors should be carried out during the construction to ensure lock offload is maintained. The geotechnical design parameters provided in Table 4 can be used for shoring system design. The design of excavation support could be incorporated as the permanent basement wall. It is recommended that the design and installation of the anchors shall be in accordance with AS4678-2002, Appendix B and BS 8081-1989. Anchors should be proof loaded as follows:

- 1.3 times Working load for temporary anchors.
- 1.5 times Working load for permanent anchors.

It is anticipated that the building will support the basement excavation over the long term and therefore the ground anchors are expected to be temporary only. The use of permanent anchors would require careful attention to corrosion protection including full column grouting and the use of internal corrugated sheathing over the full length of the anchor. A detailed specification would need to be prepared for the installation and stressing of permanent anchors.

Survey monitoring (inclinometers) should be carried out during the construction of the shoring system to check and confirm that deflections and movements are within tolerable values accepted in design. This can be developed as a part of the excavation management and monitoring plan.

### 4.4. Lateral Earth Pressure Coefficients

Earth retaining structures should be designed in accordance with AS 4678-2002, to withstand the applied lateral pressures of the subsurface soil layers, hydrostatic pressure together with the existing live surcharge loads within the zone of influence of the adjoining service station referring to the parameters provided in Table 4.

**Table 4- Parameters for Retaining Structure Design**

| Description | C′ (kPa) | Ø′ (degrees) | $\gamma$ (KN/m$^3$) | $K_a$ | $K_p$ | $K_o$ | E MPa |
|---|---|---|---|---|---|---|---|
| Unit 2 - Residual | 1 | 26 | 18 | 0.39 | 2.56 | 0.56 | 15 |
| Unit 3 - EL St – VL St Sandstone | 50 | 28 | 22 | 0.36 | 2.77 | 0.53 | 75 |
| Unit 4 - VL St – M St Sandstone | 100 | 33 | 22 | 0.29 | 3.39 | 0.46 | 200 |
| Unit 5 - M St – H St Sandstone | 200 | 40 | 23 | 0.22 | 4.60 | 0.36 | 500 |

| | |
|---|---|
| Legend:<br>Ø′ : Effective Friction Angle<br>$\gamma$ : Unit Weight<br>$K_a$: Active earth pressure | $K_o$: Earth pressure at rest<br>E: Elasticity Modulus<br>$\vartheta$: Poisson's Ratio<br>c': Effective Cohesion |

For the design of a flexible retaining structure, where some lateral movement is acceptable, an 'active' lateral earth pressure coefficient is recommended ($k_a$). If it is critical to limit the horizontal deformation of a retaining structure of an earth pressure coefficient 'at rest' should be considered ($k_o$).

If the retaining system is to be constructed with top to bottom bracing or anchoring method, the retaining wall should be preliminarily designed using a trapezoidal pressure distribution. The braced shoring system may be modelled utilising finite element numerical analysis software. In this case, surcharge pressure including the pressure applied by the pilling rig and machinery placed within the zone of influence of the excavation should be added to the above stress distribution.

### 4.5. Foundation

It is expected that the majority of the bulk excavation will expose Unit 5. However, weathered clay seams presence and Unit 4 is expected towards the eastern portion of the site (towards the service station). A reduction in bedrock strength was observed within Borehole 5 at anticipated founding levels (low to medium strength sandstone at approx. 9.4m below ground level). It is recommended to found footings on the same material to avoid the risk of differential settlements. On this basis, deepened pad or strip footings on Unit 5 – medium to high strength sandstone may be adopted. The adoption of this allowable bearing pressure for a traditional working stress design of footing will generally result in footing settlements of less than 1% of the footing width.

Alternatively, if loads are such that rock socketed piles are required, the preliminary design of piles may be based on the following parameters outlined in Table 5 for bored piles.

**Table 5 – Geotechnical Design Parameters for Deep Foundations**

| Description | Ultimate End Bearing Pressure (MPa) | Serviceability End Bearing Pressure (MPa) | Ultimate Shaft Adhesion (kPa) | Elastic Modulus (MPa) |
|---|---|---|---|---|
| **Unit 4 Sandstone** | 4 | 1 | 200 | 200 |
| **Unit 5 Sandstone** | 15 | 2.5 | 650 | 500 |

As mentioned in Section 3.3 and Section 4.1, significant groundwater inflow during pile boring is expected. Therefore, placing bored pile concrete by tremie concrete placement method is recommended.

For traditional working stress design approaches, the allowable bearing pressure values should result in settlements of less than 1% of the least footing/pile width. Shaft adhesion is based on adequately clean and roughened sockets of category "R2", or better (Pells et al., 1998). Inspections should be

undertaken during the pile boring or before lowering the reinforcement cage and pouring concrete. An experienced geotechnical engineer should confirm the design socket depths on-site and also confirm that the base of the piles is clean and free of soft, loose, wet, or disturbed soils.

## 5. Limitations

Atlas Geotechnical Services Pty Ltd (AGS) has performed its services for this project in accordance with current industry codes and practices. The advice given in this report assumes that the test results are representative of the overall ground conditions. However, it should be noted that actual conditions in some parts of the site might differ from those found. If excavations reveal ground conditions significantly different from those shown in our findings, AGS must be consulted.

The scope and the period of AGS services are described in the report and are subject to restrictions and limitations. AGS did not perform a complete assessment of all possible conditions or circumstances that may exist at the Site. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by AGS regarding it.

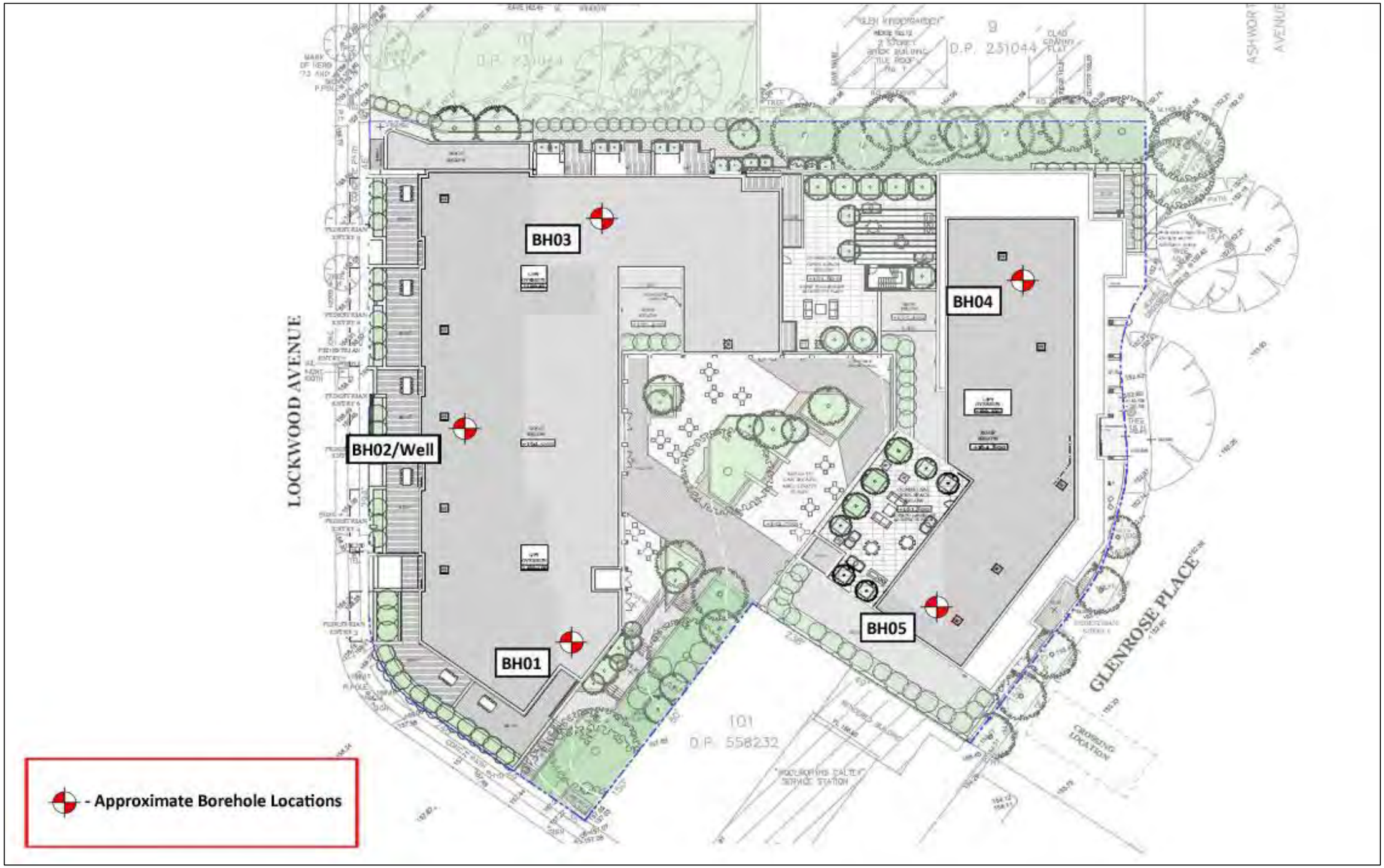
Where data has been supplied by the client or a third party, it is assumed that the information is correct unless otherwise stated. No responsibility is accepted by AGS for incomplete or inaccurate data supplied by others. Any drawings or figures presented in this report should be considered only as pictorial evidence of our work. Therefore, unless otherwise stated, any dimensions should not be used for accurate calculations or dimensioning.

# 6. References


- AS1726-1993 - Geotechnical Site Investigations
- AS 1289 – 2006 - Method of testing soils for engineering purposes
- AS 2870-2011 - Residential slabs and Footings Construction
- AS 2159-2009 - Piling - Design and Installation
- AS 3798 – 2007 - Guidelines on Earthworks for Commercial and Residential Developments
- AS 4678 -2002 – Earth Retaining Structures
- BS 8081 – 1989 Ground Anchorages
- The 1:100,000 NSW Department of Mineral Resources Geological Map of Sydney

# APPENDIX A

## FIGURES




Source: Client Supplied

| | | | | | | |
|---|---|---|---|---|---|---|
| Atlas Geotechnical Services<br>On Budget. On Time. Professional Service<br>ABN: 67 626 182 349<br>W: www.atlasgeoservice.com.au<br>E: info@atlasgeoservice.com.au<br>P: PO BOX 39, Bonnyrigg NSW 2177 | Client:<br>Mills Oakley Pty Ltd | Project Name:<br>Proposed Mixed-Use Development<br>Project Address:<br>28 Lockwood Ave, Belrose NSW 2085 | Report No:<br>G10132-1<br>Figure Date:<br>26/3/21 | | Figure No:<br>Figure 1 | Figure Title:<br>Borehole Location Plan |


**Figure 2.1 – General View of Residual Profile (BH01)**


**Figure 2.2 – General View of Drilling Operation (BH02)**

**Figure 2.3 – Detail View of SPT Recovered Material (1.0m blg)**

| | | | | | | |
|---|---|---|---|---|---|---|
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| | | Project Address:<br>28 Lockwood Ave, Belrose NSW 2085 | Figure Date:<br>26/3/21 | | | |


**Figure 3.1 – Borehole 1 Core Specimens**


**Figure 3.2 – Borehole 2 Core Specimens**


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| Client: | Project Name: | Report No: | | Figure No: | Figure Title: |
|---|---|---|---|---|---|
| Mills Oakley Pty Ltd | Proposed Mixed-Use Development | G10132-1 | | Figure 3 | Core Specimens |
| | Project Address: 28 Lockwood Ave, Belrose NSW 2085 | Figure Date: 26/3/21 | | | |


**Figure 4.1 – Borehole 3 Core Specimens**


**Figure 4.2 – Borehole 4 Core Specimens**

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| Mills Oakley Pty Ltd | Proposed Mixed-Use Development | G10132-1 | | Figure 4 | Core Specimens |
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**Figure 5 – Borehole 5 Core Specimens**

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| Client: | Project Name: | Report No: | | Figure No: | Figure Title: |
|---|---|---|---|---|---|
| Mills Oakley Pty Ltd | Proposed Mixed-Use Development | G10132-1 | | Figure 5 | Core Specimens |
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| Mills Oakley Pty Ltd | Proposed Mixed-Use Development | G10132-1 | | Figure 6 | Point Load Testing |
| | Project Address: 28 Lockwood Ave, Belrose NSW 2085 | Figure Date: 26/3/21 | | | |

# APPENDIX B

## BOREHOLE LOGS

Atlas Geotechnical Services Pty Ltd
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**BH No: BH01**
**PAGE 1 OF 2**
**Job No:** G10132-1

# Borehole Log

**Client:** Mills Oakley
**Project:** Proposed Mixed-Use Development
**Location:** 28 Lockwood Av, Belrose NSW 2085
**Started:** 15/3/21
**Finished:** 17/3/21
**Borehole Size:** 100 mm

**Rig Type:** Hanjin
**Hole Location:** Refer to Figure 1
**Driller:** BG Drilling
**Logged:** PC
**RL Surface (m):** 156
**Contractor:**
**Bearing:** ---
**Checked:** MH

| Method | Water | RL (m) | Depth (m) | Graphic Log | Classification Symbol | Material Description | Samples Tests Remarks | Moisture Condition | Consistency/ Density Index | Additional Observations |
|---|---|---|---|---|---|---|---|---|---|---|
| ADT | | | | | | Silty Sand, dark brown, with rootlets | | M | | TOPSOIL |
| | | | | | CLS | Sandy Clay, orange brown, trace of fine gravel | SPT 1, 2, 4 N=6 | M | F | RESIDUAL |
| | | 154 | 2 | | | Silty Sand, red brown, trace of fine ironstone gravel, slightly ironstained | SPT @ 0.5m | D | MD | |
| | | | | | | Sandstone, grey, extremely weathered, extremely low strength | | | | BEDROCK |
| | | | | | | Borehole BH01 continued as cored hole | | | | |
| | | 152 | 4 | | | | | | | |
| | | 150 | 6 | | | | | | | |
| | | 148 | 8 | | | | | | | |
| | | 146 | 10 | | | | | | | |
| | | 144 | 12 | | | | | | | |
| | | 142 | 14 | | | | | | | |
| | | 140 | 16 | | | | | | | |
| | | 138 | 18 | | | | | | | |
| | | 136 | 20 | | | | | | | |

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**BH No: BH01**
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**Job No:** G10132-1

# Cored Borehole Log

**Client:** Mills Oakley
**Project:** Proposed Mixed-Use Development
**Location:** 28 Lockwood Av, Belrose NSW 2085
**Started:** 15/3/21
**Finished:** 17/3/21
**Borehole Size:** 100 mm

**Rig Type:** Hanjin
**Hole Location:** Refer to Figure 1
**Driller:** BG Drilling
**Logged:** PC
**RL Surface (m):** 156
**Contractor:**
**Bearing:** ---
**Checked:** MH

| Method | Water | RL (m) | Depth (m) | Graphic Log | Material Description | Weathering | Estimated Strength (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH) | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | Defect Spacing mm (30, 100, 300, 1000, 3000) | Additional Data |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 154 | 2 | | Continued from non-cored borehole | | | | | | |
| NMLC CORING | | | | | Sandstone, light grey, extremely low strength | HW | | D 0.16 A 0.16 | | | INFILL<br>-2.57m, BP, QZ, UN, RF |
| | | | | | Sandstone, brown, low strength | HW | | | | | -2.6m, BP, QZ, UN, RF |
| | | | | | Siltstone, light grey, low strength | EW | | | | | -2.7m, BP, QZ, UN, RF<br>-2.77m, JT 10°, CN, UN, RF |
| | | | | | Sandstone, light grey, low strength | HW | | | | | -2.94m, BP, CN, UN, S |
| | | 152 | 4 | | Sandstone, light grey, high strength | HW | | D 0.22 A 0.13 | 87 | | -3.0m, HB, QZ, UN, RF<br>-3.13m, BP, X, PR, S |
| | | | | | Sandstone, light grey, high strength | MW | | | | | -3.45m, BP, X, CLAY, PR, S<br>-3.46m, JT 15°, CLAY, IR, RF |
| | | | | | Sandstone, light grey, high strength | MW | | D 1.10 A 0.96 | | | -3.67m, BP, CN, PR, S<br>-3.91m, BP, CN, CU, S |
| | | | | | | | | | | | -4.0m, HB, CN, UN, S<br>-4.2m, BP, X, PR, S |
| | | 150 | 6 | | | | | D 0.75 A 0.87 | | | -4.48m, BP, CN, PR, S<br>-4.51m, BP, CLAY, UN, S<br>-4.71m, BP, CN, UN, S |
| | | | | | Sandstone, brown, medium strength | EW | | | | | -5.0m, HB, QZ, UN, RF |
| | | | | | Sandstone, light grey, low strength | HW | | D 0.16 A 0.16 | 95 | | -5.41m, BP, CN, PR, S<br>-5.56m, BP, QZ, CU, RF<br>-5.71m, BP, X, CU, S |
| | | | | | Siltstone, light grey, low strength | EW | | | | | -6.0m, HB, CN, CU,S<br>-6.35m, BP, CN, PR, S |
| | | 148 | 8 | | Sandstone, light grey, very low strength | MW | | D 0.04 A 0.03 | | | -6.75m, BP, CN, UN, S<br>-6.94m, BP, CN, PR, S<br>-7.0m, HB, CN, UN, S |
| | | | | | Sandstone, light grey, light brown, medium strength | SW | | D 0.88 A 0.55 | | | -7.05m, JT 20°, QZ, PR, RF<br>-7.32m, BP, QZ, PR, RF<br>-7.46m, SM, CLAY, UN, S |
| | | | | | | | | | | | -7.6m, SM, CLAY, UN, S<br>-7.87m, BP, CLAY, CU, S<br>-8.0m, HB, QZ, CU, RF |
| | | | | | Sandstone, light grey, medium strength | SW | | | | | -8.2m, BP, CN, PR, S |
| | | 146 | 10 | | Siltstone, light grey, medium strength | EW | | D 0.69 A 1 | 91 | | -8.51m, DB, CN, CU, S<br>-8.95m, BP, QZ, PR, RF |
| | | | | | Sandstone, light grey, light brown, medium strength | SW | | | | | -9.0m, HB, QZ, UN, RF<br>-9.3m, BP, CLAY, UN, S |
| | | | | | Sandstone, light grey, light brown, medium strength | SW | | D 1.12 A 1.29 | | | -9.43m, BP, X, CU, RF<br>-9.9m, BP, X, UN, S |
| | | | | | | | | | | | -10.0m, HB, CN, UN, S<br>-10.05m, JT 20°, CN, CU, S |
| | | 144 | 12 | | Sandstone, grey, medium strength | SW | | D 0.72 A 1.41 | 100 | | -10.16m, BP, CN, PR, S<br>-10.35m, BP, CN, UN, RF |
| | | | | | | | | | | | -10.41m, BP, CN, UN, S<br>-10.55m, BP, CN, UN, S<br>-10.66m, BP, CN, PR, S |
| | | | | | | | | D 0.77 A 0.69 | 75 | | -10.73m, BP, CN, PR, S<br>-10.93m, BP, CN, PR, RF<br>-11.0m, HB ,CN, UN,S |
| | | | | | | | | | | | -11.12m, HB, QZ, UN, RF<br>-11.17m, BP, CN, PR, S |
| | | 142 | 14 | | Clay seam, light brown | EW | | D 0.47 A 0.45 | | | -11.3m, BP, CN, PR, S |
| | | | | | Sandstone, light grey, light brown, medium strength | SW | | | | | -11.37m, BP, CN, PR, S<br>-11.61m, DB, CN, UN, S<br>-12.0m, HB, CN, UN, RF |
| | | | | | | | | D 0.76 A 0.6 | 89 | | -12.1m, BP, CN, UN, S<br>-12.21m, BP, CN, CU, S |
| | | | | | | | | | | | -12.37m, DB, CN, CU, S<br>-12.44m, BP, CN, CU, S<br>-12.49m, BP, CN, CU, S |
| | | | | | | | | D 0.66 A 0.44 | | | -12.57m, BP, CN, CU, S<br>-12.67m, BP, CN, CU, S<br>-12.70m, BP, CN, CU, S |
| | | | | | | | | | | | -12.82m, BP, CN, CU, S<br>-13.0m, HB, QZ, UN, RF<br>-13.2m, BP, CN, CU, S |
| | | 140 | 16 | | BH01 terminated at 15.73m | | | | | | -13.67m, BP, QZ, CU, RF<br>-13.77m, SM, CLAY, IR, S |
| | | 138 | 18 | | | | | | | | -13.87m, SM, CLAY, IR, S<br>-14.0m, HB, CN, UN, RF<br>-14.1m, BP, CN, CU, S |
| | | | | | | | | | | | -14.22m, BP, CN, PR, S<br>-14.28m, JT 30°, CN, PR, S<br>-14.35m, BP, CLAY, UN, S |
| | | 136 | 20 | | | | | | | | -15.0m, HB, QZ, ST, RF<br>-15.2m, BP, CN, CU, S<br>-15.67m, BP, CN, CU, S<br>-15.73m, BP, CN, CU, S |

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# Borehole Log

**Client:** Mills Oakley
**Project:** Proposed Mixed-Use Development
**Location:** 28 Lockwood Av, Belrose NSW 2085
**Started:** 15/3/21
**Finished:** 17/3/21
**Borehole Size:** 100 mm

**Rig Type:** Hanjin
**Hole Location:** Refer to Figure 1
**Driller:** BG Drilling
**Logged:** PC
**RL Surface (m):** 157.6
**Contractor:**
**Bearing:** ---
**Checked:** MH

| Method | Water | Well Details | RL (m) | Depth (m) | Graphic Log | Classification Symbol | Material Description | Samples Tests Remarks | Moisture Condition | Consistency/ Density Index | Additional Observations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | | | | | | | Silty Sand, dark brown, with rootlets | | D | | TOPSOIL |
| | | | | | | CLS | Gravelly Clay, light brown and grey, fine to medium gravel, appears well compacted | | M | St | FILL |
| | | | | | | | Sandy Clay, orange brown, trace of fine gravel | | M | | RESIDUAL |
| | | | 156 | 2 | | SP-SM | Silty Sand, red brown, trae of fine ironstone gravel, slightly ironstained | SPT 25, 30, R SPT @ 1.0m | M | D | |
| | | | | | | | Sandstone, red brown, extremely weathered, extremely low strength | | | | BEDROCK |
| | | | | | | | Borehole BH02 continued as cored hole | | | | |
| | | | 154 | 4 | | | | | | | |
| | | | 152 | 6 | | | | | | | |
| | | | 150 | 8 | | | | | | | |
| | | | 148 | 10 | | | | | | | |
| | | | 146 | 12 | | | | | | | |
| | | | 144 | 14 | | | | | | | |
| | | | 142 | 16 | | | | | | | |
| | | | 140 | 18 | | | | | | | |
| | | | 138 | 20 | | | | | | | |

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**BH No: BH02**
**PAGE 2 OF 2**
**Job No:** G10132-1

# Cored Borehole Log

**Client:** Mills Oakley
**Project:** Proposed Mixed-Use Development
**Location:** 28 Lockwood Av, Belrose NSW 2085
**Started:** 15/3/21
**Finished:** 17/3/21
**Borehole Size:** 100 mm

**Rig Type:** Hanjin
**Hole Location:** Refer to Figure 1
**Driller:** BG Drilling
**Logged:** PC

**RL Surface (m):** 157.6
**Contractor:**
**Bearing:** ---
**Checked:** MH

| Method | Water | Well Details | RL (m) | Depth (m) | Graphic Log | Material Description | Weathering | Estimated Strength (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH) | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | Defect Spacing mm (30, 100, 300, 1000, 3000) | Additional Data |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 156 | 2 | | Continued from non-cored borehole | | | | | | |
| NMLC CORING | Static Level | | 154 | 4 | | Sandstone, Brown, Very low - Low strength | HW | | D 0.34 A 0.23 | 83 | | INFILL |
| | | | | | | Sandstone, Brown, Light Brown, Very low - Low strength | | | D 0.32 A 0.37 | | | -3.0m, HB, CN, UN, RF<br>-3.13m, BP, CLAY, UN, RF<br>-3.41m, BP, CLAY, UN, RF<br>-3.67m, BP, QZ, UN, RF<br>-3.91m, BP, QZ, UN, RF<br>-3.97m, BP, QZ, UN, RF<br>-4.0m, HB, QZ, UN, S<br>-4.09m, BP, QZ, UN, S<br>-4.54m, BP, MS, PR, S<br>-4.62m, BP, MS, PR, S<br>-4.79m, BP, QZ, UN, S<br>-5.0m, HB, QZ, UN, RF<br>-5.14m, BP, QZ, UN, RF<br>-5.41m, JT 20°, QZ, UN, RF<br>-5.43m, FZ, IR, QZ, RF<br>-5.55m, BP, QZ, UN, RF<br>-5.76m, BP, X, PR, RF<br>-6.0m, HB, QZ, PR, RF<br>-6.2m, BP, X, PR, S<br>-6.3m, JT 30°, QZ, IR, S<br>-6.35m, JT 30°, QZ, IR, S<br>-6.59m, BP, QZ, PR, RF<br>-6.74m, BP, QZ, UN, RF<br>-6.9m, BP, CALY, UN, S<br>-7.0m, HB, CALY, UN, S<br>-7.17m, BP, X, UN, S<br>-7.5m, BP, X, PR, S<br>-7.56m, BP, FE, UN, S<br>-7.65m, BP,ST,CLAY,S<br>-7.74m, BP, ST, CLAY, S<br>-7.9m, FZ, QZ, IR, RF<br>-8.0m, HB,QZ, IR, RF<br>-8.7m, DB, QZ, IR, RF<br>-8.72m, DP, QZ, IR, RF<br>-8.93m, BP, QZ, IR, RF<br>-9.0m, HB, QZ, IR, RF<br>-9.2m, BP, UN, IR, RF<br>-9.6m, BP, CN, UN, RF<br>-9.83m, BP, CLAY, PR, S<br>-10.0m, HB, CLAY, PR, RF<br>-10.12, BP, CLAY, PR, S<br>-10.23m, BP, CLAY, PR, S<br>-10.94m, BP, CLAY, PR, S<br>-11.0m, HB, QZ, IR, RF<br>-11.36m, BP, QZ, UN, RF<br>-11.6m, DB, CLAY, UN, S<br>-11.76m, BP, QZ, UN, RF<br>-12.0m, HB, QZ, IR, RF<br>-12.3m, BP, QZ, CU, RF<br>-12.63m, BP, QZ, CU, RF<br>-12.71m, BP, QZ, CU, RF<br>-12.83m, BP, QZ, CU, RF<br>-13.0m, HB, QZ, CU, RF<br>-13.08m, FZ, QZ, IR, RF<br>-13.19m, BP, QZ, PR, RF<br>-13.3, SM, CLAY, PR, S<br>-13.36m, SM, CLAY, PR, S<br>-13.9m, BP, QZ, IR, RF<br>-14.0m, HB, QZ, IR, RF<br>-14.06m, HB, QZ, PR, RF<br>-14.6m, BP, QZ, PR, RF |
| | | | 152 | 6 | | Sandstone, Light Grey, Very low - Low strength | HW | | D 0.26 A 0.32 | | | |
| | | | | | | Sandstone, Light Grey, Very low - Low strength | MW | | | | | |
| | | | | | | Sandstone, Light Grey, Very low - Low strength | HW | | D 0.56 A 0.24 | | | |
| | | | | | | Sandstone, Light Grey, Very low - Low strength | MW/HW | | | | | |
| | | | | | | Sandstone, Light Grey, Very low - Low strength | MW/HW | | | | | |
| | | | | | | Sandstone, Light Brown, Brown, low - Medium strength | EW | | D 0.88 A 0.75 | 85 | | |
| | | | | | | Sandstone, Light Grey, low - Medium strength | HW | | | | | |
| | | | 150 | 8 | | Siltstone, Light Grey, low - Medium strength | EW | | D 0.24 A 0.09 | | | |
| | | | | | | Sandstone, Light Grey, low - Medium strength | HW | | | | | |
| | | | | | | Siltstone, Light Grey, low - Medium strength | | | | | | |
| | | | | | | Sandstone, Light Grey, Very low - Low strength | MW/HW | | | | | |
| | | | | | | Core Loss (700mm) | | | | | | |
| | | | 148 | 10 | | Sandstone, Light Brown, Brown, Medium - High strength | | | D 0.89 A 0.15 | | | |
| | | | | | | | | | D 0.82 A 0.53 | | | |
| | | | | | | | | | D 1.56 A 0.88 | 94 | | |
| | | | 146 | 12 | | | | | D 1.02 A 0.66 | | | |
| | | | | | | | | | D 0.57 A 0.51 | | | |
| | | | 144 | 14 | | | | | D 0.59 A 0.23 | 91 | | |
| | | | | | | | | | D 0.52 A 0.67 | | | |
| | | | | | | BH02 terminated at 14.6m | | | | | | |
| | | | 142 | 16 | | | | | | | | |
| | | | 140 | 18 | | | | | | | | |
| | | | 138 | 20 | | | | | | | | |

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**BH No: BH03**
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**Job No:** G10132-1

# Borehole Log

**Client:** Mills Oakley
**Project:** Proposed Mixed-Use Development
**Location:** 28 Lockwood Av, Belrose NSW 2085
**Started:** 15/3/21
**Finished:** 17/3/21
**Borehole Size:** 100 mm

**Rig Type:** Hanjin
**Hole Location:** Refer to Figure 1
**Driller:** BG Drilling
**Logged:** PC
**RL Surface (m):** 155.74
**Contractor:**
**Bearing:** ---
**Checked:** MH

| Method | Water | RL (m) | Depth (m) | Graphic Log | Classification Symbol | Material Description | Samples Tests Remarks | Moisture Condition | Consistency/ Density Index | Additional Observations |
|---|---|---|---|---|---|---|---|---|---|---|
| ADT | | | | | | Silty Sand, dark brown, with rootlets | | D | | TOPSOIL |
| | | | | | CLS | Sandy Clay, orange brown, trace of fine gravel (rounded) | SPT 2, 3, 4 N=7 SPT @ 0.5m | M | F - St | RESIDUAL |
| | | 154 | 2 | | | Silty Sand, red brown, trace of fine ironstone gravel | | D | MD | |
| | | 152 | 4 | | | Borehole BH03 continued as cored hole | | | | |
| | | 150 | 6 | | | | | | | |
| | | 148 | 8 | | | | | | | |
| | | 146 | 10 | | | | | | | |
| | | 144 | 12 | | | | | | | |
| | | 142 | 14 | | | | | | | |
| | | 140 | 16 | | | | | | | |
| | | 138 | 18 | | | | | | | |
| | | 136 | 20 | | | | | | | |

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**BH No: BH03**
**PAGE 2 OF 2**
**Job No:** G10132-1

# Cored Borehole Log

**Client:** Mills Oakley
**Project:** Proposed Mixed-Use Development
**Location:** 28 Lockwood Av, Belrose NSW 2085
**Started:** 15/3/21
**Finished:** 17/3/21
**Borehole Size:** 100 mm

**Rig Type:** Hanjin
**Hole Location:** Refer to Figure 1
**Driller:** BG Drilling
**Logged:** PC
**RL Surface (m):** 155.74
**Contractor:**
**Bearing:** ---
**Checked:** MH

| Method | Water | RL (m) | Depth (m) | Graphic Log | Material Description | Weathering | Estimated Strength (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH) | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | Defect Spacing mm (30, 100, 300, 1000, 3000) | Additional Data |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 154 | 2 | | Continued from non-cored borehole | | | | | | |
| NMLC CORING | | | | | Sandy Clay, brown (infill) | EW | | D 0.61 A 0.94 | | | - 2.9m, DP, CN, UN, RF |
| | | | | | Sandstone, grey/light grey, medium strength | MW/HW | | D 0.33 A 0.41 | | | - 3.17m, BP, CLAY, UN, RF<br>- 3.26m, BP, CLAY, UN, RF<br>- 3.46m-3.54m, CLAY SEAM |
| | | 152 | 4 | | Sadnstone, red brown and grey, medium strength | EW/HW | | | | | - 3.89m-4.0m, CLAY SEAM |
| | | | | | Sandstone, red brown, medium strength | | | D 0.34 A 0.55 | 87 | | - 4.13m, BP, CN, UN, RF<br>- 4.33m, JT 25°, CN, PR, RF<br>- 4.63m-4.75m, CLAY SEAM |
| | | 150 | 6 | | Sandstone, red brown and grey, very low strength | EW/HW | | D 0.94 A 0.94 | | | - 5.4m, BP, CN, CU, RF<br>- 5.43m, BP, CN, UN, RF |
| | | | | | Sandstone, grey brown, high strength | | | D 0.08 A 0.09 | | | - 5.86m, BP, CN, UN, S<br>- 5.97m, BP, CN, U S<br>- 6.01m, BP, CN, UN, S<br>- 6.11m, JT 45°, CN, CU, S<br>- 6.3m, BP, UN, CN, S<br>- 6.5m, BP, CN, UN, S |
| | | | | | Sandstone, red brown, high strength | HW | | D 2.49 A 1.68 | 83 | | - 6.62m, BP, CN, UN, S<br>- 6.75m, BP, CN, UN, S<br>- 6.89m, JT 45°, CN, CU, RF |
| | | 148 | 8 | | Sandstone, grey brown, medium to high strength | MW | | | | | - 6.95m, BP, CN, CU, S<br>- 7.11m, BP, CN, UN, S<br>- 7.54m, BP, CN, UN, S<br>- 7.6m, BP, CN, CU, S<br>- 7.63m, BP, CN, UN, S<br>- 7.78m, BP, CN, UN, S<br>- 7.9m, BP, CN, UN, S<br>- 8.37m, BP, CN, PR, RF<br>- 8.75m, DB, CN, UN, RF<br>- 8.86m, BP, CN, PR, S |
| | | | | | | | | D 1.008 A 0.77 | | | |
| | | 146 | 10 | | Sandstone, red brown and grey, high strength | MW/SW | | D 1.178 A 1.3 | 97 | | - 9.25m, BP, CN, UN, S<br>- 9.89m, BP, CN, PR, S<br>- 10.06m, BP, CN, UN, RF<br>- 10.67m, BP, CN, PR, RF<br>- 11.03m, BP, CN, PR, S<br>- 11.17m, BP, CN, UN, S |
| | | | | | | | | D 1.48 A 1.4 | | | |
| | | 144 | 12 | | | | | D 1.172 A 1.64 | | | - 11.58m, BP, CN, PR, S<br>- 11.75m, DB, CN, PR, S<br>- 11.78m, HB, CN, IR, S |
| | | | | | Sandstone, grey brown, medium strength | SW/MW | | D 0.477 A 0.44 | | | - 12.35m, BP, CN, UN, S<br>- 12.56m, BP, CN, UN, S |
| | | | | | Sandstone, red brown, medium strength | SW | | D 0.505 A 0.42 | 88 | | - 12.94m, BP, CN, PR, RF<br>- 13.12m, BP, CN, UN, S<br>- 13.2m, BP, CN, PR, S<br>- 13.46m, BP, CN, UN, S |
| | | 142 | 14 | | Sandstone, grey and red brown, medium strength | MW/SW | | | | | - 13.94m, BP, CN, UN, RF |
| | | | | | | | | D 0.886 A 0.89 | | | - 14.52m, SM, CN, UN, S<br>- 14.64m, SM, SN, UN, S |
| | | | | | BH03 terminated at 14.74m | | | | | | |
| | | 140 | 16 | | | | | | | | |
| | | 138 | 18 | | | | | | | | |
| | | 136 | 20 | | | | | | | | |

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**BH No: BH04**
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**Job No:** G10132-1

# Borehole Log

**Client:** Mills Oakley
**Project:** Proposed Mixed-Use Development
**Location:** 28 Lockwood Av, Belrose NSW 2085
**Started:** 15/3/21
**Finished:** 17/3/21
**Borehole Size:** 100 mm

**Rig Type:** Hanjin
**Hole Location:** Refer to Figure 1
**Driller:** BG Drilling
**Logged:** PC
**RL Surface (m):** 153.45
**Contractor:**
**Bearing:** ---
**Checked:** MH

| Method | Water | RL (m) | Depth (m) | Graphic Log | Classification Symbol | Material Description | Samples Tests Remarks | Moisture Condition | Consistency/ Density Index | Additional Observations |
|---|---|---|---|---|---|---|---|---|---|---|
| ADT | | 153 | 0 | | | Silty Sand, dark brown, with rootlets | | D | | TOPSOIL |
| | | | | | CLS | Gravelly Clay, light brown and grey, fine to medium gravel, appears well compacted | | M | | FILL |
| | | 152 | 2 | | | Sandy Clay, orange brown, trace of fine gravel | SPT 2, 0, 5 N=5 SPT @ 1.0m | M | F - St | |
| | | 150 | 4 | | | Borehole BH04 continued as cored hole | | | | |
| | | 148 | 6 | | | | | | | |
| | | 146 | 8 | | | | | | | |
| | | 144 | 10 | | | | | | | |
| | | 142 | 12 | | | | | | | |
| | | 140 | 14 | | | | | | | |
| | | 138 | 16 | | | | | | | |
| | | 136 | 18 | | | | | | | |
| | | 134 | 20 | | | | | | | |

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**BH No: BH04**
**PAGE 2 OF 2**
**Job No:** G10132-1

# Cored Borehole Log

**Client:** Mills Oakley
**Project:** Proposed Mixed-Use Development
**Location:** 28 Lockwood Av, Belrose NSW 2085
**Started:** 15/3/21
**Finished:** 17/3/21
**Borehole Size:** 100 mm

**Rig Type:** Hanjin
**Hole Location:** Refer to Figure 1
**Driller:** BG Drilling
**Logged:** PC
**RL Surface (m):** 153.45
**Contractor:**
**Bearing:** ---
**Checked:** MH

| Method | Water | RL (m) | Depth (m) | Graphic Log | Material Description | Weathering | Estimated Strength (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH) | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | Defect Spacing mm (30, 100, 300, 1000, 3000) | Additional Data |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 152 | 2 | | Continued from non-cored borehole | | | | | | |
| NMLC CORING | | | | | Sandy Clay, brown | EW | | | | | - 2.75m, FZ, IR, CN, RF |
| | | | | | Sandstone, red brown, medium strength | HW/MW | | D 0.72 A 0.69 | | | - 2.91m, BP, CN, CU, RF<br>- 2.95m, BP, CLAY, PR, RF<br>- 3.15m, BP, CN, PR, RF |
| | | 150 | | | Sandstone, grey/light grey, medium strength | MW | | | | | |
| | | | 4 | | Sandstone, brown, medium strength | MW | | D 0.59 A 0.41 | 84 | | - 3.8m, JT 30°, PR, MS |
| | | | | | Sandstone, red brown and grey, medium strength | MW | | D 0.54 A 0.73 | | | - 4.35m, BP, CN, PR, S<br>- 4.57m, BP, CN, PR, S<br>- 4.75m, BP, CLAY, PR, VR |
| | | 148 | | | | | | | | | |
| | | | 6 | | Sandstone, red brown and grey, medium strength | MW/SW | | D 0.70 A 0.72 | | | - 5.32m, BP, CN, PR, RF<br>- 5.52m, BP, CN, PR, RF |
| | | | | | | | | D 0.58 A 0.77 | | | - 6.16m, BP, MS, PR, RF<br>- 6.47m, BP, CN, PR, S |
| | | 146 | | | | | | | 94 | | - 6.95m, BP, CN, UN, RF |
| | | | 8 | | | | | D 0.32 A 0.26 | | | - 7.55m, BP, CN, PR, S<br>- 7.7m, BP, CLAY, PR, RF |
| | | | | | | | | D 0.58 A 0.37 | | | - 8.1m, BP, CLAY, PR, RF<br>- 8.31m, BP, CN, PR, RF<br>- 8.34m, JT 45°, CN, CU, RF<br>- 8.66m, DB, CN, CU, RF<br>- 8.87m, BP, CN, PR, RF |
| | | 144 | | | | | | | | | |
| | | | 10 | | Sandstone, red brown and grey, high strength | | | D 0.52 A 0.47 | | | - 9.5m, BP, CN, IR, RF<br>- 9.61m, BP, CN, PR, RF<br>- 9.9m, BP, CLAY, PR, S<br>- 10.18m, BP, CLAY, PR, S |
| | | | | | | | | D 2.31 A 2.11 | 93 | | |
| | | 142 | | | Sandstone, red brown and brown, medium strength | SW | | | | | - 11.2m, JT 60°, CN, PR, RF |
| | | | 12 | | | | | D 0.77 A 0.86 | | | - 11.51m, BP, CN, CU, RF<br>- 11.56m, BP, CN, PR, RF<br>- 11.9m, BP, CN, PR, S |
| | | | | | | | | D 0.43 A 0.55 | | | - 12.3m, JT 45°, CN, RF |
| | | | | | Sandstone, grey/light grey, medium strength | MW | | | | | - 12.65m, BP, CN, PR, S<br>- 12.85m, BP, CN, PR, S<br>- 13.05m, BP, CN, PR, RF |
| | | 140 | | | | | | D 0.38 A 0.22 | 96 | | - 13.4m, BP, CLAY, PR, RF |
| | | | 14 | | | | | | | | - 13.8m, BP, CN, PR, S<br>- 13.94m, BP, CN, PR, S<br>- 14.28m, BP, CLAY, IR, S |
| | | | | | | | | D 0.33 A 0.33 | | | - 14.67m, BP, PR, RF |
| | | | | | BH04 terminated at 14.7m | | | | | | |
| | | 138 | 16 | | | | | | | | |
| | | 136 | 18 | | | | | | | | |
| | | 134 | 20 | | | | | | | | |

CORED BOREHOLE SAMPLE LOG -MILLS OAKLEY.GPJ GINT STD AUSTRALIA.GDT 26/3/21

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**BH No: BH05**
**PAGE 1 OF 2**
**Job No:** G10132-1

# Borehole Log

**Client:** Mills Oakley
**Project:** Proposed Mixed-Use Development
**Location:** 28 Lockwood Av, Belrose NSW 2085
**Started:** 15/3/21
**Finished:** 17/3/21
**Borehole Size:** 100 mm

**Rig Type:** Hanjin
**Hole Location:** Refer to Figure 1
**Driller:** BG Drilling
**Logged:** PC
**RL Surface (m):** 154.2
**Contractor:**
**Bearing:** ---
**Checked:** MH

| Method | Water | RL (m) | Depth (m) | Graphic Log | Classification Symbol | Material Description | Samples Tests Remarks | Moisture Condition | Consistency/ Density Index | Additional Observations |
|---|---|---|---|---|---|---|---|---|---|---|
| ADT | | 154 | | | CLS | Silty Sand, dark brown, with rootlets | | D | | TOPSOIL |
| | | | | | | Sandy Clay, orange brown, trace of fine gravel (rounded) | | M | St | RESIDUAL |
| | | | | | | Silty Sand, red brown, trace of fine gravel | | D | VD | |
| | | 152 | 2 | | | | SPT 21, 25, 30 N=55 SPT @ 1.5m | | | |
| | | | | | | Borehole BH05 continued as cored hole | | | | |
| | | 150 | 4 | | | | | | | |
| | | 148 | 6 | | | | | | | |
| | | 146 | 8 | | | | | | | |
| | | 144 | 10 | | | | | | | |
| | | 142 | 12 | | | | | | | |
| | | 140 | 14 | | | | | | | |
| | | 138 | 16 | | | | | | | |
| | | 136 | 18 | | | | | | | |
| | | | 20 | | | | | | | |

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**BH No: BH05**
**PAGE 2 OF 2**
**Job No:** G10132-1

# Cored Borehole Log

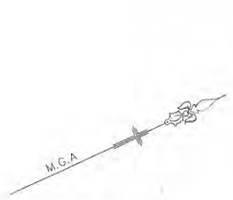
**Client:** Mills Oakley
**Project:** Proposed Mixed-Use Development
**Location:** 28 Lockwood Av, Belrose NSW 2085
**Started:** 15/3/21
**Finished:** 17/3/21
**Borehole Size:** 100 mm

**Rig Type:** Hanjin
**Hole Location:** Refer to Figure 1
**Driller:** BG Drilling
**Logged:** PC
**RL Surface (m):** 154.2
**Contractor:**
**Bearing:** ---
**Checked:** MH

| Method | Water | RL (m) | Depth (m) | Graphic Log | Material Description | Weathering | Estimated Strength (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH) | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | Defect Spacing mm (30, 100, 300, 1000, 3000) | Additional Data |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 154 | | | | | | | | | |
| | | 152 | 2 | | Continued from non-cored borehole | | | | | | |
| NMLC CORING | | | | | Sandstone, grey/light grey, with clay induration, extremely low strength | EW | | D 0.02 A 0.02 | | | - 2.65m, Clay Seam |
| | | | | | Sandstone, red brown, extremely low strength | HW | | | | | |
| | | | 4 | | Sandstone, light grey, with iron indurated bands, low to medium strength | MW/HW | | D 0.079 A 0.1 | 87 | | - 3.46m BP, CN, CU, RF<br>- 3.73m, JT 10°, PR, RF<br>- 3.83m, BP, CN, PR, RF |
| | | 150 | | | | | | | | | - 4.27m, BP CLAY, IR<br>- 4.39m, BP, MS, PR, S<br>- 4.46m, BP, CN, CU, S<br>- 4.56m, FZ QZ, CU, VR |
| | | | | | | | | D 0.4 A 0.67 | | | |
| | | | 6 | | | | | D 0.276 A 0.39 | | | - 5.28m, BP, MS, UN, RF<br>- 5.52m, BP, CN, PR, S<br>- 5.65m, BP, CN, PR, S<br>- 5.97m, BP, CN, PR, S |
| | | 148 | | | | | | | | | |
| | | | | | | | | D 0.63 A 0.78 | | | - 6.35m, BP, CN, CU, RF<br>- 6.55m, BP, MS, PR, VR |
| | | | | | | | | | 95 | | |
| | | | | | | | | D 0.5 A 1.12 | | | - 7.2m, BP, CN, PR, S<br>- 7.33m, BP, CN, PR, S<br>- 7.68m, BP, CN, PR, S<br>- 7.88m, BP, MS, PR, RF |
| | | | 8 | | | | | | | | |
| | | 146 | | | | | | D 0.982 A 0.9 | | | - 8.32m, BP, CN, PR, S<br>- 8.46m, FZ, CN, IR, VR |
| | | | | | | | | | | | |
| | | | | | | | | D 0.579 A 0.61 | | | - 9.45m, BP, CN, CU, S |
| | | | 10 | | | | | | | | |
| | | 144 | | | | | | | 93 | | - 10.08m, BP, CLAY, CU, S<br>- 10.36m, BP, CLAHY, PR, S<br>- 10.6m, JT 20°, FE, RF |
| | | | | | Sandstone, red brown, with clay induration, low strength | MW | | D 0.876 A 0.79 | | | - 10.92m, BP, CN, PR, S<br>- 10.94m, BP, CN, PR, S |
| | | | | | | | | | | | |
| | | | 12 | | | | | D 0.835 A 0.82 | | | |
| | | 142 | | | | | | | | | - 11.95m, BP, CLAY, PR, RF<br>- 12.07m, BP, CN, PR, S<br>- 12.27m, BP, CN, PR, S<br>- 12.5m, BP, CN, PR, RF<br>- 12.75m, BP, CN, PR, S<br>- 12.9m, BP, CN, PR, S<br>- 13.14m, BP, CN, PR, S |
| | | | | | Sandstone, light grey, low strength | HW/EW | | D 0.291 A 0.27 | | | |
| | | | | | Sandstone, grey and brown, | MW | | | 100 | | |
| | | | | | | | | D 0.323 A 0.17 | | | |
| | | | 14 | | | | | | | | |
| | | 140 | | | | SW/MW | | | | | - 13.67m, BP, CN, UN, RF<br>- 13.88m, BP, MS, CU, RF<br>- 13.95m, BP, MS, PR<br>- 14.18m, BP, CN, PR, RF |
| | | | | | | | | D 1.114 A 1 | | | |
| | | | | | BH05 terminated at 14.65m | | | | | | |
| | | 138 | 16 | | | | | | | | |
| | | | | | | | | | | | |
| | | | 18 | | | | | | | | |
| | | 136 | | | | | | | | | |
| | | | | | | | | | | | |
| | | | 20 | | | | | | | | |

# APPENDIX C

## SUPPLIED DOCUMENTS




Bearings on this plan relate to Grid North from D.P. 1199795 which approximates True North

SCHEDULE OF SHORT AND CURVED BOUNDARIES

| NO. | BEARING | DISTANCE | ARC LENGTH | RADIUS |
|---|---|---|---|---|
| 1 | 128° 14' 00" | 10.94 | 11.2 | 14.89 |
| 2 | 110° 43' 10" | 8.135 | | |
| 3 | 118° 51' 10" | 4.265 | 4.275 | 19.85 |
| 4 | 128° 45' 00" | 5.61 | | |
| 5 | 139° 52' 45" | 7.845 | 7.89 | 20.565 |
| 6 | 267° 47' 50" | 11.41 | 11.84 | 12.575 |

| TREE TABLE | | | |
|---|---|---|---|
| No. | Trunk | Spread | Height |
| 1 | 0.4 | 6.0 | 15.0 |
| 2 | 0.3 | 2.0 | 8.0 |
| 3 | 0.3 | 5.0 | 18.0 |
| 4 | 0.3 | 5.0 | 18.0 |
| 5 | 0.3 | 4.0 | 15.0 |
| 6 | 0.3 | 4.0 | 8.0 |
| 7 | 0.3 | 5.0 | 18.0 |
| 8 | 1.2 | 15.0 | 18.0 |
| 9 | 0.3 | 2.0 | 8.0 |
| 10 | 0.3 | 5.0 | 15.0 |
| 11 | 0.3 | 5.0 | 18.0 |
| 12 | 0.2 | 3.0 | 8.0 |
| 12A | 0.2 | 3.0 | 8.0 |
| 13 | 0.3 | 5.0 | 18.0 |
| 14 | 0.3 | 4.0 | 5.0 |
| 15 | 0.6 | 6.0 | 12.0 |
| 16 | 0.2 | 3.0 | 5.0 |
| 17 | 0.2 | 3.0 | 5.0 |
| 18 | 0.2 | 3.0 | 10.0 |
| 19 | 1.0 | 10.0 | 20.0 |
| 20 | 0.8 | 15.0 | 18.0 |
| 21 | 0.3 | 3.0 | 8.0 |
| 22 | 0.4 | 6.0 | 15.0 |
| 23 | 0.3 | 3.0 | 8.0 |
| 24 | 0.5 | 5.0 | 10.0 |
| 25 | 0.2 | 3.0 | 8.0 |
| 26 | 1.0 | 12.0 | 22.0 |
| 27 | 0.2 | 5.0 | 5.0 |
| 28 | 0.2 | 3.0 | 8.0 |
| 29 | 1.0 | 12.0 | 20.0 |
| 30 | 0.4 | 5.0 | 12.0 |
| 31 | 0.4 | 3.0 | 4.0 |
| 32 | 0.1 | 2.0 | 3.0 |
| 32A | 0.2 | 3.0 | 5.0 |
| 33 | 0.2 | 5.0 | 8.0 |
| 34 | 0.2 | 3.0 | 8.0 |
| 35 | 0.4 | 6.0 | 5.0 |
| 36 | 5.0 | 8.0 | 12.0 |
| 37 | 0.2 | 2.0 | 5.0 |
| 38 | 0.2 | 2.0 | 5.0 |
| 39 | 0.2 | 2.0 | 5.0 |
| 40 | 0.2 | 2.0 | 5.0 |
| 41 | 0.2 | 4.0 | 10.0 |
| 42 | 0.2 | 4.0 | 10.0 |
| 43 | 0.3 | 5.0 | 10.0 |
| 44 | 0.5 | 6.0 | 18.0 |
| 45 | 0.2 | 4.0 | 10.0 |
| 46 | 0.3 | 4.0 | 13.0 |
| 47 | 0.3 | 4.0 | 5.0 |
| 48 | 0.3 | 5.0 | 15.0 |
| 49 | 0.3 | 4.0 | 18.0 |
| 50 | 0.3 | 3.0 | 10.0 |
| 51 | 0.2 | 3.0 | 6.0 |
| 52 | 0.2 | 3.0 | 6.0 |
| 53 | 0.4 | 5.0 | 15.0 |
| 54 | 0.4 | 6.0 | 15.0 |
| 55 | 0.6 | 8.0 | 15.0 |
| 56 | 0.3 | 3.0 | 5.0 |
| 57 | 0.3 | 5.0 | 5.0 |
| 58 | 0.2 | 4.0 | 8.0 |
| 59 | 0.4 | 6.0 | 15.0 |
| 60 | 0.4 | 6.0 | 18.0 |
| 61 | 0.4 | 5.0 | 18.0 |
| 62 | 0.4 | 5.0 | 15.0 |
| 63 | 0.3 | 7.0 | 8.0 |
| 64 | 0.4 | 10.0 | 12.0 |
| 65 | 0.3 | 5.0 | 7.0 |
| 66 | 0.5 | 8.0 | 18.0 |
| 67 | 0.3 | 5.0 | 15.0 |
| 68 | 0.8 | 15.0 | 18.0 |
| 69 | 1.0 | 12.0 | 12.0 |
| 70 | 0.5 | 10.0 | 12.0 |
| 71 | 1.0 | 10.0 | 12.0 |
| 72 | 0.1 | 2.0 | 3.0 |
| 73 | 0.1 | 2.0 | 4.0 |
| 74 | 0.1 | 2.0 | 4.0 |
| 75 | 0.1 | 2.0 | 4.0 |
| 76 | 0.1 | 2.0 | 4.0 |
| 77 | 0.1 | 2.0 | 7.0 |

(R) – RESTRICTION(S) ON THE USE OF LAND (DP231044)

– LAND EXCLUDES MINERALS AND IS SUBJECT TO RESERVATIONS & CONDITIONS IN FAVOUR OF THE CROWN– SEE CROWN GRANT(S)

– EXCEPTING LAND BELOW A DEPTH FROM THE SURFACE OF 15.24 METRES RESERVED BY THE CROWN GRANT

NOTES:

1) ORIGIN OF LEVELS TAKEN FROM SSM 9129 (RL 158.773 A.H.D) CLASS LC
2) ALL AREAS AND DIMENSIONS HAVE BEEN COMPILED FROM PLANS MADE AVAILABLE AT THE LAND TITLES OFFICE AND ARE SUBJECT TO FINAL SURVEY.
3) NO BOUNDARY INVESTIGATION HAS BEEN CARRIED OUT, RELATIONSHIP OF IMPROVEMENTS AND DETAIL TO BOUNDARIES ARE DIAGRAMMATIC ONLY
4) ONLY SPOT LEVELS SHOULD BE USED FOR CALCULATIONS OF QUANTITIES WITH CAUTION.
5) NO INVESTIGATION OF UNDERGROUND SERVICES HAS BEEN MADE. ALL RELEVANT AUTHORITIES SHOULD BE NOTIFIED PRIOR TO ANY EXCAVATION ON OR NEAR THE SITE
6) SERVICES THAT ARE NOT SHOWN ON THE PLAN WERE NOT VISIBLE AT THE TIME OF SURVEY.
7) WINDOW, RIDGE, & EAVE HEIGHTS HAVE BEEN OBTAINED BY AN INDIRECT METHOD AND ARE ACCURATE FOR PLANNING PURPOSES ONLY.

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THE SEAL OF THE LAND AND ENVIRONMENT COURT NEW SOUTH WALES

LAND AND ENVIRONMENT COURT OF NSW
FILED ON
30 SEP 2020
INT

ECS Surveying Pty Ltd
Email: ecssurveying@gmail.com
SYDNEY
P.O. BOX 560 PANANIA, N.S.W. 2213
Ph: 0420-222-650

PLAN SHOWING:
DETAIL & LEVEL SURVEY OVER LOT 1 IN D.P 1199795 KNOWN AS:– No.28 LOCKWOOD AVENUE, BELROSE.

| | | | | |
|---|---|---|---|---|
| LGA: WARRINGAH | | DATE: | REV: | AMENDMENTS: |
| CLIENT: PLATINUM RESTAURANT GROUP | | 28/07/15 | 00 | DETAIL & LEVEL SURVEY |
| SCALE: | 1:200(A1) 1:400(A3) | 03/08/19 | 01 | TREES UPDATED |
| DATUM: | A.H.D. | 25/08/19 | 02 | TREES NO. UPDATED |
| CONTOUR INTERVAL: | 0.5m | | | |
| JOB REF: | 15084 | | | |
| SHEET: | 1 OF 1 | | | |