Manage the earth, eliminate the risk

# Alliance Geotechnical

**Engineering | Environmental | Testing**

## Geotechnical Investigation Report

**Prepared for Lendlease**

**Proposed Retirement Village (51 Villas)**
**Lot 3991 of DP 1190132, Jordan Springs Boulevard, Jordan Springs, NSW 2747**

Project Number: 6715
Report Number: 6715-GR-1-2-Rev A
Report Date: 30th May 2018

We give you the right information to make the right decisions

Alliance Geotechnical Pty Ltd - Phone: 1800 288 188 - Web: www.allgeo.com.au

## TABLE OF CONTENTS

**1. INTRODUCTION ..... 3**
1.1. Objectives ..... 3
1.2. Scope of Work ..... 4
**2. SITE SETTING ..... 4**
2.1. Site Description & History ..... 4
2.2. Regional Geology ..... 5
2.3. AG's Previous Geotechnical Investigations ..... 5
**3. FIELDWORK ..... 6**
3.1. Test Pit Excavation ..... 6
3.2. DCP Test Results ..... 6
**4. SUBSURFACE CONDITIONS ..... 7**
**5. LABORATORY TESTS ..... 7**
**6. Existing Fill Material ..... 7**
**7. SITE CLASSIFICATION ..... 8**
**8. PRELIMINARY FOOTING DESIGN PARAMETER ..... 8**
**9. SITE PREPARATION ..... 8**
9.1. Fill Placement & Compaction ..... 9
9.2. Cut & Fill Batters ..... 9
**10. LIMITATIONS ..... 10**

## Attachments

- Drawing: 6715-GR-1-2-A
- Borehole Logs (TP1 to TP5, BH101 & BH102 & BH1 to BH6,)
- DCP Test Result

## 1. INTRODUCTION

This report presents the findings of a supplementary geotechnical investigation undertaken by Alliance Geotechnical Pty Ltd (AG) at Jordan Springs Boulevard (Lot 3991 DP 1190132), Jordan Springs, NSW for Lendlease (Client), in accordance with AG's fee proposal No. 709, dated 26th February 2018.

The previous geotechnical investigations which were carried out in 2016 & 2018, were presented in AG's latest report No. 2715-GR-1-1, dated 26th February 2018.

As described in AG's report No. 2715-GR-1-1, a portion of the site was underlain by fill material. Referring to AG's site investigation in 2016, and the limited number of boreholes drilled in February 2018, the majority of the site was classified as Class P and a limited area was classified as Class H1 (as reported in report No. 2715-GR-1-1).

As per the client's request, AG planned for further investigation across this site to assess the fill material compaction ratio and re-classify the site. AG suggested to excavate a number of test pits across the site (instead the boreholes) to determine the extent of the area underlain by fill material. Therefore, a subsequent geotechnical investigation consisting of five (5) test pits was undertaken (as presented in this report).

AG were provided with concept layout plans and as such do not have final design levels after bulk earthworks. Moreover, AG were informed by the client that the site is subject to further fill placement which will be undertaken as a part of site preparation scheme.

AG were supplied with the following documents:

- The site survey plan with reference No. 7202, prepared by Land Development Solutions (SDG), dated 15/01/2018; [1]
- Jordan Springs CD Site, drawing No. AND-28405, Sheet 1 & 2, prepared by A&N Design Group, dated 15/01/2018 which indicates the concept lots layout and the site analysis.

A previous geotechnical investigation was undertaken by AG in December 2016 on this same site, at the time the site was proposed for the construction of multi-storey developments as described in Section 2.3.

This report is prepared based on the geotechnical investigation findings during AG's previous site investigations (as reported in report No. 6715-GR-1-1, date 26th February 2018) and additional test pit investigation work described in Section 3 of this report.

### 1.1. Objectives

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

- Geotechnical subsurface and groundwater conditions;
- Re-classifying of the site from previous "P" classification;
- Certifying the existing fill material;
- Allowable bearing pressure for the preliminary footing design.

[1] All levels shown in this report are relative to AHD.

### 1.2. Scope of Work

In order to achieve the project objectives, the following scope of work was carried out for the investigation:

- Review of the site's geological setting, topographic maps and AG's previous geotechnical investigation report;
- Obtaining Dial Before You Dig (DBYD) plans;
- Site walkover inspection and documentation of the existing conditions and features;
- Excavation of five (5) test pits to 1.5m below the ground surface (bgs);
- Undertaking five (5) Dynamic Cone Penetrometer (DCP) tests to assess soil consistency;
- Collecting five (5) soil samples for laboratory Atterberg Limits tests;
- Preparing a subdivision geotechnical investigation report.

## 2. SITE SETTING

### 2.1. Site Description & History

The site is located in Jordan Springs, approximately 40m west of an existing man-made lake. The site is a section of a vacant land which is bounded by Jordan Springs Boulevard to the north and Lakeside Parade to the north and east. There is a sedimentation pond in the eastern portion of the site. Figure 1 shows the general site locality and geology.

The supplied survey plan indicates that the current surface levels over the site vary by approximately 5 m. The higher section of the site is at approximate RL 40.5m on the north-west corner and varies to approximate RL 35.5m on the south-east corner, adjacent to the existing sedimentation pond. The site has an approximate 1 % slope falling the south-east. The site is covered with asphalt at the northwest corner and the other parts are covered with grass and few trees.


**Figure 1- General Site Locality and the site geology**

A portion of the site has been filled with fill material during the roadworks during the construction of Jordan Springs Bulverde. This area is marked with red line in Figure 2.


**Figure 2- The earthwork in the site during Jordan Springs Bulverde construction in 2011– Extracted from Nearmap**

## 2.2. Regional Geology

The 1:100,000 NSW Department of Mineral Resources Geological Map of the Penrith Region indicates the site is underlain by Bringelly Shale (Rwb) of the Mesozoic dating back to the middle Triassic period. The formation is generally described as *Shale, carbonaceous claystone, Claystone, laminate, fine to medium-grained lithic sandstone, rare coal and tuff.*

## 2.3. AG's Previous Geotechnical Investigations

AG's previous geotechnical site drilling investigations were carried out in November 2016 and February 2018. During the first investigation undertaken in 2016, AG supervised the drilling of six (6) boreholes (BH1 to BH6) which were drilled to a maximum depth of 12.5 m bgs for the proposed multi-storey buildings project. During the second investigation in 2018, AG drilled two (2) additional boreholes (BH101 & BH102) to indicate the site classification as reported in AG's report No. 6715-GR-1-1. A summary of the soil and rock profile are presented in Table 1 and the borehole locations are shown in drawing 6715-GR-1-2-A.

**Table 1 - Summary of Subsurface Profile – AG's Investigation 2016 & 2018**

| Soil Profile | BH1 | BH2 | BH3 | BH4 | BH5 | BH6 | BH101 | BH102 |
|---|---|---|---|---|---|---|---|---|
| **Topsoil (m)** Clayey SILT | 0.0 – 0.2 | 0.0 – 0.1 | 0.0 – 0.2 | 0.0 – 0.2 | 0.0 – 0.2 | 0.0 – 0.2 | 0.0 – 0.1 | 0.0 – 0.1 |
| **Fill (m)** Silty CLAY, medium plasticity | 0.2 – 0.9 | 0.1 – 6.1 | 0.2 – 1.7 | 0.2 – 1.4 | 0.2 – 1.6 | 0.2 – 2.5 | 0.1 – 0.7 | - |
| **Alluvial (m)** Silty CLAY, medium to high plasticity | - | - | 1.7 – 3.8 | 1.4 – 1.9 | 1.6 – 2.4 | 2.5 – 4.0 | 0.7 – 2.7 | 0.1 – 1.3 |
| **Residual soil (m)** silty CLAY, brown, high plasticity | 0.9 – 5.1 | - | 3.8 – 4.6 | 1.9 - 5.0 | 2.4 – 4.7 | 4.0 – 6.6 | 2.7 – 4.0 | 1.3 – 4.0 |
| **Very Low Strength Shale (m)** | 5.1 – 7.5 | 6.1 – 7.5 | 4.6 – 8.4 | 5.0 – 7.2 | 4.7 – 7.6 | 6.6 – 8.8 | - | - |
| **Medium Strength Shale (m)** | 9.15 – 10.5 | - | - | - | - | 8.8 – 12.5 | - | - |
| **Groundwater Seepage (m)** | - | - | - | - | 5.6 | 6.4 | - | - |

## 3. FIELDWORK

### 3.1. Test Pit Excavation

AG's geotechnical site investigation was carried out on 13th March 2018. During the investigation, AG supervised the excavation of five (5) test pits across the site (TP1 to TP5) to a maximum depth of 1.5m below the ground surface (bgs).

The test pits were excavated using a 15T Excavator operated by MatVel Excavations. The approximate locations of the test pit are shown on the attached sketch plan (refer Drawing No. 6715-GR-1-2-A).

Due to the limited site access, excavation of a test pit was not possible at the northern side of the site.

During the site investigation, the subsurface strata encountered were logged by an AG geotechnical engineer and the in-situ strength of the subsurface soils were recorded by either visual assessment and/or performing in situ Dynamic Cone Penetrometer (DCP) Test.

### 3.2. DCP Test Results

Field testing using a DCP was undertaken at the surface levels to provide additional data for an assessment of soil consistency and soil strength of the near-surface soils. The locations of the DCP tests are shown on attached Drawing No. 6715-GR-1-2-A. The results are presented in the appendix and indicate that the site is underlain by stiff to hard clay natural soils and well compacted fill material.

## 4. SUBSURFACE CONDITIONS

Detailed test pits logs (TP1 to TP5) are provided in the appendix. The inferred subsurface soil profiles at the borehole locations are summarised in Table 2.

**Table 2 - Summary of Subsurface Profile**

| Soil Profile | TP1 | TP2 | TP3 | TP4 | TP5 |
|---|---|---|---|---|---|
| **Topsoil** | 0.0 – 0.2 | 0.0 – 0.3 | 0.0 – 0.25 | 0.0 – 0.25 | 0.0 – 0.2 |
| **Alluvium**- Sandy/Silty CLAY | 0.2 – 1.6 | 0.3 – 1.4 | 0.25 – 1.4 | 0.25 – 0.6 | 0.2 – 0.8 |
| **Residual soil** – CLAY | - | - | - | 0.6 – 0.8 | 0.8 – 1.5 |
| **Groundwater Seepage** | The water seepage was not observed to the depth of drilling | | | | |

Based on the excavated test pits, the site is underlain by topsoil, very stiff to hard alluvial sandy /silty clay material and stiff to hard residual clay.

## 5. LABORATORY TESTS

The Atterberg limits tests were conducted in accordance with AS1289-2006 on selected samples from test pits. The results are summarised in Table 3 and the detailed results are presented in Appendix E. Based on the Atterberg limits tests, the site soil are mainly highly plastic silty clay.

**Table 3 - Summary of Atterberg Limits Tests**

| Borehole No. | Depth (m) | LL (%) | LS (%) | PL (%) | PI (%) |
|---|---|---|---|---|---|
| TP 1 | 0.5 – 0.6 | 40 | 8.5 | 12 | 28 |
| TP 2 | 1.0 – 1.1 | 69 | 18.5 | 19 | 50 |
| TP3 | 1.0 – 1.5 | 41 | 14 | 10 | 31 |
| TP4 | 0.7 – 1.0 | 41 | 13 | 14 | 27 |
| TP 5 | 0.5 – 0.6 | 53 | 18 | 15 | 38 |

Notes:
LL Liquid Limit LS Linear Shrinkage
PL Plastic Limit PI Plastic Index

## 6. Existing Fill Material

Based on the subsurface profile encountered in the excavated test pits (as summarised in Section 4) and DCP tests, the preliminary assessment indicates the site is mainly underlain by alluvial and residual soils. It has been confirmed during test pit investigation that the area with fill material is just limited to the northern side of the site as is illustrated in Figure 2.

The existing fill which has been placed as a part of Jordan Spring Bulverde road construction works, has been assessed as a well-compacted fill referring to AG's DCP tests.

## 7. SITE CLASSIFICATION

Considering the geotechnical investigation findings, the whole site (excluding the marked area on Drawing 6715-GR-1-2-A) has been generally classified as **Class H2** and is described as highly reactive clay site, which may experience high ground movements from moisture changes with an estimated characteristic surface movement ($y_s$) to be in the range between 60mm and 75mm for the existing subsurface conditions.

As indicated on Drawing 6715-GR-1-2-A, there are two portions which have been classified as **Class E** (Extremely Reactive Clay Site), which may experience extreme ground movement from moisture changes with an estimated characteristic surface movement (ys) to be more than 75mm for the existing subsurface conditions.

The site classification has been undertaken in accordance with AS2870-2011 "Residential Slabs and Footings".

It should be noted that, this site classification is subject to change if site levels change by more than 400mm of clayey fill and 800mm of sandy fill as a result of bulk earthworks. A geotechnical engineer should assess the site classification on completion of the subdivision earthworks, provided that the placed fill is an engineered fill and has been certified.

## 8. PRELIMINARY FOOTING DESIGN PARAMETER

Considering the site classifications (Class H2 & Class E) it is recommended that a site specific geotechnical investigation and assessment be undertaken for the proposed developments and the footings be designed based on engineering principles.

The standard footings appropriate to **Class H2** or an engineered designed slab may be used on this site. The wet or loose material, and topsoil should be selectively removed to provide a suitable founding base. An allowable bearing capacity of up to **150 kPa** under shallow footing founded on natural soils with a minimum embedment depth of 0.3m (not topsoil material) will be acceptable (provided that adequate drainage is installed on this site).

For a portion of the site, classified as E, the footings should be designed based on the engineering principles and site specific geotechnical recommendations.

Generally, considering the highly reactive clayey material in this site, it is recommended not to found the footings on the shallow foundations and pier footings founded on the bedrock may be considered.

The proposed developments may be founded on piers to take the load of the building to the bedrock. It is recommended the piers be founded and socketed in the underlying very low strength shale with an assumed maximum allowable bearing pressure of **700 kPa**. The pile footings should be designed in accordance with AS 2159-2009 Piling – Design and Installation

## 9. SITE PREPARATION

To prepare the site for the construction of structures and pavements, the following procedures are suggested:

- Strip topsoil and remove topsoil and soft material.
- Deeper stripping of soils underlying topsoil or where water softened soils are present. Prior to stripping of these materials a geotechnical engineer should be consulted to provide advice.
- Where fill is to be placed, a test roll to the exposed upper surface should be undertaken on the exposed subgrade with a smooth drum roller of at least 8 tonne static deadweight capacity, during the presence of a geotechnical engineer and a minimum of six passes of the roller.
- where soft spots or unacceptable subgrade conditions are encountered, remove the unsuitable material to a further 300 mm and inspect.

### 9.1. Fill Placement & Compaction

It may be necessary to place and compact fill materials to establish the ground levels. All fill should be placed in a controlled manner as defined in Australian Standard "AS 3798 – Earthworks for residential and commercial developments". All the fills should be a controlled fill for the later site re-classification.

Filling materials should not contain vegetation or other organic matter. It is recommended that all compaction control testing in areas that will support structures and pavements be undertaken under appropriate supervision by an approved GITA.

Filling material should be placed with density ratio and moisture content specified in Table .

**Table 3 – Compaction specifications**

| Fill | Loose layer thickness (mm) | Minimum density ratio | Moisture |
|---|---|---|---|
| General filling | 250 | 95% | ± 2 % OMC |
| Engineered filling to support pavement, subgrades and structures | 250 | 98% | ± 2 % OMC |

OMC – Optimum Moisture Content (for compaction)

General filling to form the platform with a compaction ratio of less than 98%, can't be relied on as appropriatefoundation strata for the shallow footings.

Granular filling is preferred although clay soils may be suitable for general filling provided they are of low to medium plasticity. The maximum particle size for any placed fill should be 75mm nominal diameter. Shale, clay or sand materials may be used for general filling but are not suitable for upper pavement layers of select fill. Pavement fill layer properties, thicknesses and material requirements are not commented on in this report and should form part of the civil/structural drawings.

### 9.2. Cut & Fill Batters

The earthworks plan, sediment control and drainage plan should be prepared by a civil engineer. All designed fill batters should be constructed no steeper than 2.5:1 (horizontal: vertical). All batters must be protected against erosion by vegetating the exposed surface as soon as possible following construction and incorporate toe and spoon drains as means of controlling surface water flows on the batters. During earthworks operations, installation of silt fences, hay bales or equivalent sediment erosion controls should be undertaken where runoff will exit the site, to limit sediment runoff from the site during construction.

## 10. LIMITATIONS

Alliance Geotechnical Pty Ltd (AG) has prepared this report for the site located at Jordan Springs Boulevard (Lot 3991 DP 1190132), Jordan Springs, NSW, in accordance with AG's fee proposal and Terms of Engagement. This geotechnical report has been prepared for Lendlease for this project and for the purposes outlined in this report.

This preliminary site classification and the allowable bearing pressure for the footings are based on the current condition of the site and will need to be reviewed on completion of the any cut/fill earthworks and subdivision construction.

This report cannot be relied on for other projects, other parties on this site or any other site. The comments and recommendations provided in this report are based on the assumption that the geotechnical recommendations contained in this report will be fully complied with during the design and construction of the proposed site development

The borehole investigation and testing results provided in this report are indicative of the subsurface conditions at the site only at the specific sampling and testing locations, and to the depths drilled at the time of the investigation. Subsurface conditions can change significantly due to geological and human processes. Where variations in conditions are encountered further geotechnical advice should be sought from AG.

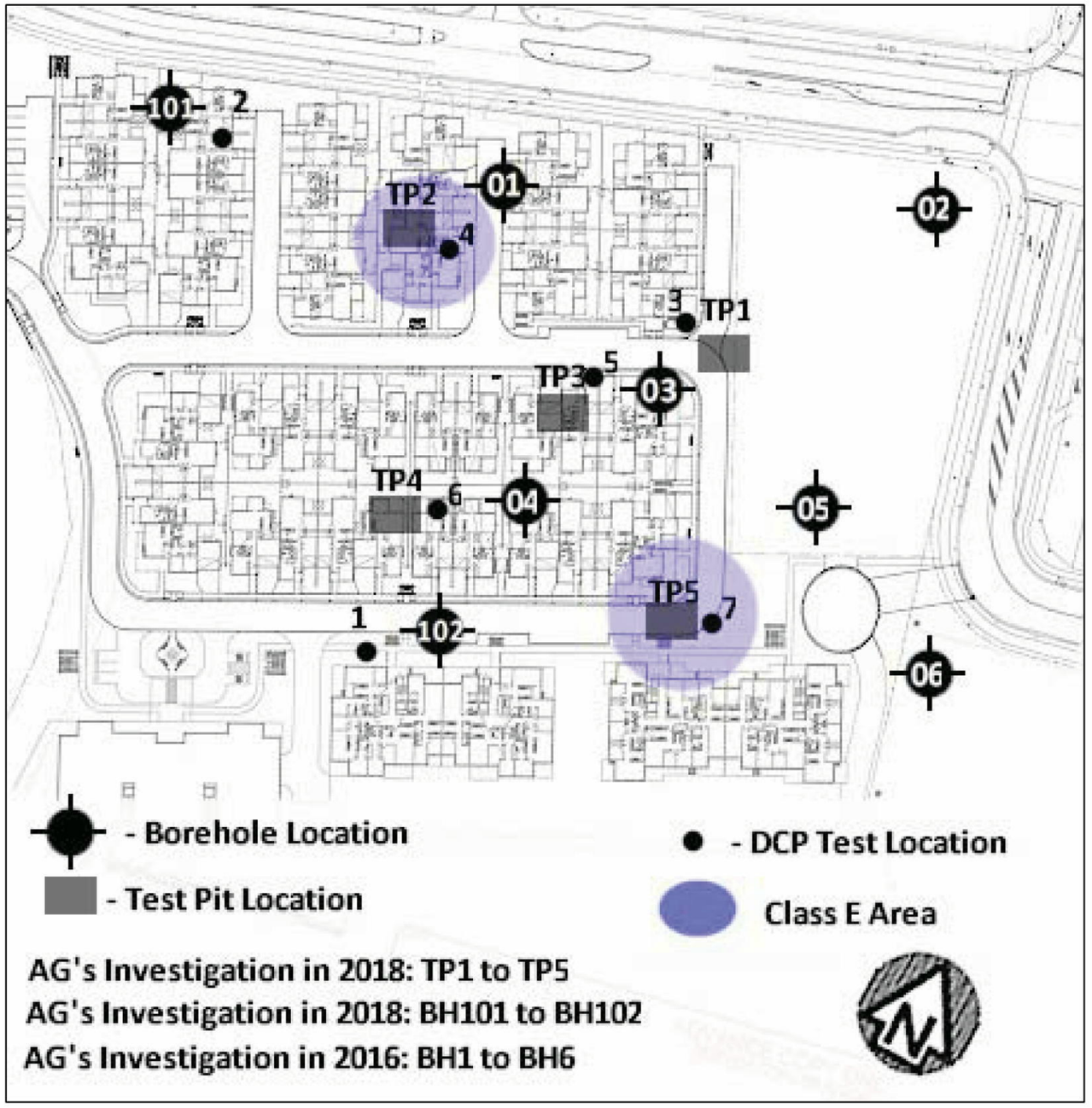
Reviewed

Sahar Mamouri
BE (Civil) , M.Sc (Geotechnical)
Senior Geotechnical Engineer
Alliance Geotechnical Pty Ltd

Thomas Dale
BE(Hons), MIEAust
Senior Geotechnical Engineer
Alliance Geotechnical Pty Ltd

## References


- AS1726-1993 - Geotechnical Site Investigations
- AS 1289 – 2006 - Method of testing soils for engineering purposes
- AS 2159-2009 - Piling - Design and Installation
- AS2870-2011 - Residential slabs and Footings Construction
- AS 3798 – 2007 - Guidelines on Earthworks for Commercial and Residential Developments
- Pells et al "Foundations on Sandstone and Shale in the Sydney Region" AGJ, 1998
- The 1:100,000 NSW Department of Mineral Resources Geological Map of Penrith




Source: Site Grading (ref: 110487SK/SK07, prepared by J. Wyndham Price)

Not to Scale

Alliance Geotechnical Pty Ltd
ENGINEERING | ENVIRONMENTAL | TESTING
10 Welder Road, Seven Hills, NSW
T: 1800 288 188 E: enviro@allgeo.com.au

| Project Address: | Client: | Project Name: | Report No: | | Drawing No: | Figure Title: |
|---|---|---|---|---|---|---|
| Lot 3991 of DP 1190132, Jordan Springs Boulevard, Jordan Springs, NSW 2747 | Lendlease | Proposed Retirement Village (51 Villas) | 6715-GR-1-2-Rev A<br>Figure Date: 30/05/2018 | | 6715-GR-1-2-A | Site Locality Plan |

Alliance Geotechnical
ENGINEERING | ENVIRONMENTAL | TESTING
Your On-Site Geotechnical & Environmental Specialists

Your On-Site Geotechnical Specialists
Phone Us Today – 1800 288 188

# Dynamic Cone Penetrometer Test Report

| | | | |
|---|---|---|---|
| Client: | Lendlease | Report Number: | 6715-GR-1-2-Rev A |
| Project Name: | Proposed Retirement Village (51 Villas) | Report Date: | 30/05/2018 |
| Project Location: | Lot 3991 of DP 1190132, Jordan Springs Boulevard, Jordan Springs, NSW 2747 | Date Tested: | 13/03/2018 |
| Test Method: | AS 1289 6.3.2 | | |

| Test Number | DCP-1 | DCP-2 | DCP-3 | DCP-4 | DCP-5 |
|---|---|---|---|---|---|
| Test Location | Refer Drawing 6715-GR-1-2-A | | | | |
| R.L (AHD) | | | | | |
| Depth (meters) | | | | | |
| 0.00 – 0.15 | 17 | 16 | 2 | 2 | 5 |
| 0.15 – 0.30 | 17 | 21 | 3 | 8 | 15 |
| 0.30 – 0.45 | 24 | 24 | 17 | 8 | 21 |
| 0.45 – 0.60 | >25 | >25 | 19 | 10 | 25 |
| 0.60 – 0.75 | | | 14 | 8 | 11 |
| 0.75 – 0.90 | | | 12 | 4 | 25 |
| 0.90 – 1.05 | | | 10 | 8 | 25 |
| 1.05 – 1.20 | | | 9 | 12 | 15 |
| 1.20 – 1.35 | | | 17 | 21 | 16 |
| 1.35 – 1.50 | | | 21 | >25 (Refusal) | 12 |
| 1.50 – 1.65 | | | 21 | | 11 |
| 1.65 – 1.80 | | | | | 8 |

| Test Number | DCP-6 | DCP-7 |
|---|---|---|
| Test Location | Refer Drawing 6600-GR-1-A | Refer Drawing 6600-GR-1-A |
| R.L (AHD) | | |
| Depth (meters) | | |
| 0.00 – 0.15 | 4 | 2 |
| 0.15 – 0.30 | 16 | 14 |
| 0.30 – 0.45 | 16 | 20 |
| 0.45 – 0.60 | 11 | 22 |
| 0.60 – 0.75 | 9 | 13 |
| 0.75 – 0.90 | 9 | 11 |
| 0.90 – 1.05 | 7 | 10 |
| 1.05 – 1.20 | 5 | 7 |
| 1.20 – 1.35 | 5 | 6 |
| 1.35 – 1.50 | 6 | 5 |
| 1.50 – 1.65 | 5 | 6 |
| 1.65 – 1.80 | 7 | 6 |
| 1.80 – 1.95 | 12 | |
| 1.95 – 2.10 | 16 | |
| 2.10 – 2.25 | 11 | |

**Alliance Geotechnical**
Manage the earth, eliminate the risk

Alliance Geotechnical Pty Ltd
T: 1800 288 188
F: 02 9675 1888
E: office@allgeo.com.au
W: www.allgeo.com.au

**BH No: TP 1**
**Sheet: 1 of 1**
**Job No:** 6715

# Borehole Log

**Client:** Lendlease
**Project:** Proposed Retirement Village (51 Villas)
**Location:** Lot 3991 of DP 1190132, Jordan Springs Boulevard, Jordan Springs, NSW 2747

**Started:** 13-3-18
**Finished:** 13-3-18
**Borehole Size:** N/A

**Rig Type:** 15T Excavator
**Hole Location:** Refer Drawing: 6715-GR-1-2-A
**Driller:** D. Vela
**Logged:** MS

**RL Surface:** 37.4
**Contractor:** MatVel Excavations
**Bearing:** ---
**Checked:** LM

| Method | Water | RL (m) | Depth (m) | Graphic Log | Classification Symbol | Material Description | Samples Tests Remarks | Moisture Condition | Consistency/ Density Index | Additional Observations |
|---|---|---|---|---|---|---|---|---|---|---|
| E | No Groundwater Encountered | 37.0 | 0.0 | | | TOPSOIL: Clayey SILT, low plasticity, brown, with fine grained sand | | SM | | TOPSOIL |
| | | | | | CL | Sandy CLAY, medium plasticity, orange and yellow brown, fine grained sand, with rootlets | | SM | H | ALLUVIUM |
| | | | 0.5 | | | | Plasticity Index | | | |
| | | 36.5 | 1.0 | | CI | Silty CLAY, medium plasticity, red mottled grey and brown, trace fine grained sand, trace rootlets | | M | VSt | |
| | | 36.0 | 1.5 | | CI | As above, with subrounded fine gravel | | M | H | |
| | | | | | | Borehole TP 1 terminated at 1.6m | | | | End of Test Pit |
| | | 35.5 | 2.0 | | | | | | | |
| | | 35.0 | 2.5 | | | | | | | |
| | | 34.5 | 3.0 | | | | | | | |
| | | 34.0 | 3.5 | | | | | | | |
| | | 33.5 | 4.0 | | | | | | | |
| | | 33.0 | 4.5 | | | | | | | |
| | | 32.5 | 5.0 | | | | | | | |

BOREHOLE / TEST PIT 6715 TEST PITS 1-5.GPJ GINT STD AUSTRALIA.GDT 30-5-18

**Alliance Geotechnical**
Manage the earth, eliminate the risk

Alliance Geotechnical Pty Ltd
T: 1800 288 188
F: 02 9675 1888
E: office@allgeo.com.au
W: www.allgeo.com.au

**BH No: TP 2**
**Sheet: 1 of 1**
**Job No:** 6715

# Borehole Log

**Client:** Lendlease
**Project:** Proposed Retirement Village (51 Villas)
**Location:** Lot 3991 of DP 1190132, Jordan Springs Boulevard, Jordan Springs, NSW 2747

**Started:** 13-3-18
**Finished:** 13-3-18
**Borehole Size:** N/A

**Rig Type:** 15T Excavator
**Hole Location:** Refer Drawing: 6715-GR-1-2-A
**Driller:** D. Vela
**Logged:** MS
**RL Surface:** 39.3
**Contractor:** MatVel Excavations
**Bearing:** ---
**Checked:** LM

| Method | Water | RL (m) | Depth (m) | Graphic Log | Classification Symbol | Material Description | Samples Tests Remarks | Moisture Condition | Consistency/ Density Index | Additional Observations |
|---|---|---|---|---|---|---|---|---|---|---|
| E | No Groundwater Encountered | 39.0 | 0.0 | | | TOPSOIL: Silty CLAY, low plasticity, red-brown, trace subrounded fine gravel, with roots/rootlets | | SM | | TOPSOIL |
| | | | 0.5 | | CH | Silty CLAY, high plasticity, red mottled brown, trace fine subrounded gravel, trace roots/rootlets | | SM | VSt | ALLUVIUM |
| | | 38.5 | | | CH | As above, red mottled grey, moist | | M | VSt - H | |
| | | | 1.0 | | | | Plasticity Index | | | |
| | | 38.0 | | | | | | | | |
| | | | 1.5 | | | Borehole TP 2 terminated at 1.4m | | | | End of Test Pit |
| | | 37.5 | | | | | | | | |
| | | | 2.0 | | | | | | | |
| | | 37.0 | | | | | | | | |
| | | | 2.5 | | | | | | | |
| | | 36.5 | | | | | | | | |
| | | | 3.0 | | | | | | | |
| | | 36.0 | | | | | | | | |
| | | | 3.5 | | | | | | | |
| | | 35.5 | | | | | | | | |
| | | | 4.0 | | | | | | | |
| | | 35.0 | | | | | | | | |
| | | | 4.5 | | | | | | | |
| | | 34.5 | | | | | | | | |
| | | | 5.0 | | | | | | | |

BOREHOLE / TEST PIT 6715 TEST PITS 1-5.GPJ GINT STD AUSTRALIA.GDT 30-5-18

**Alliance Geotechnical**
Manage the earth, eliminate the risk

Alliance Geotechnical Pty Ltd
T: 1800 288 188
F: 02 9675 1888
E: office@allgeo.com.au
W: www.allgeo.com.au

**BH No: TP 3**
**Sheet: 1 of 1**
**Job No:** 6715

# Borehole Log

**Client:** Lendlease
**Project:** Proposed Retirement Village (51 Villas)
**Location:** Lot 3991 of DP 1190132, Jordan Springs Boulevard, Jordan Springs, NSW 2747

**Started:** 13-3-18
**Finished:** 13-3-18
**Borehole Size:** N/A

**Rig Type:** 15T Excavator **Hole Location:** Refer Drawing: 6715-GR-1-2-A **Driller:** D. Vela **Logged:** MS
**RL Surface:** 38.2 **Contractor:** MatVel Excavations **Bearing:** --- **Checked:** LM

| Method | Water | RL (m) | Depth (m) | Graphic Log | Classification Symbol | Material Description | Samples Tests Remarks | Moisture Condition | Consistency/ Density Index | Additional Observations |
|---|---|---|---|---|---|---|---|---|---|---|
| E | No Groundwater Encountered | 38.0 | 0.0 | | | TOPSOIL: Clayey SILT, low plasticity, brown, with fine grained sand | | M | | TOPSOIL |
| | | | | | CL | Silty CLAY, medium plasticity, yellow brown mottled brown,with fine grained sand, trace roots | | SM | H | ALLUVIUM |
| | | 37.5 | 0.5 | | | | | | | |
| | | | 1.0 | | CI-CH | Silty CLAY, medium to high plasticity, orange mottled grey, with fine grained sand | | SM | H | |
| | | 37.0 | | | CI-CH | As above, red mottled grey, moist | | M | VSt | |
| | | | 1.5 | | | Borehole TP 3 terminated at 1.4m | | | | End of Test Pit |
| | | 36.5 | | | | | | | | |
| | | | 2.0 | | | | | | | |
| | | 36.0 | | | | | | | | |
| | | | 2.5 | | | | | | | |
| | | 35.5 | | | | | | | | |
| | | | 3.0 | | | | | | | |
| | | 35.0 | | | | | | | | |
| | | | 3.5 | | | | | | | |
| | | 34.5 | | | | | | | | |
| | | | 4.0 | | | | | | | |
| | | 34.0 | | | | | | | | |
| | | | 4.5 | | | | | | | |
| | | 33.5 | | | | | | | | |
| | | | 5.0 | | | | | | | |

BOREHOLE / TEST PIT 6715 TEST PITS 1-5.GPJ GINT STD AUSTRALIA.GDT 30-5-18

Alliance Geotechnical
Manage the earth, eliminate the risk

Alliance Geotechnical Pty Ltd
T: 1800 288 188
F: 02 9675 1888
E: office@allgeo.com.au
W: www.allgeo.com.au

**BH No: TP 4**
**Sheet: 1 of 1**
**Job No:** 6715

# Borehole Log

**Client:** Lendlease
**Project:** Proposed Retirement Village (51 Villas)
**Location:** Lot 3991 of DP 1190132, Jordan Springs Boulevard, Jordan Springs, NSW 2747

**Started:** 13-3-18
**Finished:** 13-3-18
**Borehole Size:** N/A

**Rig Type:** 15T Excavator
**Hole Location:** Refer Drawing: 6715-GR-1-2-A
**Driller:** D. Vela
**Logged:** MS
**RL Surface:** 38.2
**Contractor:** MatVel Excavations
**Bearing:** ---
**Checked:** LM

| Method | Water | RL (m) | Depth (m) | Graphic Log | Classification Symbol | Material Description | Samples Tests Remarks | Moisture Condition | Consistency/ Density Index | Additional Observations |
|---|---|---|---|---|---|---|---|---|---|---|
| E | No Groundwater Encountered | 38.0 | 0.0 | | | TOPSOIL: Silty CLAY, low plasticity, brown, with fine grained sand, with roots/rootlets | | M | | TOPSOIL |
| | | | | | CI-CH | Silty CLAY, medium to high plasticity, orange mottled brown,with fine grained sand, with subrounded gravel | | SM | H | ALLUVIUM |
| | | 37.5 | 0.5 | | CH | CLAY, high plasticity, red mottled grey | | M | St - VSt | RESIDUAL |
| | | 37.0 | 1.0 | | | Borehole TP 4 terminated at 0.8m | | | | End of Test Pit |
| | | 36.5 | 1.5 | | | | | | | |
| | | 36.0 | 2.0 | | | | | | | |
| | | 35.5 | 2.5 | | | | | | | |
| | | 35.0 | 3.0 | | | | | | | |
| | | 34.5 | 3.5 | | | | | | | |
| | | 34.0 | 4.0 | | | | | | | |
| | | 33.5 | 4.5 | | | | | | | |
| | | | 5.0 | | | | | | | |

BOREHOLE / TEST PIT 6715 TEST PITS 1-5.GPJ GINT STD AUSTRALIA.GDT 30-5-18

Alliance Geotechnical
Manage the earth, eliminate the risk

Alliance Geotechnical Pty Ltd
T: 1800 288 188
F: 02 9675 1888
E: office@allgeo.com.au
W: www.allgeo.com.au

**BH No:** TP 5
**Sheet:** 1 of 1
**Job No:** 6715

# Borehole Log

**Client:** Lendlease
**Project:** Proposed Retirement Village (51 Villas)
**Location:** Lot 3991 of DP 1190132, Jordan Springs Boulevard, Jordan Springs, NSW 2747

**Started:** 13-3-18
**Finished:** 13-3-18
**Borehole Size:** N/A

**Rig Type:** 15T Excavator
**Hole Location:** Refer Drawing: 6715-GR-1-2-A
**Driller:** D. Vela
**Logged:** MS

**RL Surface:** 37.0
**Contractor:** MatVel Excavations
**Bearing:** ---
**Checked:** LM

| Method | Water | RL (m) | Depth (m) | Graphic Log | Classification Symbol | Material Description | Samples Tests Remarks | Moisture Condition | Consistency/ Density Index | Additional Observations |
|---|---|---|---|---|---|---|---|---|---|---|
| E | No Groundwater Encountered | | | | | TOPSOIL: Silty CLAY, low plasticity, brown, with fine grained sand, trace fine subrounded garvel, with roots/rootlets | | M | | TOPSOIL |
| | | 36.5 | 0.5 | | CI | Silty CLAY, medium plasticity, orange mottled grey, trace fine grained sand, trace subrounded gravel | Plasticity Index | SM | H | ALLUVIUM |
| | | 36.0 | 1.0 | | CH | CLAY, high plasticity, red mottled grey | | M | St | RESIDUAL |
| | | 35.5 | 1.5 | | | Borehole TP 5 terminated at 1.5m | | | | End of Test Pit |
| | | 35.0 | 2.0 | | | | | | | |
| | | 34.5 | 2.5 | | | | | | | |
| | | 34.0 | 3.0 | | | | | | | |
| | | 33.5 | 3.5 | | | | | | | |
| | | 33.0 | 4.0 | | | | | | | |
| | | 32.5 | 4.5 | | | | | | | |
| | | 32.0 | 5.0 | | | | | | | |

BOREHOLE / TEST PIT 6715 TEST PITS 1-5.GPJ GINT STD AUSTRALIA.GDT 30-5-18

**Alliance Geotechnical**
Manage the earth, eliminate the risk

Alliance Geotechnical Pty Ltd
T: 1800 288 188
F: 02 9675 1888
E: office@allgeo.com.au
W: www.allgeo.com.au

**BH No: BH 101**
**Sheet: 1 of 1**
**Job No:** 6715

# Borehole Log

**Client:** Lendlease Pty Ltd
**Project:** Proposed Retirement Village (51 Villas)
**Location:** Lot 3991, Jordan Springs Boulevard, Jordan Springs, NSW

**Started:** 9-2-18
**Finished:** 9-2-18
**Borehole Size:** 125mm

**Rig Type:** Hanjin D&B
**Hole Location:** Refer Drawing 6715-GR-1-A
**Driller:** B.S
**Logged:** DJ

**RL Surface:** 40.96
**Contractor:** Rockwell P/L
**Bearing:** ---
**Checked:** LM

| Method | Water | RL (m) | Depth (m) | Graphic Log | Classification Symbol | Material Description | Samples Tests Remarks | Moisture Condition | Consistency/ Density Index | Additional Observations |
|---|---|---|---|---|---|---|---|---|---|---|
| ADT | None Observed | 40 | 1 | | | TOPSOIL/FILL: Clayey Sandy Silt, grey/brown, grass roots | | D | | TOPSOIL/FILL |
| | | | | | | FILL: Silty Clay, medium to high plasticity, brown, with fine to medium gravel, organics (plant fibres, rootlets etc.). Appears well compacted | | D | VSt - H | FILL |
| | | | | | CI - CH | Silty CLAY, medium to high plasticity, brown mottled grey/red mottled grey | | D | VSt - H | ALLUVIUM |
| | | | | | CI - CH | As above, but grey mottled red | | D | VSt - H | |
| | | 39 | 2 | | CI - CH | As above, but red to red mottled grey | | D | VSt - H | |
| | | 38 | 3 | | CH | Silty CLAY, high plasticity, red and grey, trace ironstone gravel and extremely weathered siltstone fragments | | D | VSt - H | RESIDUAL |
| | | 37 | 4 | | | | | | | |
| | | 36 | 5 | | | Borehole BH 101 terminated at 4m | | | | |
| | | 35 | 6 | | | | | | | |
| | | 34 | 7 | | | | | | | |

BOREHOLE / TEST PIT 6715-101-102.GPJ GINT STD AUSTRALIA.GDT 30-5-18

**Alliance Geotechnical**
Manage the earth, eliminate the risk

Alliance Geotechnical Pty Ltd
T: 1800 288 188
F: 02 9675 1888
E: office@allgeo.com.au
W: www.allgeo.com.au

**BH No: BH 102**
**Sheet: 1 of 1**
**Job No:** 6715

# Borehole Log

**Client:** Lendlease Pty Ltd
**Project:** Proposed Retirement Village (51 Villas)
**Location:** Lot 3991, Jordan Springs Boulevard, Jordan Springs, NSW

**Started:** 9-2-18
**Finished:** 9-2-18
**Borehole Size:** 125mm

**Rig Type:** Hanjin D&B
**Hole Location:** Refer Drawing 6715-GR-1-A
**Driller:** B.S
**Logged:** DJ

**RL Surface:** 37.63
**Contractor:** Rockwell P/L
**Bearing:** ---
**Checked:** LM

| Method | Water | RL (m) | Depth (m) | Graphic Log | Classification Symbol | Material Description | Samples Tests Remarks | Moisture Condition | Consistency/ Density Index | Additional Observations |
|---|---|---|---|---|---|---|---|---|---|---|
| ADT | None Observed | 37 | 0 | | | TOPSOIL: Silt/Clayey Silt, brown and grey, with grass roots | | D | | TOPSOIL |
| | | | | | CI - CH | Silty CLAY, medium to high plasticity, brown/dark brown, trace of fine to medium sand, trace fine to medium subrounded to subangular gravel, organics (plant fibres, rootlets etc.) | | D | VSt - H | ALLUVIUM |
| | | | 1 | | | | | | | |
| | | 36 | 2 | | CI - CH | Silty CLAY, medium to high plasticity, grey and brown/grey, trace of fine to medium sand, trace fine to medium subrounded to subangular gravel | | D | VSt - H | RESIDUAL |
| | | 35 | 3 | | CI - CH | As above, but grey/brown and red/brown | | D | VSt - H | |
| | | 34 | | | CI - CH | Silty CLAY, medium to high plasticity, grey, trace of ironstone gravel and extremely weathered siltstone fragments | | D | VSt - H | |
| | | | 4 | | | Borehole BH 102 terminated at 4m | | | | |
| | | 33 | 5 | | | | | | | |
| | | 32 | 6 | | | | | | | |
| | | 31 | 7 | | | | | | | |

BOREHOLE / TEST PIT 6715-101-102.GPJ GINT STD AUSTRALIA.GDT 30-5-18

**Alliance Geotechnical**
Manage the earth, eliminate the risk

Alliance Geotechnical Pty Ltd
T: 1800 288 188
F: 02 9675 1888
E: office@allgeo.com.au
W: www.allgeo.com.au

**BH No: BH 1**
**PAGE 1 OF 2**
**Job No:** 2625

# Borehole Log

**Client:** Investor Property Holdings Pty Ltd
**Project:** Proposed Mixed-Use Development - Stage 1
**Location:** Jordan Springs Boulevard, Jordan Springs, NSW 2747

**Started:** 29/11/16
**Finished:** 29/11/16
**Borehole Size:** 110mm

**Rig Type:** MD300 Drill
**Hole Location:**
**Driller:** HD
**Logged:** LM
**RL Surface:** 38.5
**Contractor:** AG P/L
**Bearing:** ---
**Checked:** SM

| Method | Water | RL (m) | Depth (m) | Graphic Log | Classification Symbol | Material Description | Samples Tests Remarks | Moisture Condition | Consistency/ Density Index | Additional Observations |
|---|---|---|---|---|---|---|---|---|---|---|
| ADT | Dry Before Coring | | | | | TOPSOIL/FILL: Clayey Silt, brown, with gravel, grass roots | | D | | TOPSOIL/FILL |
| | | 38 | | | | FILL: Mixture of Silty Clay high plasticity, with Gravelly Shaley Clay, brown/grey and red, fine to coarse gravel, with some sand. Appears well compacted | CBR Sample SPT 6, 10, 9 N=19 | D | | FILL |
| | | | | | CH | Silty CLAY, red and brown, high plasticity | Aggressivity Sample | M | Vst - H | RESIDUAL |
| | | | 2 | | | | | | | |
| | | 36 | | | | | SPT 9, 8, 10 N=18 | | | |
| | | | | | CH | Silty CLAY, grey and red, high plasticity, trace of fine gravel | | M | H | |
| | | | 4 | | | | SPT 10, 11, 12 N=23 | | | |
| | | 34 | | | CI | Shaley CLAY/Gravelly Silty CLAY, grey and red/brown, medium plasticity, fine to coarse ironstone and shale gravel | | M | H | |
| | | | | | | SHALE, grey and brown, extremely to highly weathered, extremely low to very low strength, with some clay bands. Moderate TC bit resistance | Aggressivity Sample | | | BEDROCK |
| | | | 6 | | | | | | | |
| | | 32 | | | | SHALE, grey and dark grey, highly weathered, very low to low strength. High TC bit resistance | | | | |
| | | | | | | SHALE, grey and brown/light brown, extremely to highly weathered, extremely low strength, with clay bands. Low to moderate TC bit resistance | | | | |
| | | | | | | SHALE, grey and brown, highly weathered, very low strength, with clay bands. Low TC bit resistance | | | | |
| | | | 8 | | | Borehole BH 1 continued as cored hole | | | | |
| | | 30 | | | | | | | | |
| | | | 10 | | | | | | | |
| | | 28 | | | | | | | | |
| | | | 12 | | | | | | | |
| | | 26 | | | | | | | | |

BOREHOLE / TEST PIT GINT LOGS BH1TOBH6 JORDANSPRINGS.GPJ GINT STD AUSTRALIA.GDT 8/12/16

**Alliance Geotechnical**
Manage the earth, eliminate the risk

Alliance Geotechnical Pty Ltd
T: 1800 288 188
F: 02 9675 1888
E: office@allgeo.com.au
W: www.allgeo.com.au

**BH No: BH 1**
**PAGE 2 OF 2**
**Job No:** 2625

# Cored Borehole Log

**Client:** Investor Property Holdings Pty Ltd
**Project:** Proposed Mixed-Use Development - Stage 1
**Location:** Jordan Springs Boulevard, Jordan Springs, NSW 2747

**Started:** 29/11/16
**Finished:** 29/11/16
**Borehole Size:** 110mm

**Rig Type:** MD300 Drill
**Hole Location:**
**Driller:** HD
**Logged:** LM

**RL Surface:** 38.5
**Contractor:** AG P/L
**Bearing:** ---
**Checked:** SM

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 38 | | | | | | | | | |
| | | | 2 | | | | | | | | |
| | | 36 | | | | | | | | | |
| | | | 4 | | | | | | | | |
| | | 34 | | | | | | | | | |
| | | | 6 | | | | | | | | |
| | | 32 | | | | | | | | | |
| | | | | | Continued from non-cored borehole | | | | | | |
| NMLC | Full Return | | 8 | | SHALE, grey and dark grey | HW | | A 0.06 | 44 | | 7.50m, EW Seam, 110mm<br>7.72m, Joint, 60°, Curved<br>7.85m, Joint, 45°, Planar<br>7.96m, Joint, 70°, Curved<br>8.06m, Clay Seam, 70mm<br>8.19m, Clay Seam, 40mm<br>8.36m, Joint, 70°, Curved<br>8.53m, EW Seam, 120mm<br>8.76m, Joint, 65°, Planar<br>8.80m, Joint, 85°, Planar<br>9.08m, Crushed Seam, 70mm with Joint 50°<br>9.15m, Clay Seam, 22mm<br>9.17m, Joint, 65°, Curved<br>9.28m, Joint, 80°, Curved<br>9.34m, EW Seam, 40mm |
| | | 30 | | | | | | D 0.27 A 0.17 | | | |
| | | | | | SHALE/SILTSTONE, grey with dark grey laminations | HW/MW | | D 0.85 A 0.56 | | | |
| | | | 10 | | | | | D 0.39 A 1.07 | | | |
| | | 28 | | | | | | A 0.74 | | | |
| | | | | | BH 1 terminated at 10.48m | | | D 0.5 A 1.09 A 3.41 | | | End of BH1 |
| | | | 12 | | | | | | | | |
| | | 26 | | | | | | | | | |

CORED BOREHOLE GINT LOGS BH1TOBH6 JORDANSPRINGS.GPJ GINT STD AUSTRALIA.GDT 8/12/16

**Alliance Geotechnical**
Manage the earth, eliminate the risk

Alliance Geotechnical Pty Ltd
T: 1800 288 188
F: 02 9675 1888
E: office@allgeo.com.au
W: www.allgeo.com.au

**BH No:** BH 2
**Sheet:** 1 of 1
**Job No:** 2625

# Borehole Log

**Client:** Investor Property Holdings Pty Ltd
**Project:** Proposed Mixed-Use Development - Stage 1
**Location:** Jordan Springs Boulevard, Jordan Springs, NSW 2747

**Started:** 1/12/16
**Finished:** 1/12/16
**Borehole Size:** 110mm

**Rig Type:** MD300 Drill
**Hole Location:**
**Driller:** HD
**Logged:** LM

**RL Surface:** 36.5
**Contractor:** AG P/L
**Bearing:** ---
**Checked:** SM

| 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 | After 4hrs ~ 100mm Water at Bottom<br>Dry on Completion | | 36 | 0 | | | FILL: Mixture of Silty Clay and Gravelly Shaley Clay, medium to high plasticity, dark grey and brown, with fine to coarse shale gravel. Appears well compacted | CBR Sample<br>SPT 7, 9, 9 N=18 | M | | FILL |
| | | | 34 | 2 | | | FILL: Gravelly Silty and Shaley Clay, medium plasticity, mixed with some fine to coarse shale gravel and some sand, dark brown and grey. Appears well compacted | | M | | |
| | | | 32 | 4 | | | FILL: Silty Clay medium plasticity, grey/dark grey and brown/yellow, with fine to coarse shale gravel and some fine to coarse sand. Appears well compacted | SPT 4, 6, 7 N=13<br>Aggressivity Sample<br>SPT 3, 6, 6 N=12<br>Aggressivity Sample | M | | |
| | | | 30 | 6 | | | SHALE, grey and dark grey/brown, extremely to highly weathered, very low strength, with frequent clay bands. Moderate TC bit resistance | | | | BEDROCK |
| | | | 28 | 8 | | | Borehole BH 2 terminated at 7.5m | | | | TC Bit Refusal |
| | | | 26 | 10 | | | | | | | |
| | | | 24 | 12 | | | | | | | |

BOREHOLE / TEST PIT GINT LOGS BH1TOBH6 JORDANSPRINGS.GPJ GINT STD AUSTRALIA.GDT 8/12/16

**Alliance Geotechnical**
Manage the earth, eliminate the risk

Alliance Geotechnical Pty Ltd
T: 1800 288 188
F: 02 9675 1888
E: office@allgeo.com.au
W: www.allgeo.com.au

**BH No:** BH 3
**Sheet:** 1 of 1
**Job No:** 2625

# Borehole Log

**Client:** Investor Property Holdings Pty Ltd
**Project:** Proposed Mixed-Use Development - Stage 1
**Location:** Jordan Springs Boulevard, Jordan Springs, NSW 2747

**Started:** 29/11/16
**Finished:** 29/11/16
**Borehole Size:** 110mm

**Rig Type:** MD300 Drill
**Hole Location:**
**Driller:** HD
**Logged:** LM
**RL Surface:** 37.5
**Contractor:** AG P/L
**Bearing:** ---
**Checked:** SM

| Method | Water | RL (m) | Depth (m) | Graphic Log | Classification Symbol | Material Description | Samples Tests Remarks | Moisture Condition | Consistency/ Density Index | Additional Observations |
|---|---|---|---|---|---|---|---|---|---|---|
| ADT | After 24hrs ~ 4m Depth Below Surface<br>Dry on Completion | 36 | | | | TOPSOIL/FILL: Clayey Silt, light brown, with gravel, grass roots | | D | | TOPSOIL/FILL |
| | | | | | | FILL: Mixed Silty Clay of medium to high plasticity with Sandy Clay of low to medium plasticity, brown/red and grey, with some gravel and fine to coarse sand. Appears well compacted | CBR Sample<br>SPT 5, 5, 10 N=15 | M | | FILL |
| | | 34 | 2 | | CI - CH | Silty CLAY, orange/grey mottled brown, medium to high plasticity, with fine to coarse (dark red bands) ironstone gravel | SPT 4, 6, 8 N=14<br>SPT 4, 4, 8 N=12 | M | VSt | ALLUVIUM |
| | | | 4 | | CH | Silty CLAY, red/brown and grey, high plasticity, with some fine to coarse ironstone and shale gravel | | M | H | RESIDUAL |
| | | 32 | 6 | | | SHALE, grey and brown, extremely to highly weathered, extremely to very low strength, with frequent clay bands. Low to moderate TC bit resistance | | | | BEDROCK |
| | | 30 | 8 | | | SHALE, light grey and brown, highly weathered, very low strength. Moderate TC bit resistance | | | | |
| | | 28 | 10 | | | Borehole BH 3 terminated at 8.4m | | | | TC Bit Refusal |
| | | 26 | 12 | | | | | | | |

BOREHOLE / TEST PIT GINT LOGS BH1TOBH6 JORDANSPRINGS.GPJ GINT STD AUSTRALIA.GDT 8/12/16

**Alliance Geotechnical**
Manage the earth, eliminate the risk

Alliance Geotechnical Pty Ltd
T: 1800 288 188
F: 02 9675 1888
E: office@allgeo.com.au
W: www.allgeo.com.au

**BH No:** BH 4
**Sheet:** 1 of 1
**Job No:** 2625

# Borehole Log

**Client:** Investor Property Holdings Pty Ltd
**Project:** Proposed Mixed-Use Development - Stage 1
**Location:** Jordan Springs Boulevard, Jordan Springs, NSW 2747

**Started:** 1/12/16
**Finished:** 1/12/16
**Borehole Size:** 110mm

**Rig Type:** MD300 Drill
**Hole Location:**
**Driller:** HD
**Logged:** LM
**RL Surface:** 37.7
**Contractor:** AG P/L
**Bearing:** ---
**Checked:** SM

| Method | Water | RL (m) | Depth (m) | Graphic Log | Classification Symbol | Material Description | Samples Tests Remarks | Moisture Condition | Consistency/ Density Index | Additional Observations |
|---|---|---|---|---|---|---|---|---|---|---|
| ADT | After 4hrs ~ 3.5m Depth Below Surface | 36 | 0 | | | TOPSOIL/FILL: Clayey Silt, grey/brown, with gravel, grass roots | | D | | TOPSOIL/FILL |
| | | | | | | FILL: Mixture of Silty Clay high plasticity with some Gravelly Shaley Clay, brown/red and grey, fine to coarse gravel, with some fine to coarse sand. Appears well compacted | SPT 8, 8, 12 N=20 | D | | FILL |
| | | | 2 | | CH | Silty CLAY, red and orange/brown, high plasticity, with fine to coarse ironstone gravel | | M | VSt | ALLUVIUM |
| | | | | | CH | Silty CLAY, red/brown and grey, high plasticity | SPT 7, 7, 14 N=21 | M | H | RESIDUAL |
| | | 34 | 4 | | CI | Shaley CLAY/Gravelly Silty CLAY, grey and red/brown, medium plasticity, fine to coarse ironstone and shale gravel | | M | H | |
| | Dry on Completion | 32 | 6 | | | SHALE, grey and brown, extremely to highly weathered, extremely to very low strength, with some fine grained sandstone and clay bands/layers. Extremely low to low TC bit resistance | | | | BEDROCK |
| | | | | | | SHALE, grey and dark grey, highly weathered, very low strength, with occasional clay bands. Moderate to high TC bit resistance | | | | |
| | | 30 | 8 | | | Borehole BH 4 terminated at 7.2m | | | | TC Bit Refusal |
| | | 28 | 10 | | | | | | | |
| | | 26 | 12 | | | | | | | |

BOREHOLE / TEST PIT GINT LOGS BH1TOBH6 JORDANSPRINGS.GPJ GINT STD AUSTRALIA.GDT 8/12/16

**Alliance Geotechnical**
Manage the earth, eliminate the risk

Alliance Geotechnical Pty Ltd
T: 1800 288 188
F: 02 9675 1888
E: office@allgeo.com.au
W: www.allgeo.com.au

**BH No: BH 5**
**Sheet: 1 of 1**
**Job No:** 2625

# Borehole Log

**Client:** Investor Property Holdings Pty Ltd
**Project:** Proposed Mixed-Use Development - Stage 1
**Location:** Jordan Springs Boulevard, Jordan Springs, NSW 2747

**Started:** 30/11/16
**Finished:** 30/11/16
**Borehole Size:** 110mm

**Rig Type:** MD300 Drill
**Hole Location:**
**Driller:** HD
**Logged:** LM
**RL Surface:** 36.5
**Contractor:** AG P/L
**Bearing:** ---
**Checked:** SM

| 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 | After 24hrs & After 24hrs | | 36 | | | | TOPSOIL/FILL: Clayey Silt, brown, with gravel, grass roots | | | | TOPSOIL/FILL |
| | | | | | | | FILL: Mixed Silty Clay high plasticity with Gravelly Sandy Clay medium plasticity, brown/red and grey, with fine to coarse sand. Appears well compacted | CBR Sample<br>SPT 7, 12, 11 N=23 | D - M | | FILL |
| | | | | 2 | | CH | Silty CLAY, red and orange/brown, high plasticity, with fine to coarse ironstone gravel | | M | Vst | ALLUVIUM |
| | | | 34 | | | CH | Silty CLAY, red/brown and grey, high plasticity, with fine to coarse ironstone gravel | SPT 6, 6, 7 N=13 | M | VSt | RESIDUAL |
| | | | | 4 | | CI | Gravelly Shaley CLAY/Shale and Sandstone layers, medium plasticity, with some red ironstone gravel bands | SPT 5, 5, 14 N=19 | M | VSt - H | RESIDUAL/ROCK |
| | | | 32 | | | | SHALE, grey and brown, extremely weathered, extremely low strength, with frequent clay bands. Extremely low TC bit resistance | Aggressivity Sample<br>Aggressivity Sample | | | BEDROCK |
| | Slight Seepage | | | 6 | | | | | | | |
| | | | 30 | | | | SHALE, grey and brown, highly weathered, very low strength, with occasional shaley clay bands. Moderate TC bit resistance | | | | |
| | | | | 8 | | | Borehole BH 5 terminated at 7.6m | | | | TC Bit Refusal |
| | | | 28 | | | | | | | | |
| | | | | 10 | | | | | | | |
| | | | 26 | | | | | | | | |
| | | | | 12 | | | | | | | |
| | | | 24 | | | | | | | | |

BOREHOLE / TEST PIT GINT LOGS BH1TOBH6 JORDANSPRINGS.GPJ GINT STD AUSTRALIA.GDT 8/12/16

**Alliance Geotechnical**
Manage the earth, eliminate the risk

Alliance Geotechnical Pty Ltd
T: 1800 288 188
F: 02 9675 1888
E: office@allgeo.com.au
W: www.allgeo.com.au



# Borehole Log

**Client:** Investor Property Holdings Pty Ltd
**Project:** Proposed Mixed-Use Development - Stage 1
**Location:** Jordan Springs Boulevard, Jordan Springs, NSW 2747

**Started:** 30/11/16
**Finished:** 30/11/16
**Borehole Size:** 110mm

**Rig Type:** MD300 Drill
**Hole Location:**
**Driller:** HD
**Logged:** LM
**RL Surface:** 36.2
**Contractor:** AG P/L
**Bearing:** ---
**Checked:** SM

| Method | Water | RL (m) | Depth (m) | Graphic Log | Classification Symbol | Material Description | Samples Tests Remarks | Moisture Condition | Consistency/ Density Index | Additional Observations |
|---|---|---|---|---|---|---|---|---|---|---|
| ADT | | 36 | | | | TOPSOIL/FILL: Clayey Silt, brown, with gravel, grass roots | | D | | TOPSOIL/FILL |
| | | | | | | FILL: Mixed Silty Clay of medium to high plasticity with Silty Sandy Clay, high plasticity, brown/red and grey, with fine to coarse sand. Appears well compacted | CBR Sample | D - M | | FILL |
| | | | | | | | SPT 6, 8, 8 N=16 | | | |
| | | | 2 | | | FILL: Silty Clay of high plasticity, mixed with some gravel, red and grey, trace of sand. Appears well compacted | | M | | |
| | | 34 | | | | | | | | |
| | | | | | CI | Silty CLAY, orange/grey mottled brown, medium to high plasticity, with fine to coarse ironstone gravel | | M | VSt | ALLUVIUM |
| | | | | | | | SPT 3, 5, 8 N=13 | | | |
| | | | 4 | | | | | | | |
| | | 32 | | | CH | Silty CLAY, red/brown and grey, high plasticity, with some fine to coarse ironstone and shale gravel | | M | H | RESIDUAL |
| | | | | | | | SPT 6, 8, 12 N=20 | | | |
| | | | | | CI | Gravelly Silty CLAY/Shaley CLAY, grey and brown/red, medium plasticity, fine to coarse ironstone and shale gravel | | M | H | |
| | Slight Seepage | | 6 | | | | | | | |
| | | 30 | | | | SHALE, grey and brown, extremely weathered, extremely low strength, with frequent clay bands. Low TC bit resistance | | | | BEDROCK |
| | | | 8 | | | SHALE, grey and brown, highly weathered, very low strength, interlayered with shaley clay bands of medium plasticity. Extremely low to moderate TC bit resistance | | | | |
| | | 28 | | | | | | | | |
| | | | | | | Borehole BH 6 continued as cored hole | | | | |
| | | | 10 | | | | | | | |
| | | 26 | | | | | | | | |
| | | | 12 | | | | | | | |
| | | 24 | | | | | | | | |

BOREHOLE / TEST PIT GINT LOGS BH1TOBH6 JORDANSPRINGS.GPJ GINT STD AUSTRALIA.GDT 8/12/16

**Alliance Geotechnical**
Manage the earth, eliminate the risk

Alliance Geotechnical Pty Ltd
T: 1800 288 188
F: 02 9675 1888
E: office@allgeo.com.au
W: www.allgeo.com.au

**BH No: BH 6**
**PAGE 2 OF 2**
**Job No:** 2625

# Cored Borehole Log

**Client:** Investor Property Holdings Pty Ltd
**Project:** Proposed Mixed-Use Development - Stage 1
**Location:** Jordan Springs Boulevard, Jordan Springs, NSW 2747

**Started:** 30/11/16
**Finished:** 30/11/16
**Borehole Size:** 110mm

**Rig Type:** MD300 Drill
**Hole Location:**
**Driller:** HD
**Logged:** LM

**RL Surface:** 36.2
**Contractor:** AG P/L
**Bearing:** ---
**Checked:** SM

| 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 -10) | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | Defect Spacing mm (30, 100, 300, 1000, 3000) | Additional Data |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 36 | | | | | | | | | |
| | | | 2 | | | | | | | | |
| | | 34 | | | | | | | | | |
| | | | 4 | | | | | | | | |
| | | 32 | | | | | | | | | |
| | | | 6 | | | | | | | | |
| | | 30 | | | | | | | | | |
| | | | 8 | | | | | | | | |
| | | 28 | | | Continued from non-cored borehole | | | | | | |
| NMLC | Full Return | | 10 | | SHALE, grey and dark grey, with brown bands | HW/MW | | A 0.77<br>A 0.32<br>D 0.27 A 1.24 | 81 | | 9.08m, Fragmented core, 138mm with 2 clay seems 22mm and 24mm<br>9.00m, EW Seam, 28mm<br>9.16m, Joint, 35°, Curved<br>9.83m, Joint, 30°, Curved<br>9.95m, Joint, 45°, Curved |
| | | 26 | | | SANDSTONE, fine grained, light grey | MW | | D 1.05 A 1.95 | | | 10.25-10.38m, SANDSTONE Band (fine grained) |
| | | | | | SHALE, grey and dark grey, with brown bands | HW/MW | | D 0.11 A 0.29 | | | |
| | | | | | SHALE, grey and dark grey | HW | | D 0.21 A 0.31 | | | 10.97m, Fragmented core, 80mm with clay seam<br>11.24m, Joint, 45°, Planar<br>11.34m, EW Seam, 28mm<br>11.65m, EW Seam, 14mm<br>11.70m, EW Seam, 12mm |
| | | | 12 | | | | | | 89 | | |
| | | 24 | | | SHALE, dark grey with grey laminations | HW/MW | | D 0.15 A 0.2<br>D 0.42 A 0.27 | | | |
| | | | | | BH 6 terminated at 12.53m | | | D 0.45 A 0.49 | | | End of BH6 |

CORED BOREHOLE GINT LOGS BH1TOBH6 JORDANSPRINGS.GPJ GINT STD AUSTRALIA.GDT 8/12/16

# EXPLANATORY NOTES - DRILL & EXCAVATION LOGS

## *GENERAL*

Information obtained from site investigations is recorded on log sheets. The "Cored Drill Hole Log" presents data from an operation where a core barrel has been used to recover material - commonly rock. The "Non-Core Drill Hole - Geological Log" presents data from an operation where coring has not been used and information is based on a combination of regular sampling and insitu testing. The material penetrated in non-core drilling is commonly soil but may include rock. The "Excavation - Geological Log" presents data and drawings from exposures of soil and rock resulting from excavtion of pits, trenches, etc.

The heading of the log sheets contains information on Project Identification, Hole or Pit Identification, Location and Elevation. The main section of the logs contains information on methods and conditions, material substance description and structure presented as a series of columns in relation to depth below the ground surface which is plotted on the left side of the log sheet. The common depth scale is 8m per drill log sheet and about 3-5m for excavation logs sheets.

As far as is practicable the data contained on the log sheets is factual. Some interpretation is inevitable in the identification of material boundaries in areas of partial sampling, the location of areas of core loss, description and classification of material, estimation of strength and identification of drilling induced fractures. Material description and classifications are based on SAA Site Investigation Code AS 1726 - 1993 with some modifications as defined below.

These notes contain an explanation of the terms and abbreviations commonly used on the log sheets.

## *DRILLING*

**Drilling & Casing**

| | |
|---|---|
| **AS** | Auger Screwing |
| **AD/V** | Auger Drilling with V-Bit |
| **AD/T** | Auger Drilling with TC Bit |
| **WB** | Wash-bore drilling |
| **RR** | Rock Roller |
| **NMLC** | NMLC core barrel |
| **NQ** | NQ core barrel |
| **HMLC** | HMLC core barrel |
| **HQ** | HQ core barrel |

**Drilling Fluid/Water**

The drilling fluid used is identified and loss of return to the surface estimated as a percentage.

**Drilling Penetration/Drill Depth**

Core lifts are identified by a line and depth with core loss per run as a percentage. Ease of penetration in non-core drilling is abbreviated as follows:

| | |
|---|---|
| **VE** | Very Easy |
| **E** | Easy |
| **F** | Firm |
| **H** | Hard |
| **VH** | Very Hard |

**Groundwater Levels**

Date of measurement is shown.

▼ Standing water level measured in completed borehole

▽ Level taken during or immediately after drilling

**Samples/Tests**

| | |
|---|---|
| **D** | Disturbed |
| **U** | Undisturbed |
| **C** | Core Sample |
| **SPT** | Standard Penetration Test |
| **N** | Result of SPT (*sample taken) |
| **VS** | Vane Shear Test |
| **IMP** | Borehole Impression Device |
| **PBT** | Plate Bearing Test |
| **PZ** | Piezometer Installation |
| **HP** | Hand Penetrometer Test |

## *EXCAVATION LOGS*

Explanatory notes are provided at the bottom of drill log sheets. Information about the origin, geology and pedology may be entered in the "Structure and other Observations" column. The depth of the base of excavation (for the logged section) at the appropriate depth in the "Material Description" column. Refusal of excavation plant is noted should it occur. A sketch of the exposure may be added.

## *MATERIAL DESCRIPTION - SOIL*

***Classification Symbol*** - In accordance with the Unified Classification System (AS 1726-1993, Appendix A, Table A1)

***Material Description*** - In accordance with AS 1726-1993, Appendix A2.3

***Moisture Condition***

| | |
|---|---|
| **D** | Dry, looks and feels dry |
| **M** | Moist, No free water on remoulding |
| **W** | Wet, free water on remoulding |

***Consistency*** - In accordance with AS 1726-1993, Appendix A2.5

| | | |
|---|---|---|
| **VS** | Very Soft | < 25kPa |
| **S** | Soft | 25 - 50kPa |
| **F** | Firm | 50 - 100kPa |
| **St** | Stiff | 100 - 200kPa |
| **VSt** | Very Stiff | 200 - 400kPa |
| **H** | Hard | ≥ 400kPa |

Strength figures quoted are the approximate range of Unconfined Compressive Strength for each class.

***Density Index.*** (%) is estimated or is based on SPT results. Approximate N Value correlation is shown in right column.

| | | | |
|---|---|---|---|
| **VL** | Very Loose | < 15% | 0 - 4 |
| **L** | Loose | 15 - 35% | 4 - 10 |
| **MD** | Medium Dense | 35 - 65% | 10 - 30 |
| **D** | Dense | 65 - 85% | 30 - 50 |
| **VD** | Very Dense | > 85% | > 50 |

## *MATERIAL DESCRIPTION -ROCK*

**Material Description**

Identification of rock type, composition and texture based on visual features in accordance with AS 1726-1993, Appendix A3.1-A3.3 and Tables A6a, A6b and A7.

**Core Loss**

Is shown at the bottom of the run unless otherwise indicated.

**Bedding**

| Description | Spacing (mm) |
|---|---|
| Thinly Laminated | < 6 |
| Laminated | 6 - 20 |
| Very Thinly Bedded | 20 - 60 |
| Thinly Bedded | 60 - 200 |
| Medium Bedded | 200 - 600 |
| Thickly Bedded | 600 - 2000 |
| Very Thickly Bedded | > 2000 |

***Weathering*** - No distinction is made between weathering and alteration. Weathering classification assists in identification but does not imply engineering properties.

| | |
|---|---|
| **Fresh (F)** | Rock substance unaffected by weathering |
| **Slightly Weathered (SW)** | Rock substance partly stained or discoloured. Colour and texture of fresh rock recognisable. |
| **Moderately Weathered (MW)** | Staining or discolouration extends throughout rock substance. Fresh rock colour not recognisable. |
| **Highly Weathered (HW)** | Stained or discoloured throughout. Signs of chemical or physical alteration. Rock texture retained. |
| **Extremely Weathered (EW)** | Rock texture evident but material has soil properties and can be remoulded. |

***Strength*** - The following terms are used to described rock strength:

| Rock Strength Class | Abbreviation | Point Load Strength Index, Is(50) (MPa) |
|---|---|---|
| Extremely Low | EL | < 0.03 |
| Very Low | VL | 0.03 to 0.1 |
| Low | L | 0.1 to 0.3 |
| Medium | M | 0.3 to 1 |
| High | H | 1 to 3 |
| Very High | VH | 3 to 10 |
| Extremely High | EH | ≥ 10 |

Strengths are estimated and where possible supported by Point Load Index Testing of representative samples. Test results are plotted on the graphical estimated strength by using:

- ° Diametral Point Load Test
- • Axial Point Load Test

Where the estimated strength log covers more than one range it indicates the rock strength varies between the limits shown.

## *MATERIALS STRUCTURE/FRACTURES*

**ROCK**

***Natural Fracture Spacing*** - A plot of average fracture spacing excluding defects known or suspected to be due to drilling, core boxing or testing. Closed or cemented joints, drilling breaks and handling breaks are not included in the Natural Fracture Spacing.

***Visual Log*** - A diagrammatic plot of defects showing type, spacing and orientation in relation to core axis.

| | | |
|---|---|---|
| **Defects** | ——— | Defects open in-situ or clay sealed |
| | - - - - - - - | Defects closed in-situ |
| | ..... | Breaks through rock substance |

***Additional Data*** - Description of individual defects by type, orientation, in-filling, shape and roughness in accordance with AS 1726-1993, Appendix A Table A10, notes and Figure A2.

| | | |
|---|---|---|
| **Type** | BP | Bedding Parting |
| | JT | Joint |
| | SM | Seam |
| | FZ | Fracture Zone |
| | SZ | Shear Zone |
| | VN | Vein |
| | FL | Foliation |
| | CL | Cleavage |
| | DL | Drill Lift |
| | HB | Handling break |
| | DB | Drilling break |

***Orientation*** - angle relative to the plane normal to the core axis.

| | | |
|---|---|---|
| **Infilling** | CN | Clean |
| | X | Carbonaceous |
| | Clay | Clay |
| | KT | Chlorite |
| | CA | Calcite |
| | Fe | Iron Oxide |
| | Qz | Quartz |
| | MS | Secondary Mineral |
| | MU | Unidentified Mineral |
| **Shape** | PR | Planar |
| | CU | Curved |
| | UN | Undulose |
| | ST | Stepped |
| | IR | Irregular |
| | DIS | Discontinuous |
| **Roughness** | POL | Polished |
| | SL | Slickensided |
| | S | Smooth |
| | RF | Rough |
| | VR | Very Rough |

**SOIL**

***Structures*** - Fissuring and other defects are described in accordance with AS 1726-1993, Appendix A2.6, using the terminology for rock defects.

***Origin*** - Where practicable an assessment is provided of the probable origin of the soil, eg fill, topsoil, alluvium, colluvium, residual soil.

24 November 2008

Alliance Geotechnical
ENGINEERING | ENVIRONMENTAL | TESTING
Your On-Site Geotechnical & Environmental Specialists

Your On-Site Geotechnical Specialists
Phone Us Today – 1800 288 188

# Dynamic Cone Penetrometer Test Report

| | | | |
|---|---|---|---|
| Client: | Lendlease | Report Number: | 6715-GR-1-1 |
| Project Name: | Proposed Retirement Village (51 Villas) | Report Date: | 26/02/2018 |
| Project Location: | Lot 3991 of DP 1190132, Jordan Springs, Boulevard, Jordan Springs, NSW 2747 | Date Tested: | 07/02/2018 |
| Test Method: | AS 1289 6.3.2 | | |

| Test Number | DCP-1 | DCP-2 |
|---|---|---|
| Test Location | Refer Drawing 6715-GR-1-A | |
| R.L (AHD) | | |
| Depth (meters) | | |
| 0.00 – 0.15 | 17 | 16 |
| 0.15 – 0.30 | 17 | 21 |
| 0.30 – 0.45 | 24 | 24 |
| 0.45 – 0.60 | >25 | >25 |
| 0.60 – 0.75 | | |
| 0.75 – 0.90 | | |