

Geotechnical Investigation Report 5 Mulawa Place, Frenchs Forest NSW

1.0 INTRODUCTION

Morrow Geotechnics Pty Ltd conducted geotechnical investigations at 5 Mulawa Place, Frenchs Forest NSW (the site). The purpose of this investigation was to provide geotechnical advice and recommendations for proposed development at the site based on project details available at the time of the investigation. Morrow Geotechnics understands that the proposed development will comprise alterations and additions to the existing residence with no proposed changes to the existing ground surface profile.

2.0 OBSERVATIONS

A senior engineering geologist inspected the site on 24 October 2017. Two hand auger boreholes were drilled during the investigation. Dynamic Cone Penetrometer (DCP) tests were carried out adjacent to borehole locations to assess soil consistency and density. The approximate borehole locations are shown on the attached plan.

A summary of the subsurface conditions encountered within the boreholes is presented in **Table 1**. More detailed descriptions of subsurface conditions at the test locations are available in the borehole logs attached to this report. The details of the method of soil and rock classification, explanatory notes and abbreviations adopted in the borehole logs are also presented attached.

TABLE 1 SUMMARY OF INFERRED SUBSURFACE CONDITIONS

| Unit | Depth (mBGL) | | Comments |
|-----------------|--------------|------------|---|
| | BH1 | BH2 | |
| 1 Fill | 0.0 to 0.75 | 0.0 to 0.2 | Fine to coarse grained Silty SAND with sandstone gravel. Unit 1 is of very loose consistency. Fill is inferred to be uncontrolled and poorly compacted. |
| 2 Residual Soil | 0.75 to 0.85 | - | Fine to coarse grained SAND. Generally very loose to loose consistency. |
| 3 Bedrock | 0.85 + | 0.2 + | Inferred extremely weathered, extremely low strength sandstone grading stronger with depth. |

Notes:

- 1 Approximate depth below ground level at the investigation locations. More detailed descriptions of subsurface conditions are available in the borehole logs attached to this report. Depths may vary across the site.

Minor seepage water was encountered above the rock level in both boreholes, inferred to be a result of surface water infiltration across the relatively impermeable rock surface.

3.0 ADVICE AND RECOMMENDATIONS

3.1 Reuse of Foundations and Foundation Design

The parameters given in **Table 2** may be used for the design of additional loading to existing footings and for any proposed new footings. Morrow Geotechnics recommends that a Preliminary Geotechnical Strength Reduction Factor (GSRF) of 0.4 is used for the design of piles in accordance with AS 2159:2009 if no allowance is made for pile testing during construction. Should pile testing be nominated, the GSRF may be reviewed and a value of 0.55 to 0.6 may be expected.

All new footings must found on Unit 3 Bedrock in order to minimise the potential for differential settlement between new and existing footings. Shallow footings and slabs on Unit 3 material should be designed in accordance with AS2870:2011 based on a Site Classification of 'A.' The site classification has been provided on the basis that the performance expectations set out in Appendix B of AS2870–2011 are acceptable and that future site maintenance will be undertaken in accordance with CSIRO BTF 18.

Ultimate geotechnical strengths are provided for use in limit state design. Allowable or serviceability bearing pressures adopted in **Table 2** are intended to limit settlements to an acceptable level for conventional building structures, typically less than 1% of the minimum footing width.

To adopt these parameters we have assumed that the bases of all footing and pile excavations are cleaned of loose debris and water and inspected by a suitably qualified Geotechnical Engineer prior to pile construction to verify that ground conditions meet design assumptions. Where groundwater ingress is encountered during pile excavation, concrete is to be placed as soon as possible upon completion of pile excavation. Pile excavations should be pumped dry of water prior to pouring concrete, or alternatively a tremmie system could be used.

TABLE 2 PAD FOOTING AND PILE DESIGN PARAMETERS

| Material | Unit 1 Topsoil | Unit 2 Residual Soil | Unit 3 Bedrock |
|---|-------------------|-------------------------|-------------------|
| Allowable Bearing Pressure (kPa) | - | N/A | 500 |
| Ultimate Vertical End Bearing Pressure (kPa) | - | N/A | 1500 |
| Elastic Modulus (MPa) | 5 | 12 | 70 |
| Ultimate Shaft Adhesion (kPa) | In Compression | 10 | 120 |
| | In Tension | 5 | 60 |
| Susceptibility to Liquefaction during an Earthquake | High | Medium | Low |

Notes:

- 1 Foundations on Unit 1 and Unit 2 material are not recommended due to the potential for differentials settlement based on the shallow bedrock level at the site.

- 2 Side adhesion values given assume there is intimate contact between the pile and foundation material. Design engineer to check both ‘piston’ pull-out and ‘cone’ pull-out mechanics in accordance with AS4678-2002 Earth Retaining Structures.
- 3 Susceptibility to liquefaction during an earthquake is based on the following definition:

| | | |
|--------|---|---|
| Low | - | Medium to very dense sands, stiff to hard clays, and rock |
| Medium | - | Loose to medium dense sands, soft to firm clays, or uncontrolled fill below the water table |
| High | - | Very loose sands or very soft clays below the water table |

3.2 AS1170 Earthquake Site Risk Classification

Assessment of the material encountered during the investigation in accordance with the guidelines provided in AS1170.4-2007 indicates:

- an earthquake subsoil class of Class B_e – Rock for the site; and
- a hazard factor (z) of 0.08 for Sydney.

3.3 Preliminary Landslip Risk Checklist

Northern Beaches Council’s landslide hazard maps for the subject area show the site to be within Landslip Risk Area B. Clause E10 of the Warringah Council DCP 2011 (WDCP 2011) requires that sites within Area B receive a preliminary risk assessment of site conditions by a suitably qualified geotechnical engineer. Site conditions and development conditions observed during the inspection were as follows:

- **Does the site or adjacent properties have history of slope instability?**
No evidence of ongoing or past instability observed during inspection.
- **Are excavations or fills greater than 2 m depth proposed?**
No.
- **Is fill greater than 1 m depth present?**
No.
- **Are cuts / excavations greater than 2 m high present?**
No.

On the basis of this checklist in accordance with Clause E10 of the WDCP 2011 a full geotechnical slope risk assessment of the site is not required.

4.0 CLOSURE

Your attention is drawn to the attached document titled “Important Information.” The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Morrow Geotechnics, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

Please do not hesitate to contact Morrow Geotechnics if you have any questions about the contents of this report.

For and on behalf of Morrow Geotechnics Pty Ltd,



Alan Morrow

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Attached: Borehole Location Plan
 Borehole Logs
 Explanatory Notes
 Important Information



Plan Source: maps.six.nsw.gov.au, October 2017

morrow

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| | |
|----------|----------|
| Drawn | AM |
| Approved | AM |
| Date | 28-10-17 |
| Scale | NTS |

Stephan & Dearne Cameron
 5 Mulawa Place, Frenchs Forest NSW
 Geotechnical Investigation
 Borehole Location Plan

Figure:

1

Project: P1355

Project No: P1355
 Client: Stephan & Dearne Cameron
 Project: Residential Development
 5 Mulawa Place
 Frenchs Forest NSW

Contractor: MHK
 Drill Rig: Hand Auger
 Sheet: 1 of 1
 Logged: MK
 Date: 24-10-17



BH1

| Drilling Method | Resistance | Water | Sampling | USCS | Depth | Stratigraphy (Additional Observations) | Consistency/Density | Moisture | DCP (blows per 100 mm) | | | |
|-----------------|------------|-------|----------|------|-------|--|---------------------|--|------------------------|-----|----|----|
| | | | | | | | | | 5 | 10 | 15 | 20 |
| HA | L | | | | 0.25 | Silty SAND, brown, fine to coarse grained with sandstone gravel and cobbles (FILL) | VL | M | | | | |
| | | | | | 0.50 | | | | | | | |
| | | | △ | | | | 0.75 | Silty SAND, black, fine to coarse grained, roots (TOPSOIL) | L | M-W | | |
| | | | | | | SAND, grey, fine to coarse grained, with roots (RESIDUAL SOIL) | | | | | | |
| | | | | | 1.00 | End BH1 at 0.85 m Practical Auger Refusal | | | | | | |
| | | | | | 1.25 | | | | | | | |
| | | | | | 1.50 | | | | | | | |
| | | | | | 1.75 | | | | | | | |
| | | | | | 2.00 | | | | | | | |
| | | | | | 2.25 | | | | | | | |
| | | | | | 2.50 | | | | | | | |
| | | | | | 2.75 | | | | | | | |
| | | | | | 3.00 | | | | | | | |
| | | | | | 3.25 | | | | | | | |
| | | | | | 3.50 | | | | | | | |
| | | | | | 3.75 | | | | | | | |
| | | | | | 4.00 | | | | | | | |

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 excavation 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

| | |
|------|----------------------------|
| ADV | Auger Drilling with V-Bit |
| ADT | 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 |
| M | Medium |
| H | High |
| VH | Very High |

Groundwater Levels

Date of measurement is shown.

Standing water level measured in completed borehole

Level taken during or immediately after drilling

| | |
|-----|------------------------------|
| D | Disturbed |
| B | Bulk |
| U | Undisturbed |
| SPT | Standard Penetration Test |
| N | Result of SPT (sample taken) |
| 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 | < 12.5 kPa |
| S | Soft | 12.5 – 25 kPa |
| F | Firm | 25 – 50 kPa |
| St | Stiff | 50 – 100 kPa |
| VSt | Very Stiff | 100 – 200 kPa |
| H | Hard | > 200 kPa |

Strength figures quoted are the approximate range of undrained shear strength for each class.

Density Index. (%) is estimated or is based on SPT results.

| | | |
|----|--------------|-----------|
| VL | Very Loose | < 15 % |
| L | Loose | 15 – 35 % |
| MD | Medium Dense | 35 – 65 % |
| D | Dense | 65 – 85 % |
| VD | Very Dense | > 85 % |

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

| | |
|---------------------|------------|
| Thinly Laminated | < 6 mm |
| 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.

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

| | | |
|-----------|--|--|
| Type | BP JT SM FZ SZ VN FL CL DL HB DB | Bedding Parting Joint Seam Fracture Zone Shear Zone Vein Foliation Cleavage Drill Lift Handling Break Drilling Break |
| Infilling | CN X Clay KT CA Fe Qz MS MU | Clean Carbonaceous Clay Chlorite Calcite Iron Oxide Quartz Secondary Mineral Unidentified Mineral |
| Shape | PR CU UN ST IR DIS | Planar Curved Undulose Stepped Irregular Discontinuous |
| Roughness | POL SL S RF VR | Polished Slickensided Smooth Rough 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.

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