# GEOTECHNICAL INVESTIGATION REPORT FOR SUBDIVISION DEVELOPMENT

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| **SITE ADDRESS** | **: 264 Mount Vernon Rd., Mount Vernon** |
| **REPORT No** | **: NE115-17** |
| **DATE** | **: 9 April 2017** |
| **CLIENT** | **: The Bathla Group** |
| **PROPOSED STRUCTURE** | **: Subdivision Development – Total 5 Lots** |
| **SITE CLASSIFICATION** | **: Class P** |

GEOTESTA

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# 1. COMMISSION AND LIMITATIONS

Geotesta was engaged to investigate the soil profile at six borehole locations (BH1 to BH6) as requested to satisfy the requirements of Australian Standard 2870 - 2011 (Residential slabs and footings - Construction) with respect to proposed subdivision. This report is based only on the information provided at the time of this report preparation and may not be valid if changes are made to the site or to the construction method.

# 2. SITE DESCRIPTION

This site is situated at 264 Mount Vernon Rd, Mount Vernon. At the time of investigation the site was occupied by a single storey dwelling. The surface of the site is steep and sloping mainly to southeast. Tall trees were observed at south-east and also some medium to tall trees observed at northern and western side of the site. The site plan showing the borehole locations is presented in Figure 1.

# 3. FIELD INVESTIGATION

The site was visited by Geotesta on 1 & 2 March 2017. Six boreholes were drilled using a PIXY 41T drilling rig to a maximum depth of 3m. Dynamic Cone Penetrometer (DCPs) testings were undertaken next to each borehole to determine the soil consistency or relative density. The soil profiles encountered are described in the attached Borehole Logs.

# 4. GEOLOGY

The geological origin of the soil profile was identified from our visual examination of the soil samples, geotechnical experience, and reference to geological maps of the area. The geological map of the area indicates that the site (Lot 1 & 2) is underlain by Triassic sedimentary rocks of the Sydney Basin. The borehole material confirmed the information on the geological map indicating presence of Hawksbury Sandstone, being cross-bedded to massive quartz sandstone with mudstone lenses. There is also an indication of a remnant capping layer of the Bringelly Shale member (claystone and siltstone, laminite, sandstone, coal and carbonaceous claystone) and Minchinbury Sandstone member (lithic sandstone) of the Wianamatta Group adjacent to the areas of Lot 3 to Lot 6.

# 5. SITE CLASSIFICATION

After considering the area geology, the soil profile encountered in the bores, the proposed structure and the climatic zone of the area; the site is classified as CLASS P, with respect to foundation construction (Australian Standard 2870-2011 Residential Slabs and Footings) due to steep terrain and presence of high trees.

It has been estimated that the Characteristic Surface Movement (ys) of the underlying natural soil material will be in the range of 40 to 60 mm provided the building site should be maintained at essentially stable moisture condition and extremes of wetting and drying prevented as described in AS 2870, Clause B2.3.

It must be emphasized that the heave mentioned and recommendations referred to in this report are based solely on the observed soil profile observed at the time of the investigation for this report, without taking into account any abnormal moisture conditions as defined in AS2870 – 2011, Clause 1.3.3 that might be created thereafter. With abnormal moisture conditions, distresses will occur and may result in "non-acceptable probabilities of serviceability and safety of the building during its design life" as defined in AS2870-2011, Clause 1.3.1. If these distresses are not acceptable to the builder, owner or other relevant parties then further fieldwork and revised footing recommendations must be carried out.

# 6. FOOTING DESIGN

## 6.1 Slab on Ground

An engineer designed Class H1 slab on ground footing system can be used on this site. We recommend that the designing engineer refer to AS2870-2011 to ensure design compliance to this document.
The founding depth of the edge and load bearing beams must be at least 100mm into naturally occurring soil layer after the removal of any material with excessively high moisture or organic content, uncontrolled fill or deleterious matter and as described in the borehole logs. As a guide with information obtained from the bores, the actual founding depth at the test locations will be as follow:

| Borehole Location | Minimum founding Depth (mm) | Founding Material | Allowable Bearing Capacity (kPa) |
|---|---|---|---|
| BH 1 & BH 5 | 500 | Silty Clay | 150 |
| BH 2 to BH 4 & BH 6 | 500 | Silty Clay | 100 |

Slab panels and internal beams can be founded in the natural soil profile or in compacted surface filling and/or as required in the design by engineering principles. Compacted filling used to raise levels beneath panels must be placed and compacted as per specifications for controlled or rolled fill.

## 6.2 Strip/Pad Footing System

An engineer designed Class H1 strip and/or pad footing system can be used on this site. We recommend that the designing engineer refer to AS2870-2011 to ensure design compliance to this document.

The strip or pad footings should be founded in the natural soil layer and penetrate through any fill material, tree roots and founded at least 100 mm into the recommended founding material. As a

guide with information obtained from the bores, the actual founding depth for strip or pad footings at the test locations should be as follow:

| Borehole Location | Minimum founding Depth (mm) | Founding Material | Allowable Bearing Capacity (kPa) |
|---|---|---|---|
| BH1 to BH6 | 500 | Silty Clay/Rock | 150 |

### 6.3 Bored Piers

The proposed building can be founded on bored piers. The carrying capacity of bored piers can be estimated using the following parameters:

| Borehole Location | Depth(m) | Soil/Rock Type | Skin Friction (kPa) | End Bearing Capacity (kPa) |
|---|---|---|---|---|
| BH1, 2 & BH5, 6 | 1.5 | Sandstone and/or Shale | - | 600 |
| BH3 & BH4 | 1.5 | Silty Clay | - | 600 |

The design end bearing capacities have been calculated based on the geotechnical parameters at the bottom of each corresponding soil layer.

It should be noted that the soil profile may vary across the site. At a minimum, the end bearing bored piers should be founded into a hard layer in natural material and penetrate through any fill material. It is recommended that a geotechnical engineer be engaged during the footing excavation stage to confirm founding depth and founding material.

# 7. Laboratory Test

Representative soil samples were sent to the NATA accredited MGT Environmental laboratory for soil salinity testing. The laboratory test results are summarised in Table 1.

Table 1: Summary of Environmental Laboratory Test Results

| Sample ID | Salinity (determined from EC) (mg/kg) | Moisture (%) | Multiplication Factor | ECe (dS/m) | Salinity Classification |
|---|---|---|---|---|---|
| **Limit of Reporting (LOR)** | **20** | **1** | **-** | **-** | **-** |
| BH1 @ 0.2-0.4m | 87 | 11 | 8 | 0.696 | **Non-Saline** |
| BH2 @ 0.3-0.5m | 210 | 23 | 8 | 1.680 | **Non-Saline** |
| BH3 @ 0.2-0.4m | 110 | 18 | 8 | 0.880 | **Non-Saline** |
| BH5 @ 0.2-0.5m | 160 | 21 | 8 | 1.280 | **Non-Saline** |

The majority of results indicate subsurface materials up to 1.0m bgl are classified as non-saline.

# 8. GENERAL RECOMMENDATIONS

- Where some structures have been or are to be removed from the building site, any stump hole should be filled with well compacted soil or the footings deepened below the disturbed depth. In dry periods the ground should be gradually soaked well prior to footing construction until the moisture conditions over the whole building site are made uniform.
- Trees and/or shrubs in general could affect the long term performance of footings. Where trees are deemed to affect the long term performance of the footings, the slab and/or footings for the building should be designed by a professional engineer familiar with the soil conditions on the site taking into account the variable moisture condition over the building site at the time of construction.If offending trees are to remain, an engineer designed pier/screw piles and beam footing system should be considered.
- Any proposed footings which are close to an easement and/or other excavations, (including those in adjoining properties) should be founded below a line projected up at $30^{o}$ to the horizontal (for Sand) and $40^{o}$ to the horizontal (for firm/stiff Clay) and measured from the nearest base of the easement excavations.
- Avoid excavations close to footings since those founded on sandy soils can experience settlements while those founded in clayey soils can also move due to the shrinking and swelling of the clay. Plumbers and drainers should follow all the recommendations made in AS 2870 and other appropriate codes with respect to drainage works.
- It is also recommended that the Owners follow the requirements of AS 2870 and the C.S.I.R.O. BTF 18, which can be obtained from www.csiro.au. The document provides some guidelines to the Owners to carry out regular maintenance of drainage and care for the soil moisture conditions.

# 9. CONDITIONS OF THE RECOMMENDATIONS

- This report is a geotechnical report only and the classification stated shall not be regarded as an engineering design nor shall it replace a design by engineering principles although it may contribute information for such designs. It shall be read in conjunction with AS 2870 and must be reproduced only in total.
- The advice given in this report is based on the assumption that the test results are representative of the overall subsurface conditions. However, it should be noted that actual conditions in some parts of the building site may differ from those found in our test holes. If excavations reveal soil conditions significantly different from those shown in our attached Borehole Log(s), Geotesta must be consulted and excavations stopped immediately.
- The foundation depths quoted in this report are measured from the surface during our testing and may vary accordingly if any filling or excavation works are carried out. The description of the foundation material for has been provided for its easy recognition over the whole building site. In all cases the foundation soil chosen should be capable of supporting the proposed building but need not be of the same type.
- Any sketches in this report should be considered as only an approximate pictorial evidence of our work. Therefore, unless otherwise stated, any dimensions or slope information should not be used for any building cost calculations and/or positioning of the building.

For and on behalf of
GEOTESTA PTY LTD

Amir Farazmand
BEng MEng MIEAust CPEng
Senior Geotechnical Engineer

## Information about This Report

The report contains the results of a geotechnical investigation conducted for a specific purpose and client. The results should not be used by other parties, or for other purposes, as they may contain neither adequate nor appropriate information. In particular, the investigation does not cover contamination issues unless specifically required to do so by the client.

### Test Hole Logging

The information on the test hole logs (boreholes, test pits, exposures etc.) is based on a visual and tactile assessment, except at the discrete locations where test information is available (field and/or laboratory results). The test hole logs include both factual data and inferred information.

### Groundwater

Unless otherwise indicated, the water levels presented on the test hole logs are the levels of free water or seepage in the test hole recorded at the given time of measuring. The actual groundwater level may differ from this recorded level depending on material permeability (i.e. depending on response time of the measuring instrument). Further, variations of this level could occur with time due to such effects as seasonal, environmental and tidal fluctuations or construction activities. Confirmation of groundwater levels, phreatic surfaces or piezometric pressures can only be made by appropriate instrumentation techniques and monitoring programmes.

### Interpretation of Results

The discussion or recommendations contained within this report normally are based on a site evaluation from discrete test hole data. Generalized, idealized or inferred subsurface conditions (including any geotechnical cross-sections) have been assumed or prepared by interpolation and/or extrapolation of these data. As such these conditions are an interpretation and must be considered as a guide only.

### Change in Conditions

Local variations or anomalies in the generalized ground conditions do occur in the natural environment, particularly between discrete test hole locations. Additionally, certain design or construction procedures may have been assumed in assessing the soil-structure interaction behaviour of the site. Furthermore, conditions may change at the site from those encountered at the time of the geotechnical investigation through construction activities and constantly changing natural forces.

Any change in design, in construction methods, or in ground conditions as noted during construction, from those assumed or reported should be referred to GEOTESTA for appropriate assessment and comment.

### Geotechnical Verification

Verification of the geotechnical assumptions and/or model is an integral part of the design process - investigation, construction verification, and performance monitoring. Variability is a feature of the natural environment and, in many instances, verification of soil or rock quality, or foundation levels, is required. There may be a requirement to extend foundation depths, to modify a foundation system or to conduct monitoring as a result of this natural variability. Allowance for verification by geotechnical personnel accordingly should be recognized and programmed during construction.

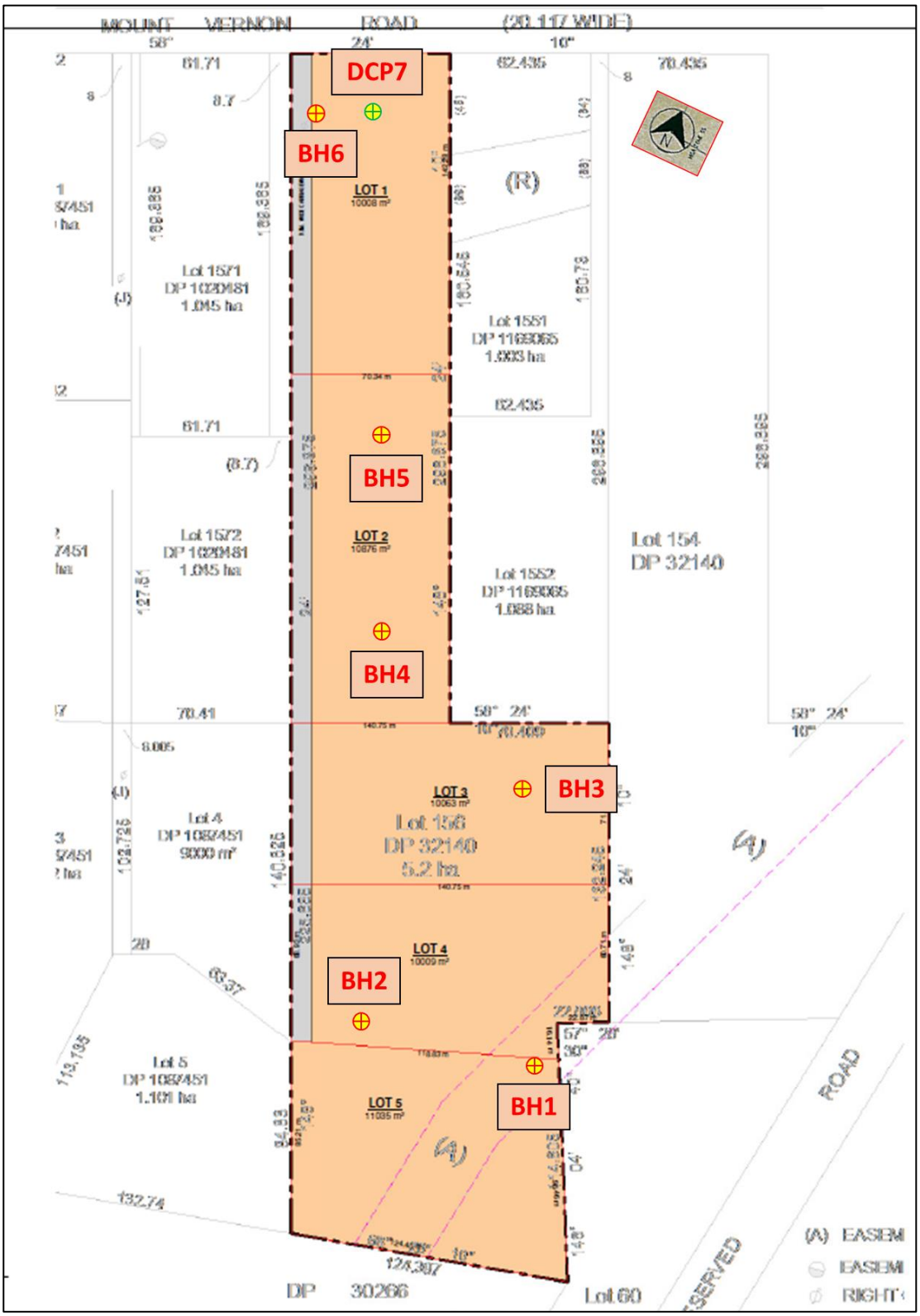
**Reproduction of Reports**

Where it is desired to reproduce the information contained in our geotechnical report, or other technical information, for the inclusion in contract documents or engineering specification of the subject development, such reproductions should include at least all of the relevant test hole and test data, together with the appropriate standard description sheets and remarks made in the written report of a factual or descriptive nature. Reports are the subject of copyright and shall not be reproduced either totally or in part without the express permission of Geotesta.

# FIGURE 1: SITE PLAN AND TEST LOCATIONS

**264 Mount Vernon Rd., Mount Vernon**

**(Not to scale)**




⊕ *Denotes Approximate Test Locations*

# BOREHOLE LOGS

| Depth (m) | Soil Class | DCP blows/ 100mm | Borehole Log: BH1 (Lot 5) |
|---|---|---|---|
| 0.0 | | | |
| 0.1 | CL | 1 | Silty CLAY, trace grass roots, brown-grey, moist, very soft |
| 0.2 | | 1 | Grades brown to grey-brown |
| 0.3 | SM | 6 | Silty SAND, trace rock fragments (red), brown, dry, dense |
| 0.4 | | 11 | Grades dense to very dense |
| 0.5 | | 22 | |
| | | End of Borehole at 0.5m – REFUSAL on Rock | |

*X denotes effective refusal – Hammer bouncing*

| Depth (m) | Soil Class | DCP blows/ 100mm | Borehole Log: BH2 (Lot 4) |
|---|---|---|---|
| 0.0 | | | |
| 0.1 | CL | 1 | Silty CLAY, trace grass roots, dark grey, moist, very soft |
| 0.2 | | 1 | Grades brown to red-brown |
| 0.3 | CI | 2 | Grades mottled red-brown, soft to firm |
| 0.4 | | 3 | Grades trace rock fragments (red), brown, firm |
| 0.5 | | 4 | Grades trace black organic matter, stiff to very stiff |
| 0.6 | | 7 | Grades very stiff |
| 0.7 | | 8 | |
| 0.8 | | 10 | Grades with rock fragments, pale brown, brown to yellow- |
| 0.9 | | 13 | brown, dry, hard |
| 1.0 | | X | |
| | | End of Borehole at 1.0m – REFUSAL on Rock | |

*X denotes effective refusal (>10/20mm) – Hammer bouncing*

| Depth (m) | Soil Class | DCP blows/ 100mm | Borehole Log: BH3 (Lot 3) |
|---|---|---|---|
| 0.0 | | | |
| 0.1 | CL | 1 | Silty CLAY, trace grass roots, dark grey, moist, soft |
| 0.2 | | 3 | Grades trace rock fragments, grey, firm |
| 0.3 | | 3 | |
| 0.4 | | 3 | |
| 0.5 | CI | 13 | Grades grey-brown, dry to moist, very stiff to hard |
| 0.6 | | 13 | |
| 0.7 | | 8 | Grades brown, mottled red-brown |
| 0.8 | | 7 | |
| 0.9 | | 11 | |
| 1.0 | | 11 | |
| 1.1 | | 12 | |
| 1.2 | | 15 | |
| 1.3 | | 14 | |
| 1.4 | | 13 | |
| 1.5 | | 16 | |
| 1.6 | | | |
| 1.7 | | | |
| 1.8 | | | |
| 1.9 | | | |
| 2.0 | | | |
| 2.1 | | | |
| 2.2 | | | |
| 2.3 | | | |
| 2.4 | | | |
| 2.5 | | | Grades trace shale fragments, grey, brown |
| 2.6 | | | |
| 2.7 | | | |
| 2.8 | | | |
| 2.9 | | | |
| 3.0 | | | |
| | | End of Borehole at 3.0m | |

| Depth (m) | Soil Class | DCP blows/ 100mm | Borehole Log: BH4 (Lot 2) |
|---|---|---|---|
| 0.0 | | | |
| 0.1 | FILL | 1 | Topsoil: Silty CLAY, trace Sand & grass roots, dark grey, |
| 0.2 | | 1 | moist, very soft |
| 0.3 | CL | 3 | Silty CLAY, trace rock fragments, brown to grey-brown |
| 0.4 | | 4 | moist, firm to stiff |
| 0.5 | CI | 7 | Grades very stiff to hard |
| 0.6 | | 13 | Grades brown, mottled red-brown, dry to moist |
| 0.7 | | 10 | |
| 0.8 | | 10 | |
| 0.9 | | 9 | |
| 1.0 | | 13 | Grades trace fine to medium rock fragments, brown to pale |
| 1.1 | | 9 | brown, dry to moist, very stiff |
| 1.2 | | 6 | |
| 1.3 | | 7 | |
| 1.4 | | 11 | |
| 1.5 | | 9 | Grades dark brown, mottled red-brown, yellow-brown |
| 1.6 | | 9 | |
| 1.7 | | | |
| 1.8 | | | |
| 1.9 | | | |
| 2.0 | | | Grades red, pale grey |
| 2.1 | | | |
| 2.2 | | | |
| 2.3 | | | |
| 2.4 | | | Grades trace shale fragments, pale grey to grey, dry, hard |
| 2.5 | | | |
| | | End of Borehole at 2.5m - REFUSAL on Rock | |

| Depth (m) | Soil Class | DCP blows/ 100mm | Borehole Log: BH5 (Lot 2) |
|---|---|---|---|
| 0.0 | | | |
| 0.1 | CL | 1 | Silty CLAY, trace grass roots, dark grey, moist |
| 0.2 | | 3 | Grades dark grey, red, moist, firm |
| 0.3 | CI | 6 | Grades red-brown, very stiff |
| 0.4 | | 11 | Grades brown to red-brown, dry to moist, hard |
| 0.5 | | 13 | |
| 0.6 | | 13 | |
| 0.7 | | 14 | |
| 0.8 | | X | Grades with rock fragments (Shale, grey, brown), grey-brown |
| 0.9 | | | |
| 1.0 | | | |
| 1.1 | | | |
| 1.2 | | | |
| 1.3 | | | |
| 1.4 | | | |
| 1.5 | | | |
| 1.6 | | | |
| 1.7 | | | |
| 1.8 | | | |
| 1.9 | | | |
| 2.0 | | | |
| 2.1 | | | |
| 2.2 | | | |
| 2.3 | | | |
| 2.4 | | | |
| 2.5 | | | |
| | | End of Borehole at 2.5m - REFUSAL on Rock | |

*X denotes effective refusal (>20/50mm)*

| Depth (m) | Soil Class | DCP blows/ 100mm | Borehole Log: BH6 (Lot 1) |
|---|---|---|---|
| 0.0 | | | |
| 0.1 | CL | 1 | Topsoil: Silty CLAY, trace grass roots, dark grey, moist to |
| 0.2 | | 2 | to wet, very soft |
| 0.3 | CI | 3 | Grades very fine tree roots, red, mottled grey, moist, firm |
| 0.4 | | 5 | Grades brown-grey, dry to moist, stiff |
| 0.5 | | 6 | |
| 0.6 | | 8 | Grades trace rock fragments brown, pale grey, yellow- |
| 0.7 | | 8 | brown |
| 0.8 | | 12 | |
| 0.9 | | 11 | |
| 1.0 | | 8 | |
| 1.1 | | 12 | Grades with shale fragments |
| 1.2 | | X | |
| 1.3 | | | |
| 1.4 | | | |
| 1.5 | | | Grades with EW-HW shale fragments (dark grey), grey |
| 1.6 | | | |
| 1.7 | | | |
| 1.8 | | | |
| 1.9 | | | |
| 2.0 | | | |
| 2.1 | | | |
| 2.2 | | | |
| | | End of Borehole at 2.2m - REFUSAL on Rock | |

*X denotes effective refusal – Hammer bouncing*
*EW-HW: Extremely-Highly Weathered*

| Depth (m) | DCP Blows per 100mm penetration | | | | |
|---|---|---|---|---|---|
| | DCP7 | | | | |
| **0.0-0.1** | 4 | | | | |
| **0.1-0.2** | 4 | | | | |
| **0.2-0.3** | 3 | | | | |
| **0.3-0.4** | 4 | | | | |
| **0.4-0.5** | 8 | | | | |
| **0.5-0.6** | 8 | | | | |
| **0.6-0.7** | 5 | | | | |
| **0.7-0.8** | 3 | | | | |
| **0.8-0.9** | 4 | | | | |
| **0.9-1.0** | 5 | | | | |
| **1.0-1.1** | 9 | | | | |
| **1.1-1.2** | 9 | | | | |
| **1.2-1.3** | 11 | | | | |
| **1.3-1.4** | 10 | | | | |
| **1.4-1.5** | 9 | | | | |
| **1.5-1.6** | 12 | | | | |