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Our Ref: PSM1802-003L Rev1
Date: 29 November 2012

Matthews Civil Pty Ltd
Level 37, Chifley Tower
2 Chifley Square
SYDNEY NSW 2000

ATTENTION: BOB STEWART
Sent by email to: bob@cisnsw.com.au)

Dear Sir,

**RE: PRELIMINARY GEOTECHNICAL ADVICE FOR PROPOSED RESIDENTIAL DEVELOPMENT AT RALSTON AVENUE BELROSE, NSW**

## 1. INTRODUCTION

This letter presents our preliminary geotechnical advice for the proposed residential development at Ralston Avenue Belrose, NSW.

We understand that this letter will be submitted to council as part of a package regarding re-zoning of the land to permit the construction of residential dwellings, roads, utility services infrastructure and landscaping.

## 2. PROPOSED DEVELOPMENT

The area proposed to be re-zoned and developed is located north west of the end of Ralston Avenue (the Site). The area is approximately 135 ha and is located at the crest of a ridge. The envisaged development will comprise approximately 169 low density lots.

Figure 1 attached to this letter provides a plan showing the location of the proposed development area. Attachment A1 presents the currently proposed concept development layout for the Site.

## 3. PSM SCOPE OF WORK

In preparing this letter, PSM has:

1. Completed a desk top study of geological maps, survey drawings provided, development details provided and aerial photos taken from Google Earth and NearMap.
2. Completed a site walkover inspection. This was carried out by Ronald Tan of PSM, accompanied by Bob Stewart of Complete Infrastructure Services (CIS) on 28 August 2012.

## 4. GEOLOGICAL SETTING

Our site inspection and a review of the 1 in 100,000 series geological map of Sydney indicate that the Site is underlain by Hawkesbury Sandstone.

## 5. SURFACE CONDITIONS

The Site is located on top of a ridge, with gentle slopes of less than 5 degrees within the proposed residential development area.

Immediately outside the proposed residential area, the slopes become steeper up to approximately 15 degrees before essentially becoming a cliff face. Bedrock exposures were observed in the trail paths within the proposed residential area with little colluvium observed.

No evidence of instability was observed within the proposed residential area.

Photos A2 to A8 show the presence of the sandstone bedrock at the trail paths and at sandstone ridges located at the edges of the proposed development area.

## 6. INFERRED SUBSURFACE CONDITIONS

It is understood that the proposed residential area will be located on the flat area, on top of a sandstone ridge. We have inferred that the sub-surface conditions in this area to comprise of some topsoil, underlain by a thin residual soil layer, underlain by Sandstone.

The residual soil is likely to be Sandy CLAY of very stiff to hard consistency and medium to high plasticity and is a weathered product of the sandstone underneath.

The sandstone is likely to be of at least low strength, slightly weathered to fresh.

## 7. PRELIMINARY GEOTECHNICAL ADVICE

### 7.1. General

It should be noted that the advice contained in this letter is of a preliminary nature and is subject to confirmation by a geotechnical site investigation.

Notwithstanding this, it is our initial assessment that the Site is geotechnically suitable for the proposed type of residential development.

### 7.2. Site Classification

Based on the field observations, the site was classified in accordance with Australian Standard AS 2870 (1996), *Residential slabs and footings – Construction*. We recommend that structures which are within the scope of AS 2870 be designed for a site classification of Class "S" based on expected foundation materials. It is possible that the Site could be reclassifed to a Class "A" site after the completion of a geotechnical site investigation.

The above classification assumes that the structures are founded below any colluvium, if present, on the residual soils or bedrock.

### 7.3. Excavatability and Earthworks

The details of the development have not yet been finalised, however we envisage that some reshaping of the surface geometry at the Site will be required.

Excavation is expected to occur in colluvium and/or residual soils. Excavation of this material is expected to require use of conventional earth moving equipment. The variable nature of the colluvium may result in rock breaking of boulders being required.

Excavation of the sandstone bedrock will require the use of large bulldozers equipped with rippers or large excavators using excavator mounted hydraulic impact breakers, grinders and rock saws.

It is our experience that excavatability is heavily dependent on both the operator and the plant used. The earthworks contractor should satisfy itself with regard to excavatability.

As part of reshaping of the surface geometry, minor filling works may be required at the Site. It is expected that the fill material would be sourced from the cut areas on site.

It is our opinion that most of the materials seen on site would be suitable for reuse on the Site as engineered fill.

Any new earthworks proposed at the Site will require the preparation of a detailed fill specification developed following the guidelines in AS 3798 (2007) "Guidelines on earthworks for commercial and residential developments". Preparation of this fill specification is outside the scope of this report. We consider, however, that the fill specification should be aimed at resulting in the required ground performance and address at least the following:

1. Subgrade preparation and base geometry requirements.
2. Material requirements, including a clear definition of:
   - Suitable and unsuitable material.
   - Grading or maximum particle size requirements.
3. Fill placement requirements, including a clear definition of maximum compacted layer thickness.
4. Compaction requirements.
5. Moisture control requirements.
6. Inspection and testing requirements.
7. Responsibilities of the contractor.
8. Responsibilities of the Geotechnical Inspection and Testing Authority (GITA).

## 7.4. Temporary and Permanent Batter Angles

The batter angles shown in Table 1, subject to the comments below, are recommended for the design of batters up to 3 m height. The batter angles assume a horizontal surface above the batter, and that no surcharge load is present at the crest of the batter.

**TABLE 1**
**BATTER ANGLES**

| INFERRED UNIT | TEMPORARY | PERMANENT |
|---|---|---|
| ENGINEERED FILL | 1H : 1V | 2H : 1V |
| COLLUVIUM/RESIDUAL SOIL | 1.5H : 1V | 2.5H : 1V |
| SANDSTONE | Vertical[1] | Vertical[1] |

[1] Batters in sandstone will need to be inspected by suitably qualified geotechnical engineers and may require support in the form of rockbolts, anchors or shotcrete.

All batters should be protected from erosion. Permanent batters should be drained. Temporary batters should not be left unsupported for more than 3 months without further geotechnical advice.

## 7.5. Retaining Wall Design

Cuts in colluvium and residual soil and engineered fill batters steeper than recommended in Table 1, will need to be supported by some form of retaining structure.

The design of these structures should be based on the effective soil strength parameters $c'$ = 0 kPa and $\phi'$ = 25 degrees or the at rest coefficient of lateral earth pressure $K_o$.

Retaining walls should be designed and constructed in accordance with the requirements of *AS4678 - 2002, "Earth Retaining Structures".*

We note that we have not provided earth pressure coefficients as these are dependent on the wall type and geometry, the batter angle, the backfill angle, the flexibility of the wall, the construction sequence, the acceptable deformation, surcharge etc. The retaining wall designer should consider all the above as part of the design.

Note that design of retention systems may be based on either $K_a$ or $K_o$ pressures. Design using active earth pressures provides the minimum lateral earth pressure that must be supported to avoid failure and requires a wall that can rotate or translate to allow the pressures to reduce to these values (vertical and lateral movements up to 2% of height may occur, typical movements will be much less).

If there is concern regarding movement due to excavation affecting adjacent structures or in ground services, it is recommended that the design and construction be based on $K_o$ pressures and construction be carefully controlled to avoid unwanted effects. It should be noted that designing for $K_o$ pressures does not, of itself, ensure that movement does not occur. Movements are controlled by construction method, especially sequence. The proximity of the neighbouring buildings to the boundaries will need to be considered when designing the basement retaining structure.

Unless adequate drainage of the wall is provided the effect of water pressures on the wall stability should be considered.

The sandstone bedrock is expected to be self-supporting in a vertical exposure. However, when loads are located at the crest of the excavation or defects are observed in the rock face, local underpinning or support (i.e. rock bolting) may be required.

### 7.6. Foundations

Pad footings or rafts should be founded below the colluvium on the residual soil or sandstone bedrock. The following allowable bearing pressures can be adopted for vertically and centrally loaded footings:

- Residual Soil/Engineered Fill 150 kPa
- Sandstone 1000 kPa

Higher bearing pressures may be able to be adopted subject to further investigation and inspections during construction.

Properly designed and constructed pad footings, designed in accordance with the above allowable bearing pressures will experience settlements in the order of 1% of the minimum footing dimension.

Where adjacent foundation details differ (e.g. pad sizes, differing loads or ground conditions) differential settlement will need to be assessed.

#### 7.6.1. Footings Adjacent to Excavation or Cliff Faces

Where a footing is located adjacent to, or in the vicinity of, an excavation face or cliff face, the allowable bearing capacity will need to be revised to allow for the presence of both the excavation and unfavourably oriented defects below the footing.

We recommend that where footings are located adjacent to, or in the vicinity of, an excavation face, further geotechnical advice be sought.

For initial sizing of the footings for costing purposes only, allowable bearing pressure of a third (1/3) of that shown above may be adopted.

### 7.7. Road Pavements

For the preliminary design of road pavements a CBR of 2% can be adopted for engineered fill and residual soil. Higher values, particularly in areas of significant cut, may be provided on completion of testing on the finished bulk earthworks.

### 7.8. Hill Side Development

Where the proposed development is located on hillside, below steep rock faces or above steep batters or rock faces, the proposed development should take into account "Practice Note Guidelines for Landslide Risk Management, 2007" – Australian Geomechanics Vol 42, No 1 March 2007.

It is our opinion that if slope risk assessment of the Site is completed, it is likely to result in an acceptable risk to both life and property.

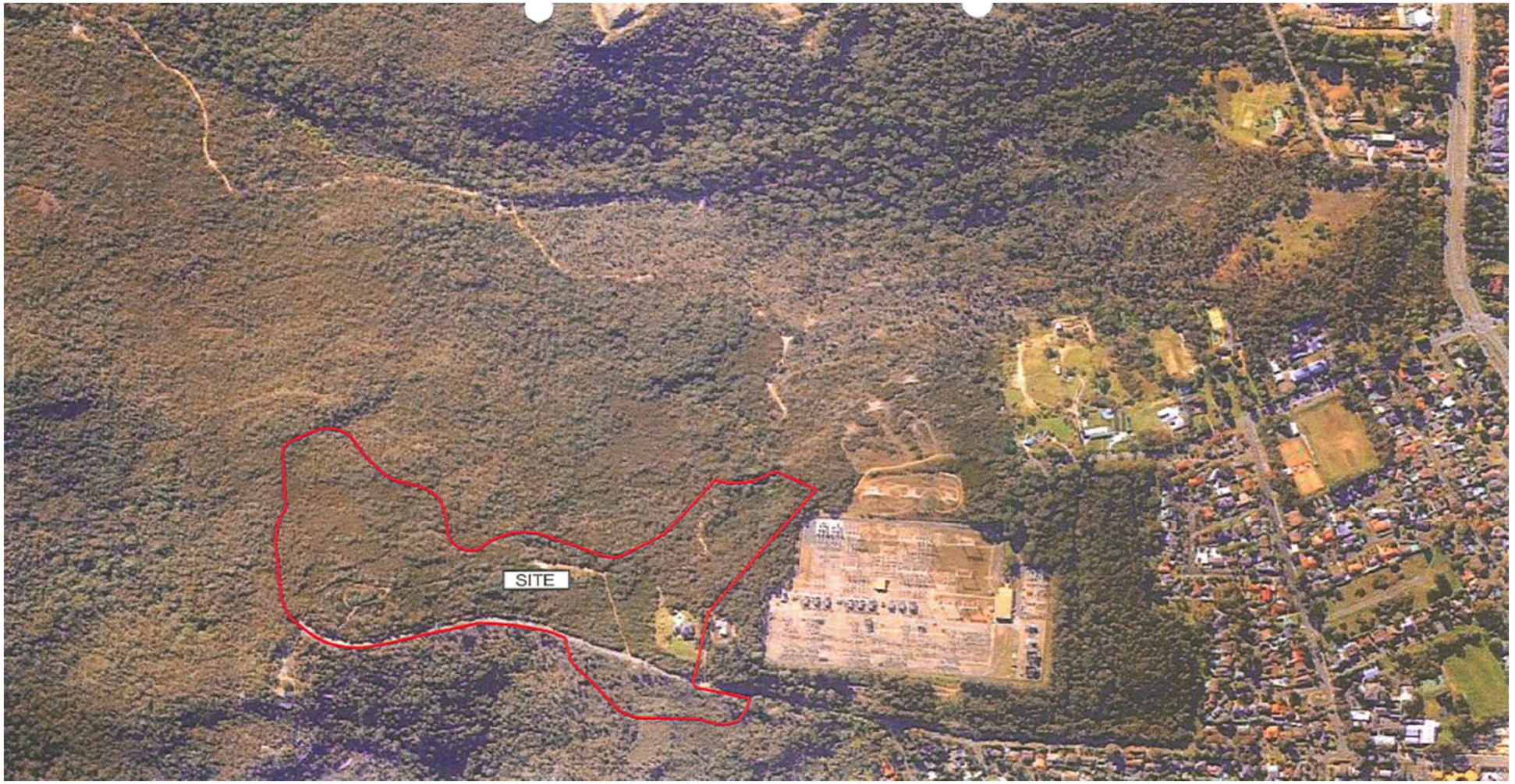
For and on behalf of
PELLS SULLIVAN MEYNINK

DAVID PICCOLO
Associate

GARRY MOSTYN
Principal

Encl:

| | |
|---|---|
| Figure 1 | Location Plan of the Proposed Development Area |
| Attachment A | Location Plan and Photographs of the Site |




Pells Sullivan Meynink

**Matthews Civil Pty Ltd**
**Preliminary Geotechnical Advice**
**Proposed Residental Development, Belrose**
**LOCATION PLAN OF**
**PROPOSED DEVELOPMENT AREA**

| PSM1802-003L | Figure 1 |
|---|---|

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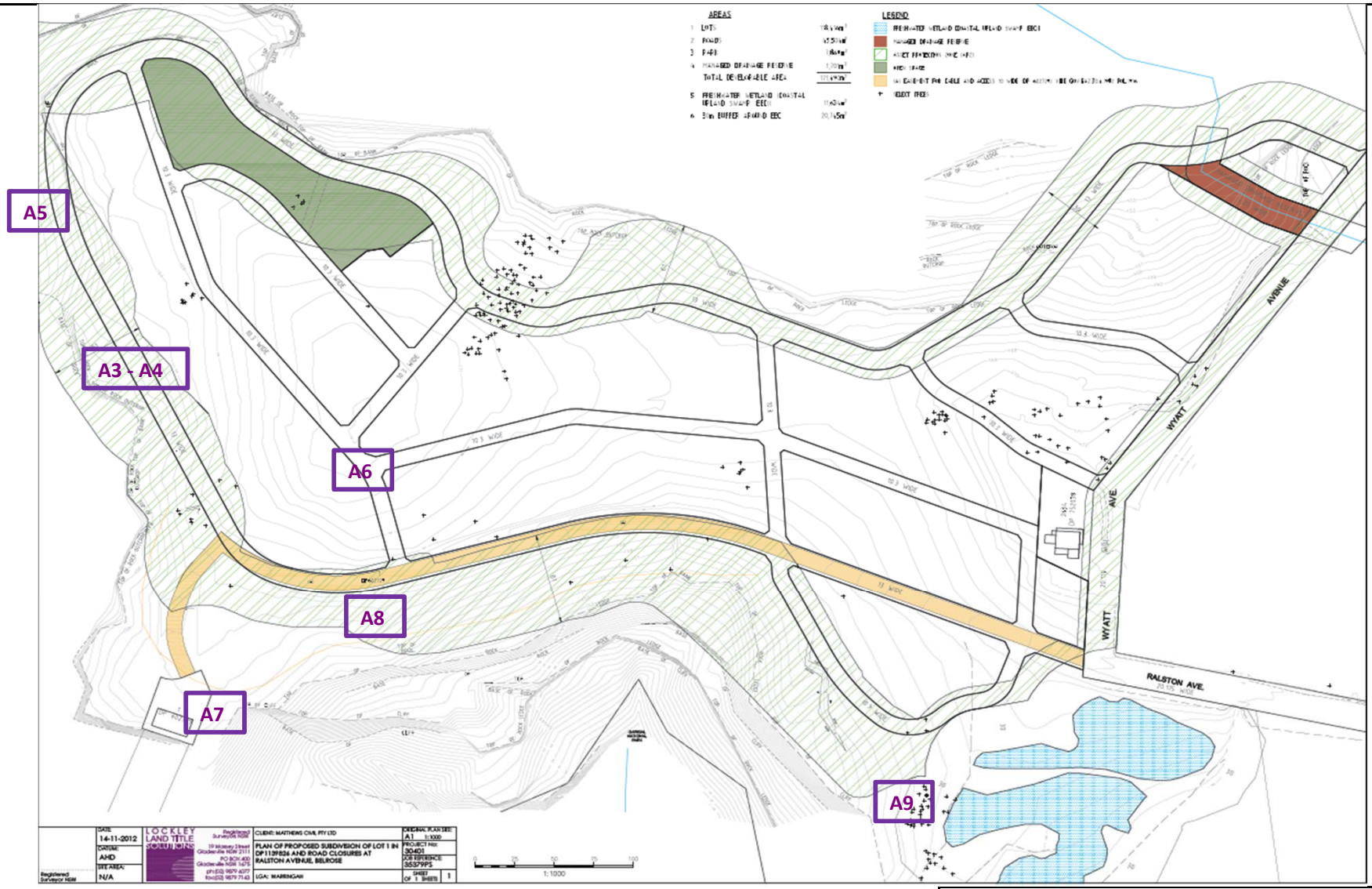
**ATTACHMENT A**

**LOCATION PLAN AND PHOTOGRAPHS OF THE SITE (RALSTON AVE)**




**Matthews Civil Pty Ltd**

**Preliminary Geotechnical Advice**

**Proposed Residental Development, Belrose**

**LOCATION PLAN OF PHOTOS**

| PSM1802-003L | Attachment A1 |
|---|---|

PSM

**Pells Sullivan Meynink**

**Photo A2:** Photo of north ridge.

**Photo A3:** Along main path near west ridge, showing sandstone.

**Photo A4:** Along main path near west ridge, showing sandstone.

**Photo A5:** Photo of west ridge.

**Photo A6:** Photo of eroded track showing residual sandstone.

**Photo A7:** Photo of southwest ridge.

**Photo A8:** Photo of south ridge.

**Photo A9:** Photo of south ridge of south side development.