Geotechnical Desktop Study

RESIDENTIAL DEVELOPMENT

1 STATION LANE, PENRITH NSW

Prepared for:

GHOSSAYN

Reference: P1566_ 01

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1 INTRODUCTION

Morrow Geotechnics Pty Ltd has undertaken a Geotechnical Desktop Study (GDS) for the proposed development at 1 Station Lane, Penrith NSW (the site). This GDS report has been prepared to provide advice and recommendations to accompany a development application (DA) to Penrith Council for the proposed residential development.

1.1 Proposed Development

Architectural drawings of the proposed development have been prepared by Antoine J Saouma for Job No 03717 dated 20 February 2018. From the drawings provided, Morrow Geotechnics understands that the proposed development will involve the construction of a six storey residential building over a two level basement car park. We expect that the basement excavation may extend to a depth of approximately 6 m below existing ground level (mBGL).

1.2 Purpose of the Desktop Study

The purpose of the GDS is to review available data and to provide geotechnical advice and recommendations addressing the following:

- Description of the anticipated surface and subsurface conditions at the site;
- Building and retaining wall foundation options, including preliminary design parameters;
- Approaches to limit potential impacts on adjacent structures, services, roads and tunnels;
- Construction constraints including groundwater management requirements, if necessary; and
- The requirement for additional geotechnical investigations.

1.3 Scope of Work

The scope of works for the GDS included:

- Review of available information from in-house sources;
- Review readily available plans, images and documents pertinent to the area;
- Review relevant soil landscape and geological maps for the project area;
- Review of any readily available aerial photographs;
- Review hydrogeological plans for the area; and
- Review DBYD plans and any plans provided by the client of existing buried services on site.

1.4 Investigation Constraints

The GDS is limited by the preliminary intent of the study and the fact that no intrusive investigations have been undertaken at this stage. The discussions and advice presented in this report are intended for the development of preliminary designs for the development. Further geotechnical investigations should be carried out after DA approval and site clearance to confirm both the geotechnical and groundwater model, and the preliminary design parameters provided in this report.

2 SITE DESCRIPTION

2.1 Site Description and Identification

The site identification details and associated information are presented in **Table 1.**

TABLE 1 SUMMARY OF SITE INFORMATION

Information	Detail
Local Government Authority	Penrith
Current Zoning	R4 – High Density Residential (Penrith Local Environmental Plan 2010)
Site Description	The site is irregular in shape and comprises a single lot. The site is shown on maps.six.nsw.gov.au to be approximately 670 m^2.

2.2 Local Land Use

The site is situated within a residential area. Current uses on surrounding land are described in **Table 2**.

TABLE 2 SUMMARY OF LOCAL LAND USE

Direction Relative to Site	Land Use Description
North	Four storey brick residential structure.
East	Station Lane followed by a four storey brick residential structure and open space.
South	Stormwater drainage channel followed by the Ripples Aquatic Centre
West	Four storey brick residential structure.

2.3 Regional Setting

The site topography, geological and hydrogeological information for the locality is summarised in **Table 3.**

TABLE 3 TOPOGRAPHIC, GEOLOGICAL AND HYDROGEOLOGICAL INFORMATION

Attribute	Description
Topography	Regional topography is generally level in the vicinity of the site.
Soil Landscapes	The Soil Conservation Service of NSW Penrith 1:100,000 Soil Landscapes Series Sheet 9030 (1st Edition) indicates that the residual landscape at the site likely comprises the Richmond Landscape. This landscape type typically includes Quaternary terraces of the Nepean and Georges Rivers. It generally comprises poorly structured, orange to red clay loams, clays and sands. These soils are noted to present localised flood hazards, localised seasonal waterlogging and localised water erosion hazard on terrace edges.
Regional Geology	The Department of Mineral Resources Geological Map Penrith 1:100,000 Geological Series Sheet 9030 (DMR 1991) indicates the site to be underlain by Quaternary Pleistocene Alluvials of the Cranebrook formation, typically comprising gravel, sand, silt and clay.
Salinity	In accordance with the Penrith Local Environmental Plan 2010 Section 7.6, salinity effects must be considered for the proposed development.
Groundwater	An online search was conducted using the NSW Office of Water (NOW) real-time database, which records relevant information pertaining to all licensed water bores for the state of New South Wales revealed six registered monitoring bores located within 500 m of the site. Only one registered monitoring well had a recorded standing water level on the NOW database, showing water recorded at 6 mBGL. From previous jobs within 100 m of the site, our experience is that standing water levels within the alluvial soils have been encountered at 6.8 m depth.

2.4 Expected Stratigraphy

Using the subsurface information from previous geotechnical investigations, published data and archived information, our proposed geotechnical units for the site have been developed to characterise the soil and rock strata and are presented in **Table 4** below.

TABLE 4 SUMMARY OF INFERRED SUBSURFACE CONDITIONS

Unit	Material	Material Description [1]
1	**Topsoil/Fill**	Mixed Gravels, Clays, and silty sand. Fill thickness varies depending on site history and land usage, but is generally less than 1 m thick.
2	**Alluvial Sand and Clay**	Generally stiff grading to hard, high plasticity silty clay over medium dense sand.
3	**Alluvial Gravel**	On projects surrounding the subject site alluvial gravels have been encountered from approximately 5 m depth. Medium to coarse gravel with river cobbles.
4	**Bedrock**	Siltstone and fine grained sandstone, slightly weathered, medium to high strength. Higher levels of weathering may be present on the subject site. On projects surrounding the subject site bedrock has been encountered from approximately 11 m depth

Detailed descriptions of the material likely to be encountered along with the depth of each stratigraphic unit can only be provided following an intrusive geotechnical investigation comprising cored boreholes.

3 GEOTECHNICAL RECOMMENDATIONS FOR DESIGN

3.1 Overview

Considering the expected subsurface conditions, the proposed development will likely be impacted by the following key geotechnical constraints:

- Any uncontrolled fill is likely to have poor engineering properties and be unsuitable for re-use as engineered fill. Unsuitable materials may be removed by screening;
- Basement Excavation and retention to prevent lateral deflections and ground loss as a result of excavations;
- Pile socket conditions within gravel beds in the Penrith area; and
- The likelihood for the proposed basement excavation intersecting the groundwater table.

Our preliminary advice and recommendations associated with management of these key geotechnical constraints are provided in the following sections.

3.2 Foundation Options

Subgrade conditions at basement excavation levels are likely to be dense alluvial gravels. The proposed building loads may be supported by pad footings on gravel or bored piles founding on suitable bedrock. This will depend on specific load cases and specific load bearing locations, which can be optimised once intrusive investigations are undertaken.

For preliminary design purposes foundation design parameters have been provided in **Table 5**. These values are indicative only and intrusive investigations must be undertaken prior to completion of designs to confirm the recommendations below.

TABLE 5 TYPICAL FOUNDATION PARAMETERS FOR FOUNDATIONS

Class of Shale	Ultimate End Bearing (MPa)[1]	Allowable End Bearing (MPa)[2]	Ultimate Shaft Adhesions (kPa)[3]
Alluvial Gravel	2.25	0.75	30
High Strength Sandstone	10.5	3.5	1000

Notes:

[1] Ultimate values occur at large settlements (>5% of minimum footing dimensions).

[2] End bearing pressure to cause settlement of <1% of minimum footing dimensions

[3] Clean socket of roughness category R2 or better.

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 0.65 may be expected.

Design of bored piles and shoring systems needs to consider the aggressivity of the ground and groundwater. Grout injected piling such as CFA piles will be necessary for works below the water table.

Shallow footings and/or piles should found on soil of similar elastic modulus to limit the risk of differential settlement across the development footprint resulting from varying founding conditions.

3.3 Excavation Retention and Retaining Walls

The type of retention system chosen will be influenced by proximity to existing structures, services and pavement, the relative stiffness required to limit deformations to an acceptable level, and the inclusion of the wall as the permanent support for buildings. Given the expected ground conditions, it is likely that control of collapsing alluvial material will be the biggest concern with selection of shoring systems. CFA piling will be necessary below the water table to prevent collapse of holes. Piling contractors should make their own assessment of the ability of piling rigs to penetrate dense gravels expected at the site. Contiguous piling is likely to be necessary in order to prevent collapse of material between piles.

Cantilevered retaining walls are typically the most economically viable retention method up to 5 m in height. Anchored walls may be more economically viable above 5 m height and will be required to limit lateral deflections where retention systems are within the zone of influence of nearby structures/services/pavements. Where a tanked, cut-off wall is proposed anchors will be necessary in order to restrain hydrostatic pressure.

For preliminary design of temporary and permanent support we recommend the following:

- Rigid retaining structures, such as propped or anchored walls, should be adopted to limit lateral and vertical movements when in close proximity to existing buildings, pavements and buried services. A rectangular earth pressure distribution may be used with a maximum pressure of 6H or 8H (kPa), depending on the amount of movement that can be tolerated, where 'H' is the effective vertical height of the wall in metres.
- Static water pressures should be taken into consideration in the design of retaining walls when extending below groundwater level, unless subsoil drainage is provided behind retaining walls. A hydrostatic pressure distribution could be used for this analysis.
- Appropriate surcharge loading from construction equipment and vehicular traffic at finished surface level should be adopted in retaining wall design. Any applicable surcharge loads should be added to earth pressures using a lateral earth pressure coefficient of 0.5. A bulk unit weight of 18 kN/m^3 can be assumed for fill and residual soils.

We recommend the use of stress/strain dependent analysis during detailed design to further consider likely deformations and to better model the earth pressures and influence of the excavation on adjacent structures, pavements and buried services.

Consideration will need to be given to monitoring lateral and vertical deflections of retained soil and to monitoring construction induced vibrations.

We recommend an allowance is made for a Geotechnical Engineer to inspect the excavation upon reaching a depth of 1.5 m, 3.0 m, 4.5 m and upon completing the bulk excavation to:

- Confirm inferred geotechnical conditions;
- Assess the suitability of design assumptions; and
- Provide further advice with regards to excavation retention and proposed construction methodologies, if required.

3.4 Site Preparation and Earthworks

All earthworks should be carried out in accordance with AS3798:2007, Guidelines on Earthworks for Commercial and Residential Developments. Earthworks compliance testing should be carried out in accordance with AS3798:2007, Table 8.1 with testing to be provided by a National Association of Testing Authority (NATA) accredited testing laboratory.

Working platforms for construction plant and crane pads, placed on in-situ materials or on new fill, should be designed by an experienced and qualified geotechnical engineer.

Should fill placement be proposed over existing ground levels, resulting in additional surcharge of in-situ soils, additional advice should be sought from an experienced and qualified geotechnical engineer regarding potential settlement of the in-situ soils.

4 RECOMMENDATIONS FOR FURTHER GEOTECHNICAL SERVICES

We recommend that further intrusive geotechnical investigations are carried out to determine:

- Boreholes to below excavation level to provide a ground model and geotechnical parameters for a stress/strain dependent analysis during detailed design of the development to further consider likely deformations and to better model the earth pressures and influence of the excavation on adjacent structures and services
- Observation of the groundwater levels within monitoring wells installed at the site. Borehole permeability testing may be undertaken to determine the hydraulic conductivity of the soil profile.
- Soil and groundwater samples should be collected and analysed for pH, chloride, sulphate content and electrical conductivity and compared against criteria in AS 2159-2009 Piling – Design and Installation to assess aggressivity of groundwater on concrete and steel structures.

Intrusive investigations can be used to assess the nature and sequence of the subsurface strata, including physical and mechanical properties for use in specifying geotechnical design parameters.

5 STATEMENT OF LIMITATIONS

This Geotechnical Desktop Study is based on reviews of previous geotechnical reports, which included specific searches through relevant, historical databases and numerical data. It was assumed that the historical records were complete at the time of preparing each assessment report. This Geotechnical Desktop Study also relies upon data, measurements and/or results taken at, or under, the particular times and conditions specified in the corresponding report.

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6 REFERENCES

AS1726:1993, *Geotechnical Site Investigations*, Standards Australia.

AS2159:2009, *Piling – Design and Installation*, Standards Australia.

AS2870:2011, *Residential Slabs and Footings*, Standards Australia.

AS3798:2007, *Guidelines on Earthworks for Commercial and Residential Developments*, Standards Australia.

Chapman, G.A. and Murphy, C.L. (1989), Soil Landscapes of the Penrith 1:100000 sheet. Soil Conservation Services of NSW, Sydney.

NSW Department of Finance and Service, Spatial Information Viewer, maps.six.nsw.gov.au.

NSW Department of Mineral Resources (1983) Penrith 1:100,000 Geological Series Sheet 9130 (Edition 1). Geological Survey of New South Wales, Department of Mineral Resources.

Pells (2004) Substance and Mass Properties for the Design of Engineering Structures in the Hawkesbury Sandstone, Australian Geomechanics Journal, Vol 39 No 3

7 CLOSURE

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
Senior Geotechnical Engineer

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