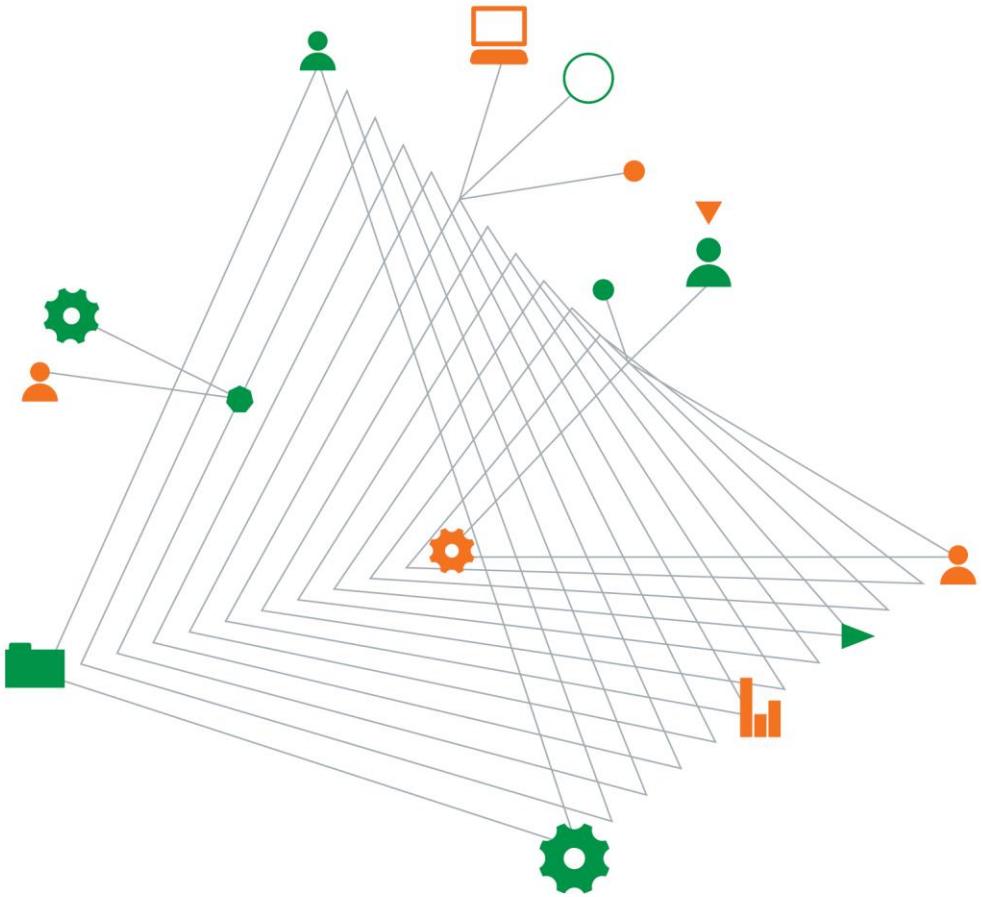
Greenrock Property Pty Ltd

1-7 Station Street, Parramatta, NSW - Initial Geotechnical Desktop Study

20 October 2015



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For and on behalf of Coffey

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Principal Geotechnical Engineer

Quality information

Revision history

Revision	Description	Date	Author	Reviewer	Signatory
0	Initial Geotechnical Desktop Study	14/10/2015	Adam Phillips	Robert Turner	Robert Turner
1	Initial Geotechnical Desktop Study	20/10/2015	Adam Phillips	Robert Turner	Robert Turner

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Table of contents

Figures

1. Introduction

This report presents the results of an initial geotechnical assessment carried out by Coffey Geotechnics Pty Ltd (Coffey) for the proposed development of the site at 1-7 Station Street, Parramatta NSW.

The proposed development of the site comprises a mixed use tower block with up to seven levels of basement car parking. A four level basement is understood to also be an option, however the number of basement levels has yet to be decided.

The purpose of this initial geotechnical assessment was to review available information on ground conditions at the site to develop a preliminary site geotechnical model for project planning, and to support the Development Application (DA) submission to council.

A Phase 1 Site Contamination Assessment that was also carried out is presented in a separate report.

2. Information on local ground conditions

Our study included review of the following archived and published information:

- Site investigation undertaken by Coffey at 122 Wigram Street, Harris Park (approx. 650m north of the site);
- Sydney, 1:100,000 Scale Geological Series Sheet 9130

3. Site Description

An Engineer from Coffey visited the site on 9 October 2015. The site is roughly square in shape, measuring approximately 45m (west to east) by 45m (north to south). A plan of the site is included as Figure 1 (Site Plan).

The site is bounded by Station Street West to the east, Raymond Street. The Sydney Trains railway lines lie within a cutting to the east of Station Street West. Raymond Street passes over the railway cutting on an over-bridge.

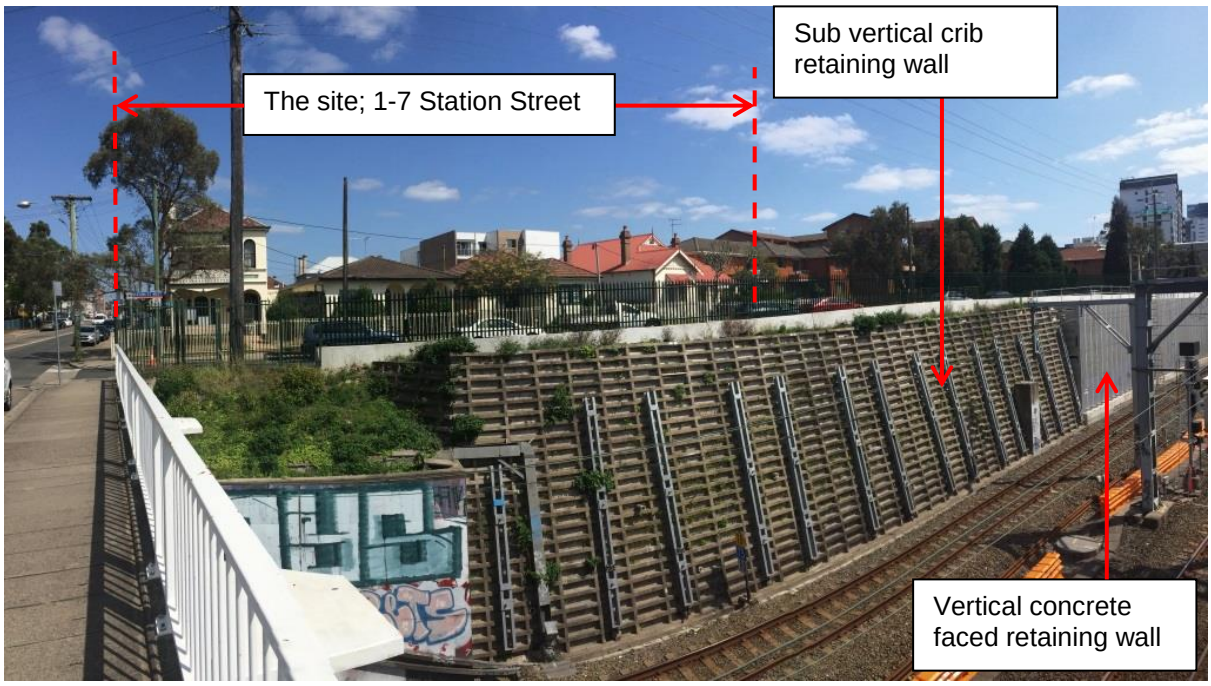
The site is currently occupied by a number of one and two storey residential buildings and associated sheds and carports. A small paved access road adjacent to the western boundary provides access to the car parks at the rear of the property. The site is surrounded by residential properties ranging from one storey houses to three level apartment blocks, some with basements.

The site is generally flat, while the surrounding topography to the north and to the south of the site slopes gently away, dropping in elevation.

The railway cutting is approximately 8m deep. Station Street separates the site and the top of the cutting by about 8m. The cutting is supported by a combination of vertical concrete faced retaining wall and a sub -vertical section of concrete crib retaining walls. The crib retaining wall has been anchored back. It is unknown what depth behind the wall the anchors protrude.

A photo of the cutting in relation to the site is shown below in Photo 1.

Photo 1 – Site location relative to the railway cutting



4. Local Geology and Soils

The Sydney 1:100,000 Geological Sheet indicates the site is underlain by Ashfield Shale, which is typically black to dark grey shale and laminite. The Ashfield Shale is the lowermost unit of the Wianamatta Group, and is underlain by the Mittagong Formation and the Hawkesbury Sandstone.

The Hawkesbury Sandstone is typically medium to coarse grained, quartzose sandstone with very minor shale and laminite lenses. The sandstone is mostly cross-bedded, with beds typically 1m to 2m thick.

Our experience at 122 Wigram Street, Harris Park, which extended to a depth of 10m, indicated ground conditions comprising residual soil (stiff to hard residual clay) to approximately 0.5m to 2m depth, underlain by variably weathered, mainly low strength siltstone of the Ashfield Shale unit.

There is an outcrop of highly weathered shale high on the railway cutting face near to existing ground level on the eastern side. This indicates similar rock to 122 Wigram Street at relatively shallow depth.

The presence of the retaining walls in the Station cutting is consistent with soil strength and low rock strength material in the ground profile that requires retention.

The shale would typically increase in strength with depth and it is possible that a deep basement excavation could penetrate into the underlying Hawkesbury Sandstone. This will need to be confirmed by ground investigation.

5. Preliminary site geological model

Based our review of existing information and our observations from the site walkover, the generalised geotechnical model for the site is presented below:

- **Unit 1 Soil –** Residual soil strength materials comprising, residual clay of stiff and hard consistency and extremely weathered shale. This unit is expected to extend generally to about 0.5m to 2m depth below ground surface.
- **Unit 2 Rock –** Shale, variably weathered comprising highly to slightly weathered, and very low to medium strength shale. This is typically Class V[1] or Class IV Shale. This unit is expected from around 0.5m to 2m (below the soil materials).
- **Unit 3 Rock –** Shale, mainly slightly weathered or fresh, and medium or high strength shale. This is typically Class III Shale possibly grading to Class I Shale.
- **Unit 4 Rock -** Sandstone, slightly weathered or fresh, and medium to very high strength sandstone. This would typically be Class III to Class I.

The depth at which the ground profile grades into Unit 3 Rock and then Class I or II Shale or Unit 4 would need to be confirmed by intrusive ground investigation.

The depth of groundwater is uncertain. The groundwater table is likely to be below the level of the railway cutting. It is anticipated that the permanent groundwater table would be intersected by excavation for seven basement levels, but may not be intersected by excavation for four basement levels. Perched or transient groundwater may occur in the rock units above the permanent groundwater table. Groundwater levels will need to be confirmed by ground investigation.

6. Geotechnical considerations for proposed development

6.1. Overview

Basement options of four or seven levels are under consideration at this stage, although a final decision has not been made. The number of basements will determine the depth of excavation and founding level of the proposed buildings. It is assumed that excavation depths of about 12m and 21m would be required for basements of four and seven levels respectively.

Ground retention will be required on all four boundaries of the site. There will be low tolerances for ground movements due to the close proximity of neighbouring buildings, roadways and the railway.

It is expected that a ~~20-storey building~~ with at least four basement levels would intersect Unit 3 Rock. A seven level basement may intersect Unit 4 rock. Hence pad and strip footings at the base of the excavation may be feasible.

Consideration will need to be given to the close proximity of the railway cutting on the eastern boundary. It is likely that approval will need to be obtained from Sydney Trains prior to excavating the basement. In order to obtain approval it will be required to demonstrate that the proposed basement excavation will not affect their assets, including the ground anchors for the crib retaining wall in the cutting that are installed below Station Street.

[1] *Rock classified using Pells et al (1998) "Foundations on Sandstone and Shale in the Sydney Region" Aust. Geomech. Jnl, Dec 1998.*

The building may be within the zone of influence of the retaining wall and therefore may affect the wall. Modelling will be required irrespective of the number of basements.

6.2. Foundations

Excavation for four levels or more of basement should facilitate strip and pad footings founded on Unit 3 or Unit 4 Rock. Rock quality will need to be assessed based on specific site investigation to provide design parameters. Preliminary serviceability geotechnical design parameters for shallow and piled footings are provided in Table 1.

Table 1 – Preliminary serviceability parameters for shallow footings

Unit	Serviceability End Bearing Pressure (kPa)	Serviceability Shaft Adhesion (kPa)	Young's Modulus (MPa)
Unit 1 Soil	200	-	30
Unit 2 Rock	1,000	75	200
Unit 3 Rock	3,500	300	600
Unit 4 Rock	5,000	800	800

Notes on Table 1:
a) Serviceability design parameters are intended to limit settlements to less than 1% of the pile diameter.
b) Shaft adhesion assumes rough socket with grooves of depth 1-4 mm, width > 5 mm, spacing of 50-200 mm).
c) The parameters for Unit 3 Rock assume Class III Shale foundation. If Class II or I shale is intersected, significantly higher design parameters may be adopted.
d) The parameters for Unit 4 Rock assume Class III Sandstone foundation. If Class II or I sandstone is intersected, significantly higher design parameters may be adopted.

6.3. Excavations

6.3.1. Excavation conditions

Units 1 and 2 should generally be excavated using hydraulic excavators. Unit 3 and Unit 4 Rock may require rock hammers and rock saws, the use of which may require prior vibration assessment.

The potential presence of a permanent groundwater table below the site within the basement depth would need to be confirmed by detailed geotechnical investigation. Perched water may be encountered as transient flows within the weathered soil/rock profile and at the top of the bedrock. Groundwater inflows during excavation are expected to be able to be managed by conventional pump and sump methods.

6.3.2. Excavation induced ground movements

Excavation for a basement will cause ground movements. Many factors can influence the size of these movements, from ground conditions to design and construction quality. Ground movements induced by excavation of a basement may have the potential to affect neighbouring structures, infrastructure and in-ground services. The proposed development will need to consider providing adequate support to, or underpinning of adjacent structures, and the potential effects on adjacent roads and underground services.

Lateral ground movements arising from excavations may extend to distances of up to twice the basement depth from the edge of excavations. Detail design would need to consider the potential impact of such movements on neighbouring structures. Where structures are located within this zone, it would be prudent to conduct dilapidation surveys to provide a baseline for excavation monitoring.

6.3.3. Excavation retention

Steep/vertical excavations in the Unit 1 soils and Unit 2 rock would require temporary shoring during construction and long term retention. This could probably be achieved by cantilever or anchored soldier pile walls, with steel walers and timber lagging, or shotcrete and mesh infill panels, but other systems could also be adopted. It is unlikely that space will permit temporary excavations cut at relatively flat batter slopes.

Temporary vertical cuts in Unit 3 rock and Unit 4 may be feasible, although local discontinuity controlled instability could require rock bolts or dowels. Weak or heavily fractured areas would require shotcrete. This can only be assessed and confirmed during progressive excavation inspections.

Unit 4 rock may not need long term support, depending on rock and groundwater conditions. Unit 2 and Unit 3 rock is likely to deteriorate over the design life of the structure and may need long term protection and permanent basement wall. Specific borehole investigation will be required to assess temporary shoring and long term support design.

6.4. Basement design

The type of design of the basement will depend on the depth of any proposed basement and groundwater levels. If permanent groundwater is below the proposed lower basement level, a drained basement structure will be feasible. If a permanent groundwater table is present above proposed lower basement level, then a tanked basement structure could be required.

7. Further Site Investigation

Detailed geotechnical investigations involving the drilling of cored boreholes will be required to support detailed basement and foundation design, we propose to drill a number of additional deep boreholes to depths approximately 5m below the design basement level or founding level. The aim of the investigation would be to assess the ground conditions and bedrock strength across the site to assist optimisation of building footing and excavation design/planning.

8. Conclusion

Based our site observations, preliminary geotechnical model, and experience on similar projects, the proposed development is considered to be feasible from a geotechnical perspective. In our opinion, the proposed development presents a low risk to surrounding structures and the groundwater environment, provided appropriate intrusive site investigation, design assessments, and construction monitoring normally associated with this type of development are carried out.

9. Closure

The description of subsurface conditions is based on a desk top study, site surface observations, published geology maps, and our experience on similar projects within the vicinity. The preliminary geotechnical model and geotechnical engineering comments/advice presented in this report are based on professional judgment, and should be reviewed following further intrusive site investigations and laboratory testing.

The attached document entitled “Important Information about your Coffey Report” presents additional information on the uses and limitation of this report.

Important information about your **Coffey** Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Important information about your **Coffey** Report

Data should not be separated from the report*

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

Rely on Coffey for additional assistance

Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction,
speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical information in Construction Contracts" published by the Institution of Engineers Australia, National headquarters, Canberra, 1987.

Figures

LEGEND

SITE BOUNDARY

10 0 10 30 50

Scale (metres) 1:1000

AERIAL IMAGE SOURCE: GOOGLE EARTH PRO 7.1.2
AERIAL IMAGE ©: 2015 AEROMETREX

drawn	AP / AW
approved	AP
date	19 / 10 / 15
scale	AS SHOWN
original size	A4

coffey

client: GREENROCK PROPERTY PTY LTD

project: 1-7 STATION STREET WEST PARRAMATTA, NSW

title: SITE LOCATION PLAN

project no: GEOTLCOV25524AA-AB | figure no: FIGURE 1 | rev: A

PLOT DATE: 19/10/2015 10:53:37 AM DWG FILE: F:\GEOTECHNICS\1-PROJECTS\GEOTLCOV\25\GEOTLCOV25524AA 1-7 STATION ST, PARRAMATTA\CAD\GEOTLCOV25524AA-AB.DWG