Geotechnical Investigation for Site Classification- Stage 38 Northlakes Estate, Cameron Park

March 2007

North Lakes Pty Ltd

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NCSI Certified Quality System ISO 9001

2122794A.PR_0345 RevA

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Date:	13/4/07
Distribution:	2 x bound to Northlakes, 1 x bound and 1 x unbound PB

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1. Introduction

At the request of North Lakes Pty Ltd, Parsons Brinckerhoff Pty (PB) has undertaken a geotechnical investigation for site classification at Stage 38 Northlakes Estate, Cameron Park. The subject stage of the development includes 25 residential allotments of varying size (Lot numbers 3801 to 3825 inclusive). A locality plan of Stage 38 can be seen on Figure 1.

The objective of this investigation was to assess subsurface conditions within the residential allotments in order to provide site classification in accordance with AS2870 – "Residential Slabs and Footings".

Reference was made to PB's pavement design investigation report for Stage 38 (reference: 2122336A.PR_1254 Geotechnical Investigation for Pavement Design Northlakes Stages 36, 37 and 38) to assist with this investigation. Previous test pit locations for Stage 38 pavement design can be seen on Figure 2.

2. Method of Investigation

Fieldwork for the investigation was undertaken on 27 March 2007 and comprised the excavation of 14 backhoe test pits TP1 to TP14 to a maximum depth of 1.60m below ground level.

A geotechnical engineer supervised all excavations and sampled the subsurface profiles. Pocket penetrometer tests and visual tactile methods were used to assess the consistency of the subsurface clayey soils.

Six linear shrinkage tests were completed on selected subsurface samples in a NATA accredited laboratory.

Test pit logs, explanatory notes, and a site plan (Figure 2) showing the approximate test pit locations are appended to this report.

3. Results of Investigation

3.1 Site Description

The subject stage is accessed via Northlakes Drive which is located off Minmi Road, Cameron Park. At the time of the investigation roadworks including bulk earthworks and pavements for Northlakes Drive had been completed. Topographically, the site slopes generally down to the north / north-east at approximately 5°. Site drainage for Lots 3801 to 3811 occurs by overland flow to a drainage easement to the rear of the lots. Site Drainage for lots 3812 to 3825 occurs by overland flow to street drainage. Stormwater drainage is directed to a creek and detention basins which are located to the west and north of Stage 38.

Mulch stockpiling was noted at the time of the investigation along the rear of Lots 3811 to 3813. No significant cut or fill was noted within the lots at the time of the investigation although a cut to Northlakes Drive north of Lots 3815 to 3825 was noted with typical slopes of 10-15^0 at the front of the lots. Lots 3819 and 3820 were also found to have a cut to Wigeon Close which separated the two lots with typical slopes 10-15^0. Some mulch was also noted on the surface of the lots up to 0.2m in depth.

3.2 Slope Stability

A geotechnical report was previously prepared for the Northlakes Estate by Coffey Geosciences Pty Ltd (referenced N7436/2-AB, 16 August 2000). The report included an assessment of slope stability for the subject area of the Northlakes residential subdivision.

For the subject stage, all Lots 3801 to 3825 have been classified by Coffey Geosciences Pty Ltd as having a **low to medium** risk of instability.

3.3 Mine Subsidence

It is noted that the site is in a mine subsidence district. Discussions with the Mine Subsidence Board (MSB) indicated that two storey brick veneer construction with footings designed in accordance with AS2870 would be acceptable. However the MSB should be consulted to confirm requirements for individual lot development.

3.4 Subsurface Conditions

Reference to the Newcastle 1:250,000 Geological Series Sheet SI 56-2 indicates that the site is underlain by the mid to upper stratigraphy of the Newcastle Coal Measures of Permian age. This unit comprises interbedded conglomerate, sandstone, tuff, shale and coal.

Reference to the Newcastle Soil Landscape Series Sheet 9232 indicates that the site lies within the Warners Bay Residual Soil Landscape. This unit comprises undulating to

rolling low hills and rises on fine-grained sediments of the Newcastle Coal Measures in the Awaba Hills. Slope gradients are typically 2^0-12^0.

A summary of the subsurface conditions encountered across the site is given below. For more detail, reference should be made to the engineering test pit logs with explanatory notes in Appendix B.

The lithology generally encountered across the site comprised shallow topsoil up to 0.2m thick, overlying a structured slopewash silty clay layer with some fine grained sand (not present within test pits TP6, TP7, and TP10) typically 0.1 to 0.3m thick up to 0.5m in depth, underlain by a massive residual silty clay to sandy clay underlain by shallow siltstone/sandstone bedrock. Bedrock was encountered at between 0.6m and >1.6m below ground level. Backhoe bucket refusal occurred in test pits TP2, TP4, TP8, TP10, TP12, and TP13 at depths 1.2m, 1.3m, 0.9m, 1.1m, 1.2m and 1.2m respectively.

The topsoil was found to comprise either silty sand, fine grained, brown, trace clay and grass root fibres or silty clay high plasticity brown with grass root fibres. The residual silty clays were generally described as high plasticity, pale grey/pale brown mottled orange, and a very stiff consistency. No bedrock was encountered in TP6 and TP7. Sandstone was encountered in TP8 with a fine to medium grain size, and shaly siltstone pale grey/ pale brown/ brown white was encountered in all other testpits.

No free ground water was encountered in any of the test pits at the time of investigation. No long term groundwater monitoring was carried out.

3.5 Laboratory Results

Linear shrinkage testing was conducted on six residual clay samples from the site to assess the soil reactivity. The laboratory results are summarised in Table 3.1.

Table 3.1 - Linear Shrinkage Results

Sample Location	Sample Depth (m)	Soil Description	Linear Shrinkage (%)
TP1	0.5 -0.6	Silty Clay high plasticity pale grey mottled orange	20
TP3	0.5 -0.6	Silty Clay high plasticity pale grey mottled orange	15
TP6	0.5 -0.7	Silty Clay high plasticity pale brown mottled orange	17
TP8	0.4 -0.5	Sandy clay high plasticity pale brown mottled orange sand fine to medium grain	6
TP12	0.4 -0.6	Silty Clay high plasticity pale brown/grey mottled orange	20
TP14	0.4 -0.6	Silty Clay high plasticity pale brown/grey mottled orange	13.5

The laboratory results generally indicate that the silty clay soils present at the site are generally of high reactivity, whilst the sandy clay soil sample tested was slightly reactive.

4. Discussion and Recommendations

4.1 Site Classification

In assessing site classification for the lots in this site, consideration has been given to the linear shrinkage test results and subsurface conditions encountered by the test pits.

The subject lots have been classified in accordance with AS2870 – 1996 "Residential slabs and footings - construction", as detailed in Table 4-1 below.

Table 4-1 - Site Classification

Lot Number	Site Class	Characteristic Surface Movement (Ys) (mm)
3801	M	20 to 30
3802	H	50 to 60
3803	H	50 to 60
3804	H	50 to 60
3805	H	50 to 60
3806	H	50 to 60
3807	H	50 to 60
3808	H	50 to 60
3809	H	50 to 60
3810	H	50 to 60
3811	H	50 to 60
3812	H	50 to 60
3813	H	50 to 60
3814	H	50 to 60
3815	H	50 to 60
3816	H	50 to 60
3817	H	50 to 60
3818	H	50 to 60
3819	H	50 to 60
3820	H	50 to 60
3821	H	50 to 60
3822	H	50 to 60
3823	H	50 to 60
3824	H	50 to 60
3825	H	50 to 60

These classifications are dependant on the application of design and construction recommendations provided in this report.

4.2 Site Preparation

Prior to construction, all topsoil and organic matter should be removed from slab areas and areas to be filled. Areas to be filled should be proof rolled under the inspection of a geotechnical engineer and any soft or heaving materials removed.

Any uncontrolled fill encountered on site should be removed from areas to support high-level footings. Any proposed site regrading should take into account the guidelines provided in Appendix F "Guidelines for Hillside Construction".

4.3 Excavations

Excavations within the topsoil, residual soils and distinctly weathered bedrock should be achievable using conventional earthmoving equipment to the refusal depths shown on the test pit logs. Deeper excavations within the bedrock may require use of hydraulic excavators with rock hammers.

Temporary excavation batters in soil or extremely weathered bedrock should be graded no steeper than 1.5 Horizontal (H) in 1 Vertical (V), while any permanent batters should be graded no steeper than 2H in 1V and protected from erosion by re-directing any surface water flows from the batter face and revegetating. If steeper batters are required they should be supported by a properly engineered retaining wall. Any distinctly weathered bedrock may be excavated at a permanent batter slope no steeper than 1H in 1 V subject to an inspection by an engineering geologist/geotechnical engineer.

4.4 Filling

The site soils are suitable for re-use as engineered fill provided that they are clean, and contain no organics or particle sizes greater than 75mm.

Any fill placed on the site should be compacted and tested under a minimum of Level 2 supervision in accordance with AS3798. Level 1 supervision should be provided in areas to support high level footings, with at least 95% (preferably 98%) compaction relative to Standard Maximum Dry Density (SMDD) at within 2% of the Standard Optimum Moisture Content (SOMC) to be achieved in the fill. The fill should be placed in maximum 200mm (loose) layers.

All permanent fill batter slopes should be no steeper than 1 vertical to 2 horizontal and protected from erosion. Alternatively, fill embankments may be retained with properly designed and constructed retaining walls.

The depth of fill placed on individual lots should not exceed a nominal 1.5m depth without prior approval by an engineering geologist/geotechnical engineer.

4.5 Footing Design and Construction

In general, flexible structures such as brick veneer or clad frames are preferred for residential development on reactive clay sites. Footings should be designed by a practising structural engineer in accordance with AS2870 - 1996 for the classifications provided in Section 4.1 above.

Strip/pad footings, raft slabs and pier and beam systems would be suitable footing types.

Any future cut and fill earthworks may affect the site classifications provided in this report. It is recommended that the site classifications be reassessed if filling in excess of 0.5 m thick is proposed.

Footings should be excavated, cleaned out and poured with minimum delay. If footing excavations are to be left open for an extended period of time, a concrete blinding layer should be provided to protect the foundation material. Should any uncompacted fill or locally deep topsoil be encountered during footing excavation, these materials should be penetrated and the footings founded in accordance with the requirements of Section 6 of AS2870. A geotechnical engineer should be consulted if these conditions are encountered.

Where footing excavations are partially on rock, the whole footing should be taken to rock to achieve uniform bearing and foundation conditions. Alternatively structures may be articulated over changes in founding conditions, in accordance with AS2870.

Where footings are to be piered to rock, reclassification of the site and amendment to footing sizes may be appropriate, and both a geotechnical and structural engineer should be consulted prior to construction of the footing.

4.6 Drainage Maintenance

Adequate site drainage should be installed to prevent ponding of surface water adjacent to structures. Surface flows should be directed away from foundation soils and into the stormwater disposal system.

All roof run off should be collected and piped to the stormwater system.

Subsoil drains from any retaining walls should be connected to the stormwater system. Surface dish drains should be provided at the crest of all cut or fill batters and retaining walls.

Classification of the subject lots has been assessed based on moisture variations caused by normal climatic and garden conditions. More severe moisture variations can be caused by other common, but controllable factors. Reactive soil notes included in Appendix E are intended as a summary to those provided in CSIRO 10 - 91 "A guide to Home Owners on Foundation Maintenance and Footing Performance" and should be regarded as 'recommendations'. Future owners should be advised of these maintenance procedures, as it is commonly accepted that most damage to residential type structures on reactive sites is due to poor site maintenance.

4.7 Limitations

This report should be read in conjunction with the appended "Limitations of Geotechnical Site Investigation", which provide important information regarding geotechnical investigation and assessment. Any changes to the scope of development of this site, or significant variation in subsurface conditions from those anticipated should be reported to this firm for reassessment.

Parsons Brinckerhoff Australia Pty Ltd