REPORT

TO
KMT CONSTRUCTIONS PTY LTD

ON
GEOTECHNICAL ASSESSMENT

FOR
PROPOSED RESIDENTIAL DEVELOPMENT

AT
5 RYNAN AVENUE, EDMONDSON PARK, NSW

10 September 2014
Ref: 27532SBrpt

JK Geotechnics
GEOTECHNICAL & ENVIRONMENTAL ENGINEERS

PO Box 976, North Ryde BC NSW 1670
Tel: 02 9888 5000 Fax: 02 9888 5001
www.jkgeotechnics.com.au

Jeffery & Katauskas Pty Ltd, trading as JK Geotechnics ABN 17 003 550 801

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Report prepared by:

Daniel Bliss
Senior Associate Geotechnical Engineer

Report reviewed by:

Paul Stubbs
Principal Geotechnical Engineer

For and on behalf of
JK GEOTECHNICS
PO Box 976
NORTH RYDE BC NSW 1670

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1 INTRODUCTION

This report presents the results of a geotechnical assessment for the proposed residential developments at 5 Rynan Avenue, Edmondson Park, NSW. The assessment was commissioned by Mr Graham Neaves of Joshua Farkash & Associates Pty Ltd, on behalf of KMT Constructions Pty Ltd, and was carried out in accordance with our proposal dated 29 August 2014 (Ref: P39232SB).

The proposed development will comprise the following:

- Demolition of the existing houses and sheds located within the eastern portion of the site.
- A riparian area within the centre of the site along the alignment of Cabramatta Creek.
- A residential unit development within the eastern portion of the site as shown in the supplied architectural drawings by Joshua Farkash & Associates Pty Ltd (Project No. 13-23665, Drawing Nos A-0000/D, A-1103/D, A-2101/E, A-2102/E, A-2103/E, A-2104/E, A-2105/E, A-2106/E, A-3101/E, A-3102/E, A-3103/E, A-3104/E, A-4101/D, A-4102/E and A-6102/D). This development will comprise the construction of three residential unit buildings with five above ground levels over one basement level. The basements will be at RL39.5m and will require excavation to depths ranging from about 2.5m to 3m.
- A residential subdivision at the western end of the site either side of the transmission easement that crosses the site, as shown on the supplied plan by Joshua Farkash & Associates Pty Ltd (Project No. 09/19556, Drawing No. SK 04H). A new access road will be constructed off Sunday Circuit and seven residential allotments created for one or two storey houses. The existing residential allotments to the west are about 1m to 2m higher than the subject site and as such the new allotments may also be filled to match these levels and those of Camden Valley Way to the north of the site. However, design levels for these lots have not been supplied.

The purpose of the assessment was to assess the likely subsurface conditions from previous investigations carried out within the site and on nearby properties as a basis for preliminary comments and recommendations on geotechnical issues for the proposed development.

2 ASSESSMENT PROCEDURE

The assessment comprised a walkover inspection of the site and its immediate surrounds by our Senior Associate, Mr Daniel Bliss, on 3 September 2014. Observations made during the walkover inspection are summarised in Section 3.1 below.

A salinity assessment of the site was completed by our specialist division, Environmental Investigation Services (EIS), as detailed within their report dated 21 August 2014 (Ref: E27532KHrpt-SAL). The borehole logs prepared as part of that assessment have been reviewed. In addition, a search of our project database was carried out to find previous geotechnical investigations carried out on nearby sites. The results of the previous investigations are summarised in Section 3.2.

3 RESULTS OF INVESTIGATION

3.1 Site Observations

The site is located on the corner of Rynan Avenue and Camden Valley Way, with Rynan Avenue to the west and Camden Valley Way to the north. The site is located within gently undulating topography and slopes down towards Cabramatta Creek (which bisects the site) at about 1° to 2° from both the eastern and western ends of the site.

A two storey brick house is located within the south-eastern corner of the site, surrounded by gardens, with an inground pool at the rear of the house. The house appeared to be in good external condition. In the north-eastern corner of the site is a single storey fibro house, with fibro sheds to the west and south-west. The house and sheds appeared to be in poor external condition. A gravel driveway runs between the two houses, to providing access to a predominantly gravel covered storage yard. At the western end of this storage yard is a concrete paved area and a single storey brick shed, which appeared to be in good external condition. Grassed paddocks are located to the south of the storage yard and shed.

Cabramatta Creek bisects the site to the west of the brick shed and is lined by shrubs and small to medium sized trees. On the western side of the creek is a vacant grassed paddock, with a small metal clad dilapidated shed on the southern side. Transmission lines cross the site towards the western end, with markers also showing a buried service running along the eastern end of the transmission easement. The ground surface showed evidence of the backfilled trench.

To the east of the site is Rynan Avenue, with vacant land on the eastern side of the road. To the north is Camden Valley Way, which is about 2m higher than the subject site, with a grassed batter sloping down from the road to the northern boundary of the site. Along the western boundary is a masonry block retaining wall, ranging in height from about 1.6m at the southern end to about 2.1m at the northern end. At the top of the retaining wall is a single storey house at the northern end and Sunday Circuit at the southern end. To the south of the site is a residential allotment

fronting Rynan Avenue, with a single storey brick house located about 40m from the common boundary. A metal clad shed is located to the west of the house. The remainder of the adjoining site is undeveloped and is covered with grass and small to medium sized trees. Cabramatta Creek flows through the adjoining property, with a smaller tributary (likely to be man made) located within the western end of the adjoining property flowing from a detention basin to the south-west and into Cabramatta Creek.

3.2 Subsurface Conditions

Reference to the Penrith 1:100 000 Geological Series Sheet indicates that the site is mapped to be underlain by Bringelly Shale.

As part of their salinity assessment EIS drilled eight boreholes within the site. As the boreholes were drilled only for salinity purposes no assessment of the strength of the clays was made. However, the results provide guidance on the subsurface conditions. The boreholes encountered fill comprising silty clay to depths ranging from 0m to 0.6m overlying natural silty clay. The natural silty clay was assessed to be of medium to high plasticity and some gravelly silty clay layers were encountered in some boreholes with depth. Boreholes BH1, BH3, BH5, BH7 and BH8 were terminated within the clays at depths ranging from 2.7m to 4.2m.

In BH2, BH4 and BH6 weathered shale was encountered at depths ranging from 2.5m to 5.0m, shallowest within BH4 at the eastern end of the site. The shale was assessed to be of extremely low to very low strength.

Groundwater seepage was encountered during drilling of some boreholes at depths ranging from 2.2m to 2.5m. Three monitoring wells were installed and groundwater was measured one week after installation at depths ranging from 1.7m to 2.8m. These wells were checked for water during our site visit on 3 September 2014 and groundwater was at depths ranging from 1.2m to 2.6m.

A search of our project database indicted that we have previously completed a geotechnical investigation with William Carey Christian School on the northern side of Camden Valley Way. The site of the investigation was located to the north of the tennis courts within the school and on the eastern side of Cabramatta Creek. The boreholes for that investigation encountered fill to depths ranging from 0.1m to 1.3m. Below the fill the natural soils comprised clayey silt, silty clay and gravelly silty clay. The silts and clays were assessed to be of variable plasticity, from low plasticity to high plasticity, and variable strength from firm to very stiff.

Weathered shale was encountered at depths ranging from 5.0m to 6.1m and was initially extremely weathered and of extremely low strength, becoming distinctly weathered and of medium strength shortly thereafter. Groundwater was encountered in some boreholes at depths ranging from 2.3m to 6m.

4 COMMENTS AND RECOMMENDATIONS

4.1 Subsurface Conditions

The results of the EIS salinity assessment and nearby geotechnical investigation indicate that the subsurface conditions comprise silty clay and gravelly silty clay grading into weathered shale at depth. From the geotechnical investigation within William Carey Christian School the strength of the clay may be variable, ranging from firm to very stiff. The shale is likely to be of extremely low strength on first contact, but will increase in strength with depth, possibly within a few metres of the shale being encountered. Groundwater was found within the monitoring wells at depths ranging from 1.2m to 2.6m.

The above inferred subsurface profile may be used for planning purposes, but will need to be confirmed to allow detailed design. A geotechnical investigation of the site should be carried out to determine the subsurface profile in more detail and allow detailed design of the development. At the eastern end of the site, the investigation should comprise the drilling of cored boreholes within the shale to optimise the bearing pressures for the design of the piles to support the five storey buildings. At the western end of the site, augered boreholes would be sufficient assuming that the houses will be of one to two storeys.

4.2 Geotechnical Issues

Based on the above inferred subsurface profile the main geotechnical issues for the proposed development as described in Section 1 are set out below. Overall, we consider that the site is geotechnically suitable for the proposed development and will be similar to other similar developments within nearby properties.

The comments and recommendations provided herein are preliminary only and may be used for planning purposes and preliminary concept design. The comments and recommendations will need to be confirmed and amplified as part of the geotechnical investigation of the site.

4.2.1 Eastern Portion of Site

For the portion of the site to the east of Cabramatta Creek where the residential unit buildings are proposed the main geotechnical issues are as follows.

Excavation and Groundwater

Excavation to the proposed depths of 2.5m to 3m will encounter surface fill and natural silty clay and gravelly silty clay. Excavation of such soils will be achievable using conventional excavation equipment, such as the buckets of hydraulic excavators.

Groundwater seepage will occur into the excavation and during construction which should be possible to control using conventional sump and pump techniques. Some areas of higher seepage may be encountered if the more gravelly clays are exposed in the excavation. In the long term, drainage should be provided behind all retaining walls and below the basement slabs. Collected seepage should be directed to sumps containing automatic and failsafe pump systems to remove water from the basements. The final extent of the drainage system should be determined following completion of the excavation when the hydraulic consultant can assess the actual seepage flows.

Approval for a drainage basement and discharge of the collected seepage may need to be obtained from relevant authorities. If a drained basement and discharge of the seepage is not allowed the basement would then need to be designed as a tanked basement to resist the hydrostatic pressures.

Retention

Where space permits, the excavation may be formed at temporary batters of no steeper than 1 Vertical in 1 Horizontal (1V:1H). Such batters may be stable in the short term, provided all surcharge loads, including construction loads, are kept well clear of the crest of the batters. However the seepage and softening that will probably occur could cause instability in which case flatter batters and/or temporary stabilisation works would be necessary. Permanent batters, if required, should be no steeper than 1V:2H, but flatter batters of the order of 1V:3H may be preferred to allow access for maintenance of vegetation. Some deep trench drains may be needed to keep seepage below the toe of batter slopes to reduce instability.

Permanent batters should be covered with topsoil and planted with a deep rooted runner grass, or other suitable coverings, to reduce erosion. All stormwater runoff should be directed away from all temporary and permanent slopes to also reduce erosion.

If insufficient space is available for temporary batters, or these are unstable or not preferred, the excavations may be supported by retention system installed prior to the start of excavation, such as soldier pile retaining walls with shotcrete infill panels.

Retaining walls of no more than about 3.5m high may be designed as cantilevered walls, provided adjoining structure or movement sensitive services are located a horizontal distance from the wall equal to at least twice the wall height, based on a triangular earth pressure distribution using an active earth pressure coefficient, K_a, of 0.33 and a bulk unit weight of 20kN/m^3. Where walls are restrained from some lateral movement, such as by other structural elements in front of the wall, an 'at rest' earth pressure coefficient, K_0, of 0.6 should be used.

The above coefficients assume horizontal backfill surfaces and where inclined backfill is proposed the coefficients should be increased or the inclined backfill taken as a surcharge load. All surcharge loads should be allowed for in the design, plus full hydrostatic pressures, unless measures are taken to provide complete and permanent drainage behind the walls.

Where batters are used, the space between the batters and the permanent retaining walls will need to be carefully backfilled to reduce future settlement of the backfill. Only light compaction equipment should be used for compaction behind retaining walls so that excessive lateral pressures are not placed on the walls. This will require the backfill to be placed in thin layers, say 100mm loose thickness, appropriate to the compaction equipment being used. The excavated clay will be difficult to properly compact within the limited space available behind the walls and consideration should be given to the use of more readily compactable materials, such as ripped or crushed rock. The compaction specification for the backfill will depend on whether paving or structures are to be supported on the fill. If the fill is to support paved areas it should be compacted to a density of at least 98% of Standard Maximum Dry Density (SMDD) for granular fill materials, but if it is only to support landscaped areas a lower compaction specification, say 95% of SMDD, may be appropriate, provided the risk of future settlement and maintenance can be accepted. An alternative for backfill would also be to use a uniform granular material, such as crushed concrete of 30mm to 70mm in size, surrounded in a geofabric.

Footings

Given the expected loads of the proposed buildings of five above ground levels and a basement, they will need to be supported on piles founded within the weathered shale. Bored piers may be possible, but difficulties with groundwater seepage may occur requiring the use of temporary

liners and tremie concreting techniques. Alternatively, auger, grout injected (CFA) pile may be used.

Allowable bearing pressures within the shale would start at 700kPa for shale of extremely low strength, increasing to 1200kPa for shale of low strength. Where cored boreholes are drilled to confirm shale of at least medium strength without significant defects is present, an allowable bearing pressure of the order of 3500kPa may be achievable. The allowable bearing pressure suitable for design should be assessed as part of the geotechnical investigation.

Basement Slabs and Subgrade

Given the seepage and sensitivity of claysoils to water, it should be expected that poor subgrade conditions will prevail. A working platform of crushed concrete or similar will be necessary to enable construction. If heavy piling plant has to traffic the subgrade then the working platform must be designed appropriately. When it is time to construct basement slabs then, as a minimum, the working platform should be proof rolled with a roller of at least 3 tonnes static weight and any soft or heaving areas repaired. Good underslab drainage will be essential. Overall, difficult subgrade conditions should be expected.

4.2.2 Western Portion of Site

For the portion of the site to the west of Cabramatta Creek where the residential subdivision is proposed the main geotechnical issues are as follows.

Subgrade Preparation and Earthworks

The extent of the earthworks proposed for the subdivision is not known, but we assume that fill will be placed to raise the levels to match those of the allotments to the west. Such earthworks should comprise stripping of the surface vegetation, root affected topsoil and any existing uncontrolled fill. The exposed subgrade should then be proof rolled with a roller of at least 8 tonnes static weight to detect any weak subgrade areas and any weak areas detected treated. The use of vibrating rollers in proximity (<30m) of existing dwellings may lead to vibration damage to the structures and the issue must be addressed by careful planning and construction.

Following any required treatment of the subgrade engineered fill should be placed to the required level in maximum 200mm loose thickness layers. Assuming that clay fill will be used, it should be compacted to a density strictly between 98% and 102% of Standard Maximum dry Density (SMDD) and at moisture contents within 2% of Standard Optimum Moisture Content (SOMC). Since we expect that the proposed houses will be supported on footings founded within the fill, it should be inspected and tested under Level 1 control in accordance with AS3798-2007.

Where batters are to be formed within the fill, the engineered fill should be placed and compacted past the line of the batters and the batters formed by cutting back the engineered fill. Permanent batters should be no steeper than 1V:2H, but flatter batters of the order of 1V:3H may be preferred to allow access for maintenance of vegetation.

Permanent batters should be covered with topsoil and planted with a deep rooted runner grass, or other suitable coverings, to reduce erosion. All stormwater runoff should be directed away from all temporary and permanent slopes to also reduce erosion.

Footings

Provided all fill is placed and compacted under Level 1 control, the proposed houses may be supported on footings founded within the fill, such as stiffened raft slabs. The design of these slabs will need to take into account the reactivity of the fill, which will need to be assessed following placement of the fill which will lead to a Class P rating in accordance with AS2870. If Level 1 controlled earthworks are completed then we would expect reclassification and design to accommodate shrink/swell movements for a Class H1 or H2 site in accordance with AS2870-2011. Footings founded within controlled, engineered fill should be able to be designed based on an allowable bearing pressure of the order of 100kPa.

5 GENERAL COMMENTS

The recommendations presented in this report are based on an inferred subsurface profile based on a salinity assessment and a nearby geotechnical investigation. A site specific geotechnical investigation will be required to allow detailed design. The comments and recommendations provided herein must be confirmed and amplified as part of the detailed geotechnical investigation.

The long term successful performance of floor slabs and pavements is dependent on the satisfactory completion of the earthworks. In order to achieve this, the quality assurance program should not be limited to routine compaction density testing only. Other critical factors associated with the earthworks may include subgrade preparation, selection of fill materials, control of moisture content and drainage, etc. The satisfactory control and assessment of these items may require judgment from an experienced engineer. Such judgment often cannot be made by a technician who may not have formal engineering qualifications and experience. In order to identify potential problems, we recommend that a pre-construction meeting be held so that all

parties involved understand the earthworks requirements and potential difficulties. This meeting should clearly define the lines of communication and responsibility.

This report provides advice on geotechnical aspects for the proposed civil and structural design. As part of the documentation stage of this project, Contract Documents and Specifications may be prepared based on our report. However, there may be design features we are not aware of or have not commented on for a variety of reasons. The designers should satisfy themselves that all the necessary advice has been obtained. If required, we could be commissioned to review the geotechnical aspects of contract documents to confirm the intent of our recommendations has been correctly implemented.

A waste classification will need to be assigned to any soil excavated from the site prior to offsite disposal. Subject to the appropriate testing, material can be classified as Virgin Excavated Natural Material (VENM), General Solid, Restricted Solid or Hazardous Waste. If the natural soil has been stockpiled, classification of this soil as Excavated Natural Material (ENM) can also be undertaken, if requested. However, the criteria for ENM are more stringent and the cost associated with attempting to meet these criteria may be significant. Analysis takes seven to 10 working days to complete, therefore, an adequate allowance should be included in the construction program unless testing is completed prior to construction. If contamination is encountered, then substantial further testing (and associated delays) should be expected. We strongly recommend that this issue is addressed prior to the commencement of excavation on site.