ABSTRACT
Report on results of flexible pavement thickness design for proposed carpark.

Prepared by: Edge Geotechnical Pty Ltd
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1 INTRODUCTION

In response to your request, Edge Geotechnical Pty Ltd (Edge) has provided consulting geotechnical engineering services for proposed carpark at 15 Park Street, Seven Hills.

Morrow Geotechnics Pty Ltd (Morrow) has carried out field and laboratory geotechnical investigations at the site and the results have been provided to you in report P1735_01 dated 24th September 2019.

Based on the information provided in your email, Edge has carried out the following work:

- Collaborated with Morrow to finalise scope of additional geotechnical investigations and scope of laboratory testing to be carried out after completion of additional field work.
- Completed a desk top study on available earthworks information associated with previous development of the site.
- Reviewed the Factual Geotechnical Report provided by Morrow and provide a flexible pavement thickness design options based on likely design standard axle repetitions. Based on the layout of the masterplan, only one potential pavement type is required. Pavement thickness design will be based on the Austroads Guide to Pavement Technology - Part 2 - Section 12 Pavement Structural Design for lightly trafficked pavements. Sufficient information is provided herein to enable detail civil design of pavement across the site and the preparation of Tender and IFC stage drawings (by others).

2 SITE DESCRIPTION & PREVIOUS GEOTECHNICAL STUDIES

The site is located on the corner of Park and Brumby Street, Seven Hills.

The site is flat with past earthworks activities carried out at the site by Hansen Yuncken with a number of geotechnical reports prepared by Pells Sullivan Meynink Pty Ltd (PSM).

You provided Edge with a number of documents to assist in preparation of this report, including:

- Master Plan Rev A of the site by DDC Architecture + Interior Design
- PSM Interim Geotechnical Design Advice letter dated 5th May 2015, ref PSM2605-011L
- PSM Interim Geotechnical Design Advice letter dated 29th March 2016, ref PSM2605-011L Rev 1
- PSM Geotechnical Investigation & Desktop Salinity Assessment, dated 22nd April 2015, ref PSM2605-008L Rev 1
- PSM Bulk Earthworks Specification dated May 2015, ref PSM2065-010S Rev 0
- PSM Geotechnical Investigation letter dated 19th August 2015, ref PSM2605-018L

Geology and soil landscape details are provided in the Morrow report, together with a site classification in accordance with AS2780, earthquake site classification in accordance with AS1170.4, advice on groundwater and construction constraints and the results of laboratory subgrade CBR testing.

Previous geotechnical testing by PSM included laboratory CBR testing and field plate load testing providing indicative subgrade stiffness values.
3 RESULTS OF RECENT GEOTECHNICAL STUDIES

As provided in the Morrow report, subgrade at the site comprises a thin amount (up to 400mm) of fill underlain by stiff highly plastic clay derived from weathered shale. Laboratory soaked CBR testing indicates pavement design subgrade CBR value of 1.5%, for material compacted to 98% of Standard Maximum Dry Density (SMDD). This is consistent with the results of previous testing by PSM where CBR values reportedly varies from 1.5% to 4.5%. Plate load testing by PSM on the site (PLT05) suggests a field subgrade stiffness value of 20 MPa, which can be compared to a CBR value of around 2%. A design subgrade CBR of 1.5% has been used in these pavement analyses.

4 PAVEMENT THICKNESS DESIGN

4.1 Design Traffic Calculation

Based on the Blacktown City Council (BCC) Engineering Guidelines for Development (2005), Table 3.2 provides design traffic volumes for a range of road types. For private/community roads, the BCC guide suggests a design traffic is $5 \times 10^4$ ESA’s. Given that this site is a carpark and not a through road, a lower design traffic is considered appropriate.

Edge has been advised by the Servants of Jesus Community that this carpark will:

- Only operational for overflow parking on Sundays and during special events.
- Only light vehicles (car and utes) will utilise the carparking area.
- Outside of Sundays, the area will be not be accessible.
- Occasional delivery trucks may use the carpark.
- Have a design life of 15-20 years.

Pavement thickness design is based on standard truck axle loading, ESAs. On this basis, the following design traffic input values are used:

- Small delivery trucks will access the site a maximum of once per week over a 20-year design life
- Number of standard axles per delivery truck is taken to be 2.8.
- Design axles loading, DESA, for 20 years is therefore $3 \times 10^3$.

4.2 Flexible Pavement

Based on a design subgrade CBR value of 1.5% and design ESA traffic value of $3 \times 10^3$, Figure 8.12.2 of the Austroads Guide to Pavement Technology: Part 2 (2017) indicates a minimum pavement depth as presented in Table 1 below.

The pavement is a fully flexible pavement with the 50 mm AC wearing surface incorporated into the overall structural thickness. Pavement surfacing would be required to comply with BCC specification documents.

Table 1: Minimum Pavement Thickness – Carpark Flexible Pavement

<table>
<thead>
<tr>
<th>Pavement Material</th>
<th>Minimum Thickness</th>
<th>Layer Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt surfacing</td>
<td>50</td>
<td>2 off 25mm layers of AC10</td>
</tr>
<tr>
<td>Unbound Base</td>
<td>100</td>
<td>Quality Crushed Rock, DGB Class 2 RMS QA Specification 3051</td>
</tr>
<tr>
<td>Unbound Subbase</td>
<td>100</td>
<td>Quality Gravel, DGS20 or 40 RMS QA 3051</td>
</tr>
<tr>
<td>Select Granular Material,</td>
<td>150</td>
<td>Imported select material. Imported crushed sandstone may be suitable. CBR 15% or better.</td>
</tr>
<tr>
<td>TOTAL</td>
<td>400 mm</td>
<td></td>
</tr>
</tbody>
</table>
A reduced pavement thickness could be possible with the introduction of composite biaxial geogrid at subgrade level, which reduces strain in the subgrade under traffic loading. Table 2 below provides an alternative pavement thickness design with incorporation of biaxial geogrid. Results of pavement analysis with Tensar geogrid are provided in Appendix A.

Table 2: Minimum Pavement Thickness – Carpark Flexible Pavement with Geogrid

<table>
<thead>
<tr>
<th>Pavement Material</th>
<th>Minimum Thickness</th>
<th>Layer Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt surfacing</td>
<td>50</td>
<td>2 off 25mm layers of AC10</td>
</tr>
<tr>
<td>Unbound Base</td>
<td>100</td>
<td>Quality Crushed Rock, DGB Class 2 RMS QA Specification 3051</td>
</tr>
<tr>
<td>Unbound Subbase</td>
<td>150</td>
<td>Quality Gravel, DGS20 or 40 RMS QA 3051</td>
</tr>
<tr>
<td>Geogrid layer</td>
<td>-</td>
<td>Tensar Triaxial Geogrid TX160 placed on prepared subgrade.</td>
</tr>
<tr>
<td>TOTAL</td>
<td>300 mm</td>
<td>Minimum pavement thickness as required by BCC</td>
</tr>
</tbody>
</table>

5 CONSTRUCTION RECOMMENDATIONS

All pavement thickness design values reported herein do not take into account construction tolerance. Target construction thickness may need to be increased to take into account construction tolerance.

All subgrade and earthworks placed on the site should be carried out in accordance with applicable Australian Standards and BCC guidelines for earthworks formation preparation and compaction of pavement gravels. This includes backfilling of any drainage features on the site.

5.1 Drainage

Surface and subsurface drainage is recommended across all pavement areas, generally positioned on either side of the formed pavement. Standard drainage trenches area on the shoulder area of the pavement, are typically 300 mm wide and extend into the pavement subgrade to ensure drainage of the pavement layers. Guidelines are provided in the Austroads Guide to Pavement Technology: Part 10 and the Blacktown City Council Engineering Guide for Development (February 2005).

6 CLOSURE

If you have any questions, please do not hesitate to contact Edge by email or telephone.

For and on behalf of

Edge Geotechnical Pty Ltd

Karen Allan  BEng (Hons), CPEng MIEAust Int(PE) GradDip(Pavements)
Principal Geotechnical Engineer, Director
**7 IMPORTANT INFORMATION**

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The accuracy, applicability or usefulness of the opinions, assessment or other information in this Report may change over time. The Report is based upon the information and other circumstances that existed and were known to Edge when the Services were performed and this Report was prepared.
APPENDIX A - Preliminary Pavement Thickness Design Incorporating TriAx Geogrid (3 pages)
Tensar software output
Output from TensarPave version 7.01

Client: NJK Consulting
Project: Servants of Jesus Carpark

This document contains Tensar software output which has been prepared by Tensar International, on a confidential basis, to enable the application of Tensar geogrids to be evaluated. The Tensar software output is merely illustrative and is not a detailed design. This Tensar software output is specific to the unique characteristics of the Tensar geogrids which are referenced within the calculations and illustrations.

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Tensar is a registered trade mark

Method of analysis
The calculation method used to create this Tensar software output is the design method for unpaved roads as detailed in TRL Report LR1132. The enhancement of performance due to the inclusion of Tensar geogrids in the stabilised layer is derived empirically from full scale pavement tests and trafficking trials carried out by independent authorities.

Reference Date 17 Dec 2019 Page 1 of 3
Application suggestion prepared by Edge Geotechnical Pty Ltd Sydney
Tel: PO Box 293
Fax: Blackheath NSW 2785
E-mail:karen@edgegeotech.com.au
www.edgegeotech.com.au
Input data

<table>
<thead>
<tr>
<th>Subgrade description</th>
<th>Clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subgrade strength</td>
<td>CBR (%)</td>
</tr>
<tr>
<td></td>
<td>1.50</td>
</tr>
<tr>
<td>Area to be stabilised</td>
<td>(m²)</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
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<tr>
<td>Construction traffic</td>
<td>N_{sc} (no ESA)</td>
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<td></td>
<td>4200</td>
</tr>
<tr>
<td>In-service traffic</td>
<td>N_{si-c} (no ESA)</td>
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<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Design standard axle load</td>
<td>(kN)</td>
</tr>
<tr>
<td></td>
<td>80.00</td>
</tr>
<tr>
<td>Function of stabilised layer</td>
<td>General stabilisation</td>
</tr>
<tr>
<td>Maximum surface deformation</td>
<td>(mm)</td>
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<tr>
<td></td>
<td>75</td>
</tr>
<tr>
<td>Stabilised layer description</td>
<td>Granular fill</td>
</tr>
<tr>
<td>Maximum particle size</td>
<td>(mm)</td>
</tr>
<tr>
<td></td>
<td>&lt;75</td>
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</table>

Section

Project: Servants of Jesus

Tensar stabilisation solution

Result

<table>
<thead>
<tr>
<th>Geogrid</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensar TX160</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thickness</th>
<th>t (mm)</th>
<th>300</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>4435</td>
</tr>
<tr>
<td>Total traffic achieved (ESAL)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specification</td>
<td>MS_ETA_TriAx_TX160</td>
<td></td>
</tr>
</tbody>
</table>

Further information relevant to this Tensar software output

Further information and specifications for this Tensar mechanically stabilised layer are given in the following documents which form part of this Tensar software output:

- Fill specification
- Compaction specification
- Outline installation method

For program users who do not have a link to the internet the contact details of your nearest Tensar representative are:

Tensar International Limited
+61 (0)7 55680174
+61 (0)7 55680174
jbuckley@tensar.com.au
Web: www.tensar-international.com
<table>
<thead>
<tr>
<th>Tensar carbon calculator</th>
<th>The output from this TensarPave program can be entered into the Tensar Carbon Calculator.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Visit <a href="http://www.tensarsustain.co.uk/carbon.asp">http://www.tensarsustain.co.uk/carbon.asp</a> and load in these project details and obtain a further report to add to your TensarPave solution</td>
</tr>
</tbody>
</table>