6 September 2019

Inquiry and Advisory Committee

C/O Terry Montebello
Maddocks

Dear Terry

NORTH EAST LINK PROJECT ENVIRONMENTAL EFFECTS STATEMENT – DENSITY AND LOS ON EASTERN FREEWAY

This memorandum has been prepared to respond to the Department of Transportation (DoT) comments in relation to ‘over-engineering’ of the Reference Design, in particular emphasising ‘density’ as being an important measure when considering an appropriate Level of Service (LOS). This memorandum summarises my further assessment of the density aspects of LOS and the results presented in the Technical Report A – Traffic & Transport Assessment (TTIA) of the North East Link Project (NELP) Environmental Effects Statement (EES).

BACKGROUND

LOS has been used in the TTIA as the key performance indicator to assess the project corridors. LOS for freeway segments is based on density, measured in Passenger Car Equivalents (PCU) per lane per kilometre.

The density criteria in the TTIA have been derived from the Highway Capacity Manual Sixth Edition (HCM6) as shown in Figure 1.

<table>
<thead>
<tr>
<th>Level of Service</th>
<th>PCU/lane/km</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.0 to 6.8</td>
<td>Free flow traffic conditions.</td>
</tr>
<tr>
<td>B</td>
<td>6.8 to 11.2</td>
<td>Reasonably free flow traffic conditions.</td>
</tr>
<tr>
<td>C</td>
<td>11.2 to 16.2</td>
<td>Stable flow traffic conditions</td>
</tr>
<tr>
<td>D</td>
<td>16.2 to 21.7</td>
<td>Approaching unstable flow</td>
</tr>
<tr>
<td>E</td>
<td>21.7 to 28.0</td>
<td>Unstable flow, operating at capacity</td>
</tr>
<tr>
<td>F</td>
<td>&gt;28.0</td>
<td>Forced or breakdown flow</td>
</tr>
</tbody>
</table>

Note: PCU – Passenger Car Unit is a metric used to assess traffic flow on a freeway. One car is considered as a single unit, while buses or trucks can be considered between 2 and 4 PCUs.

FIGURE 1. LOS CRITERIA FOR FREEWAY SEGMENTS (SOURCE: TABLE 8-7 PAGE 215 OF THE TTIA)
The TTIA adopted LOS D as a design target and LOS D or better as performance threshold during the peak periods (refer to Section 8.3.1 Page 216 of the TTIA).

It is noted that LOS D is achieved by a range of densities with the lower boundary at 16.2 PCU/lane/km and the upper boundary at 21.7 PCU/lane/km. **Figure 2** shows the speed-flow curves for Basic Freeway segments. The curve that can be applied to Eastern Freeway is the free-flow speed of 60 mi/h (equates to 97 km/h).

**Figure 2** shows that flows within the LOS D grade increase significantly (without reaching the capacity) with the increases in densities toward the upper boundary of LOS D with minor reduction in speeds. An increase of approximately 27 percent in flows is achieved for a drop of approximately 4% speeds from the lower boundary of LOS D to the upper boundary of LOS D.

![FIGURE 2. LOS CRITERIA AND SPEED-FLOW CURVES FOR BASIC FREEWAY SEGMENTS (SOURCE: EXHIBIT 12-16 OF THE HCM6)](image)

**ASSESSMENT**

For the purposes of my analysis, I have re-classified LOS D into two sub categories – LOS D1, denoting lower densities at LOS D, i.e. between 16.2 PCU/lane/km and 19 PCU/lane/km, and LOS D2, denoting upper densities at LOS D, i.e. between 19.1 PCU/lane/km and 21.7 PCU/lane/km. This was done to assess how well the freeway...
segments on Eastern Freeway faired in the TTIA and the likely spare capacity and footprint implications of that.

The above two categories and the increases in traffic flows between two consecutive LOS grades are shown in Figure 3.

![Figure 3. LOS D Sub Categories](image)

**FIGURE 3. LOS D SUB CATEGORIES**

Microsimulation results included in Appendix E (Pages E-2 to E-33) of the TTIA have been modified to reflect two sub-categories of LOS D as explained above. Table 1 presents the number of freeway segments (combination of merge, diverge, weave and mid-blocks) along Eastern Freeway in the peak direction (i.e. westbound in the AM peak period and eastbound in the PM peak period) between the City and EastLink tunnels that fall under the specified densities for LOS A-C, LOS D1 and LOS D2. Please note that none of the freeway segments on Eastern Freeway were reported to operate at LOS E or LOS F.
<table>
<thead>
<tr>
<th>DENSITY (PCU/LN/KM)</th>
<th>LOS</th>
<th>WESTBOUND AM</th>
<th>EASTBOUND PM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>FIRST HOUR</td>
<td>SECOND HOUR</td>
</tr>
<tr>
<td>&lt; 16.2</td>
<td>A-C</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>16.2 - 19</td>
<td>D1</td>
<td>16</td>
<td>11</td>
</tr>
<tr>
<td>19.1 - 21.7</td>
<td>D2</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Note:
Density and LOS criteria derived from HCM6
Eastern Freeway segments includes mid-blocks, merges, diverges and weaves

TABLE 4. FREQUENCY OF LOS ON EASTERN FREEWAY

Modified LOS results for the Eastern Freeway are shown in Figure 4 and Figure 5.

On the basis of my assessment above, key findings are:

- Half of the freeway segments on Eastern Freeway operate at LOS C or better in the peak travel direction during the AM or PM peak periods.
- Most of the remaining freeway segments on Eastern Freeway operate at LOS D1 (or, LOS D with lower densities) in the peak travel direction during the AM or PM peak periods.
- Only 3 freeway segments operate at LOS D2 (or, LOS D with upper densities). These segments are: Chandler Highway to Burke Road (density at 19.8 PCU/LN/km), Burke Road diverge (density at 20.0 PCU/LN/km) and NEL diverge (density at 19.2 PCU/LN/km). This can be interpreted as only 3 of 51 freeway segments operate within 500 PCU/h of their capacity.
AM – First Hour

AM – Second Hour

FIGURE 4. LOS RESULTS – EASTERN FREEWAY AM PEAK PERIOD
FIGURE 5. LOS RESULTS – EASTERN FREEWAY PM PEAK PERIOD

PM – First Hour

PM – Second Hour
CONCLUSION

I have drawn the following conclusion:

- The Reference Design has been prepared such that almost all freeway segments on Eastern Freeway operate at LOS C or better and LOS D (with the lower densities). All of these segments have plenty of spare capacity (in the range of 500-1,300 PCU/ln/km). This makes much of the size of Eastern Freeway excessive and unnecessary.
- Due to substantially higher spare capacity on almost all freeway segments on Eastern Freeway, the likelihood of ‘peak shortening’ would significantly increase.
- As shown in the speed-flow curves, the cusp of LOS C-D is associated with lower traffic throughputs relative to the cusp of D-E. One of the guiding principles of the NELP is to optimise the efficient use of resources. It is evident that designing and operating a major road project at the cusp of LOS C-D is not efficient use of expensive transport assets.

RECOMMENDATION

In my view, Eastern Freeway should be re-designed and operated at the cusp of LOS D-E during the peak periods which would increase traffic throughputs with minor speed reductions without flow breakdowns and ultimately result in much better use of transport assets.

If you have any queries, or wish to discuss, please contact me (0419 334404).

Yours sincerely

O’BRIEN TRAFFIC

Andrew O’Brien
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