MEMO

FROM: Peter Kelly, WSP
SUBJECT: EES – Alternative Lower Dandenong Road / Mordialloc Bypass Freeway Interchange Arrangements
DATE: 13 March 2019

1. INTRODUCTION

This memorandum has been prepared in response to the request from the Inquiry and Advisory Committee (IAC) to further assess transport related impacts associated with proposed arrangements located at Woodlands Drive. Woodlands Drive is a Council-managed collector road providing access to the Woodlands industrial precinct.

1.1 SUMMARY OF INTERCHANGE OPTIONS

In summary, four interchange options have now been identified for Woodlands Drive, as follows:

Reference Design Option: As part of the reference design for the project, it is proposed to truncate Woodlands Drive and provide connection to the Woodlands Industrial Estate via Tarnard Drive and Bell Grove. The Reference Design Option is considered in the EES and is not further addressed in this document.

Alternative Option One: Following the impact identification process and consideration of submissions, an alternative freeway interchange (Figure 2.1) was considered to further reduce the potential access impacts to the surrounding project area adjacent to the proposed Woodlands Drive / Lower Dandenong Road / Mordialloc Freeway interchange. This design was presented to the IAC as part of the EES panel hearing process and is addressed in my witness statement dated 15 February 2019.

Alternative Option Two: The IAC requested further design refinement of Alternative Option One to investigate whether it would be possible to minimise impacts on private property at 21-29 Woodlands Drive. In response, I have carried out further work to refine Alternative Option One, as detailed in this document below. The refined arrangement is referred to as Alternative Option Two and will avoid impacts to private property at 21-29 Woodlands Drive.

Alternative Option Three: The IAC also requested that a separate concept design which would connect Woodlands Drive to the proposed Lower Dandenong Road freeway interchange northbound exit ramp be investigated. This arrangement is referred to as Alternative Option Three.

The concept designs for Alternative Option Two and Alternative Option Three were tested to confirm and compare the operational performance using microsimulation modelling with results presented in this memorandum.

A high-level design review has also been undertaken to compare Alternative Option Two and Alternative Option Three to inform which of the arrangements would align better with the current design principles in accordance with current design practices under Austroads.
1.2 SUMMARY OF OPINION

It is my opinion that Alternative Option Two should be preferred overall as it has more advantages compared to Alternative Option Three or the Reference Design Option, and it avoids impacts to private property associated with Alternative Option One.

2. FREEWAY INTERCHANGE ARRANGEMENTS

2.1 ALTERNATIVE OPTION ONE

Alternative Option One, which was presented in the EES panel hearing is configured to retain the existing connection between Woodlands Drive and Lower Dandenong Road. Under this arrangement, the proposed northbound freeway exit ramp would terminate on the east side of Woodlands Drive, south of Lower Dandenong Road, as show in Figure 2.1. As a result, the existing access arrangement at Bell Grove, Tarnard Drive and Redwood Drive would remain in its current form.

Under Alternative Option One, the arrangement at Lower Dandenong Road is similar to a conventional signalised full diamond freeway interchange with the exception of Woodlands Drive that replaces the south-west leg where it would typically be a one-way freeway exit ramp terminals rather than a two-way road.

The proposed northbound exit ramp will be signalised and terminates at Woodlands Drive forming a signalised t-intersection. The ramp terminal is configured with a left turn slip lane and a double right turn lane from the exit ramp. Two approach through lanes are provided on the north and south approaches of this intersection. This initial concept layout shows that the northbound exit ramp terminal would impact on access that caters for 21-29 Woodlands Drive premises. This access is a primary access for the back entrances to the premises and that further design refinement has been undertaken to mitigate the potential access impact.

Figure 2.1 Alternative Option One layout
2.2 ALTERNATIVE OPTION TWO

The layout shown in Figure 2.2 reflects Alternative Option Two, which is an updated interchange arrangement that relocates the proposed northbound exit ramp terminal to the north of the existing private access at 21 Woodlands Drive. A number of design changes have also been incorporated in this revised layout to minimise pedestrian crossing distance, environmental and utility impacts, which includes:

- Revised internal storage area (between Woodlands Drive and southbound exit ramp terminal)
- Replacement of left turn slip lanes (give-way control) at Woodlands Drive approach (Woodlands Drive to Lower Dandenong Road left turn movement) and internal storage area (Lower Dandenong Road to Woodlands Drive left turn movement) with signalised turn lane arrangement
- Revised northbound exit ramp terminals location subsequently allows for all traffic movements at the existing 21 Woodlands Drive access (see Figure 2.3)
2.3 ALTERNATIVE OPTION THREE

Through the EES panel hearing process, a separate concept design was requested to be investigated that would realign Woodlands Drive to the proposed Lower Dandenong Road freeway interchange northbound exit ramp (Alternative Option Three). Figure 2.4 illustrates the layout of this arrangement. This configuration prioritises the northbound exit ramp over Woodlands Drive. Compared to Alternative Option Two, the northbound exit ramp terminal would be located further north of the existing 21 Woodlands Drive access by an additional 10 metres (approximately).

Figure 2.4   Alternative Option Three layout

3. TRAFFIC PERFORMANCE ASSESSMENT

Microsimulation modelling has been undertaken to assess the anticipated 2031 traffic performance of the alternative freeway interchange layouts to inform the operational feasibility of this design. The assessment was tested using a calibrated/validated 2017 base model.

The scope of the modelling focuses on the operation at Woodlands Drive, Lower Dandenong Road and Mordialloc Freeway with the extent of the model covering Howard Road, Bell Grove and Redwood Drive. The assessment methodology and base model information are discussed in a prior memorandum submitted to the EES review panel 2135645A-SE-TPL-MEM-0003.

For the purpose of this assessment the following metrics have been considered:

- Intersection level of service
- Average speed network condition

The following describes the above metrics and associated criteria used to evaluate intersection performance and are referred to throughout the following sections of this memorandum:

3.1.1 LEVEL OF SERVICE (LOS)

A measure of the average delay per vehicle completing movements at the intersection which can be calculated for a movement, an approach or for all vehicles. LOS A to F is assigned based on the criteria shown in Table 3.2.
Table 3.2  Level of Service Criteria (Source: Austroads Guide to Traffic Management Part 3, 2013)

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3.2 PERFORMANCE COMPARISON: ALTERNATIVE OPTION TWO AND ALTERNATIVE OPTION THREE

LEVEL OF SERVICE AND AVERAGE SPEED

Microsimulation modelling results indicate that Alternative Option Two and Alternative Option Three would both perform efficiently under the 2031 AM and PM peak hour traffic demand resulting in LOS C and D (meeting target LOS D). All major through movements are anticipated to operate at LOS C, individual right turn movements at the interchange are likely to operate at LOS E or F. Refer to Table 3.3 to Table 3.6 for summary results.

It should be noted that for both options traffic egressing from the northbound exit ramp to access Lower Dandenong Road may experience a combined delay from two sets of traffic signals and as a result, longer delay would be experienced compared to a conventional interchange arrangement. In turn, traffic egressing from the northbound exit ramp to access Woodlands Industrial Estate via Woodlands Drive would benefit from the alternative arrangement with direct access onto Woodlands Drive via the northbound exit ramp terminal.

Overall, Alternative Option Two reflects a slightly better performance, particularly during the PM peak period. This is largely due to the higher storage capacity available along Woodlands Drive between Lower Dandenong Road and the northbound exit ramp terminal. In comparison, Alternative Option Two provides an addition 20 meters of storage compared to Alternative Option Three. The additional storage area allows more traffic to clear during each signal cycle along Woodlands Drive which consequently reduces the saturation of the road links and chances of blocking back on to the northbound exit ramp. This condition is reflected when comparing the peak average speed conditions presented in Figures 3.1 to 3.4, whereby the overall congestion along Woodlands Drive and through the ramp intersection is predominately higher under Alternative Option Three in both peak periods, but particularly the PM peak.
### Table 3.3  Alternative Option Two - AM Peak interchange performance

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**MORDIALLOC FREEWAY / LOWER DANDENONG ROAD**

Movement South reflects southbound entry ramp

### Table 3.4  Alternative Option Two - PM Peak interchange performance

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**MORDIALLOC FREEWAY / LOWER DANDENONG ROAD**

Movement South reflects southbound entry ramp

### Table 3.5  Alternative Option Three - AM Peak interchange performance

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**MORDIALLOC FREEWAY / LOWER DANDENONG ROAD**

Movement South reflects southbound entry ramp
### Table 3.6  Alternative Option Three - PM Peak interchange performance

<table>
<thead>
<tr>
<th>INTERSECTION</th>
<th>APPROACH</th>
<th>DIRECTION</th>
<th>VOLUME</th>
<th>DELAY</th>
<th>LOS</th>
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<tbody>
<tr>
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<td>N-E</td>
<td>-</td>
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<td>Southbound Exit Ramp Terminal</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
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<td>-</td>
<td>143</td>
<td>88</td>
<td>B</td>
</tr>
<tr>
<td>Southbound Exit Ramp Terminal</td>
<td>N-GW</td>
<td>-</td>
<td>62</td>
<td>88</td>
<td>B</td>
</tr>
<tr>
<td>North</td>
<td>N-AG</td>
<td>-</td>
<td>390</td>
<td>58</td>
<td>A</td>
</tr>
<tr>
<td>East</td>
<td>E-N</td>
<td>-</td>
<td>117</td>
<td>46</td>
<td>A</td>
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<tr>
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<td>25</td>
<td>F</td>
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<tr>
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<td>337</td>
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<tr>
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<td>East</td>
<td>E-App</td>
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<td>733</td>
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<tr>
<td>Total</td>
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<td>-</td>
<td>1434</td>
<td>18</td>
<td>B</td>
</tr>
</tbody>
</table>

**MORDIALLOC FREEWAY / LOWER DANDENONG ROAD**

Movement South reflects southbound entry ramp

**NORTHBOUND EXIT RAMP TERMINAL**

**Figure 3.1**  Alternative Option Two - AM average speed plot indicates anticipated level of congestion (lanes represented in pink, red and dark orange indicate an average speed of less than 30km/hr).
3.3 VOLUME COMPARISON

A review of the 2031 AM and PM volumes at the intersection of Woodlands Drive / northbound exit ramp terminal has been undertaken. Approach volumes are summarised in Table 3.7 below.
Table 3.7  Anticipated 2031 AM and PM approach volumes at Woodlands Drive / Northbound exit ramp terminal

<table>
<thead>
<tr>
<th>Approach Description</th>
<th>2031 AM Peak Hour Volume (rounded) (vph)</th>
<th>2031 PM Peak Hour Volume (rounded) (vph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woodlands Drive North Approach</td>
<td>470</td>
<td>320</td>
</tr>
<tr>
<td>Woodlands Drive South Approach</td>
<td>400</td>
<td>750</td>
</tr>
<tr>
<td>Woodlands Drive two-way volume - TOTAL</td>
<td>870</td>
<td>1,070</td>
</tr>
<tr>
<td>Northbound Exit Ramp Terminal</td>
<td>440</td>
<td>360</td>
</tr>
</tbody>
</table>

The outcome of this indicates that the anticipated 2031 peak hour volumes along Woodlands Drive are significantly higher compared to the traffic egressing from the northbound exit ramp terminal during both AM and PM peaks. These are 870 vph verses 440 vph in the AM peak, and 1,070 vph verses 360 vph in the PM peak.

On the basis of the anticipated volumes, Woodlands Drive alignment should be prioritised over the northbound exit ramp alignment. As such, Alternative Option Two is considered to be more appropriate from a volume standpoint.

4. DESIGN COMPARISON: ALTERNATIVE OPTION TWO AND ALTERNATIVE OPTION THREE

A high-level design review has been undertaken to compare the two northbound exit ramp terminal arrangements against the current Austroads road design guidelines.

Through this review a number of design issues have been identified in Alternative Option Three. These issues are primarily related to the orientation of the intersection and Woodlands Drive alignment which impacts:

- Intersection alignment
- Potential see-through effect
- Ability to reduce vehicle speed along the northbound exit ramp.

These items are further explained in the following subsections.

4.1 ALIGNMENT ISSUES

As a result of the alignment and orientation of the Woodlands Drive / northbound freeway exit ramp under Alternative Option Three, delineation for the north and southbound Woodlands Drive traffic through the intersection is not considered to be desirable. Particularly due to the higher proportion of heavy vehicle movements along Woodlands Drive, vehicles travelling in the inner traffic lane (lower radii curve) may naturally force vehicles on adjacent lane (high radii curve) out of the carriageway leading to potential side swipe crashes or head-on crashes at the intersection. These movements are illustrated in Figure 4.1 and 4.2 below. Maintaining straight travel paths is recommended, in this instance.
4.2 POTENTIAL ‘SEE-THROUGH’ EFFECTS

The revised alignment of Woodlands Drive as part of Alternative Option Three may cause ‘see-through’ effects in low light conditions. As shown in Figure 4.3, vehicles travelling in a northbound direction on Woodlands Drive may drive straight towards street lights at the Lower Dandenong Road intersection, without realising that the alignment of the road curves to the east. This has the potential for vehicles to run-off the road which may have serious consequences when travelling at speed. To minimise these impacts, a mount may be required (as shown in Figure 4.4). A mount is used to make the driver aware of the alignment of the carriageway and minimise ‘see-through’ effects. However, a mount would require additional work to assess environmental impacts. Sight distance is likely to be impacted by the mount with motorists travelling northbound on Woodlands Drive unable to see if there is storage available south of the Lower Dandenong Road intersection.
4.3 ABILITY TO REDUCE VEHICLE SPEED ALONG THE NORTHBOUND EXIT RAMP

Alternative Option Three would reduce the horizontal curvature along the northbound exit ramp approaching the terminal at Woodlands Drive. This effectively limits the ability to physically reduce vehicle speed along the ramp which may lead to a higher relative collision speed should a collision occur. As a result, Alternative Option Two is considered to be a safer arrangement compared to Alternative Option Three.

5. OTHER CONSIDERATIONS

In addition to the design considerations discussed in the previous sections, the Alternative Option Three arrangement is considered to be less desirable compared to the Alternative Option Two arrangement due to the following:

- additional tree removals required
- does not utilise existing pavement as effectively
- requires additional mount and pavement which may in turn increase environmental impacts.

6. CONCLUSION

This assessment demonstrates that the Alternative Option Two and Alternative Option Three arrangements both meet the level of service target performance. Considering the safety and operational outcomes associated with these two concept designs, the Alternative Option Two arrangement is to be preferred with more advantages compared to the Alternative Option Three arrangement.