North East Link – Traffic & Design

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My involvement

Engaged by Boroondara and Banyule separately early in the project.
Engaged by Maddocks, on behalf of Boroondara, Banyule, and Whitehorse Councils.

My involvement included:
• Critiquing the Reference Design
• Preparing my Evidence Report including my Alternative Design
• Attending three conclaves – with GTA and Marshall, with other traffic engineers, with all traffic engineers including GTA, each of which were minuted and signed
• Attended a meeting at GHD to view the micro-simulation of the Alternative Design (un-minuted, but notes taken)
Scope

Engaged to:

- provide traffic planning advice;
- provide design advice,
- critique the Reference Design
- assess whether the traffic assessments & designs in the EES allow for the environmental effects of the Project to be minimised
- prepare alternative design options that address the identified weaknesses in the Reference Design
Presentation structure

- Road design including Reference Design and Alternative Design
- Issues with the EES, and comments related to the EES
Road Design
Road design matters

After review of Reference Design, following matters were identified:

- Road safety issues
- There appears to be better, less impacting ways to achieve similar capacity
- The Alternative Design was developed to demonstrate one way that design could be improved
Design/safety problems with the Reference Design

A desktop road safety audit identified over 30 safety issues that need to be resolved, and which would likely increase the design’s footprint.

Figure 18 shows the required sight distance to the exit area (red dashed line).

Figure 18: Required line-of sight at the off-ramp to Bulleen Road

ASD to the exit nose – for 100 km/ speed limit = 310 m, for 80 km/h speed limit = 250 m

Source: Austroads GRD Part 4C – Interchanges Table 7.1
Design/safety problems with the Reference Design

There are substantial sight distance deficiencies at a number of major exit points (shortfall is in brackets in each point below), including:

- M80 eastbound exit to Greensborough Bypass and Grimshaw Street (120 m)
- NEL northbound exit to Grimshaw Street (70 m)
- NEL southbound at split to Eastern Freeway (in tunnel) (130 m)
- Eastern Freeway at Doncaster Road eastbound exit (about 140 m) – exit is on a sharp left hand bend, on a crest, and with a concrete barrier beside the shoulder

‘Fixing’ will mostly involve significant design changes

Note also that no ramp meter is proposed for the eastbound on-ramp from Springvale Road – virtually guaranteeing flow breakdown
Design problems with the Reference Design

- Ramp splits 50 m apart
- 2 m radius U-turns on shared path (numerous locations)
- Right hand off-ramp to Bulleen Road (banned)
Design problems with the Reference Design

Ramps not wide enough to pass a disabled vehicle
Design problems with the Reference Design

Right hand tunnel lane splits into 2 lanes immediately prior to the NEL to west ramp exit – resulting in the two right hand lanes beyond the exit being no more than half full. If this design has ‘passed’ the micro-simulation tests, then it is over-designed and the 3rd lane to Eastern Freeway is not needed.
Design problems with the Reference Design

The designers of the RD have now modified the westbound ‘split to Eastern Freeway and NEL carriageways in response to my road safety audit comments, and it is now where I proposed it in the AD.

Top image – Reference Design provided in mapbook
Below image – Detailed design provided on 7 August 2019
The Alternative Design

The Alternative Design aimed to address the following:

• Addressing safety issues with the Reference Design
• Providing a simplified and more effective design for the proposed busway;
• Recognising the legitimate need to minimise the adverse environmental impacts of the Reference Design;
• Addressing the unjustified complexity of the designs on the Eastern Freeway and of the M80 interchange;
• Providing simplified, but more effective and safer, alternatives to many of the components of the Reference Design;
• Complying with widely accepted design standards – such as provision of safety shoulders.
The Alternative Design

The Alternative Design:

- is consistent with the principles of VicRoads and Austroads guidelines – noting that these are guidelines and not ‘standards’
- addresses the weaving between Tram Road and Middleborough Road in both directions using ramp metering, auxiliary lanes, and reducing demand for local trips when the ramp meters operate. VicRoads ramp metering algorithms appear to create a typical delay of about 4 minutes when in operation, usually in the peaks, which discourages the use of freeway for local trips
- For weaving distances ‘weaving’ analysis is applied to weaving distances of Where ramps are less than 750 m or less apart, mindful that HCM6 provides that detailed weaving analysis in not required when ramp metering is used on the on-ramp. Because both Reference Design and AD contemplate a managed motorway with ramp metering, a weaving analysis is not required (HCM6).
Ramp metering experiences informed the Alternative Design

My ramp metering experiences informed the Alternative Design in particular with respect to high levels of weaving. Weaving volumes were far higher than those expected on Eastern Freeway and the weaving distances far shorter. I am confident that the Alternative Design can readily handle the lower levels of flow compared to those in Newmarket (Auckland).
The road safety audit informed the Alternative Design

The road safety audit was one of the items that contributed to the Alternative Design – demonstrating issues that needed to be addressed.

A particular design/safety issue was the right hand exit from the West to NEL ramp to Bulleen Road – this is an absolute ‘no no’ in freeway interchange design.
The road safety audit informed the Alternative Design

The northbound Greensborough Highway approaching Grimshaw Street has two successive exits 50 m apart – with both ramps going under a bridge structure. AGTM Part 6 Table 6.3 requires a minimum separation of 300 m for freeways.
Reference Design or Alternative Design

Watsonia to M80 and Greensborough Bypass

- AD requires a substantially reduced interchange between NEL/Greensborough Bypass/M80 – with far lower costs and land impact – and overcomes some RD design deficiencies (plan book)
- AD replicates the northern side of the Grimshaw Street interchange, and is similar on the southern side
- AD provides far better local access to Greensborough Highway between Grimshaw Street and Watsonia
- The AD proposed east-west link from Frensham Road to Watsonia Road greatly improves access to the centre, and provides a bus/rail interchange
- The AD replaces the awful intersection of Watsonia Road and Greensborough Road in the RD
Reference Design or Alternative Design

Busway and Bulleen Road bus station & car park

- Car park access to/from Bulleen Road is proposed
- AD has the busway in the median west of Bulleen Road, then connecting to the RD alignment east of Koonung Reserve – avoiding the need for a busy at-grade crossing of Thompsons Road
- At the western end, the RD outbound busway commences on the north to east on-ramp – which no route buses use
- The AD provides a future opportunity to carry a busway further to the west
Reference Design or Alternative Design

Eastern Freeway east of Bulleen Road

• AD does not mix westbound NEL bound traffic with Eastern Freeway traffic – thereby not offering users the choice of beating queues by using the other carriageway, and congesting the NEL one

• AD allows two options to join the NEL ramp from any interchange other than Elgar Road

• Alternative Design minimises likely confusion by users due to the complexity of the RD

• The AD ‘works’ with a huge reduction in cost compared to the RD

• From Bulleen Park to Wetherby Road, about 13 Ha of open space is saved with the AD
Reference Design or Alternative Design

Bulleen Road area

• AD requires minimal change to golf course
• AD allows all sports grounds to be re-instated
• AD impacts on BWS, Dan Murphy, and function centre
• AD allows existing, or similar, accesses to schools/facilities to be retained due to the slightly extended ‘cut & cover’ tunnels
• EPR safeguard for Marcellin College could be that one of the two affected ovals be retained at all times
Reference Design or Alternative Design
Bulleen Road interchange conclave

After GTA’s evidence that they had not looked in detail at either Reference Design or the Alternative Design, I was instructed to approach the traffic engineers whose clients are impacted by the Reference Design for the Bulleen Road interchange to discuss whether each of their individual concerns could be addressed by either the Alternative Design or any variation to it.

- No consensus was able to be reached
- The views on particular issues were as discussed in the conclave report
TN 41 response

• The response to TN41 demonstrates that the issues raised can be suitably addressed
• There is no matter that would prevent the adoption of the Alternative Design
Collector-distributor v normal practice

- The Reference Design tries to separate through movements by introducing barriers. One reason given is that it reduces weaving. I do not consider that the barriers will achieve any better outcomes than would be achieved by ramp metering and good signage of the motorway.

- There is strong evidence that ramp metering and motorway management produces a much safer freeway environment.

- There is no evidence that barriers segregating lanes are any safer.

- The barriers themselves create a potential for dangerous weaving at the points where the lanes begin to be segregated.
Lane changing, weaving, and safety

Drivers change lanes for at least two main reasons: to access a freeway off-ramp (non-optional move), or to pass a vehicle in their current lane (optional move). Some drivers do not plan their journey well – leaving lane changes to exit until the last moment.

I provided 4 examples, on p. 37 of my report, that demonstrate that some major weaves are problematic with the RD but less so with the AD.

By the time NEL is open, a substantial proportion of the vehicle fleet will have ‘surround awareness’ operating – which will significantly assist safe lane-changing.

The Alternative Design is designed on this basis.
Freeway safety & ramp metering

- DOT referred to an article by John Gaffney (2016), and also the motorway design volume guide (2017) which describes the approach that VicRoads now takes, which is that freeways should be managed motorways.
- This shift by VicRoads in traffic planning is new to VicRoads but not novel.
- The most important elements of a managed motorway are ramp metering and the use of technology to guide motorists on their journeys on the motorway.
- The benefits of managing a motorway have been long-known and used in other places (including by me in Auckland since 2005-8).
Freeway safety & ramp metering

- This slide was produced by DOT which says that Princes Freeway west is a ‘managed motorway’, but it is not. Neither does it have express lanes with barriers.
- The graph actually demonstrates that VicRoads has just one ‘managed motorway’ (Monash); and 6 largely unmanaged motorway with higher crash rates.
- Auckland ramp metering before & after study – 34% reduction in crashes outbound, 17% inbound - on both Southern Motorway and Northwestern Motorway.
Ramp metering

- Ramp metering algorithms are usually set so that the throughput of a motorway is maximised while avoiding flow breakdown.
- This means that the critical sections of a managed motorway are operated at LOS E.
- Most ramp metering algorithms would ensure signals would commence operation at close to LOS D conditions.
Alternative Design micro-simulation

I reviewed SmedTech’s model of the Alternative Design on 13 August. It showed:

• LOS D achieved north of Watsonia (after adjusting for using the Reference Design layout at Grimshaw Street)

• Congestion at the Watsonia Road/Greensborough Road intersection – but the new road crossing the NEL and the railway with the bus interchange was not incorporated in the model. That inclusion, with minor modification of the Watsonia Road/Greensborough Road intersection, would achieve LOS D
Alternative Design micro-simulation (cont.)

• LOS D achieved east of Bulleen Road except for some minor flow breakdown near two locations – which could be fixed by more accurate modelling, or a minor design changes
• Congestion at the Bulleen Road off-ramp – fixable by signal retiming and possible minor change to lane allocations on the off-ramp
• Congestion on the Thompsons Road on-ramp – as the modellers were not permitted to reduce the cycle time at the ramp meter from 6 s to 5.5 s – which would have eliminated the congestion
• With minor modelling or design changes, the Alternative Design would have operated at LOS D
• The modellers expressed confidence that the Alternative Design was suitable with some minor ‘tweaks’
The briefing headed ‘Eastern Freeway performance and bottlenecks - eastbound pm period’ expresses opinions about the Alternative Design which were provided 19 August 2019

• It should be noted that the briefing describes the current poor performance eastbound as a direct result of VicRoads treatment of this freeway as an ‘un-managed motorway’ that is consistent with the observations I make in my report (items 1, 2 and 3 describe the current situation)

• In item 4, the author asserts that the Alternative Design does not adequately address the bottleneck locations

• none of the authors of the briefing note were present when we observed the micro-simulation at GHD on Aug 13
• The micro-simulation of the Alternative Design demonstrates that his concerns for my Alternative Design are shown not to exist. This is also true in relation to the concerns shown in items 5 and 6.
Content of EES generally
EES

Inadequacy of EES Materials:

- Micro-simulation model extents far too restricted
- The micro-simulation modelling reports made it very difficult to critically examine them, due to missing data
- Reference Design was at a scale of 1:3200 and incapable of being interpreted and tested
- Detail plans and long-sections finally provided on 7 Aug 2019 after my Alternative Design and report were completed
Inadequacy of Micro-simulation model extents

- The micro-simulation modelling needs to incorporate ALL adjacent critical intersections to be able to assess the true effects and extent of effects, of the Project—i.e. typically major signalised intersections
- Many of the critical intersections near the Eastern Freeway are already congested, and the Project adds significant additional traffic to them,
- Consequently possible Project impacts on congestion, air quality, and noise are not accounted for
- Along the Eastern Freeway, critical intersections that needed to be incorporated are: Springvale Road/Springfield Road, Blackburn Road/Springfield Road, Middleborough Road/Springfield Road, Chandler Highway/Heidelberg Road, Kew Junction, and of course Hoddle Street
- Impacts of Melba tunnels – how to control eastbound demand into the tunnel?
Potential modelling risks

• The micro-simulation modelling is unrealistic and gives a incomplete set of outcomes which wrongly imply that there are no problems when it is highly likely that there are problems – or problems, or effects of the Project which have not been assessed

• OBT SIDRA modelling of the intersections on Springfield Road, using publicly available data and model outputs, show demands far exceeding capacities, with queues likely to extend back to, or near, the Eastern Freeway

• The SIDRA modelling was criticised by GTA (conclave),

• GTA subsequently provided a spreadsheet that just incorporated a complexity of modelling information – which did not address the issue, or justify the criticism.
An example - Hoddle Street & Chandler Highway

• along the Eastern Freeway, the AM peak queues typically extend to the Yarra River, and the ability to service those queues will not change;
• if the arrival rates at the back of the queue increase, then the queue will grow until the peak period ends (i.e. when demand decreases)
• arrival rates are predicted to increase by 1900-2000 vph over 2 hours
• the current rolling queue will grow – about 1 km for every 250 vph arriving
• Chandler Highway exit – increase of 500-700 vph onto a currently congested off-ramp
• queueing from Chandler Highway plus Hoddle Street will grow by 1 km every 5-6 minutes – quickly extending back to the NEL ramp, that will also start to queue.
Traffic queues from Kew Junction back to near Burke Road (29/7) – denied by Kiriakidis in the conclave “JK expressed a view that queues back from that node do not interfere with the Chandler Highway interchange” (conclave)
Hoddle Street & Chandler Highway

VicTraffic July 31 7:54 am

VicTraffic August 20 8:09 am
Eastern Freeway queues allegedly extending to Burke Road

- Item 4 of internal briefing sets out what data is available, and also the data is free of charge upon request.

- On 8 April I emailed John Gaffney, one of the lead authors of the motorway design guide (December 2017), who I know both professionally and socially “John, are you able to provide me with existing peak hour and/or daily flows by segment along the Eastern Freeway from Hoddle to Ringwood? We are doing some work for the impacted Councils”, but received no response.

- I have now reviewed the data presented in the note provided on 19 August. The data is consistent with the observations in my report. The is regularly a queue from Hoddle Street, back to and beyond the Yarra River, approaching and sometimes reaching the Chandler Highway. From the Chandler Highway easterly, there is regularly a queue in the left lane approaching the off-ramp that extends to and beyond Burke Road. I accept that the queues rarely join at present, but I expect that, as volumes on the Eastern Freeway increase, the queues will join as explained in my report.
Springvale Road

• While many roads in the northeast will receive a reduction on traffic, there will be very large increases in traffic demand between Springvale Road and the Eastern Freeway.

• The micro-simulation model shows huge increases in traffic between Springvale Road and Eastern Freeway to/from the west.

• It also shows little increase in traffic north & south of Eastern Freeway.

• Reason – ‘traffic evaporation’ - large decrease in traffic crossing the Eastern Freeway in Springvale Road.
Springvale Road

Eastern Freeway west facing ramps at Springvale Road

Source:
2019 existing - SCATS data (March 2019)
2036 Project Case Off ramp - reported in Appendix E of TTIA
2036 Project Case On ramp - derived from Appendix of TTIA
Springvale Road

Existing Observed AM Peak Volumes

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<th>EASTERN FREeway WEST Facing Ramps</th>
<th>SPRINGVALE ROAD</th>
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Estimated 2036 Project Case AM Peak Volumes

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<td>2110</td>
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<tr>
<td>330</td>
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Evaporation of 290 vph

Source:
2019 existing - SCATS data (March 2019)

Source:
Approach volumes provided in TTIA distributed through the intersection using 2019 SCATS observed counts
Springvale Road

Existing Observed PM Peak Volumes

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<td>1210</td>
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Project Case PM Peak Volumes

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<tr>
<td>1560</td>
<td>150</td>
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<tr>
<td>2610 (+300)</td>
<td>2780 (+880)</td>
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Source: 2019 existing - SCATS data (March 2019)

Evaporation of 240 vph

Approach volumes provided in TTIA distributed through the intersection using 2019 SCATS observed counts

Source: 2019 observed SCATS data (March 2019)
The difference in flow rate at LOS D and LOS E is about 400 vph.

A 4-lane freeway carriageway at LOS E, would be the equivalent of a 5-lane carriageway at LOS D.

If a freeway was designed for LOS D, then, in the peak, the peak period would shorten and the freeway would operate at LOS E – ‘peak spreading’ would change to ‘peak shortening’.

Micro-simulation shows Alternative Design achieves LOS D anyway.
Reference Design & Level of Service D

It is virtually impossible to restrict the operation of a freeway to LOS D if it is operating in a major urban area unless:

- Access to the freeway is effectively prevented – either by on-ramp controls, or the inability to get access to the interchanges
- The freeway is so far over-designed – at least relative to access to it.

The typical outcome is that users will access the freeway to the level of creating congestion – unless motorway management (ramp metering) is in place, and which would keep critical sections of the freeway operating at LOS E.

In my written report I stated that I did not consider it appropriate to try to design to LOS D in the peaks. I stand by my reasons for that opinion, though I note that the Alternative Design can achieve LOS D.
Conclusions

• The projected traffic on the Eastern Freeway and NEL cannot access the facilities, and the modelling is extremely flawed
• The Reference Design is a waste of resources due to its over-design and associated excessive cost
• The Alternative Design can perform at LOS D with very minor adjustments
• The Alternative Design has far lower impacts north of Grimshaw Street, around Bulleen Road, and to the east of Bulleen Road