Flemington Road – Review of Options

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1. Introduction

As part of the Citylink Tulla Widening: Bulla Road to Power Street project, there is a requirement to modify the existing Flemington Road exit ramp to cater for the future demands on the road network. This includes providing additional lanes on the exit ramp and creating additional storage for vehicles exiting the Toll Road prior to connecting to the local road network, without causing traffic to queue back onto the motorway.

As a result of the increased number of lanes on the exit ramp, modifications to the existing intersection are required. The current proposed road design requires the removal of an existing island and trees to provide sufficient space for a safe intersection to meet the requirements outlined above.

CPB Contractors have been requested to provide a review of four Options for the intersection as a solution to retaining a number of the Lemon Scented Gum trees that currently stand on the traffic island near the intersection of Flemington Road and Church Street North Melbourne.

This Options Report will summarise the engineering attributes of the four Options for consideration in determining the preferred intersection arrangement.

In general terms the key features of each option are:

Option Number	**Key Features**
Option 1	Modify kerbs to move closer to the gum trees to provide room for the required number of lanes at the Church Street Intersection. This has a risk of damage to the roots of the trees. The resulting approach geometry will provide higher probability of vehicular conflict. Pedestrian connectivity from north to south across Flemington Road is not equivalent to existing conditions. Existing bike lanes will be retained.
Option 2	Modify kerbs on northern edge of Flemington Road to provide room for the required number of lanes at the Church Street Intersection. This will require extensive utility service relocation in the northern footpath immediately adjacent to existing residences but reduces the risk of damage to the tree roots. The approach geometry of Option 1 remains with a higher probability of vehicular conflict. Pedestrian connectivity from north to south across Flemington Road is not equivalent to existing conditions. Existing bike lanes will be retained.
Option 3	Similar to Option 2, but with additional length of painted lane separation approaching the island as a road safety improvement. Again, this will require extensive utility service relocation in the northern footpath immediately adjacent to existing residences and reduces the risk of damage to the tree roots. The approach geometry is improved but a high probability of vehicular conflict remains. Pedestrian connectivity from north to south across Flemington Road is not equivalent to existing conditions. Existing bike lanes will be retained.
Option 4	Similar to Option 3, but with an additional footpath provided around the tram stop on the north bound carriageway to provide improvement to pedestrian connectivity. It will require extensive utility service relocation in the northern footpath immediately adjacent to existing residences and it will reduce the risk of damage to the tree roots. The approach geometry is improved but a high probability of vehicular conflict remains. Existing bike lanes will be retained.

2. Context

The four Options are considered in detail later in this report. There are commonalities between the Options as each option requires various compromises in terms of damage to tree roots, utility service and traffic disruption during construction, pedestrian connectivity and road geometry including lane widths and vehicle path conflicts for larger vehicles and bicycles.

All options are required to have the following functional requirements:

- Five lanes connecting from the Flemington Road Exit Ramp to Flemington Road city bound
- Retain the existing traffic island and the large lemon scented gum tree closest to Church Street
- On-road city bound bike lane
- Retain the existing rail and tram infrastructure
- Provide two lanes for Elizabeth Street traffic and the Flemington Road service Road to the left of the trees and Peel Street to the right of the trees.

Some of the issues at the intersection listed below that need to be considered for the Options are:

(a) Existing rail and tram infrastructure, most notably the Upfield Rail bridge and the tram stop
(b) Intersection design requirements from Austroads Guide to Road Design and associated VicRoads Supplements with regards to:
  i. Approach and compound geometries
  ii. Safe passage for cyclists
  iii. Reduced speed limits
  iv. Road Safety
(c) Pedestrian connectivity between the north and south sides of Flemington Road
(d) Utility service relocations adjacent to existing residences on the northern side of Flemington Road.

(a) Existing rail and tram infrastructure

The existing pier of the Shared User Path Bridge limits options for increasing lane widths and introducing buffer zones between lanes to improve safety on approach to the traffic island surrounding the Lemon Scented Gums.

The bridge pier is as close to the existing carriageway as possible and therefore constrains any horizontal realignment to the north at this location.

(b) Intersection design requirements

i. Approach and compound geometries
- The proposed arrangement will require the use of a horizontal curve of approximate radius 110m for the lane closest to the tram stop, which is less than the desirable minimum radius of 165m for 3% cross falls in AGRD Part 3 Figure 7.7.
- Vehicle tracking for the turning movement onto Flemington Road will be impacted. The clearance between turning vehicles will be reduced, in particular for the three northern turning lanes. A vehicle clearance of less than 0.3m will be provided for a 3 x 19m semi-trailer configuration, and a vehicle clearance of less than 0.8m will be provided for 19m semi/car/19m semi configuration.
- Due to the 2/3 lane split either side of the median island, the approach geometry will present potential vehicle confusion and risk of side to side clashes – particularly between vehicles in the middle lane and the lane immediately right of middle.

ii. Safe passage for cyclists
- As a result of the reduced clearance between concurrent turning vehicles a safety risk will be created of vehicles colliding or cyclists getting 'squeezed'.

iii. Reduced speed limits
- Due to the reduction in the radius, the intersection is only suitable for a speed limit of 53km/h

iv. Road Safety
- Retention of the existing trees presents a road safety hazard.
- Pedestrian pathway widths are reduced from 2.5m to 1.74m along the northern side of Flemington Road thus compromising pedestrian safety.
- Medium to long term pavement ride-ability and subsequent performance deterioration will occur in the pavement adjacent to the Lemon Scented Gums due to shallow roots underlying pavement.

(c) Pedestrian Connectivity

From site observation there is a current road safety issue with the existing arrangement. Pedestrians generated from the Lennon Street connection are crossing over the exit ramp straight to the back of the tram stop rather than using the lights at Church Street.

- The 'desire line' from pedestrians originating at Lennon Street appears to be the tram stop and the crossing for Boundary Road. Due to the presence of the existing island, there is clear evidence that pedestrians are crossing the existing exit ramp in an unsafe manner rather than using the signalised crossing at Church Street. Fencing arrangements within the Options should aim to address this issue by corralling pedestrians to the signalised crossing, or making use of the existing grade separated Shared User Path to the west of the Upfield Rail Bridge.
- A footpath connection from the south side of Flemington Road is provided in Option 4. This requires the following south side works:
    - New lane line marking (requires milling and resurfacing)
    - New kerb works on south side of outbound tram stop so as to provide an adjacent pedestrian footway
    - Minor modification to tram stop to provide sufficient footway width.
    - Pedestrian safety fence adjacent to roadway.
- The provision of the new footpath behind the tram stop does not appear to be a satisfactory solution. The pedestrian path will be immediately adjacent to traffic lanes. The utilisation of the footpath alongside the tram stop is expected to be low based on pedestrians being stuck between a fence and the back of the platform.
- Impacts on the tram stop may be more difficult in terms of approval for utilising the platform as the pedestrian route and renegotiating non-standard arrangements with Yarra Trams.

(d) Utility Service Relocations – North Side Flemington Road

- In order to provide adequate road pavement width the footpath width on the northern side of Flemington Road adjacent to existing residences will have to be reduced.
- The footpath width on the north side is already restricted to approximately 2.5 metres and feels less than that on site. The proposed road geometry arrangement will reduce the footpath width to 1.74m from back of kerb to fence line.
- Reduction of the footpath width will possibly require a further reduction of footpath width where a section of pedestrian safety fence would to need to be provided.
- Existing services located adjacent to the northern kerb line will be affected by the proposed road pavement widening. This is a highly complex issue and all of the services will require consideration. Existing services along the northern side of Flemington Road, adjacent to existing residences and primarily in the footpath include:
    - LV and HV power
    - VESI street lighting
    - Telstra
    - Water services
    - Victrack fibre
    - Yarra Trams power and communications
    - Relocation of existing light poles will be required and may potentially clash with existing water main and Telstra services.
- Sub Soil Drains when relocated in conjunction with new kerb lines may clash with Telstra and Water services currently installed in footpaths.
- The Services in footpaths are in close proximity to residences and will require road lane closures to provide access for construction. There will be substantial elements of this work that will need to be done at night and will cause considerable additional disruption and inconvenience to local residents and through traffic for a period of four to six months.

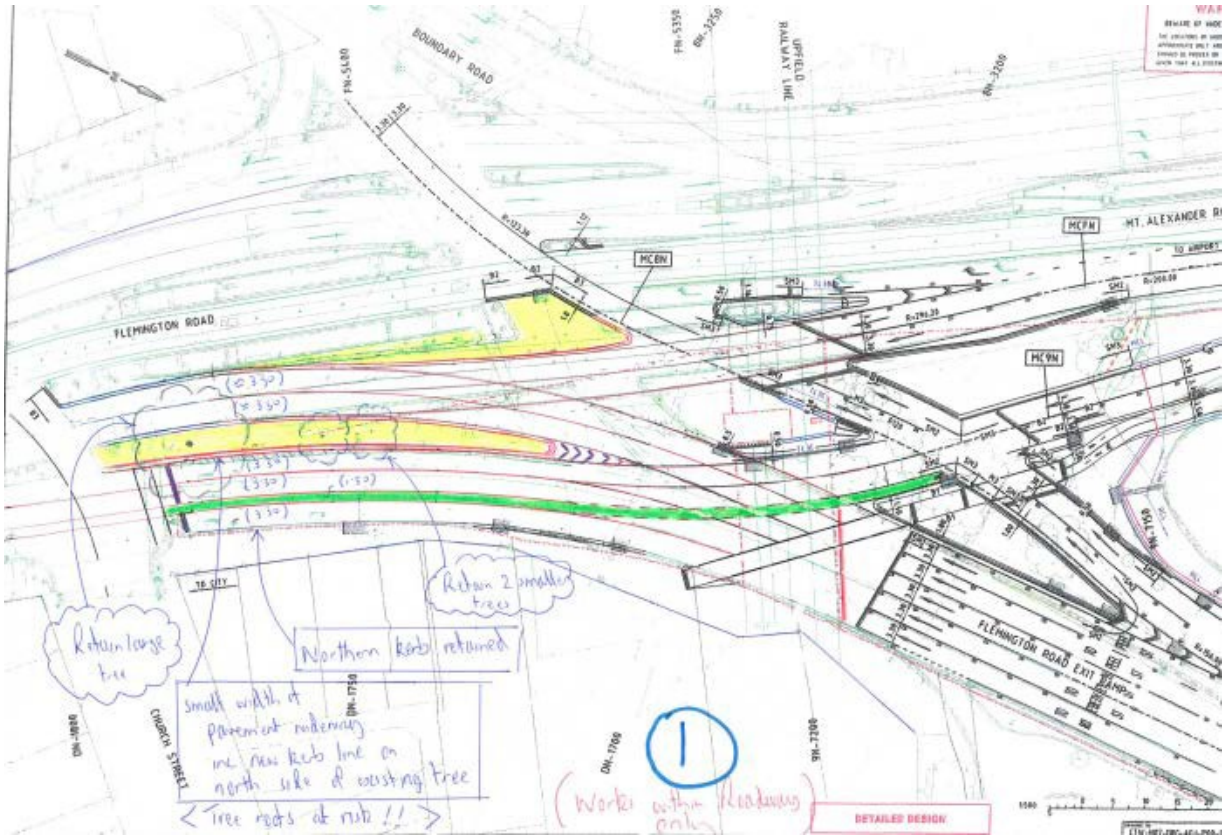
3. Option Assessment

Common Elements Table

There are a number of common items between the options and the following table covers those commonalities. The same format has been included assessing each option so that the option specific issues can be easily identified

Common Elements: Commentary	
Description	Refer to Option specific description in Section 3.1 to 3.4
Benefits	1. Retains the large tree, and potentially the nearest 2 small trees 2. Provides the required functionality with a minimum of 3.3m lanes
Detriments	1. Requires the removal of 2 or more trees 2. Requires a Radius of 110m for the lane closest to the tram stop which is below the 165m required for 60km/h (at 3% crossfall). R110 is suitable for 53km/h based on Austroads Guide to Road Design Part 3 Figure 7.7 3. Requires the use of compound horizontal curves leaving the exit ramp 4. Pedestrian pathway widths reduced compromising pedestrian safety 5. Bicycle safety compromised by reduced lane widths and squeezing the space for turning vehicles 6. Medium to long term pavement ride-ability and performance deterioration of the pavement over the Lemon Scented Gum roots and adjacent areas. 7. Retains the existing tree in the middle of a carriageway which presents a road safety hazard 8. Due to continued presence of the island around tree promotes undesirable pedestrian behaviours crossing the road away from controlled crossing point. 9. Flow widths over pavement may increase with compromises in drainage geometry. 10. Deficiency in approach lane definition
Potential Non-Conformances	1. Reduction in the design speed for the intersection from 60km/h to 50km/h 2. Expected relaxation required for ride quality and vehicle stability for Peel Street bound traffic due to retaining the existing kerb line 3. Vehicle tracking of adjacent 19m semi's doesn't meet the desirable 1m body separation (minimum of 295mm achieved) based on Austroads Guide to Road Design Part 4A Figure 7.3
Risks	1. Any fencing and guardrail installed to protect the trees may damage the tree roots. 2. Roadside hazard is retained 3. Unfamiliar road environment for drivers exiting a freeway 4. Pedestrian behaviours 5. Speed in intersection 6. Approach lane definition causing potential vehicle confusion. 7. Use of compound geometry is a risk to safe vehicle tracking within the lanes, particularly given the relatively narrow lane widths.

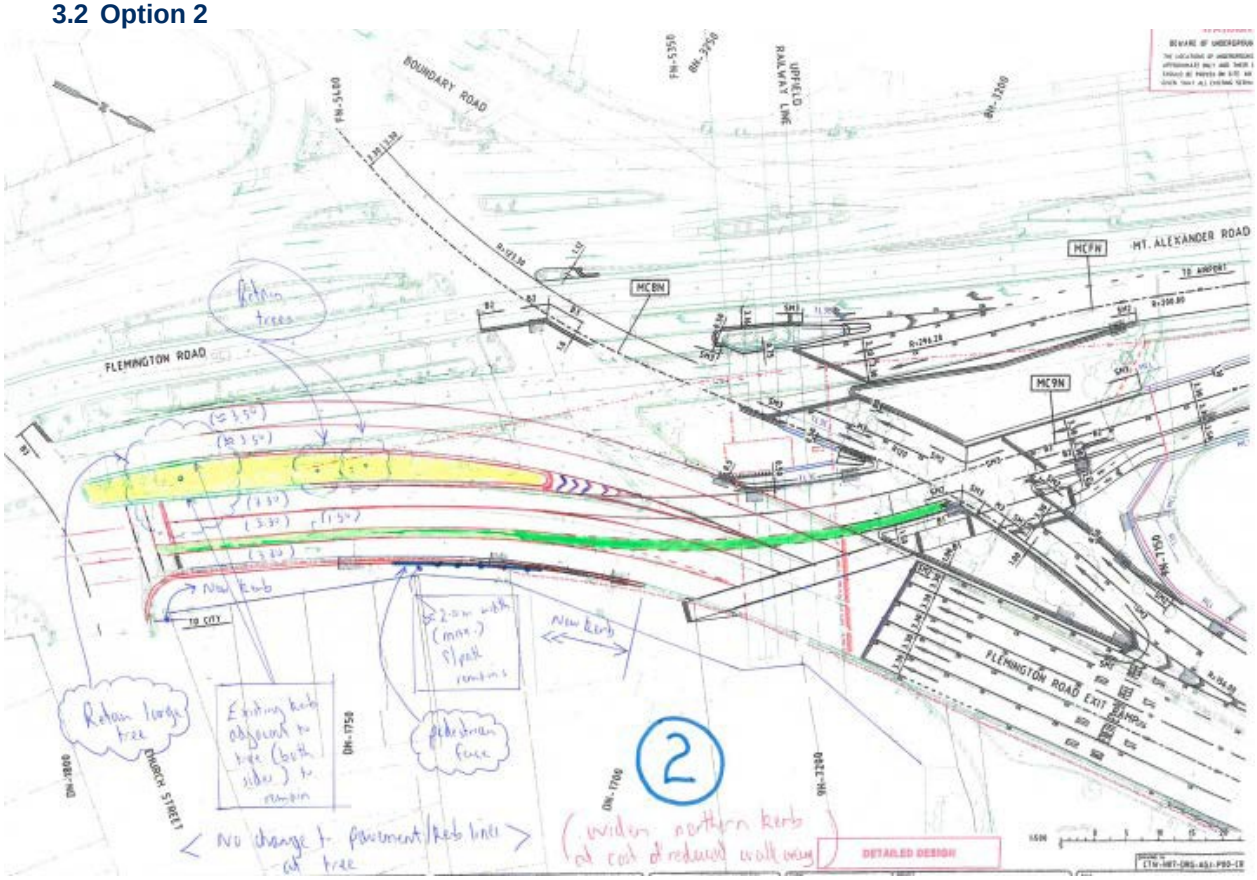
3.1 Option 1



Option 1: Commentary	
Description	To provide the required width for 3 lanes, plus the bike lane to the north of the tree, the existing kerb alongside the tree is proposed to be realigned. This retains the existing northern kerb line.
Benefits	1. Retains the large tree, and potentially the nearest 2 small trees 2. Provides the required functionality with a minimum of 3.3m lanes Retains the existing northern footpath width (approx. 2.5m min) 3. Allows existing utilities in the northern footpath to be retained
Detriments	1. Requires the removal of 2 or more trees 2. Requires a Radius of 110m for the lane closest to the tram stop which is below the 165m required for 60km/h (at 3% crossfall). R110 is suitable for 53km/h based on Austroads Guide to Road Design Part 3 Figure 7.7 3. Requires the use of compound horizontal curves leaving the exit ramp 4. Bicycle safety compromised by reduced lane widths and squeezing the space for turning vehicles 5. Medium to long term pavement ride-ability and performance deterioration of the pavement over the Lemon Scented Gum roots and adjacent areas. 6. Retains the existing tree in the middle of a carriageway which presents a road safety hazard 7. Due to continued presence of the island around tree promotes undesirable pedestrian behaviours crossing the road away from controlled crossing point. 8. Flow widths over pavement may increase with compromises in drainage geometry. 9. Deficiency in approach lane definition

	10. Requires kerb realignment adjacent to the large tree which may cause damage to the tree roots during any construction
Potential Non-Conformances	1. Reduction in the design speed for the intersection from 60km/h to 50km/h 2. Expected relaxation required for ride quality and vehicle stability for Peel Street bound traffic due to retaining the existing kerb line 3. Vehicle tracking of adjacent 19m semi's doesn't meet the desirable 1m body separation (minimum of 295mm achieved) based on Austroads Guide to Road Design Part 4A Figure 7.3
Risks	1. Roadside hazard is retained 2. Unfamiliar road environment for drivers exiting a freeway 3. Pedestrian behaviours 4. Speed in intersection 5. Approach lane definition causing potential vehicle confusion. 6. Use of compound geometry is a risk to safe vehicle tracking within the lanes, particularly given the relatively narrow lane widths. 7. Works may cause damage to the tree roots and negate the desire to retain the tree 8. Pedestrian movements north to south requires use of the tram platforms

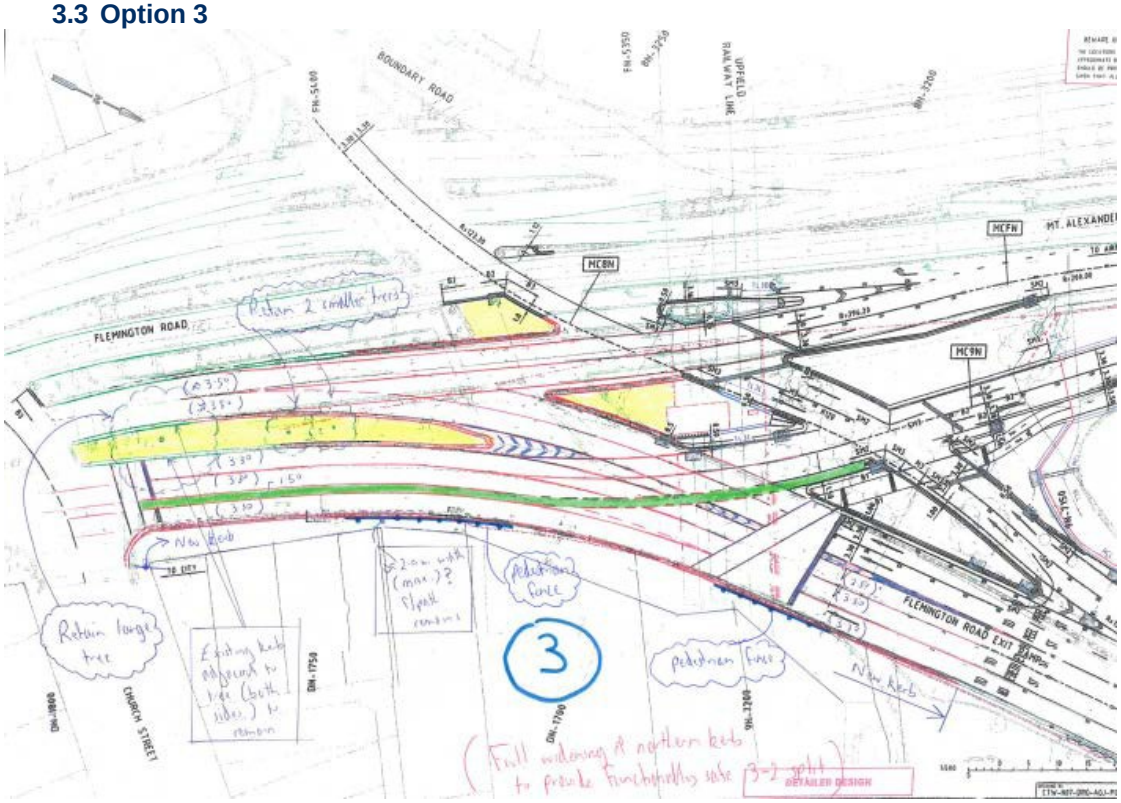
3.2 Option 2



Option 2: Commentary	
Description	To provide the required width for 3 lanes, plus the bike lane to the north of the tree, the existing northern kerb line is proposed to be realigned.
Benefits	1. Retains the large tree, and potentially the nearest 2 small trees 2. Provides the required functionality with a minimum of 3.3m lanes 3. Retains the kerbs alongside the large tree and reduces risk of root damage as part of the works.
Detriments	1. Requires the removal of 2 or more trees 2. Requires a Radius of 110m for the lane closest to the tram stop which is below the 165m required for 60km/h (at 3% crossfall). R110 is suitable for 53km/h based on Austroads Guide to Road Design Part 3 Figure 7.7 3. Requires the use of compound horizontal curves leaving the exit ramp 4. Pedestrian pathway widths reduced compromising pedestrian safety 5. Bicycle safety compromised by reduced lane widths and squeezing the space for turning vehicles 6. Medium to long term pavement ride-ability and performance deterioration of the pavement over the Lemon Scented Gum roots and adjacent areas. 7. Retains the existing tree in the middle of a carriageway which presents a road safety hazard 8. Due to continued presence of the island around tree promotes undesirable pedestrian behaviours crossing the road away from controlled crossing point. 9. Flow widths over pavement may increase with compromises in drainage geometry. 10. Deficiency in approach lane definition 11. Requires kerb realignment on northern edge of Flemington Road and will require significant utilities relocation

Potential Non-Conformances	1. Reduction in the design speed for the intersection from 60km/h to 50km/h 2. Expected relaxation required for ride quality and vehicle stability for Peel Street bound traffic due to retaining the existing kerb line 3. Vehicle tracking of adjacent 19m semi's doesn't meet the desirable 1m body separation (minimum of 295mm achieved) based on Austroads Guide to Road Design Part 4A Figure 7.3Northern footpath width reduced to 1.74m minimum from the existing 2.5m (kerb to property boundary) 4. Increased height of kerb required to suit extension of cross fall due to widening and match existing footpath
Risks	1. Roadside hazard is retained 2. Unfamiliar road environment for drivers exiting a freeway 3. Pedestrian behaviours 4. Speed in intersection 5. Approach lane definition causing potential vehicle confusion. 6. Use of compound geometry is a risk to safe vehicle tracking within the lanes, particularly given the relatively narrow lane widths. 7. Reduction in the design speed for the intersection from 60km/h to 50km/h 8. Expected relaxation required for ride quality and vehicle stability for Peel Street bound traffic due to retaining the existing kerb line 9. Works may cause damage to the utility services located in the northern footpath 10. Pedestrian movements north to south requires use of the tram platforms 11. The Utility Services works in the northern footpath area will require night work and disruption to the area for a period of four to six months.

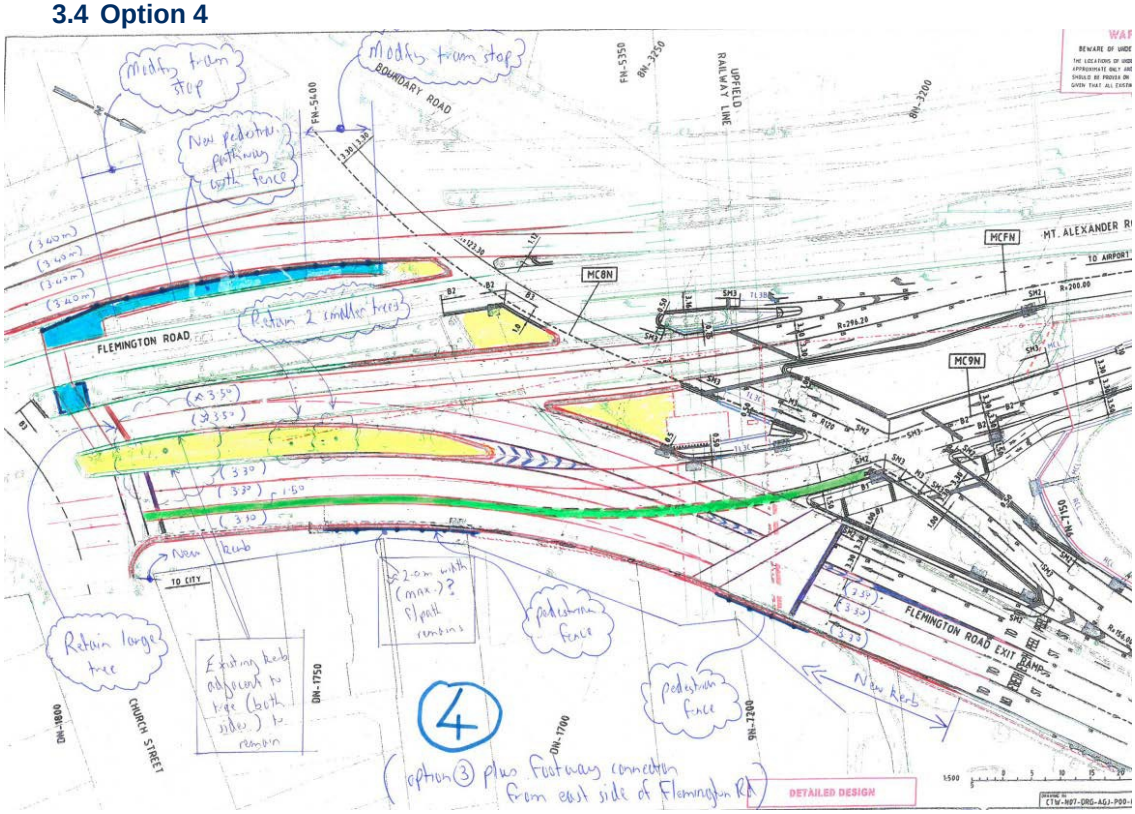
3.3 Option 3



Option 3: Commentary	
Description	To provide the required width for 3 lanes, plus the bike lane to the north of the tree, the existing northern kerb line is proposed to be realigned. In addition, a painted "splitter" island is provided on the approach to the intersection where lanes are locally reduced to 3.2m to provide the splitter.
Benefits	1. Retains the large tree, and potentially the nearest 2 small trees 2. Provides the required functionality with a minimum of 3.3m lanes 3. Retains the kerbs alongside the large tree and reduces risk of root damage as part of the works. 4. Provides painted lane separation on the approach to traffic island to improve intersection safety
Detriments	1. Requires the removal of 2 or more trees 2. Requires a Radius of 110m for the lane closest to the tram stop which is below the 165m required for 60km/h (at 3% crossfall). R110 is suitable for 53km/h based on Austroads Guide to Road Design Part 3 Figure 7.7 3. Requires the use of compound horizontal curves leaving the exit ramp 4. Pedestrian pathway widths reduced compromising pedestrian safety 5. Bicycle safety compromised by reduced lane widths and squeezing the space for turning vehicles 6. Medium to long term pavement ride-ability and performance deterioration of the pavement over the Lemon Scented Gum roots and adjacent areas. 7. Retains the existing tree in the middle of a carriageway which presents a road safety hazard 8. Due to continued presence of the island around tree promotes undesirable pedestrian behaviours crossing the road away from controlled crossing point. 9. Flow widths over pavement may increase with compromises in drainage geometry.

	10. Deficiency in approach lane definition 11. Requires kerb realignment on northern edge of Flemington Road and will require significant utilities relocation 12. Requires localised reduction of traffic lane width to 3.2m at the stop line to provide the painted separation to retain existing bridge piers
Potential Non-Conformances	1. Reduction in the design speed for the intersection from 60km/h to 50km/h 2. Expected relaxation required for ride quality and vehicle stability for Peel Street bound traffic due to retaining the existing kerb line 3. Vehicle tracking of adjacent 19m semi's doesn't meet the desirable 1m body separation (minimum of 295mm achieved) based on Austroads Guide to Road Design Part 4A Figure 7.3 4. Northern footpath width reduced to 1.74m from the existing 2.5m (kerb to property boundary) 5. Increased height of kerb required to suit extension of cross fall due to widening and match existing footpath
Risks	1. Roadside hazard is retained 2. Unfamiliar road environment for drivers exiting a freeway 3. Pedestrian behaviours 4. Speed in intersection 5. Approach lane definition causing potential vehicle confusion. 6. Use of compound geometry is a risk to safe vehicle tracking within the lanes, particularly given the relatively narrow lane widths. 7. Works may cause damage to the utility services located in the northern footpath 8. Pedestrian movements north to south requires use of the tram platforms 9. The Utility Services works in the northern footpath area will require night work and disruption to the area for a period of four to six months.

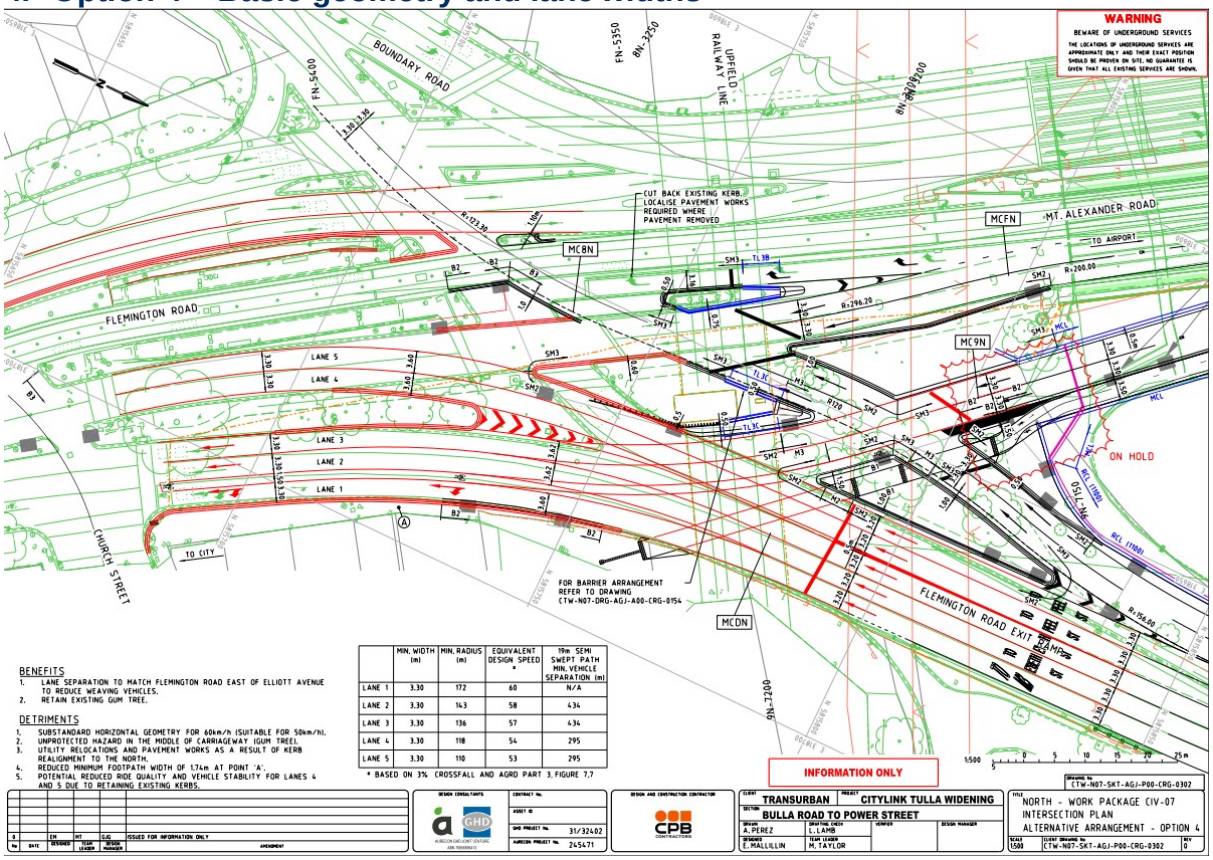
3.4 Option 4



Option 4: Commentary	
Description	To provide the required width for 3 lanes, plus the bike lane to the north of the tree, the existing northern kerb line is proposed to be realigned. In addition, a painted “splitter” island is provided on the approach to the intersection where lanes are locally reduced to 3.2m at the stop line to provide the painted splitter island. A new pedestrian path is provided around the out bound tram platform to replace the Shared User Path connection that exists beside the large tree.
Benefits	1. Retains the large tree, and potentially the nearest 2 small trees 2. Provides the required functionality with a minimum of 3.3m lanes 3. Retains the kerbs alongside the large tree and reduces risk of root damage as part of the works. 4. Provides painted chevron lane separation on approach to traffic island to improve intersection safety 5. Provides separated 2m pedestrian footpath in addition to the tram platforms 6. Retains the existing Church Street intersection
Detriments	1. Requires the removal of 2 or more trees 2. Requires a Radius of 110m for the lane closest to the tram stop which is below the 165m required for 60km/h (at 3% crossfall). R110 is suitable for 53km/h based on Austroads Guide to Road Design Part 3 Figure 7.7 3. Requires the use of compound horizontal curves leaving the exit ramp 4. Pedestrian pathway widths reduced compromising pedestrian safety 5. Bicycle safety compromised by reduced lane widths and squeezing the space for turning vehicles 6. Medium to long term pavement ride-ability and performance deterioration of the pavement over the Lemon Scented Gum roots and adjacent areas. 7. Retains the existing tree in the middle of a carriageway which presents

	a road safety hazard 8. Due to continued presence of the island around tree promotes undesirable pedestrian behaviours crossing the road away from controlled crossing point. 9. Flow widths over pavement may increase with compromises in drainage geometry. 10. Deficiency in approach lane definition will present potential vehicle confusion and risk of side to side clashes. 11. Requires kerb realignment on northern edge of Flemington Road and will require significant utilities relocation adjacent to existing residences. 12. Requires localised reduction of traffic lane width to 3.2m at the stop line to provide the painted lane separation to retain existing bridge piers 13. Requires modification to the existing tram stop to provide 2m footpath 14. Creates additional traffic impacts with a new work zone and additional pavement works on the north bound carriageway of Flemington Rd
Potential Non-Conformances	1. Reduction in the design speed for the intersection from 60km/h to 50km/h 2. Expected relaxation required for ride quality and vehicle stability for Peel Street bound traffic due to retaining the existing kerb line 3. Vehicle tracking of adjacent 19m semi's doesn't meet the desirable 1m body separation (minimum of 295mm achieved) based on Austroads Guide to Road Design Part 4A Figure 7.3 4. Northern footpath width reduced to 1.74m from the existing 2.5m (kerb to property boundary) 5. Increased height of kerb required to suit extension of cross fall due to widening and match existing footpath
Risks	1. Roadside hazard is retained 2. Unfamiliar road environment for drivers exiting a freeway 3. Bicycle safety risk increased due to narrowed lanes. 4. Pedestrian behaviours 5. Speed in intersection 6. Approach lane definition causing potential vehicle confusion and risk of side to side clashes. 7. Use of compound geometry is a risk to safe vehicle tracking within the lanes, particularly given the relatively narrow lane widths. 8. Works may cause damage to the utility services located in the northern footpath 9. Pedestrian movements north to south requires use of the tram platforms 10. The Utility Services works in the northern footpath area will require night work and disruption to the area for a period of four to six months.

4. Option 4 – Basic geometry and lane widths



	MIN. WIDTH (m)	MIN. RADIUS (m)	EQUIVALENT DESIGN SPEED *	19m SEMI SWEPT PATH MIN. VEHICLE SEPARATION (m)
LANE 1	3.30	172	60	N/A
LANE 2	3.30	143	58	434
LANE 3	3.30	136	57	434
LANE 4	3.30	118	54	295
LANE 5	3.30	110	53	295

5. Current Design