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## **VicRoads**

### **Report for Hoddle Street Preliminary Traffic Advice**

#### **High Level Options Assessment**

September 2008



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# 1. Introduction

In early 2007, the State Government appointed a Study Team led by Sir Rod Eddington to undertake a review of the transport solutions for connecting Melbourne's eastern and western suburbs. In his report dated March 2008, Sir Rod made a number of recommendations considering road, public transport and freight options. Included in the recommendations was a cross-city road connection (East West Link) extending between the Eastern Freeway and the western suburbs.

The recommendation has not provided any direct connections from the proposed East West Link to the Central Business District. The EWLNAS identified that the reason for this is to avoid adding to the current congestion problems on existing north-south roads (such as Nicholson Street and Smith Street), to avoid the impact of queuing within the tunnel, to maximise the use of the tunnel for cross-city travel and to support any strategy of encouraging travel to the CBD to occur by public transport.

The forecast traffic volumes (produced by Veitch Lister Consulting (VLC) Zenith travel forecasting model) indicate that volumes along the Eastern Freeway just east of Hoddle Street are of the order of 190,000 vehicles per day (in 2031), with approximately 40% of these vehicles predicted to continue to/from the East West Link. It would be expected that the remaining 60% of the traffic would be accessing the Eastern Freeway to/from Hoddle Street and Alexandra Parade. Therefore, the current congestion issues, particularly on Hoddle Street, will not be resolved by the recommendations outlined in the EWLNAS.

GHD Pty Ltd (GHD) has been engaged to undertake a high-level review of the potential short, medium and long-term options available for reducing congestion on Hoddle Street. Currently, the road is used as the major north-south arterial connecting the Eastern Freeway to the inner east and the CBD. High volumes of traffic, particularly travelling to/from the Eastern Freeway, are causing congestion and delays on Hoddle Street, with long travel times throughout the day, particularly during peak periods.

The scope of this report is as follows:

- ▶ Review existing conditions along Hoddle Street;
- ▶ Identify potential short-term improvements;
- ▶ Identify potential medium-term improvements
- ▶ Identify potential long-term improvements;
- ▶ Discuss the benefits and impacts of each of the options;
- ▶ Discuss the design and construction issues relating to the long-term improvements;
- ▶ Make recommendations as to the actions required to further investigate the options and provide approximate costs; and
- ▶ Recommend the next steps required to progress with the planning of the options.



## 2. Understanding the Project

Hoddle Street is a major north-south corridor providing connections to the CBD and inner east. It is subject to high demand and in addition to being the arterial feeder road to Eastern Freeway (with Alexandra Parade) it has a number of east-west arterial road connections intersecting with Hoddle Street including:

- ▶ Johnston Street;
- ▶ Victoria Parade/Victoria Street;
- ▶ Wellington Parade/Bridge Road; and
- ▶ Swan Street/Olympic Boulevard.

Consequently, there is significant congestion, queuing and travel time delays along the route during the peak periods that impacts commuter travel and decreases the reliability of Hoddle Street. In addition, the demand for the route during off peak periods to provide connections to major traffic generators, such as the Melbourne Sporting Arena Precinct (MCG, Rod Laver Arena and Olympic Park), means congestion issues can be present at other times.

This report will identify a broad range of options available for the short and long term relief of congestion on Hoddle Street. The possible issues and benefits associated with each of these options will be discussed at a high level based on the information available. It is important to note that it is not possible to quantify the benefits of these treatments without support from further detailed analysis. Recommendations will be made as to which options GHD understands should be further investigated, and the details of the investigation required to reach a firm conclusion on the viability of the options will be identified.

The option of 'do nothing' is not included as part of this study as the impacts of doing nothing would result in the following:

- ▶ Congestion would increase along the route, increasing travel time delays and queues and travel time reliability would decrease;
- ▶ Public transport delays would increase countering priority initiatives being implemented and discouraging commuter mode change from cars;
- ▶ Local amenity would worsen; and
- ▶ Alternate 'rat-run' routes may become more attractive.

With traffic congestion currently costing this state approximately \$2 billion a year any positive measures to reduce congestion should be considered.

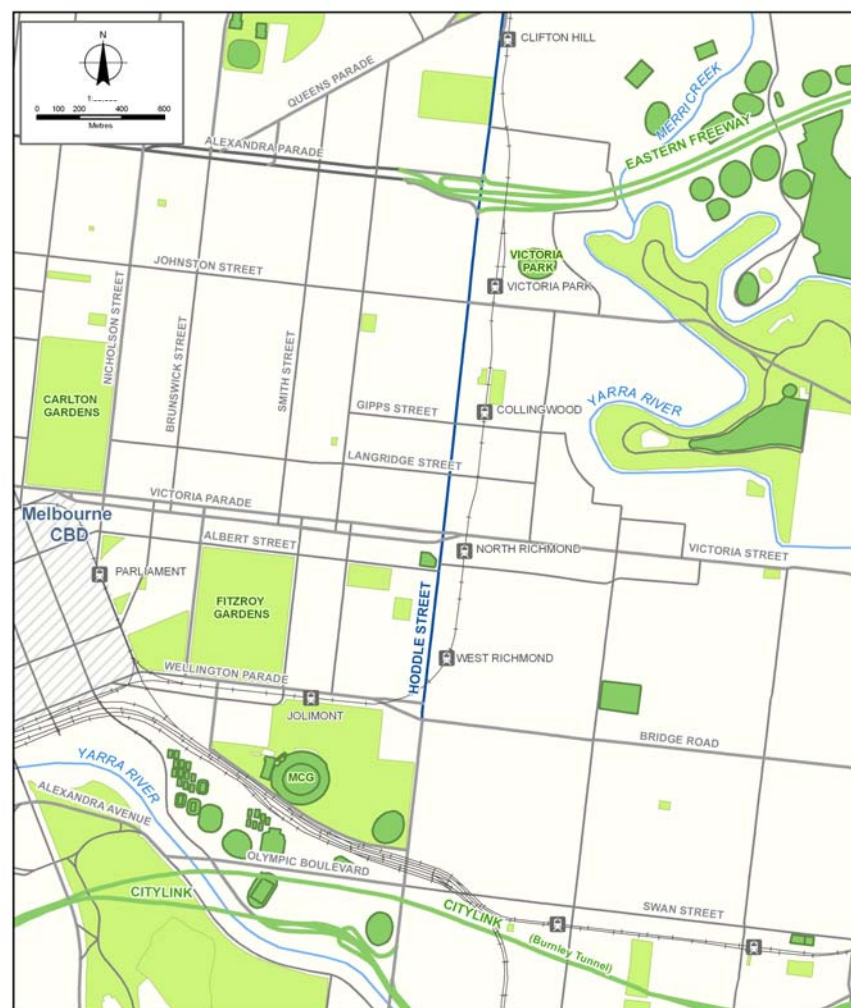
## 3. Existing Conditions

### 3.1 Study Area

The study area for this project consists of an eight kilometre length of Hoddle Street/Punt Road (herein referred to as Hoddle St), between Heidelberg Road to the north, and the St Kilda Road/Dandenong Road junction to the south. Located approximately 2 km east of Melbourne's Central Business District, Hoddle Street provides a major north-south link between Clifton Hill and St Kilda.

This report will focus on the four kilometre section of Hoddle Street between CityLink (Monash Freeway) and the Eastern Freeway. This section of Hoddle Street lies in the municipalities of City of Melbourne and City of Yarra. It includes the suburbs of Cremorne, Melbourne, East Melbourne, Richmond, Abbotsford and Collingwood. The study area locality plan is shown in Figure 1.

**Figure 1 Locality Plan**





An operational plan summarising the existing conditions on Hoddle Street is attached in Appendix A.

## **3.2 Background Studies**

The following studies have been reviewed to provide background information for this study.

### **3.2.1 Performance of Melbourne's Two High Occupancy Vehicle Lanes**

Sinclair Knight Merz was engaged to investigate and report on the performance and efficiency of high occupancy vehicle (HOV) lanes as a congestion management treatment<sup>1</sup>. Melbourne's two HOV (or T2) lanes are located on the Eastern Freeway westbound carriageway between Burke Road and Hoddle Street, and on the Hoddle Street northbound carriageway between Victoria Parade and Johnston Street.

The results of Sinclair Knight Merz's investigations found that vehicles in the HOV lane on the Eastern Freeway made a travel time saving of approximately 5 min, whilst on Hoddle Street, the travel time saving was minimal. This was due in part to the large volume of buses (30 per hour) and 64% non-compliance from single occupant vehicles.

Sinclair Knight Merz's conclusions were that the Eastern Freeway HOV lane was an effective congestion reducing measure because it is enforced by Victoria Police. However the Hoddle Street HOV lane is not enforced, likely due to the lack of adjacent road space, and thus is not an effective treatment.

## **3.3 Road Network**

Hoddle Street is a VicRoads Declared Arterial Highway between St Kilda and the Eastern Freeway, and a Declared Arterial Road from the Eastern Freeway to Heidelberg Road.

Within the study area, the speed limit along Hoddle Street is 60 km/h between the CityLink overpass and Swan Street, and 70 km/h between Swan Street and the Eastern Freeway. A 40 km/h school zone operates from 8:00 am to 9:30 am, and 2:30 pm to 4:00 pm between York Street and Victoria Parade.

Between CityLink and Swan Street, the cross-section of Hoddle Street is six-lane, two-way with no shoulders and no median.

Between Swan Street and Albert Street, Hoddle Street is six-lane two-way with no shoulders, and the northbound and southbound carriageways separated by a central median. Figure 2 shows the typical cross section through this section of Hoddle Street.

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<sup>1</sup> Bourlotos, P., Duff, M., Neal, J., (n.d.). *Performance of Melbourne's Two High Occupancy Vehicle Lanes*. Sinclair Knight Merz. Paper presented at the 2008 AITPM. National Conference.



**Figure 2 Hoddle Street between Wellington Parade and Albert Street, View North**



Between Albert Street and Johnston Street, Hoddle Street is eight-lane, two-way with no shoulders, and the northbound and southbound carriageways separated by a central median. Figure 3 shows the typical cross section through this section of the study area. A barrier between the northbound and southbound carriageways discourages pedestrians from crossing Hoddle Street at non-signalised intersections through this section.

**Figure 3 Hoddle Street between Gipps Street and Johnston Street, View North**



Between Victoria Parade intersection and Johnston Street in the northbound direction, a T2 transit lane operates in the PM peak between 4:30 pm and 7:30 pm. Also in the southbound direction, beginning at Eastern Freeway and terminating at Victoria Parade, a bus lane operates in the AM peak from 7:00 am to 9:30 am.

Within this section there are two service roads in the northbound direction. The first service road immediately follows the Gipps Street intersection. Small businesses front this service road. The second service road immediately follows the Vere Street footbridge. It offers access to Collingwood Housing Commission flats only.

Figure 4 and Figure 5 show the two service roads.

**Figure 4 Hood Street Service Road**



**Figure 5 Collingwood Housing Commission Service Road**



Between Johnston Street and the Eastern Freeway, Hoddle Street is nine-lane, two-way with five lanes in the southbound direction and four lanes in the northbound direction. There are no shoulders and the carriageways are separated by a central median. Figure 6 shows the typical cross section through this section of the study area.

Throughout this section, a bus lane operates in the AM peak between 7:00 am and 9:30 am in the southbound direction.

**Figure 6 Hoddle Street, Truro Street intersection between Johnston Street and Eastern Freeway, View South**



The median varies in width along Hoddle Street and is used to accommodate right turn and U-turn slip lanes at several signalised and non-signalised intersections.

### **3.3.1 Intersections**

Hoddle Street forms signalised intersections with the following arterial roads and freeways within the study area:

- ▶ Swan Street/Olympic Boulevard (herein referred to as Swan Street)
- ▶ Brunton Avenue;
- ▶ Wellington Parade/Bridge Road (herein referred to as Wellington Parade);
- ▶ Victoria Parade/Victoria Street (herein referred to as Victoria Parade);
- ▶ Johnston Street; and
- ▶ Eastern Freeway.

Traffic signals are also provided at a number of local roads including:

- ▶ Rowena Parade;
- ▶ Freeman Street;
- ▶ Albert Street/Elizabeth Street;
- ▶ Langridge Street;
- ▶ Gipps Street; and
- ▶ Truro Street.

The standard configuration of approach lanes at signalised intersections on Hoddle Street is three to four through lanes, (depending on the section, as referred to in Section 3.3 above) and right turn lane (two in the case of Hoddle Street to Victoria Parade, north to west movement).

The intersection of Hoddle Street and Swan Street differs from the standard configuration. On the southern approach of Hoddle Street, in addition to the three through lanes and right turn lane, there is a shared left turn and through lane and a through lane separated by a bus stop refuge island.

### 3.3.2 Traffic Survey Data

SCATS turning movement data for Hoddle Street at three key intersections has been provided by VicRoads for Wednesday 20 August 2008. A summary of the volumes on Hoddle Street is provided in Table 1.

**Table 1 Hoddle Street Traffic Volume Data**

Location	Direction	AM Peak (veh/hour)	PM Peak (veh/hour)	Daily Volume (veh/day)
Hoddle Street/Swan Street Intersection	NB	3,750	3,600	47,150
	SB*	2,100	2,550	32,500
Hoddle Street/Victoria Parade Intersection	NB**	1,900	2,350	28,750
	SB	3,400	2,950	39,400
Hoddle Street/Eastern Freeway Intersection	NB	1,050	1,850	20,450
	SB	4,450	2,450	42,900

\* Values do not include Swan Street left turn movement (east-south)

\*\* Values do not include Victoria Parade left turn movement (west-north)

Turning movement diagrams for each of the three intersections are provided in Appendix B.

### 3.3.3 Parking

Parking restrictions vary along the length of Hoddle Street depending on adjacent land uses and available road space. In the southbound direction, clearways and bus lanes operate during peak periods for the length of the study area.

In the northbound direction, the section between the CityLink overpass and Wellington Parade is a permanent no standing zone. From Wellington Parade to Victoria Parade, a clearway operates during the peak periods. From Victoria Parade to Johnston Street marked on-street parking is provided with a limit of up to 4-hours. On-street parking is also available on the Hood Street service lane. Parking is not available between Johnston Street and the Eastern Freeway.

Permanent No Standing zones apply in the vicinity of bus stops in both directions.





### **3.4 Public Transport Network**

Within the study area, 22 bus services operate along part of or intersect Hoddle Street in the study area. This includes:

- ▶ 15 bus services travelling between the Eastern Freeway and Victoria Parade via Hoddle Street;
- ▶ 1 bus service travelling between the Eastern Freeway and Johnston Street via Hoddle Street;
- ▶ 1 bus service travelling along the entire length of Hoddle Street;
- ▶ 1 bus service travelling between CityLink and Swan Street via Hoddle Street; and
- ▶ 4 bus services crossing Hoddle Street at Johnston Street.

Appendix C provides a summary of these bus routes.

Between CityLink and the Eastern Freeway, there are eleven bus stops in the northbound direction and eleven stops in the southbound direction on Hoddle Street. At the Swan Street and Bridge Road/Wellington Parade stops there are localised bus lanes and bus lanes also operate between Victoria Parade and Johnston Street in peak periods in each direction.

Five east-west tram services cross Hoddle Street, two on Victoria Parade, two on Bridge Road/Wellington Parade and one on Swan Street. A summary of these tram routes is also provided in Appendix C.

The Epping and Hurstbridge line trains run parallel to Hoddle Street on the eastern side. Four stations are located approximately 200 metres or less from Hoddle Street. These stations are:

- ▶ West Richmond Station, accessed from Jika Place;
- ▶ North Richmond Station, accessed from Elizabeth Street and Victoria Street;
- ▶ Collingwood Station, accessed from Stanton Street; and
- ▶ Victoria Park Station accessed from Johnston Street.

Trains servicing the Eastern and Southern suburbs intersect Hoddle Street at Richmond Station, via a grade separated bridge between Swan Street and Brunton Avenue.



### **3.5 Pedestrian and Cyclist Network**

Footpaths are provided to accommodate pedestrian movements on either side of Hoddle Street for the length of the study area. All signalised intersections incorporate pedestrian crossings. In addition, pedestrian operated signals are provided at four mid locations:

- ▶ Between Richmond Terrace and Yarra Park Gate 5;
- ▶ Between Hotham Street and Egan Street;
- ▶ At Collingwood Town Hall (between Stanton Street and Vere Street); and
- ▶ At Collingwood Housing Commission (between Studley Street and Perry Street).

There are currently minimal bicycle facilities along Hoddle Street. Whilst there are no dedicated bicycle lanes, bicyclists are able to share the T2 and bus lanes or the shared footpath between Victoria Parade and Johnston Street.

### **3.6 Land Use**

Hoddle Street has a mix of residential, public reserve, commercial and school uses. The section between CityLink and Albert Street is predominantly residential with public reserve on the western side at Yarra Park. The section between Albert Street and the Eastern Freeway is predominantly commercial with residential uses at the Collingwood Housing Commission and in the vicinity of Truro Street.



## 4. Improvements Workshop

A workshop was held on September 1, 2008 with a range of VicRoads officers. The VicRoads attendees ranged from strategic planners to traffic engineers to network operations officers and it was facilitated by GHD. The purpose of the workshop was to discuss the issues involved and draw relevant information from VicRoads operational staff involved in traffic management along the Hoddle Street corridor.

The key items discussed were:

- ▶ What is the source of the problem?
- ▶ Is the objective of any Hoddle street improvement to improve north-south traffic flow?
- ▶ Is the objective of any Hoddle street improvement to improve public transport flow?
- ▶ What short-term solutions are available?
- ▶ What medium-term solutions are available?
- ▶ What long-term solutions are available?

The options identified through this workshop have formed the set of base options for assessment in later sections of this report.



## 5. Short Term Improvements

This section of the report focuses on potential short-term improvements to reduce congestion along Hoddle Street. GHD has defined short-term improvements as those that could be implemented over a two-year period and consequently the improvements are generally focussed on treatments such as signal alterations. These improvements may provide interim benefits in relieving congestion along Hoddle Street while planning and construction for major works associated with long-term improvements occurs.

### 5.1 Traffic Signal Alterations

#### 5.1.1 Review of Signal Timings

There are a number of intersection and pedestrian signals along Hoddle Street that would be subject to signal linking and co-ordination to improve the north-south flow. VicRoads has advised that the route has been reviewed and optimised where possible and that there would be minimal improvements that could be achieved by undertaking this review in isolation.

A review of the signal co-ordination and timings would be better undertaken following implementation of other improvements discussed in this report. Following their implementation, there may be increased capacity or available green time at signals that can be re-directed to improve other approaches or adjacent intersections.

#### ***Benefits***

- ▶ As this option has previously been undertaken by VicRoads, there would be limited benefits without implementing other options prior to review.

#### ***Impacts***

- ▶ Altering the signal operation at intersections may increase delays on approaches to cross roads, including delaying public transport routes.

#### ***Actions***

- ▶ Following the implementation of other options, the signal operation and co-ordination should be reviewed taking into consideration the demands and modal priorities along the Hoddle Street corridor.

**GHD recommends that the actions be implemented to further investigate this option following implementation of other short-term improvements.**

### **5.1.2 Balancing of Eastern Freeway and Johnston Street Queues**

During the AM peak, it is understood that the majority of traffic exiting the Eastern Freeway onto Hoddle Street continues in a southbound direction. The immediate east-west arterial road intersecting Hoddle Street to the south of the Eastern Freeway is Johnston Street, with traffic signals controlling this intersection. This intersection is the first major delay point for southbound traffic, with the southbound movement queuing to the Eastern Freeway interchange at times.

While queuing on the southbound approach is extensive, the Johnston Street westbound approach often experiences minor queuing and delays in comparison based on preliminary advice from VicRoads Network Operations Officers at the workshop previously discussed in Section 4. This provides an opportunity to increase the green time allocated to the through movement on Hoddle Street and reduce the green time for Johnston Street traffic. This balancing of the queues may occur by installing loop detectors on Johnston Street that alter the green phase when the queuing reaches a certain location. This could be an automated process or monitored and controlled by the Traffic Control Centre.

A limitation of this option is that by reducing the available green time for Johnston Street the coinciding east-west pedestrian phase may be insufficient for pedestrians to undertake this movement. This will restrict the opportunities for balancing the queuing between the Eastern Freeway and Johnston Street. Therefore options that provide for this east-west pedestrian movement at alternative locations would need to be considered in combination with this option.

Another limitation of this option is that the congestion and queuing along Hoddle Street downstream of this intersection may also impact upon the benefits achieved by this treatment. If southbound queuing at Gipps Street is to the Johnston Street intersection, then increasing the available green time for Hoddle Street traffic will provide minimal benefit.

#### ***Benefits***

- ▶ Reduced queuing at the end of the Eastern Freeway and improved southbound flow on Hoddle Street through the Johnston Street intersection.

#### ***Impacts***

- ▶ Increased queuing on Johnston Street;
- ▶ Johnston Street is a bus route and buses may be delayed by increased queuing;
- ▶ Potential re-distribution of traffic to Eastern Freeway as motorists are delayed along Johnston Street, countering the benefits achieved;
- ▶ Downstream queuing may impact on the Johnston Street intersection; and
- ▶ East-west pedestrian movements along Johnston Street need to be accommodated.



### **Actions**

- ▶ Review the queuing along Johnston Street and test the impacts and benefits of increasing the green time for Hoddle Street at the expense of the Johnston Street approaches. This would include investigating the downstream impacts of this option on adjacent intersections.

**GHD recommends that the actions be implemented to further investigate this option.**

#### **5.1.3 Signal Gating on Eastern Freeway**

The high traffic volumes travelling southbound in the AM Peak, south of the Eastern Freeway are due to not only the high volume exiting the Eastern Freeway but also the southbound traffic from Queens Parade and Heidelberg Road. The AM peak traffic volumes, as shown in Appendix B, indicate that there is a 70/30 split of southbound traffic from the Eastern Freeway to Queens Parade/Heidelberg Road traffic, respectively. This equates to approximately 2900 vehicles from the Eastern Freeway and approximately 1400 vehicles from the north. This results in high levels of congestion at the Eastern Freeway exit ramp due to the conflicting movements between the left turn off the Eastern Freeway onto Hoddle Street and the southbound through movement on Hoddle Street. In many instances, left turning Eastern Freeway traffic queuing to the ramp from Johnston Street impacts on the flow of southbound traffic from the north.

This option involves controlling the green time allocated at the Eastern Freeway intersection in order to manage where the queuing is stored. This would be undertaken by reducing the green time for the left turning traffic from the Eastern Freeway and storing the queuing along the Eastern Freeway rather than on Hoddle Street. This application is commonly known as signal gating. This will allow for improved flows along Hoddle Street for southbound traffic from the north, as the previous southbound queuing along Hoddle Street is now stored along the Eastern Freeway. While storing traffic on freeways is generally not desirable, as this location is the end of the Eastern Freeway it could be considered to have less impacts and safety issues associated with it than queuing from ramps on to the freeway.

### **Benefits**

- ▶ Improved traffic flow for southbound traffic from the north (Queens Parade and Heidelberg Road) on Hoddle Street; and
- ▶ The queuing can be managed so that it occurs in areas where it can be stored sufficiently.

### ***Impacts***

- ▶ Increased queuing and delays on the Eastern Freeway potentially impacting on through traffic travelling to Alexandra Parade;
- ▶ Potential delays to buses exiting the Eastern Freeway from increased red phase at the intersection of Hoddle Street/Eastern Freeway; and
- ▶ Potential for traffic to avoid queues along Eastern Freeway and re-distribute to roads north of the Eastern Freeway and travel southbound along Hoddle Street.

### ***Actions***

- ▶ If this option were to continue the action would be to review the signal timings, queuing and demand at the Eastern Freeway and Alexandra Parade intersection. However, this option is not recommended as the travel time benefits achieved by southbound traffic from the north would be negated by the increased travel time delays to Eastern Freeway traffic. This option provides an opportunity to manage queue storage rather than providing overall travel time and congestion benefits.

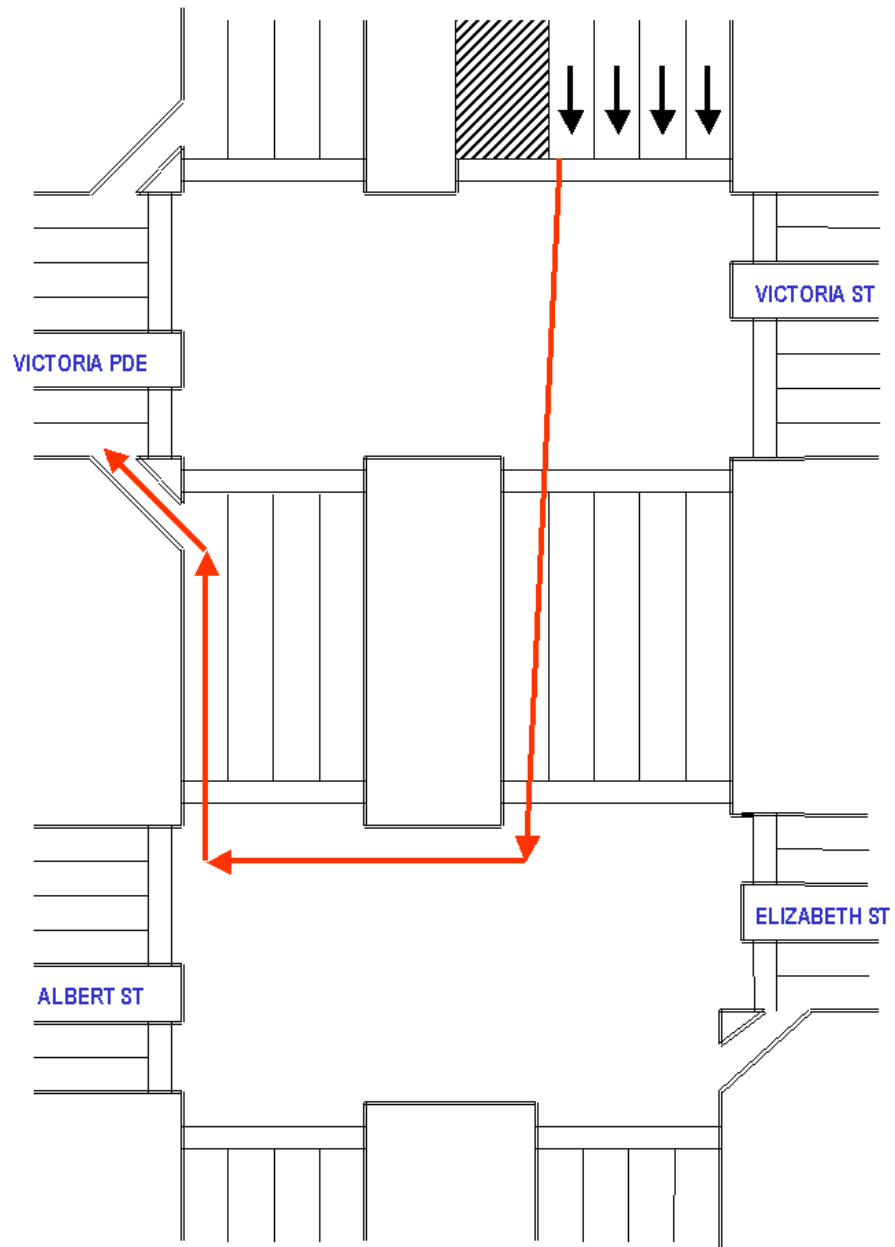
**GHD does NOT recommend that the actions be implemented to further investigate this option.**

## **5.2 Ban Right Turn at Victoria Parade and Allow P Movements**

Victoria Parade is a major east-west route from Hoddle Street to the CBD and the eastern suburbs with high flows and consequently there are delays for traffic on all approaches. Victoria Parade also has east-west tram movements. There is a high demand for the right turn from Hoddle Street into Victoria Parade (South to West), particularly in the AM peak. Consequently, the movement requires an increased right turn phase, limiting the time available for conflicting movements (such as the northbound through movement).

An option to relieve congestion at this intersection would be to ban right-turn movements from Hoddle Street into Victoria Parade. Traffic wishing to make this movement will be required to travel further south to the Albert Street intersection and complete a U-turn before turning left into Victoria Parade (known as a P movement) from the slip lane, as shown in Figure 7. This option should be considered in combination with the following option of encouraging right turn traffic to travel along Albert Street.

**Figure 7 P-Movement Treatment**



### **Benefits**

- ▶ Removing the right turn from the Victoria Parade intersection provides increased green time for other movements on Hoddle Street or Victoria Parade; and
- ▶ Improved public transport movements through the intersection, potentially for both the north-south and east-west public transport movements.



### ***Impacts***

- ▶ The right-turn/U-turn capacity at Albert Street would need to be increased; and
- ▶ Right turning vehicles would be further delayed.

### ***Actions***

- ▶ Undertake microsimulation testing of the Victoria Parade and Albert Street intersections to test the impacts and benefits of the option;
- ▶ As the P movement would be an unusual turn for drivers, undertake a driver behaviour review to test whether this option would be successfully taken up by drivers; and
- ▶ Investigate this option in conjunction with the following option of encouraging right turns into Albert Street.

**GHD recommends that the actions be implemented to further investigate this option.**

## **5.3 Encourage Right Turn into Albert Street**

Another option to reduce congestion at the Hoddle Street/Victoria Parade intersection would be to encourage traffic to use Albert Street instead of Victoria Parade. This movement can be encouraged by increasing the green time for the right turn from Hoddle Street into Albert Street and also by providing more right-turn storage. Improvements may also be required to Albert Street to accommodate the increase in traffic volumes.

Improvements to the right-turn provision at this intersection will support the P movement discussed in Section 5.2.

### ***Benefits***

- ▶ Traffic heading east towards the city would be more evenly distributed between Albert Street and Victoria Parade;
- ▶ Removing the right turn from the Victoria Parade intersection provides increased green time for through movements on Hoddle Street; and
- ▶ Improved public transport movements through the Victoria Parade intersection, potentially for both the north-south and east-west public transport movements.

### ***Impacts***

- ▶ Increased volumes and decreased amenity on Albert Street; and
- ▶ Works would be required to increase the right turn capacity into Albert Street

### **Actions**

- ▶ Undertake microsimulation testing of the Victoria Parade and Albert Street intersections to test the impacts and benefits of the option; and
- ▶ Investigate this option in conjunction with the previous option of banning right turns at Victoria Parade and allowing P movements.

**GHD recommends that the actions be implemented to further investigate this option.**

## **5.4 Clearways and Parking Restrictions**

As discussed in Section 3.3.3, on-street parking conditions vary along the length of Hoddle Street. In most cases, clearways operate during peak periods, maximising the road space available for traffic flow. Increasing the operation times of these clearways or converting them to 24 hour clearways will improve traffic flow during off-peak periods.

In the southbound direction on-street parking occurs in the bus lane and in the kerbside lane during the off-peak periods. During the off-peak (between 10am and 4pm), southbound traffic volumes are approximately 2400 vehicles per hour which was 85% of the AM peak period volumes, indicating that there is high demand in this period that would also benefit from increased capacity provided by implementing 24 hour clearways.

In addition, there is a section of Hoddle Street northbound between Victoria Parade and Johnston Street that has marked on-street parking. While this parking does not impact on the traffic flow (except in the short periods when parking manoeuvres occur) removing this parking would provide for an additional traffic lane in the northbound direction. It should be noted that this would only provide a short length of five-lane capacity as the approach to the Eastern Freeway is constricted to four lanes and therefore limited benefits.

Parking bans on roads intersecting Hoddle Street should also be investigated. This will improve east-west traffic flow across Hoddle Street and possibly allow for an increase in green time allocated to Hoddle Street.

### **Benefits**

- ▶ Increased capacity on Hoddle Street, particularly during off-peak periods when demand is still high;
- ▶ Reduced impacts on traffic flow from parking manoeuvres; and
- ▶ Removing parking in the vicinity of intersections, particularly for east-west approaches, will improve traffic flow through these intersections, possibly allowing for an increase in green time allocated to the through traffic movement on Hoddle Street.



### ***Impacts***

- ▶ Removing parking will impact on adjacent land owners and businesses;

### ***Actions***

- ▶ A review of the parking conditions and utilisation along Hoddle Street and intersecting east-west routes; and
- ▶ Investigate possible locations for off-street parking to offset the removal of on-street parking.

**GHD recommends that the actions be implemented to further investigate this option.**

## 6. Medium Term Improvements

This section of the report focuses on potential medium-term improvements to improve congestion along Hoddle Street. GHD has defined medium-term improvements as those that could be implemented over a five-year period and consequently the improvements are generally focussed on treatments that require minor infrastructure works utilising existing road space.

### 6.1 Alexandra Parade City Access

The majority of traffic accessing the western suburbs from the Eastern Freeway currently continues along Alexandra Parade from the end of the Freeway and distributes onto the arterial road network. By providing an underground cross-city connection between the Eastern Freeway and the western suburbs (East West Link), the use of Alexandra Parade for this through movement to the western suburbs is expected to be reduced, freeing up capacity on this road.

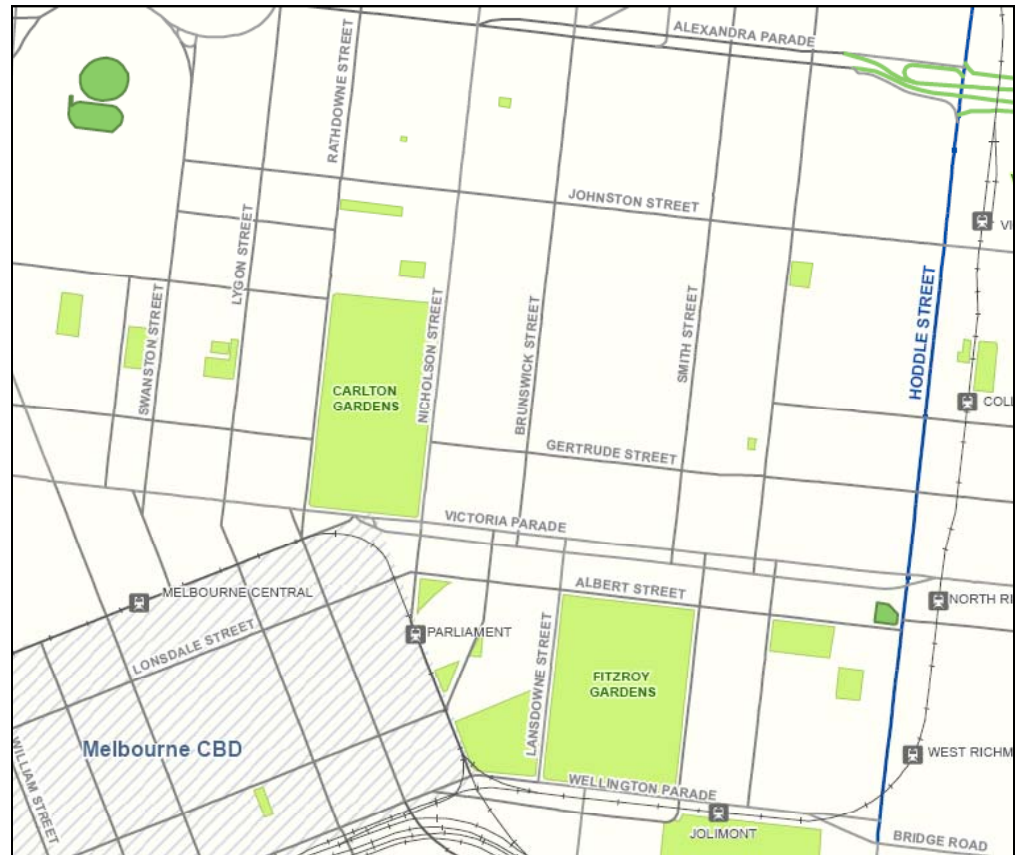
While the East West Link will provide for the east-west movement, it will not cater for north-south movements from the Eastern Freeway. All vehicles wishing to exit north or south from the east-west corridor at the Eastern Freeway/East West Link junction are required to exit the Freeway onto Hoddle Street.

At present, Hoddle Street is used as the major link between the Eastern Freeway and the CBD, with the majority of city bound vehicles connecting from Hoddle Street onto east-west roads such as Victoria Parade, Albert Street and Wellington Parade. Motorists are deterred from travelling along Alexandra Parade and connecting north-south to the city due to the limited capacity and congestion on roads such as Smith Street, Brunswick Street, Nicholson Street and Rathdowne Street.

With Alexandra Parade predicted to carry lower volumes as a result of the East West Link, there is an opportunity to encourage city bound movements along this route, removing pressure from Hoddle Street. This will need to be accompanied by improvements to the north-south links to the city. As can be seen in Figure 8, Nicholson Street and Rathdowne Street are two possible roads that could accommodate the increased north-south traffic movement and provide a direct link to the CBD area. This would require an increase in capacity on these roads, possible treatments include:

- ▶ Widening to increase the number of traffic lanes;
- ▶ The introduction of clearways;
- ▶ Turn bans and access control to improve through movements; and
- ▶ Intersection improvements to reduce delays.

**Figure 8 Alternative North-South Routes**



It is acknowledged that the East West Link is a long-term project and prior to this link being constructed Alexandra Parade will continue to carry cross-city traffic, hence maintaining high traffic volumes and reducing the ability to encourage this as a city access route. In the medium term, improvements can be made to increase the capacity of Alexandra Parade in conjunction with the north-south improvements discussed above. This will provide medium-term relief to Hoddle Street, which will be magnified when/if the East West Link is opened.

It should be noted that some of the benefits of the East West Link, as identified in EWLNAS, are that Alexandra Parade will have reduced east-west traffic providing the opportunity to improve north-south public transport movements, create more walking and cycling opportunities and improve amenity in the area. Encouraging Alexandra Parade as an alternate city access will counter these benefits and impact on the objectives of the East West Link.

### **Benefits**

- Encouraging Alexandra Parade as an alternate city access will relieve pressure from Hoddle Street;

### ***Impacts***

- ▶ There is limited capacity on Alexandra Parade to accommodate this increase in traffic until the East West Link is constructed, which is a long-term project. Therefore works to increase capacity on Alexandra Parade will be required in the short-term;
- ▶ Works would be required to increase capacity on north-south routes such as Nicholson Street and Rathdowne Street;
- ▶ Works may be required at the end of the Eastern Freeway to accommodate the increase in vehicles continuing straight onto Alexandra Parade; and
- ▶ Increasing volumes along Alexandra Parade and other north-south roads will decrease amenity along these routes;

### ***Actions***

- ▶ Investigate options for increasing capacity along Alexandra Parade, Nicholson Street and Rathdowne Street; and
- ▶ Determine the possible re-distribution of traffic.

This option is not recommended as encouraging Alexandra Parade as an alternate city access will counter the potential benefits and impact on the objectives of the East West Link.

**GHD does NOT recommend that the actions be implemented to further investigate this option.**

## **6.2 Northbound Bus Lane in Service Road**

As discussed in Section 3.3, there are several service roads on the northbound side of Hoddle Street between Gipps Street and the Eastern Freeway. These service roads are separated from Hoddle Street by an outer separator. It may be possible to utilise the road reserve space taken up by these service lanes to add additional northbound lanes to Hoddle Street.

For this option to operate efficiently, works would be required to join the service roads to provide a continuous lane. Abutting buildings at the Johnston Street/Hoddle Street intersection are very close to the road, limiting opportunity to continue the additional lane through this intersection.

### **Benefits**

- ▶ The service lanes could be used as a northbound bus lane, resulting in increased efficiency for public transport;

### ***Impacts***

- ▶ Parking in the service lanes would be removed and access to abutting properties and businesses would need to be maintained;

- ▶ Land acquisition may be required to provide a connection along the service lanes and provide a continuous lane;
- ▶ Roadside vegetation within the median would need to be removed; and
- ▶ Buildings are located adjacent to the road in the vicinity of the Johnston Street intersection, limiting the opportunities for connecting the service lanes.

#### **Actions**

- ▶ Investigate opportunities to convert northbound service lanes to a northbound bus lane.

**GHD recommends that the actions be implemented to further investigate this option.**

### **6.3 Grade Separated Pedestrian Crossing at Johnston Street**

Major pedestrian movements are generated from Victoria Park Train Station which is located approximately 100m east of Hoddle Street, with pedestrians crossing Hoddle Street on Johnston Street to access houses, school and employment on the west side of Hoddle Street. For pedestrians travelling along Hoddle Street, in addition to the intersection crossings, there are pedestrian operated signals located approximately 150m south of Johnston Street and a pedestrian bridge located approximately 350m south, near Collingwood College. However pedestrians wishing to continue east or west along Johnston Street will not utilise these facilities, instead using the pedestrian crossing provided at the Johnston Street/Hoddle Street intersection.

The high volumes of pedestrians at the Hoddle Street/Johnston Street intersection mean that the phase time required for pedestrians to cross Hoddle Street (east-west) is often longer than the phase time that is required to clear the through traffic on Johnston Street. Therefore, if this pedestrian movement is removed, the through movement on Johnston Street could be given a shorter phase time and the through movement on Hoddle Street could be increased, hence reducing delays and queuing on Hoddle Street.

An option for removing this pedestrian movement would be to provide a pedestrian overpass. This would allow pedestrians to cross Hoddle Street on Johnston Street without requiring a phase in the traffic signal cycle. This will allow more phase time for the through movement on Hoddle Street and also provide opportunities to implement some other treatments previously discussed such as balancing Eastern Freeway and Johnston Street queues.

While this option has been included in the medium-term options, it could be considered a medium term option as it requires significant infrastructure to be completed. The building of a pedestrian overpass at this location may also limit the options for some long-term solutions such as grade separating Hoddle Street.



### ***Benefits***

- ▶ Removing the east-west pedestrian movement from the intersection will allow the signal timings to be optimised to improve the north-south movement along Hoddle Street.

### ***Impacts***

- ▶ Constructing a pedestrian overpass may limit options for future infrastructure projects in the vicinity of the Johnston Street/Hoddle Street intersection; and
- ▶ A pedestrian bridge will be expensive and travel time gains will be minimal.

### ***Actions***

- ▶ Investigate the opportunities for constructing a pedestrian overpass within the vicinity of the Johnston Street/Hoddle Street intersection.

**GHD recommends that the actions be implemented to further investigate this option.**





## 7. Long Term Improvements

This section discusses some potential long-term solutions that may assist in relieving congestion on Hoddle Street. The majority of these treatments involve major infrastructure works. Preliminary concept layouts have been developed for many of these options and the broad benefits and impacts have been discussed. However for these options to be implemented, further investigation would be required and the actions needed to progress with the options have been identified. The construction issues associated with the recommended options are discussed separately in Section 8.

When grade-separating intersections, the two main options are to either construct an above ground or an underground structure. In a dense urban environment such as Hoddle Street, creating large above ground structures can have a detrimental impact on the amenity of the area. For this reason, when the option is available, GHD have preferred to focus on grade-separating underground.

### 7.1 Johnston Street Intersection Treatments

As discussed in Section 5.1.2, the intersection of Hoddle Street and Johnston Street is the first major delay point for traffic travelling southbound on Hoddle Street from the Eastern Freeway. Options for grade separation at this intersection involve running Hoddle Street underneath Johnston Street through the construction of a sub level structure and access ramps (cut and cover). Johnston Street will remain at the existing surface level.

Two options have been considered for the possible treatment at this intersection:

- **Connections to Johnston Street**

This involves running one lane in each direction on Hoddle Street next to the access ramps at the existing surface level. This will allow the intersection of Johnston Street and Hoddle Street to remain at surface level with all movements accommodated. As a result of removing the through movement on Hoddle Street, the configuration of the intersection and signal timings can be altered, improving operation and reducing delays. This option will leave sufficient road space for 3 lanes in each direction on Hoddle Street for the through movement underneath Johnston Street.

- **No connections to Johnston Street**

This option does not provide connections between Hoddle Street and Johnston Street. This will improve flows on Johnston Street by completely removing the conflicting movement with Hoddle Street. This will leave sufficient road space for 4 lanes in each direction on Hoddle Street for the through movement underneath Johnston Street.



It is considered that providing connections to Johnston Street is the preferred option for the following reasons:

- ▶ If no connections to Johnston Street were provided, other intersections would need to accommodate the demand for this movement, placing additional strain on other east-west links;
- ▶ A bus service (route 203) currently connects from Hoddle Street to Johnston Street, this bus would need to be re-routed if no connections were provided;
- ▶ It is expected that three through lanes in each direction on Hoddle Street will provide sufficient capacity for this through movement (this cannot be confirmed without traffic counts and origin-destination surveys). If this is the case, it would be practical to use the additional road space to provide Johnston Street connections; and
- ▶ Running a lane in each direction next to the access ramps maintains access to abutting properties and connecting roads.

A concept layout of the cut and cover grade separation with connections to Johnston Street is provided in Appendix D. The length of the ramps are the minimum required to reach a sufficient depth at the intersection to construct the bridge deck allowing Johnston Street to pass over the cut and cover structure. The remainder of the cut and cover structure is open on top with barriers separating the cut from the surface lanes. Access to adjacent properties and roads connecting to Hoddle Street within the cut and cover section will be restricted to left-in left out movements only.

The EWLNAS identified the option of locating a bus-rail interchange at Victoria Park Station, accessed via Lulie Street with buses connecting to Johnston Street. The grade-separation of the Johnston Street/Hoddle Street intersection will reduce delays to buses travelling east-west along Johnston Street.

The lane configurations at the entry and exit of the access ramps will need to be managed to mitigate any weaving issues caused by vehicles changing lanes. This is particularly the case at the northern end. The close proximity of the Eastern Freeway interchange will result in vehicles needing to get into the correct lane to continue either northbound on Hoddle Street or enter the on-ramp to the Eastern Freeway. Possible treatments may include turn restrictions to/from streets in the vicinity of the ramp entry/exit points, appropriate signage and linemarking.

The following impacts, benefits and actions relate to the preferred option of running Hoddle Street underneath Johnston Street via a cut and cover tunnel with connections to Johnston Street.

### ***Benefits***

- ▶ Grade separating the Hoddle Street through movement will free up capacity at the existing intersection and significantly reduce congestion on both Hoddle Street and Johnston Street; and
- ▶ This will benefit bus services running on both Hoddle Street and Johnston Street.

### ***Impacts***

- ▶ Significant infrastructure would be required to implement this option;
- ▶ Restricted access to adjoining properties and connecting streets; and
- ▶ There may be weaving issues at the entries and exits to the ramps, particularly at the north end, which is close to the Eastern Freeway.

### ***Actions***

- ▶ Undertake an intersection analysis or traffic modelling to determine the benefits of grade separation at this location;
- ▶ Investigate the demand for connections to Johnston Street and determine which movements are required for access to Johnston Street;
- ▶ Undertake a capacity analysis to determine the number of through lanes required on Hoddle Street;
- ▶ Investigate the portal locations and possible weaving issues;
- ▶ Further develop concept designs taking into consideration factors such as services, geotechnical, geometrical and structural details; and
- ▶ Undertake a detailed benefit-cost analysis.

**GHD recommends that these actions be implemented to further investigate this option.**

## **7.2 Victoria Parade Intersection Treatments**

Hoddle Street and Victoria Parade are major north-south and east-west routes respectively. The intersection of Hoddle Street and Victoria Parade currently has large queues and long delays. There are limited opportunities to increase the capacity of this intersection if it remains at-grade, as abutting properties and buildings are located close to the existing road. Grade separation of this intersection is an option to significantly reduce the current congestion issues at this intersection.

### **7.2.1 Road Grade Separation**

Two options have been identified for the grade separation of Hoddle Street and Victoria Parade. This section describes and compares these two options and makes a recommendation on the preferred solution.

### **North to West Grade Separation**

This option would involve grade separating the movement between Hoddle Street to the north and Victoria Parade to the west. This would require the construction of a grade separated elevated structure or cut and cover tunnel. Through movements would remain at surface level at the intersection however the right turn from Hoddle Street into Victoria Parade and the left turn from Victoria Parade to Hoddle Street would be grade separated from the intersection via the proposed structure and access ramps. A concept layout of the grade separation elevated structure is provided in Appendix E.

### **North-South Hoddle Street Grade Separation**

This option would involve grade separating the through movement on Hoddle Street. This option involves running Hoddle Street underneath Victoria Parade through the construction of a sub level structure and access ramps (cut and cover). A concept layout for this grade separation is provided in Appendix E. The cut and cover structure is designed to allow bridge decks to be constructed at Victoria Parade, Albert Street, Langridge Street and Gipps Street. The ramp structures begins north of Gipps Street and south of Albert Street, with the length of the ramps the minimum required to reach a sufficient depth at these intersections to construct the bridge deck and allow the east-west roads to pass over the cut and cover structure. This provides the added benefit of grade separation at these three other signalised intersections (as well as Victoria Parade).

The remainder of the cut and cover structure can be decked to allow for movements at surface level or remain open to reduce construction costs. If the tunnel is left open, access to adjacent properties and roads connecting to Hoddle Street within the cut and cover section (other than the decked intersections) will be restricted to left-in left out movements only.

Treatments will be required at the ends of the ramps to/from the sub-level structure to mitigate weaving issues. This may involve the implementation of turn restrictions to/from streets in the vicinity of the ramp entry/exit points, appropriate signage and linemarking.

### **Recommended Grade Separation Option**

Grade separating (using either option) will free up capacity at the existing intersection and significantly reduce congestion on both Hoddle Street and Victoria Parade. For both options, the Victoria Parade/Hoddle Street intersection will remain at surface level. Based on the 2008 turning movement diagrams in Appendix B, it is expected that grade separating the through movement on Hoddle Street would remove in the order of 4,000 vehicles from the intersection in the peak hours. This will allow the configuration of the intersection and signal timings to be altered to improve operation and reduce delays. Both grade separations would also provide decreased delays at the intersection for trams travelling along Victoria Parade and buses travelling on Hoddle Street and Victoria Parade.



The preferred option is the *North-South Hoddle Street Grade Separation* for the following reasons:

- ▶ Turning movement diagrams in Appendix B indicate that the demand for the through movement on Hoddle Street is much higher than the right-turn movement from Hoddle Street to Victoria Parade (north to west);
- ▶ If the through movement on Hoddle Street is not grade separated, through traffic will still be subject to delays at the signalised intersection. The option of the north-south Hoddle Street grade separation will provide greater improvements to traffic flows along Hoddle Street;
- ▶ By increasing the capacity of the north to west movement between Hoddle Street and Victoria Parade, it is encouraging city bound vehicle movements. This may encourage additional vehicle trips to the CBD and is not consistent with any strategy to encourage public transport travel to/from the CBD;
- ▶ A large above ground structure may be required to grade separate the north to west movement, which will have a detrimental impact on the amenity of the area and may require land acquisition. Alternatively, a cut and cover tunnel could be constructed which would remove this amenity impact but would increase the cost significantly;

The following impacts, benefits and actions relate to the preferred option of running Hoddle Street underneath Victoria Parade via a cut and cover tunnel.

#### ***Benefits***

- ▶ Grade separating the Hoddle Street through movement will free up capacity at the existing intersection and significantly reduce congestion on both Hoddle Street and Victoria Parade;
- ▶ Grade separation will also be achieved at the signalised intersections of Albert Street, Langridge Street and Gipps Street; and
- ▶ Tram and bus movements will be improved through the intersection.

#### ***Impacts***

- ▶ Significant infrastructure would be required to implement this option;
- ▶ Restricted access to adjoining properties and connecting streets; and
- ▶ There may be weaving issues at the entries and exits to the ramps.

#### ***Actions***

- ▶ Undertake an intersection analysis or traffic modelling to determine the benefits of grade separation at this location;
- ▶ Investigate the demand for turning movements at Victoria Parade to determine the required configuration of the intersection and signal timings;
- ▶ Undertake a capacity analysis to determine the number of through lanes required on Hoddle Street;
- ▶ Investigate the portal locations and possible weaving issues;



- ▶ Further develop concept designs taking into consideration factors such as services, geotechnical, geometrical and structural details; and
- ▶ Undertake a detailed benefit-cost analysis.

**GHD recommends that these actions be implemented to further investigate this option.**

### **7.2.2 Grade Separate Trams on Victoria Parade**

This option would involve constructing an elevated structure over (or cut and cover tunnel under) Hoddle Street connecting the tramlines on Victoria Street to Victoria Parade. This will allow trams heading east-west to pass unopposed across Hoddle Street, removing delays to trams at this intersection. Also, removing trams from the signalised intersection will allow the signal phasing to be reconfigured to optimise movements and reduce delays to traffic on all approaches.

Options for grade separation are limited by the close proximity of the rail bridge crossing Victoria Street approximately 100m east of the intersection. The angled alignment and limited road space on Victoria Street through the intersection are also constraints for this option.

For eastbound tram movements, trams are often delayed by vehicle traffic on Victoria Street shortly after the Hoddle Street intersection. Therefore, there will be minimal travel time gains for trams crossing eastbound over Hoddle Street because they will still face the congestion on Victoria Street.

#### ***Benefits***

- ▶ Trams will not be delayed at this intersection; and
- ▶ Removing the tram movement will allow the traffic signals to be reconfigured to allow better traffic flow through the intersection.

#### ***Impacts***

- ▶ The construction of this option will be restricted by the alignment of the intersection and the close proximity of the rail bridge crossing Victoria Street approximately 100m east of the intersection;
- ▶ Land acquisition may be required;
- ▶ This option would require a large amount of infrastructure for a minimal benefit.

#### ***Actions***

- ▶ Further investigate the geometrical constraints on constructing this option; and
- ▶ Analyse the potential time savings and tram patronage to further understand the benefits.

**GHD does NOT recommend that these actions be implemented to further investigate this option.**

### 7.3 Wellington Parade Intersection Treatments

Wellington Parade forms a complex intersection with Hoddle Street. Wellington Parade splits in the vicinity of Hoddle Street, with Wellington Parade North and South forming two signalised intersections with Hoddle Street. Trams also run east-west between Bridge Road and Wellington Parade South. This complex intersection with many conflicting movements and high volumes results in high levels of congestion.

In order to relieve congestion and reduce delays at this intersection, options have been investigated to grade separate. Options for running Hoddle Street underneath this intersection are restricted by a number of factors. The rail line passes underneath Hoddle Street to the north of Wellington Parade and there is a steep grade along Hoddle Street in this area. For these reasons, a cut and cover structure will not be possible through this section. The steep grades also restrict the options for constructing an elevated grade separated structure. If Hoddle Street is to pass underneath this intersection, a driven tunnel will be required with tunnel portals on either side of Wellington Parade. A concept layout for this option is provided in Appendix F.

It should be noted that further investigation is required to determine the geometrical and geological constraints of constructing a driven tunnel at this location. The road width in this location may not provide sufficient width to construct this option without significant land acquisition. The construction issues discussed in Section 8.3 also apply to this option, however the options for providing a construction zone next to Hoddle Street are limited at this location, particularly at the northern end of the tunnel.

The requirement of providing access to/from Wellington Parade at surface level raises issues regarding the access ramp configuration at either end of the tunnel. The option of running one lane on either side of the access ramps at surface level has been presented on the concept layout. This configuration needs to be further investigated, including analysis of the weaving issues at entry and exit of the ramps.

The following impacts, benefits and actions relate to the option of a driven tunnel along Hoddle Street.

#### ***Benefits***

- ▶ Grade separating the Hoddle Street through movement will free up capacity at the existing intersection and significantly reduce congestion on both Hoddle Street and Wellington Parade;
- ▶ Tram and bus movements will be improved through the intersection.

#### ***Impacts***

- ▶ A driven tunnel would be required to overcome the geometrical constraints, high costs are associated with this option;
- ▶ Restricted access to adjoining properties and connecting streets; and
- ▶ There may be weaving issues at the entries and exits to the ramps.

### **Actions**

- ▶ Undertake an intersection analysis or traffic modelling to determine the benefits of grade separation at this location;
- ▶ Investigate the demand for turning movements at Wellington Parade to determine the required configuration of the intersection and signal timings;
- ▶ Undertake a capacity analysis to determine the number of through lanes required on Hoddle Street;
- ▶ Investigate the portal locations and possible weaving issues;
- ▶ Further develop concept designs taking into consideration factors such as services, geotechnical, geometrical and structural details; and
- ▶ Undertake a detailed benefit-cost analysis.

**GHD recommends that these actions be implemented to further investigate this option.**

## **7.4 Swan Street Intersection Treatments**

Swan Street and Brunton Avenue form complex intersections with Hoddle Street. East-west tram movements run along Swan Street through the intersection and a large rail bridge runs over Hoddle Street between Swan Street and Brunton Avenue.

The options for grade separating this intersection include:

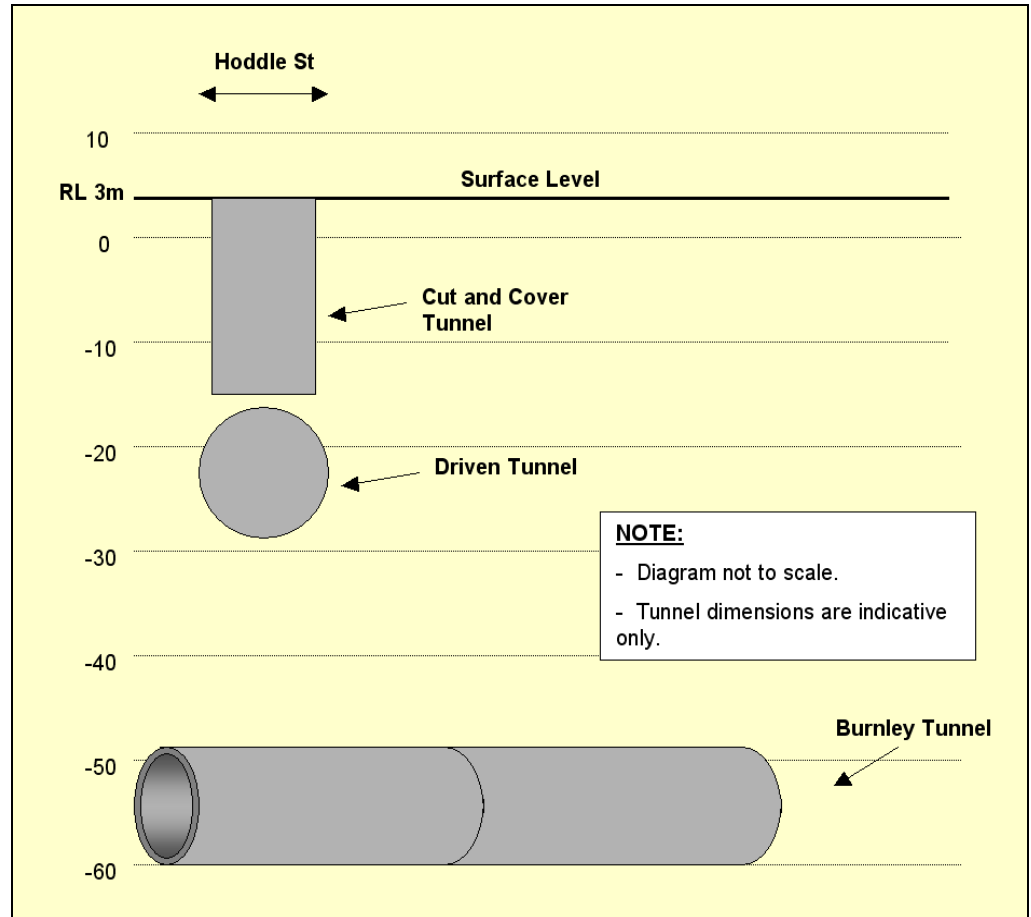
- ▶ Hoddle Street over Swan Street: This option is limited by the location of the rail bridge crossing Hoddle Street to the north of Swan Street;
- ▶ Hoddle Street under Swan Street: This option is limited by the location of the CityLink Burnley Tunnel south of Swan Street and the bridge piles north of Swan Street;
- ▶ Swan Street over Hoddle Street: This option is limited by the location of the rail bridge crossing Swan Street to the east of Hoddle Street; and
- ▶ Swan Street under Hoddle Street: This option is limited by the close proximity of the Burnley Tunnel running parallel to Swan Street in this location and the location of the rail bridge crossing Swan Street to the east of Hoddle Street.

A vertical schematic showing the approximate location of the Burnley Tunnel is provided in Figure 9.

It is understood that the crown of the Burnley Tunnel is located approximately 50m below the surface in the vicinity of the Hoddle Street/Swan Street intersection. This may allow for sufficient depth to construct a cut and cover or driven tunnel at this location. Both of these options have been indicated on Figure 9, however it should be noted that both options would not be constructed, this is just to provide an indication of the relative depths.



**Figure 9 Vertical Schematic at Hoddle Street/Swan Street Intersection**



With the limitations on grade-separation of the intersection, options to relieve congestion at this intersection may involve expanding the intersection to increase capacity on the approaches. There is vacant land adjacent to the intersection that may be utilised for widening of the intersection, with some acquisition required. However, widening of the southbound approach of the intersection is limited by the road space available underneath the rail bridge.

A long term option at this intersection may involve a re-development of the Richmond Railway Station. Any works at the Richmond Station should consider the traffic issues at Swan Street and Brunton Avenue and aim to incorporate solutions.

The following impacts, benefits and actions relate to the option of running Hoddle Street underneath Swan Street via a cut and cover tunnel. However, further investigation is required to determine whether the constraints on grade separation at this location can be overcome.

### ***Benefits***

- ▶ Grade separating the Hoddle Street through movement will free up capacity at the existing intersection and significantly reduce congestion on both Hoddle Street and Swan Street; and
- ▶ Tram and bus movements will be improved through the intersection.

### ***Impacts***

- ▶ Significant infrastructure would be required to implement this option;
- ▶ There are several geometrical and geotechnical constraints that need to be overcome to grade separate at this intersection; and
- ▶ There may be weaving issues at the entries and exits to the ramps.

### ***Actions***

- ▶ Undertake an intersection analysis or traffic modelling to determine the benefits of grade separation at this location;
- ▶ Investigate the demand for turning movements at Swan Street to determine the required configuration of the intersection and signal timings;
- ▶ Undertake a capacity analysis to determine the number of through lanes required on Hoddle Street;
- ▶ Investigate the portal locations and possible weaving issues;
- ▶ Further develop concept designs taking into consideration factors such as services, geotechnical, geometrical and structural details; and
- ▶ Undertake a detailed benefit-cost analysis.

**GHD recommends that these actions be implemented to further investigate this option.**

## **7.5 Tunnel Underneath Hoddle Street**

Several previous options have considered separating the north-south movements along Hoddle Street. These options considered the possibility of short tunnels to separate movements at intersections. This option looks to draw those options together into one long tunnel underneath Hoddle Street.

The construction of a tunnel will significantly increase the capacity of Hoddle Street and remove a large portion of north-south traffic from the surface level on Hoddle Street. This will significantly reduce the volumes of Hoddle Street through traffic at intersections and allow intersections to be reconfigured and signal timings to be altered. This will significantly improve traffic flow and reduce congestion on both Hoddle Street and intersecting east-west roads. This will provide reduced delays for tram and bus services (in both the north-south and east-west directions). It is expected that bus movements will remain at surface level to allow for buses to stop on Hoddle

Street and connect to east-west routes. Removing a large portion of the surface traffic will also provide opportunities to improve amenity along Hoddle Street.

It is expected that the tunnel will act as a north south bypass with two lanes in each direction and no lateral connections. There are several options for the location of the north and south tunnel portals. One option that has been considered locates the north portal between the Eastern Freeway and Johnston Street and the south portal between Wellington Parade and Brunton Avenue (near the MCG). Concept layouts of the north and south tunnel portals are provided in Appendix G. The issues associated with the construction of the tunnel and the portal locations are discussed in Section 8. This includes further discussion on the location and details of the north and south tunnel portals in Section 8.3.2.

This option was tested using the Melbourne Integrated Transport Model (MITM) to determine the broad demand for this movement and the impact that constructing the tunnel will have on travel times and traffic volumes. MITM runs were completed for the AM peak using projected 2031 volumes. This found that constructing the tunnel gave an approximate decrease in travel time of 12% between the Eastern Freeway and CityLink (Monash Freeway). The model indicated that the increased capacity of Hoddle Street as a result of the tunnel induced additional traffic demand. While travel times through the tunnel were low, there were high levels of congestion at the entry and exit of the tunnels (particularly the southbound tunnel in the AM peak). This caused increased travel times for the sections of road at either end of the tunnel, negating the benefits of the travel time savings through the tunnel. It is expected that if the congestion issues at the ends of the tunnel did not exist, the travel time savings would be much greater.

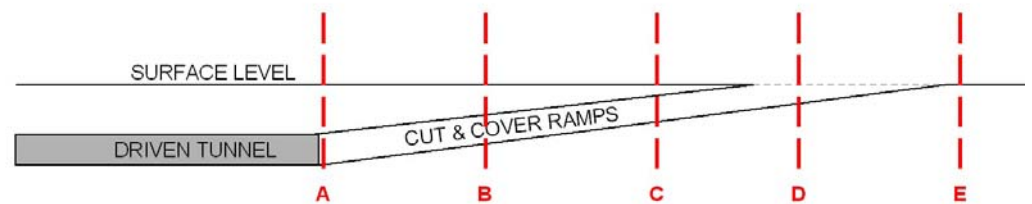
The findings from the MITM run indicate that a major issue associated with the option of running a driven tunnel underneath Hoddle Street will revolve around the entry and exit points. It would be preferable to provide a direct connection to the Eastern Freeway on the northern end of the tunnel, as well as an entry via Hoddle Street.

At the southern end, underground constraints in the vicinity of Swan Street (as discussed in Section 7.4) may require the tunnel to surface south of Wellington Parade, exposing the through traffic to the constraints at the Brunton Avenue and Swan Street intersections, causing congestion at the southern end of the tunnel. However, as presented in Figure 9, there may be sufficient depth to construct a cut and cover or driven tunnel at this location. The option of surfacing the tunnel south of Swan Street would need to be further investigated, particularly regarding the geotechnical details in the area.

Another issue facing this option is the configuration of the lanes for the merging and weaving at the northern end, before the Eastern Freeway ramps. GHD have developed a potential solution to this issue and this is outlined in Figure 10.

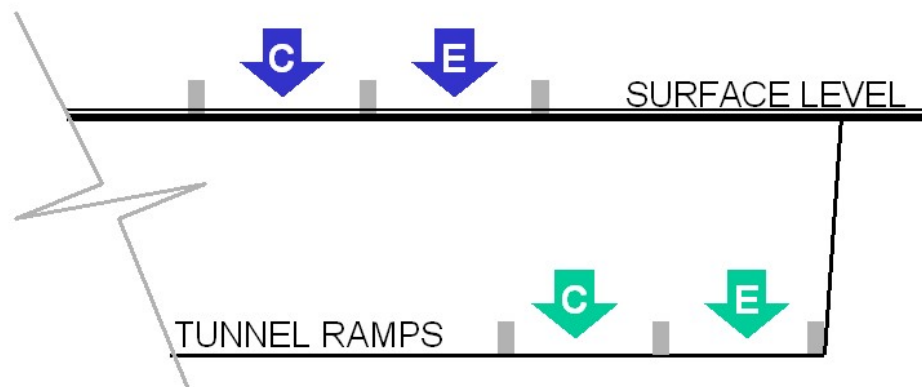
**Figure 10 Northbound Lane Configuration at Northern End of Tunnel**

Cross-sections of the ramp configuration are provided at locations corresponding to the sections below.



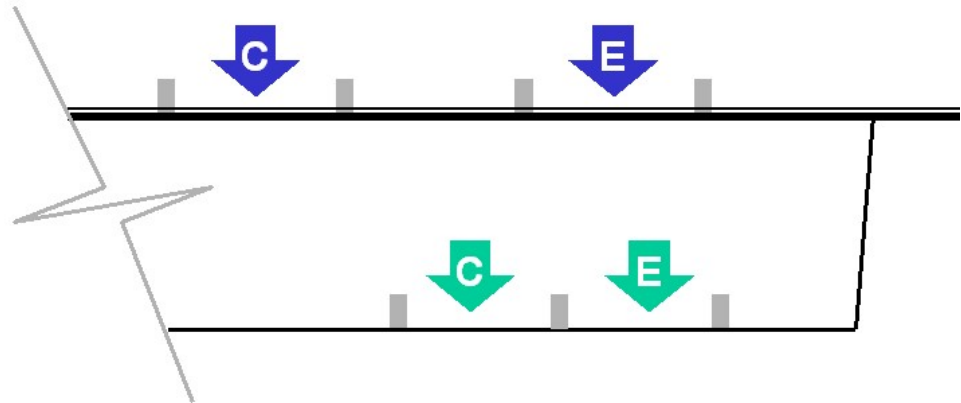
**LOCATION A – At driven tunnel portal**

E – LANES TO EASTERN FREEWAY  
C – LANES TO CLIFTON HILL



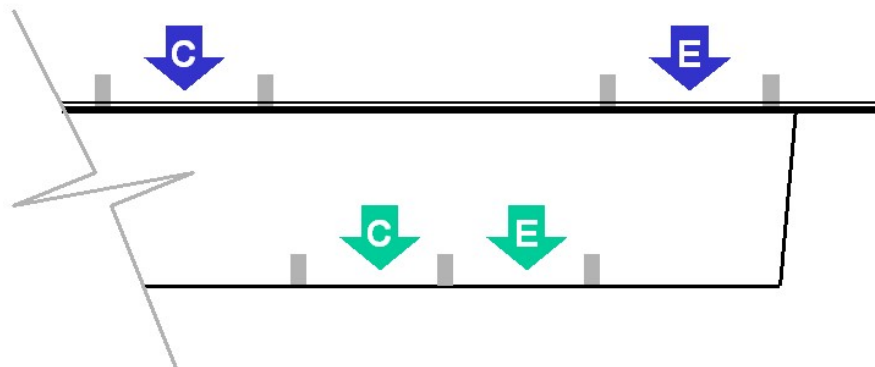
- ▶ Cut and Cover ramps start at the end of the driven tunnel portal;
- ▶ Surface roads unaffected;

#### LOCATION B – Partway along cut and cover ramps



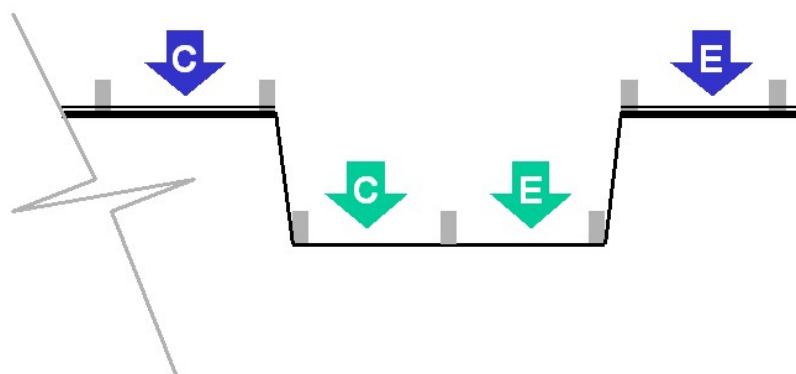
- As the ramps approach the surface level, the ramp lanes move toward the centre of the carriageway and the surface road lanes split apart.

#### LOCATION C – Near the end of the cut and cover ramps



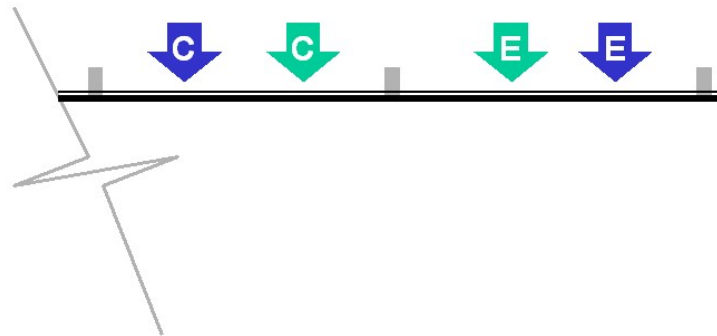
- The splitting of surface lanes continues as the ramp approaches the surface

#### LOCATION D – At the cut ramp section, prior to joining in at surface level



- The deck is no longer in place and the surface lanes have been fully separated

#### LOCATION E – Once the ramps have re-joined at surface level



- The Clifton Hill lanes have successfully been separated from the Eastern Freeway lanes at surface level and traffic can now continue on to its destination without weaving.

The analysis in this section is based on a high-level preliminary assessment of the tunnel. Detailed studies need to be conducted to determine the requirements for the tunnel and also the viability of this option. These actions are outlined below.

#### **Benefits**

- Increased capacity of Hoddle Street;
- Decreased travel times;
- Removal of conflicting movements that are causing congestion at surface level; and
- Removing surface traffic may allow for improved public transport services and increased amenity along Hoddle Street.

#### **Impacts**

- Major infrastructure requirements and resulting costs;
- Geometrical and geological constraints on the options for the north and south portals of the tunnel;
- Induced traffic to Hoddle Street as a result of increased capacity; and
- Issues with congestion at the entries and exits to the tunnel and weaving issues.

#### **Actions**

- Undertake origin-destination surveys and traffic modelling to determine the demand for the tunnel, possible requirements for tunnel connections and requirements for the location of the north and south tunnel portals;
- Undertake a capacity analysis to confirm the number of lanes required through the tunnel;
- Further investigate the portal locations and possible weaving and congestion issues at the ends of the tunnel;



- ▶ Further develop concept designs taking into consideration factors such as services, geotechnical, geometrical and structural details; and
- ▶ Undertake a detailed benefit-cost analysis.

**GHD recommends that these actions be implemented to further investigate this option.**

## **7.6 Park and Ride Facility at Victoria Park Station**

It is understood that a large portion of traffic travelling along Hoddle Street is city bound traffic. This option would involve constructing a park and ride facility in this vicinity of Victoria Park Station, which would provide commuters with the option of parking their vehicles and boarding the train for the remainder of their journey.

The park and ride facility would have direct access to the Eastern Freeway, hence reducing congestion at the Hoddle Street/Eastern Freeway interchange and also on Hoddle Street.

For this solution to be successful, the Clifton Hill Rail Group (Epping and Hurstbridge Lines) would need to have sufficient capacity to handle the increase in passengers boarding at Victoria Park Station.

It would also need to be a financially viable option for commuters, with a balance between the travel time savings and the cost of public transport. This could be provided in the form of subsidised public transport tickets or free parking at the park and ride facility.

The EWLNAS identified the option of constructing a bus only link between the Eastern Freeway and a bus-rail interchange at Victoria Park Station (via Lulie Street). This would require new traffic signals at the Lulie Street/Johnston Street intersection and other possible associated works to improve bus priority. The park and ride facility could be designed to tie in with this option. Utilising the ramps from the Eastern Freeway and allowing commuters to park their private vehicles at Victoria Park Station and transfer to either bus or rail services.

### ***Benefits***

- ▶ Providing a direct connection from the Eastern Freeway will relieve congestion at the end of the freeway and on Hoddle Street;
- ▶ This option will also reduce traffic and ease congestion on east-west roads used to access the CBD and inner suburbs;
- ▶ Reduces parking demand in the CBD.

### **Impacts**

- ▶ This option will require the acquisition of surrounding properties and buildings;
- ▶ The Clifton Hill Rail Group would need to have sufficient capacity to accommodate the increased boardings at Victoria Park Station;
- ▶ Major infrastructure works will be required to connect the park and ride facility to the Eastern Freeway;

### **Actions**

- ▶ Develop concepts for the park and ride facility and the connection to the Eastern Freeway;
- ▶ Conduct patronage forecasting to determine the demand for the facility and the required number of parking spaces. This would include consideration of the cost to the user and factors such as travel time savings; and
- ▶ Investigate the capacity of the Clifton Hill Rail Group and its ability to accommodate the increased patronage.

**GHD recommends that these actions be implemented to further investigate this option.**

## **7.7 Elevated Bus Lanes Above Hoddle Street**

This option involves the construction of a grade separated bus lane running along an elevated structure above Hoddle Street. This would allow buses to be completely segregated from traffic and flow freely along Hoddle Street before connecting east-west. The majority of bus routes travelling along Hoddle Street connect to Victoria Parade, therefore it is assumed that such a structure would provide a direct link between the Eastern Freeway and Victoria Parade.

By providing an elevated bus lane, it may be possible to remove the bus lanes from Hoddle Street, increasing capacity. However, there are also other bus routes that connect to Johnston Street and run along the length Hoddle Street. Therefore, depending on the location of the connections of the elevated structure, these buses would need to mix with traffic and incur delays at surface level. While some capacity will be gained on Hoddle Street, it is expected that the reduction in congestion will be minimal.

### **Benefits**

- ▶ Decreased travel time for buses between the Eastern Freeway and Victoria Parade;
- ▶ This would promote public transport as the preferred mode of transport and possibly induce a modal shift towards bus usage; and
- ▶ Raising buses above Hoddle Street will allow bus lanes to be removed from the surface level on Hoddle Street.



### **Impacts**

- ▶ Major infrastructure works would be required with significantly high costs and several complicated issues;
- ▶ This option would have minimal influence on reducing congestion on Hoddle Street; and
- ▶ No bus stops will be available on Hoddle Street between the Eastern Freeway and Victoria Parade.

### **Actions**

- ▶ Further investigation would be required to understand the level of benefit associated with such a significant piece of infrastructure.

**GHD does NOT recommend that these actions be implemented to further investigate this option.**

## **7.8 Grade Separated Road Above Train Line**

This option will involve the use of the existing rail corridor to construct an elevated structure above the train line. At the northern end, the new elevated road would connect directly to the Eastern Freeway. The rail line corridor runs down to Wellington Parade before continuing east towards Jolimont Station. Options would need to be considered as to which of the east-west roads to connect to and where to end the road at the southern end. Other factors to consider include:

- ▶ Will the new road be one-way, two-way or tidal flow?
- ▶ How will buses be accommodated?
- ▶ What treatments will be provided to Hoddle Street at the surface level given the reduction of traffic?

Detailed studies need to be conducted to determine the answer to these questions and in-turn determine the viability of this option. This will include origin-destination surveys and traffic modelling to determine traffic behaviour and the effect of the road options.

### **Benefits**

- ▶ Effectively providing a bypass of Hoddle Street, hence reducing volumes and freeing up capacity on Hoddle Street;
- ▶ Removal of conflicting movements that are causing congestion at surface level; and
- ▶ Reducing surface traffic may allow for improved public transport services and increased amenity along Hoddle Street.

### **Impacts**

- ▶ Major infrastructure requirements, particularly at the train stations and possible interchanges with connecting east-west roads.



### ***Actions***

- ▶ Undertake origin-destination surveys and traffic modelling to determine the demand for the new road and the requirements for road connections; and
- ▶ Further investigation would be required to understand the level of benefit associated with such a significant piece of infrastructure.

**GHD does NOT recommend that these actions be implemented to further investigate this option.**

## 8. Design and Construction Issues

For each of the short-term, medium-term and long-term improvements discussed throughout this report, benefits and impacts have been identified. These impacts have not focussed on the construction issues associated with any recommended work. In the case of the long-term options where significant infrastructure is required, the construction impacts on traffic flow could outweigh the long-term benefits. The following sections identify the potential construction impacts that may be faced with the various options.

### 8.1 Road Reserve Widths

Several of the options are dependent on there being sufficient cross-section in order to develop the infrastructure. This cross-section is required to provide for any works and allow space to continue traffic flow around the site. The existing road reserve width is not constant along Hoddle Street, and changes a number of times.

From north to south;

- ▶ To the north of the Eastern Freeway, the road reserve is approximately 40 metres wide;
- ▶ Between the Eastern Freeway and Johnston Street, the road reserve is slightly greater than 50 metres wide. This includes the existing service road on the west side of the main carriageways;
- ▶ Between Johnston Street and Victoria Parade, the road reserve is approximately 45 metres wide;
- ▶ Between Victoria Parade and Wellington Parade, the road reserve reduces to approximately 30 metres wide; and
- ▶ Between Wellington Parade and Swan Street, the road reserve is approximately 35 metres wide.

These varying widths of the road reserve will influence the impact that a particular option may have on the surrounding traffic, and the ability of the traffic using Hoddle Street to be catered for in the road reserve width remaining. This needs to be a major consideration in planning this work and temporary land acquisition may be required.

## **8.2 Cut and Cover Tunnels**

### **8.2.1 Physical Footprint**

Options for the construction of cut and cover tunnels to grade separate major intersections along Hoddle Street have been discussed in Section 7. The various options have different cross-sections proposed. Discussion in this section is based on the assumption that two through lanes in each direction will be provided under Hoddle Street. The typical section for the ramp and cut and cover roadway during construction is provided in Appendix H. The cross section of the cut and cover roadway is as follows:

- ▶ A central support of 1.0 metre width;
- ▶ Concrete barriers on each side of the central support of total width 0.73 metres;
- ▶ Inner shoulders of 0.5 metres width;
- ▶ Two lanes in each direction of 3.5 metres width;
- ▶ Outer shoulders of 0.5 metres width;
- ▶ Walkways on the outside of each carriageway of 1.3 metres width; and
- ▶ Columns/bored piles on each side of 1.2 metres width.

The above elements result in a minimum road width footprint of 22.8 metres for a cut and cover tunnel, including an allowance for the outer supports/walls of the tunnel. This footprint would take up considerable road space for the length of the cut ramp sections. Once the ramps had reached sufficient clearance, decking could be provided to reduce the impact on the surface.

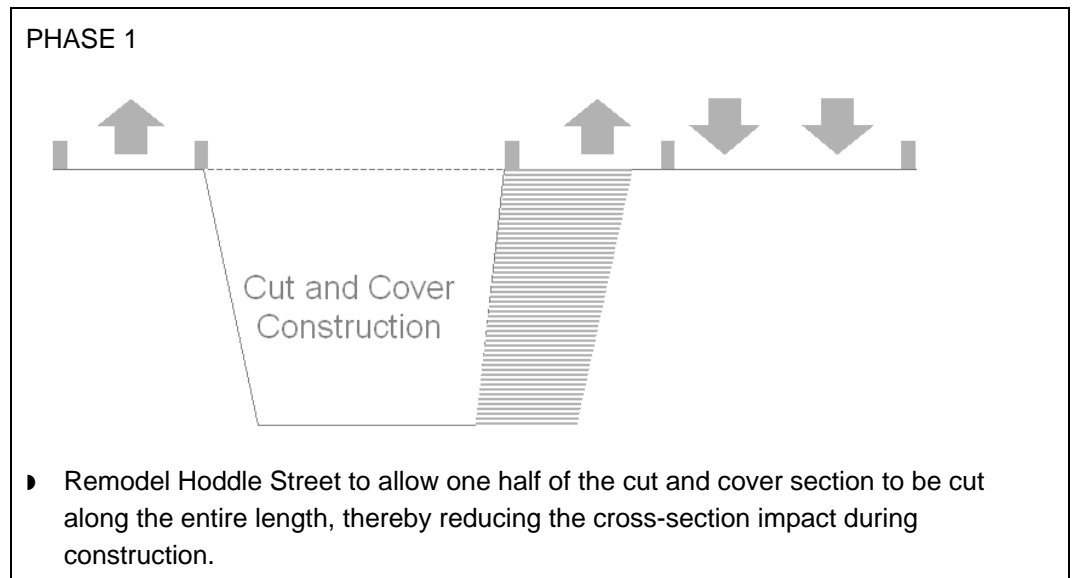
### **8.2.2 Construction Issues**

To allow for barriers and clearances to through traffic it was assumed a 3.0 metre clearance on the outside of each carriageway would be sufficient. This would bring the “construction footprint” for a cut and cover tunnel to approximately 29 metres. This footprint will apply for the entire length of the construction corridor. Note that the above assumption of a 3.0 metre clearance is not based on any geotechnical information or slope stability analysis of the proposed cut and cover trench.

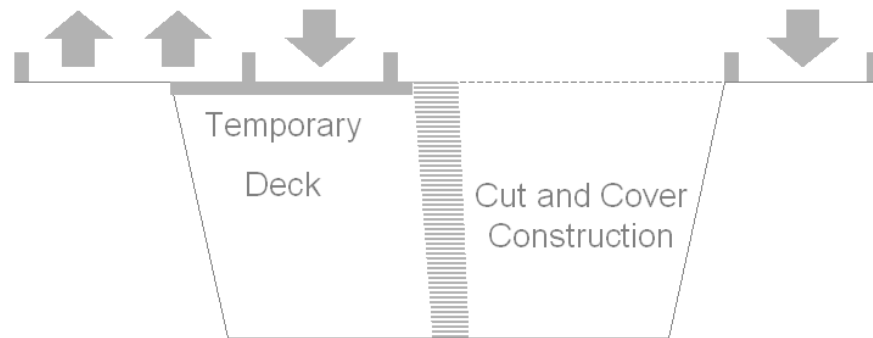
During construction of the tunnels, it is assumed there will be a need to provide one or two through lanes of 3.2 metres minimum width in each direction, along with a footpath (say 2.0 metres wide) on each side of the road. As a result, the minimum width required to construct a cut and cover tunnel - including the provision of through lanes adjacent to the construction footprint - will be approximately 40 metres for one through lane in each direction, and 46 metres for two through lanes in each direction. Please note however that even with the provision of two through lanes in each direction during the construction phase, it is felt that the impact on traffic flow along Hoddle Street through the construction phase will be severe.

As a result, it is considered that the construction of a cut and cover tunnel can be accommodated within the existing road reserve to the north of Victoria Parade, including the provision of either one or two through lanes in each direction adjacent to the construction zone. However to the south of Victoria Parade, the existing road reserve only has width for the construction footprint of a cut and cover tunnel, and does not have sufficient width for the provision of adjacent through lanes and footpaths. Property acquisition may be required through these areas to widen the road reserve, both during the construction phase and to allow for the final road arrangement. The extent of the acquisition required during the construction could be minimised if the works are staged from one side of Hoddle Street to the other, as per Figure 11. However even under this complicated scenario, the traffic impacts are likely to be significant and acquisition may be required.

**Figure 11 Staging of Cut and Cover Construction**

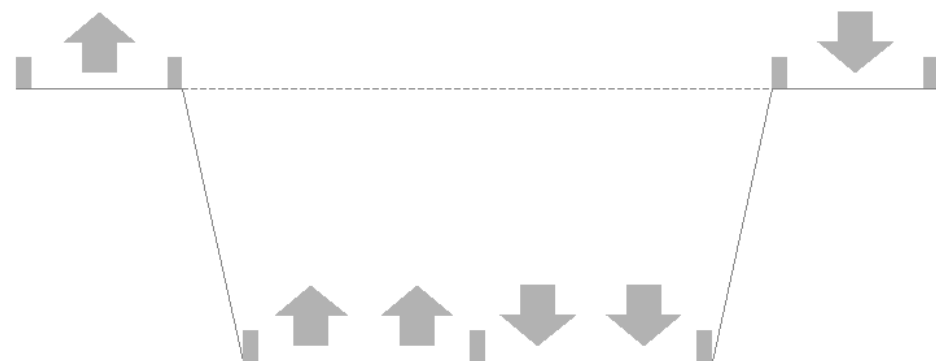


## PHASE 2



- ▶ Construct a temporary deck structure of the first half of the cut and cover tunnel to allow traffic flow;
- ▶ Begin construction work on the second half;

## PHASE 3



- ▶ Finalise construction of second half;
- ▶ Remove temporary deck structure;
- ▶ Open to full traffic.

Another critical issue will be the construction impact of a cut and cover tunnel across the arterial roads crossing Hoddle Street. Of particular concern here will be the impact on the tram routes along Victoria Parade. The simplest way to construct these crossings will be to close the east-west arterial roads across Hoddle Street during the construction phase, allowing the tunnel construction to proceed as quickly as possible. Keeping the east-west arterial roads open during the construction phase will require the staged construction of the tunnel at each intersection. Additionally, the tight road reserves of many of the cross roads will limit the extent traffic can be shifted through a staged construction of the tunnel, and may inhibit the ability to keep the cross arterial roads open. Of perhaps greater impact will be the restrictions on the movement of construction vehicles if the complete length of the site is not open.

## **8.3 Driven Tunnels**

### **8.3.1 Physical Footprint**

In addition to the cut and cover options, a driven tunnel along a significant length of Hoddle Street was also considered. It is assumed that a driven tunnel will have two through lanes in each direction. The typical section at the driven tunnel portal during construction is provided in Appendix H. The cross section of the through lanes in each tunnel is as follows:

- ▶ Inner shoulders of 0.5 metres width;
- ▶ Two lanes in each direction of 3.5 metres width; and
- ▶ Outer shoulders of 0.5 metres width.

If the tunnel is to be bored using a Tunnel Boring Machine (TBM) then the tunnel will be circular with an internal diameter of 11.0 metres. An additional width of 1.0 metre is allowed for the lining of the tunnel. It is assumed that the clearance between the two driven tunnels needs to be a minimum of 8.0 metres. As above, this assumption is not based on site specific geotechnical information or analysis, and this needs to be confirmed.

The above dimensions result in a minimum cross section of 32 metres for a driven tunnel. However this large cross-section would be required at the tunnel portals at a depth of 18 metres, whereas the ramps to these portals could be constructed as cut and cover thereby minimising the footprint required at the surface level. Assuming the existing surface is flat and the maximum grade at the tunnel entrance is 5%, the length of this cut and cover ramp would be approximately 450 metres. Once the ramps have reached sufficient clearance, a deck structure could be constructed to reduce the footprint impact on the surface. It is expected that the final arrangement would have cut and cover ramps with a similar cross section to those mentioned above for a ramp length of approximately 200 metres.

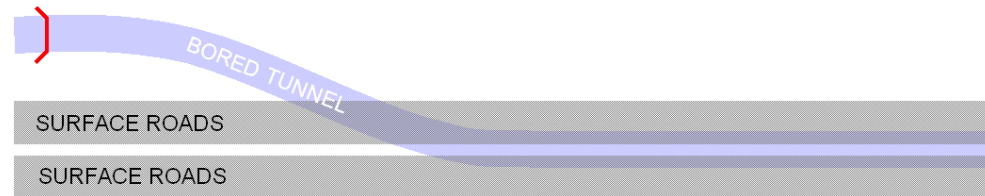
### **8.3.2 Construction Issues**

In order to minimise the impact on traffic during construction, it is proposed to create a construction area adjacent to Hoddle Street to commence the tunnelling operations at both the north and south ends of a driven tunnel, and construct the tunnel portals and ramp footprints in a “quick” stage once the main tunnel construction is completed.

This process is shown in Figure 12 below.

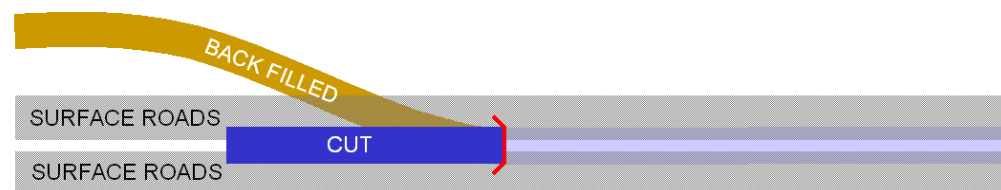
**Figure 12 Staging of Bored Construction**

**PHASE 1**



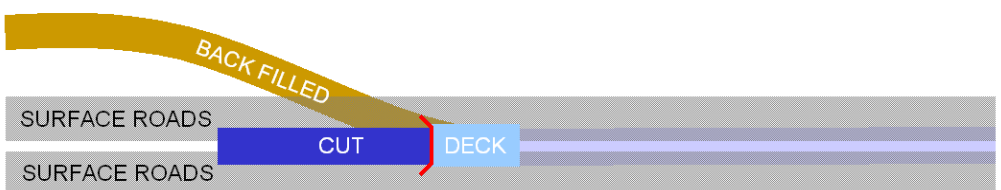
- ▶ Develop a worksite in available space adjacent to Hoddle Street;
- ▶ Start bored tunnel at this location (effectively a construction period tunnel portal); and
- ▶ Bore across to Hoddle Street and straighten the alignment to continue along Hoddle Street (the final tunnel alignment).

**PHASE 2**



- ▶ Develop a cut ramp section down to the preferred tunnel alignment portal; and
- ▶ Backfill the tunnel section branching out from here.

**PHASE 3**



- ▶ Construct a deck section over the cut ramp to provide full utilisation of the surface roads;

Opportunities for a tunnel construction area separate to Hoddle Street appear to exist between Victoria Park and the Clifton Hill Railway Line at the north end of Hoddle Street, and to the north of the Punt Road Oval at the south end of Hoddle Street (at the locations shown in Appendix G). This would allow a driven tunnel to be constructed under Johnston Street, Victoria Parade and Bridge Road with minimum impact on the amenity and functionality of Hoddle Street through the construction phase. The tunnel portals and associated ramps would then be constructed at the end of the tunnel-driving phase. It should be noted that the area between Victoria Park Oval and Victoria





Park Station has been flagged for a potential Bus Interchange in the East-West Needs Assessment, and the use of this area as a tunnel construction site will need to consider the timing and extent of the proposed bus facilities.

Due to the required ramp lengths, the northern tunnel portal would need to be constructed to the south of Johnston Street, with the ramp passing underneath Johnston Street to surface between Johnston Street and the Eastern Freeway. Note that the ramp under Johnston Street will effectively need to be constructed as a cut and cover tunnel, which will create similar issues to those discussed for cut and cover tunnels as described above. Some property acquisition may be required to the south of Johnston Street to allow for this arrangement. The southern tunnel portal could be constructed to the south of Bridge Road, where the existing grade of Hoddle Street will help to reduce the required length of the ramp. The ramp and portal construction could not fit within the existing road reserve, but the opportunity probably exists to use a thin section of Yarra Park to the north of Punt Road Oval to provide the required width for construction and adjacent surface lanes.



## 9. Costings

GHD has prepared high-level cost estimates for the options recommended for further investigation in the short, medium and long-term improvement sections. These costings are preliminary and based on GHD's previous experience on projects of this nature and industry rates and are provided for comparison purposes only. Detailed planning and design of projects would be required for more accurate cost estimates.

The assumptions that have been applied as part of the development of these cost estimates are:

- ▶ Land acquisition costs have not been allowed for;
- ▶ For services, broad allowances have been made due to the difficulty of quantifying the location and type of services at this stage. As this is an inner suburban area, it is expected that many services will be affected;
- ▶ No design works have been undertaken;
- ▶ 30% minimum contingencies on all options; and
- ▶ High allowances have been made for traffic management, as all works would need to be undertaken whilst maintaining traffic flows.

The costings for the short, medium and long-term improvement recommendations are summarised in Table 2, Table 3 and Table 4.



**Table 2 Short Term Improvements Preliminary Costings**

Option No	Description	Comments	Workings	Estimated Cost
5.1.1	Review of Signal Timings	VicRoads staff time only	<ul style="list-style-type: none"> <li>• Traffic management staff at VicRoads Control Centre</li> <li>• On-site observations/measurement of traffic flow</li> </ul>	\$100,000
5.1.2	Balancing Queues Eastern Freeway and Johnston Street	VicRoads staff time only	<ul style="list-style-type: none"> <li>• Traffic management staff at VicRoads Control Centre</li> <li>• On-site observations/measurement of traffic flow</li> </ul>	\$100,000
5.2	Ban Right Turn at Victoria Parade and Allow P-Movements	Modelling and some physical works	<ul style="list-style-type: none"> <li>• VicRoads staff time (\$100,000)</li> <li>• Microsimulation model (\$200,000)</li> <li>• Driver behaviour model (\$100,000)</li> <li>• Physical works – kerbs, etc (\$500,000)</li> </ul>	\$900,000
5.3	Encourage Right Turn into Albert Street	Modelling and various studies		\$400,000
5.4	Clearways and Parking Restrictions	Modelling and VicRoads staff time	<ul style="list-style-type: none"> <li>• VicRoads staff time to review parking (\$200,000)</li> <li>• Microsimulation model (\$200,000)</li> <li>• Various other – signs, etc (\$200,000)</li> </ul>	\$600,000



**Table 3 Medium Term Improvements Preliminary Costings**

Option No	Description	Comments	Workings	Estimated Cost
6.2	Northbound Bus Lane in Service Road	Physical works on service roads	<ul style="list-style-type: none"> <li>▶ Civil works – alter pavements, kerbs, extra strengthening may be required (\$1.5M)</li> <li>▶ New pavements (\$1.5M)</li> <li>▶ Signals/conduits (\$3.0M)</li> <li>▶ Services (\$0.5M)</li> <li>▶ Design (\$0.5M)</li> <li>▶ 40% Contingency (\$3M)</li> </ul>	\$12 million
6.3	Pedestrian Bridge Crossing at Johnston Street		Based on similar costs at EastLink	\$6 million



**Table 4 Long Term Improvements Preliminary Costings**

Option No	Description	Comments	Workings	Estimated Cost
7.1(a)	Hoddle Street under Johnston Street (cut and cover tunnel) with connections	<ul style="list-style-type: none"> <li>3 lanes in each direction along Hoddle Street</li> <li>1 lane surface road to Johnston Street</li> </ul>	<ul style="list-style-type: none"> <li>Physical works (\$60M)</li> <li>Services (\$30M)</li> <li>Traffic Management (\$20M)</li> <li>Project Management and Design (\$10M)</li> <li>Contingency (\$40M)</li> </ul>	\$160 million
7.2.1	Hoddle Street under Victoria Parade (cut and cover tunnel)	<ul style="list-style-type: none"> <li>4 lane underpass from Albert Street to Gipps Street</li> </ul>	<ul style="list-style-type: none"> <li>Physical works (\$350M)</li> <li>Services (\$80M)</li> <li>Traffic Management (\$30M)</li> <li>Project Management and Design (\$40M)</li> <li>Contingency (\$100M)</li> </ul>	\$600 million
7.3	Driven Tunnel under Wellington Parade		<ul style="list-style-type: none"> <li>Physical works (\$200M)</li> <li>Services (\$80M)</li> <li>Traffic Management (\$30M)</li> <li>Project Management and Design (\$40M)</li> <li>Contingency (\$120M)</li> </ul>	\$530 million
7.5	Tunnel under Hoddle Street	4 lane tunnel from north of Johnston Street to north of Brunton Avenue	<ul style="list-style-type: none"> <li>Physical works (\$900M)</li> <li>Services (\$150M)</li> <li>Traffic Management (\$40M)</li> <li>Project Management and Design (\$110M)</li> <li>Contingency (\$300M)</li> </ul>	\$1.5 billion



Option No	Description	Comments	Workings	Estimated Cost
7.6	Park and Ride at Victoria Park Station		<ul style="list-style-type: none"><li>Physical works (\$50M)</li><li>Project Management and Design (\$5M)</li><li>Contingency (\$15M)</li></ul>	\$70 million



## 10. Recommendations

This report has identified a number of potential short, medium and long-term options for relieving congestion along Hoddle Street. Several benefits and impacts have been identified for each of the options. However, before GHD can make any firm recommendation on the potential solution, further work and investigation is required. The following sections outline GHD's understanding of this further work and future courses of action.

### 10.1 Short Term Improvements

The potential short-term improvements discussed have the potential to relieve congestion along Hoddle Street and as they do not require major infrastructure works, they may provide benefits while planning and construction of the long-term improvements occurs. The short-term improvements are generally focussed on signal alterations that can be implemented and therefore will be low-cost.

GHD recommends the actions associated with the following short-term improvements be further investigated:

#### ***Review of Signal Timings***

- ▶ Following the implementation of other options, the signal operation and co-ordination should be reviewed taking into consideration the demands and modal priorities along the Hoddle Street corridor.

#### ***Balancing of Eastern Freeway and Johnston Street Queues***

- ▶ Review the queuing along Johnston Street and test the impacts and benefits of increasing the green time for Hoddle Street at the expense of the Johnston Street approaches. This would include investigating the downstream impacts of this option on adjacent intersections.

#### ***Ban Right Turn at Victoria Parade and Allow P Movements***

- ▶ Undertake microsimulation testing of the Victoria Parade and Albert Street intersections to test the impacts and benefits of the option;
- ▶ As the P movement would be an unusual turn for drivers, undertake a driver behaviour review to test whether this option would be successfully taken up by drivers; and
- ▶ Investigate this option in conjunction with the following option of encouraging right turns into Albert Street.

### ***Encourage Right Turn into Albert Street***

- ▶ Undertake microsimulation testing of the Victoria Parade and Albert Street intersections to test the impacts and benefits of the option; and
- ▶ Investigate this option in conjunction with the previous option of banning right turns at Victoria Parade and allowing P movements.

### ***Clearways and Parking Restrictions***

- ▶ A review of the parking conditions and utilisation along Hoddle Street and intersecting east-west routes; and
- ▶ Investigate possible locations for off-street parking to offset the potential removal of on-street parking.

## **10.2 Medium Term Improvements**

This section of the report focuses on the potential medium term improvements to relieve congestion along Hoddle Street. GHD has defined medium-term improvements as those that could be implemented over a five-year period and consequently the improvements are generally focussed on treatments that require minor infrastructure works utilising existing road space.

GHD recommends the actions associated with the following medium-term improvements be further investigated:

### ***Northbound Bus Lane in Service Road***

- ▶ Investigate opportunities to convert northbound service lanes to a bus or T2 lane.

### ***Grade Separated Pedestrian Crossing at Johnston Street***

- ▶ Investigate the opportunities for constructing a pedestrian overpass within the vicinity of the Johnston Street/Hoddle Street intersection.

## **10.3 Long Term Improvements**

The potential long-term improvements provided are predominantly based on grade separation projects. Options have been identified to grade separate individual intersections, as well as an option of a long driven tunnel running underneath Hoddle Street. This section will discuss each of the options individually and the actions required to move forward with each of the options.

### ***Johnston Street Intersection Treatments***

The preferred option for grade separation at Johnston Street is to run Hoddle Street underneath Johnston Street through the construction of a sub level structure and access ramps (cut and cover) with connections to Johnston Street provided at surface level.





GHD recommends that the following actions be implemented to further investigate this option:

- ▶ Undertake an intersection analysis or traffic modelling to determine the benefits of grade separation at this location;
- ▶ Investigate the demand for connections to Johnston Street and determine which movements are required for access to Johnston Street;
- ▶ Undertake a capacity analysis to determine the number of through lanes required on Hoddle Street;
- ▶ Investigate the portal locations and possible weaving issues;
- ▶ Further develop concept designs taking into consideration factors such as services, geotechnical, geometrical and structural details; and
- ▶ Undertake a detailed benefit-cost analysis.

#### ***Victoria Parade/Victoria Street Intersection Treatments***

The preferred option for grade separation at Victoria Parade is to run Hoddle Street underneath Victoria Parade through the construction of a sub level structure and access ramps (cut and cover) with the intersection remaining at surface level with all movements accommodated.

GHD recommends that the following actions be implemented to further investigate this option:

- ▶ Undertake an intersection analysis or traffic modelling to determine the benefits of grade separation at this location;
- ▶ Investigate the demand for turning movements at Victoria Parade to determine the required configuration of the intersection and signal timings;
- ▶ Undertake a capacity analysis to determine the number of through lanes required on Hoddle Street;
- ▶ Investigate the portal locations and possible weaving issues;
- ▶ Further develop concept designs taking into consideration factors such as services, geotechnical, geometrical and structural details; and
- ▶ Undertake a detailed benefit-cost analysis.

#### ***Wellington Parade Intersection Treatments***

The preferred option for grade separation at Wellington Parade is to run Hoddle Street underneath Wellington Parade through the construction of a driven tunnel with tunnel portals on Hoddle Street on either side of Wellington Parade.

GHD recommends that the following actions be implemented to further investigate this option:

- ▶ Undertake an intersection analysis or traffic modelling to determine the benefits of grade separation at this location;

- ▶ Investigate the demand for turning movements at Wellington Parade to determine the required configuration of the intersection and signal timings;
- ▶ Undertake a capacity analysis to determine the number of through lanes required on Hoddle Street;
- ▶ Investigate the portal locations and possible weaving issues;
- ▶ Further develop concept designs taking into consideration factors such as services, geotechnical, geometrical and structural details; and
- ▶ Undertake a detailed benefit-cost analysis.

#### ***Swan Street Intersection Treatments***

There are many limitations on the options for grade separation at this intersection. However a preliminary investigation into the vertical cross-section in the vicinity of this intersection has identified that there may be an opportunity to grade separate via either a cut and cover or driven tunnel. There may also be opportunities to widen the intersection to increase capacity on the approaches, however this will be limited by the space available under the rail bridge crossing Hoddle Street north of Swan Street.

GHD recommends that the following actions be implemented to further investigate this option:

- ▶ Undertake an intersection analysis or traffic modelling to determine the benefits of grade separation at this location;
- ▶ Investigate the demand for turning movements at Swan Street to determine the required configuration of the intersection and signal timings;
- ▶ Undertake a capacity analysis to determine the number of through lanes required on Hoddle Street;
- ▶ Investigate the portal locations and possible weaving issues;
- ▶ Further develop concept designs taking into consideration factors such as services, geotechnical, geometrical and structural details; and
- ▶ Undertake a detailed benefit-cost analysis.

#### ***Tunnel Underneath Hoddle Street***

This option involves running a driven tunnel underneath Hoddle Street. It is expected that the tunnel would act as a north south bypass with two lanes in each direction and no lateral connections. There are several options for the location of the north and south tunnel portals and further investigation is required to determine the preferred location of these portals.

GHD recommends that the following actions be implemented to further investigate this option:

- ▶ Undertake origin-destination surveys and traffic modelling to determine the demand for the tunnel, possible requirements for tunnel connections and requirements for the location of the north and south tunnel portals;

- ▶ Undertake a capacity analysis to confirm the number of lanes required through the tunnel;
- ▶ Further investigate the portal locations and possible weaving and congestion issues at the ends of the tunnel;
- ▶ Further develop concept designs taking into consideration factors such as services, geotechnical, geometrical and structural details; and
- ▶ Undertake a detailed benefit-cost analysis.

#### ***Park and Ride Facility at Victoria Park Station***

This option involves constructing a park and ride facility in the vicinity of Victoria Park Station. This facility would have direct access to the Eastern Freeway and provide commuters with the option of parking their vehicles and boarding the train for the remainder of their journey.

GHD recommends that the following actions be implemented to further investigate this option:

- ▶ Develop concepts for the park and ride facility and the connection to the Eastern Freeway;
- ▶ Conduct patronage forecasting to determine the demand for the facility and the required number of parking spaces. This would include consideration of the cost to the user and factors such as travel time savings; and
- ▶ Investigate the capacity of the Clifton Hill Rail Group and its ability to accommodate the increased patronage.

### **10.4 Next Steps**

Through the recommendations outlined above there are several actions identified. Many of these actions involve further investigation of the traffic impacts and capacity requirements of the recommendations. GHD consider that the next course of action to effectively investigate improvements along this corridor and satisfy the actions identified is the following package of work:

#### **10.4.1 Data Collection**

Significant data collection and collation of the following:

- ▶ Traffic volumes at midblocks;
- ▶ Turning movement counts;
- ▶ Origin – Destination surveys along the length of the corridor;
- ▶ Queue length surveys; and
- ▶ Travel Time surveys.

This data would be able to provide a detailed understanding of the problems and their causes along the corridor and would form the first step in gaining more understanding of this vital piece of Melbourne transport network.



#### **10.4.2 Strategic Study**

GHD considers that a study should be undertaken which considers the Hoddle Street corridor as a part of the collection of other north-south corridors across this area of eastern Melbourne.

This study should consider recommended improvements to the operation of Hoddle Street and should assess the potential impacts across the broader road network, including other north-south corridors such as Denmark Street and Burke Road. Any other major connections in the road network would also need to be considered in this study to understand their impacts.

One element of this study would be to refine a strategic model (such as MITM) based on the traffic data collected above. This data would assist to refine a calibration of a model through this area. This refined model would then be able to test significant changes in the corridor to understand their impacts on Hoddle Street and the broader network.

#### **10.4.3 Microsimulation Modelling**

In conjunction with the previous two steps, a microsimulation model should be developed for the length of the Hoddle Street corridor in question. This model would also draw on the previous data collection and would need to be accurately calibrated to test a suite of potential solutions. The model should incorporate:

- ▶ Grade and the impacts this has on heavy vehicles (for both existing conditions and potential tunnel options);
- ▶ Public transport services to understand how they may be affected;
- ▶ Adjacent intersections to ensure that immediate impacts have been considered; and
- ▶ Signal timings or SCATS interface so that any signal modification testing is accurate.

This model would be used to understand the realistic benefits that could be achieved by the various options, both in isolation and as a package. This will allow for a comparison of the improvement options (such as whether it is more beneficial to tunnel along a significant length of Hoddle Street or grade-separate individual intersections) to determine the recommended package of works. The model would be used to output detailed time and cost saving data, which could be used in a Benefit Cost Assessment.



#### **10.4.4 Functional Design**

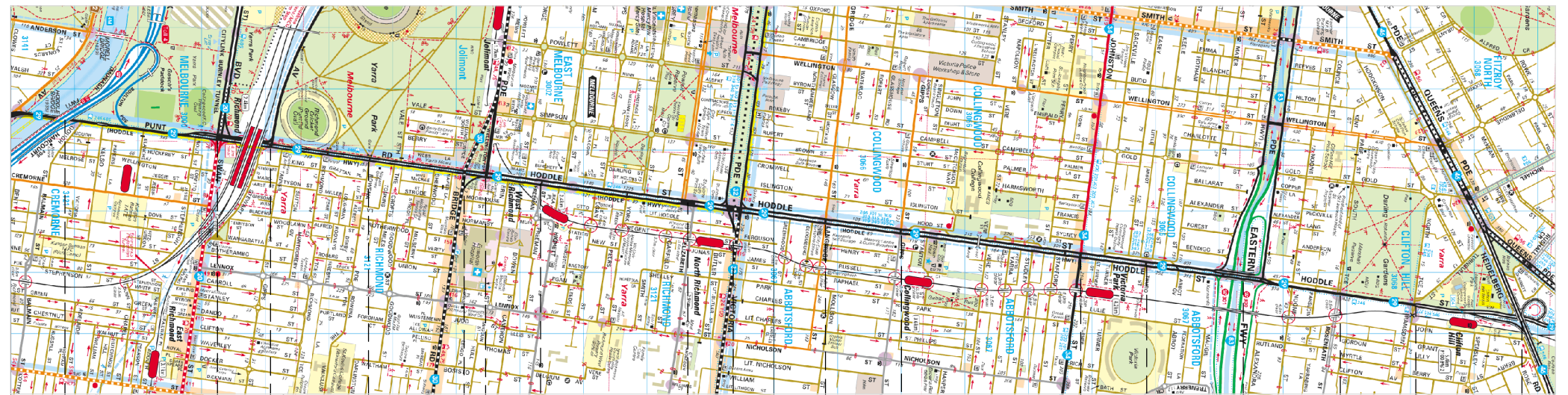
Following on from the studies outlined above, any recommended treatments would then need to be further developed. These designs would involve a greater level of detail to the concept sketches provided in this report. The functional designs would need to consider (but not be limited to):

- ▶ Services;
- ▶ Topography; and
- ▶ Geotechnical constraints.



Appendix A

# Hoddle Street Operational Plan



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[illegible]



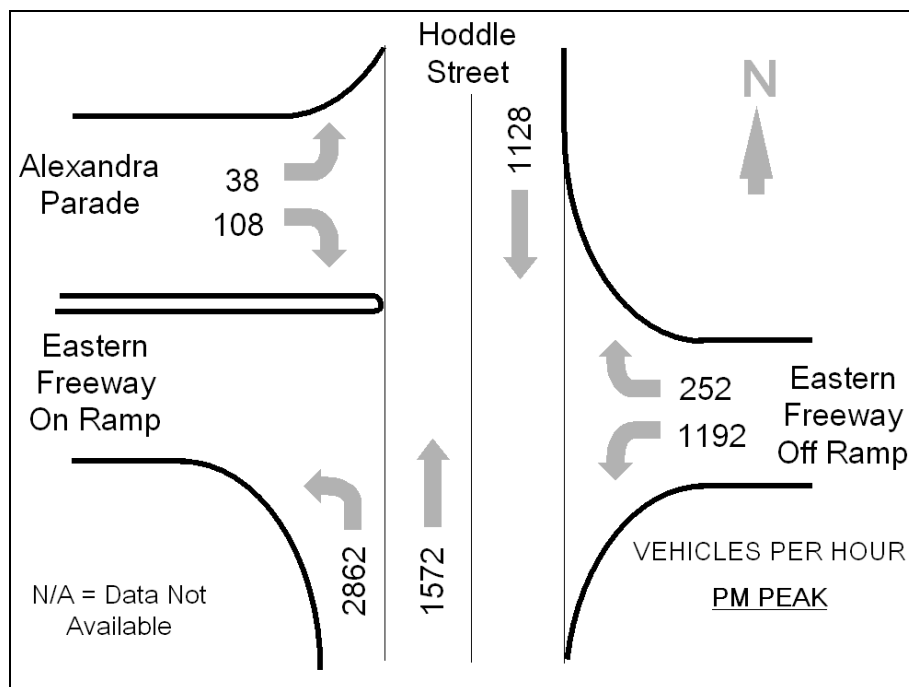
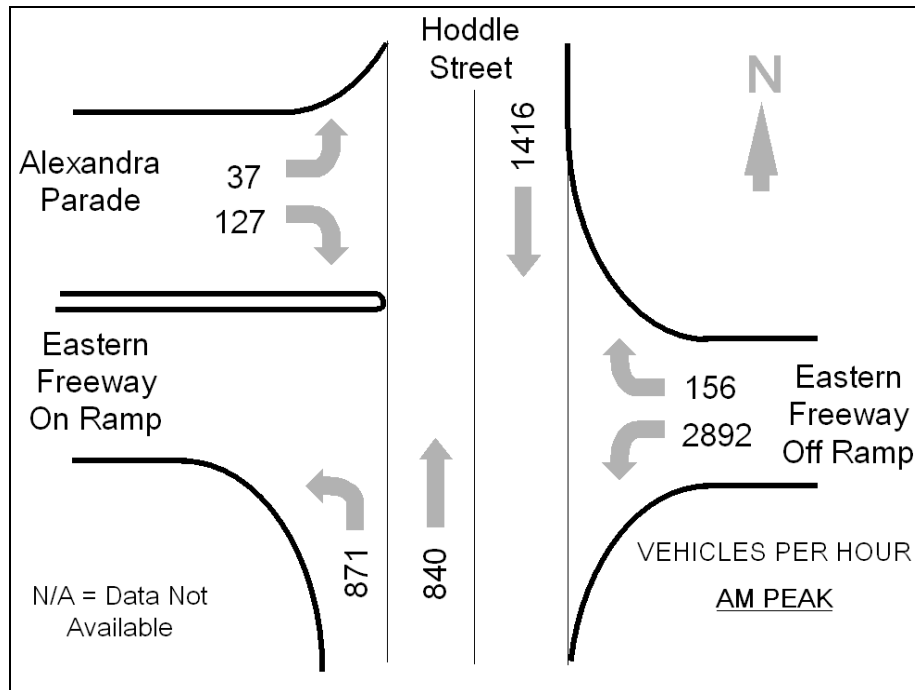
## Appendix B

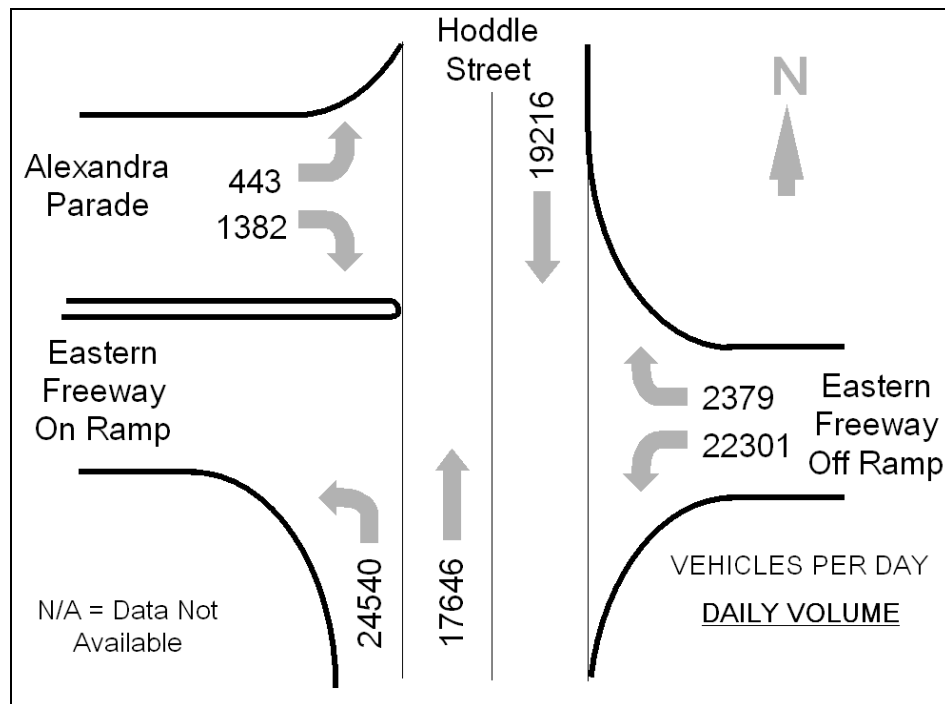
# Turning Movement Diagrams



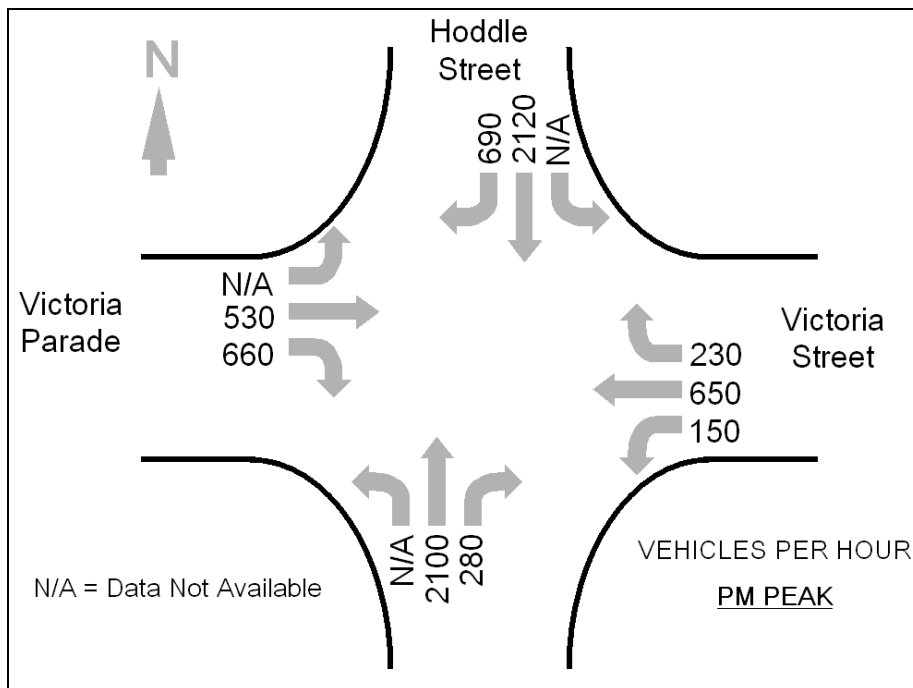
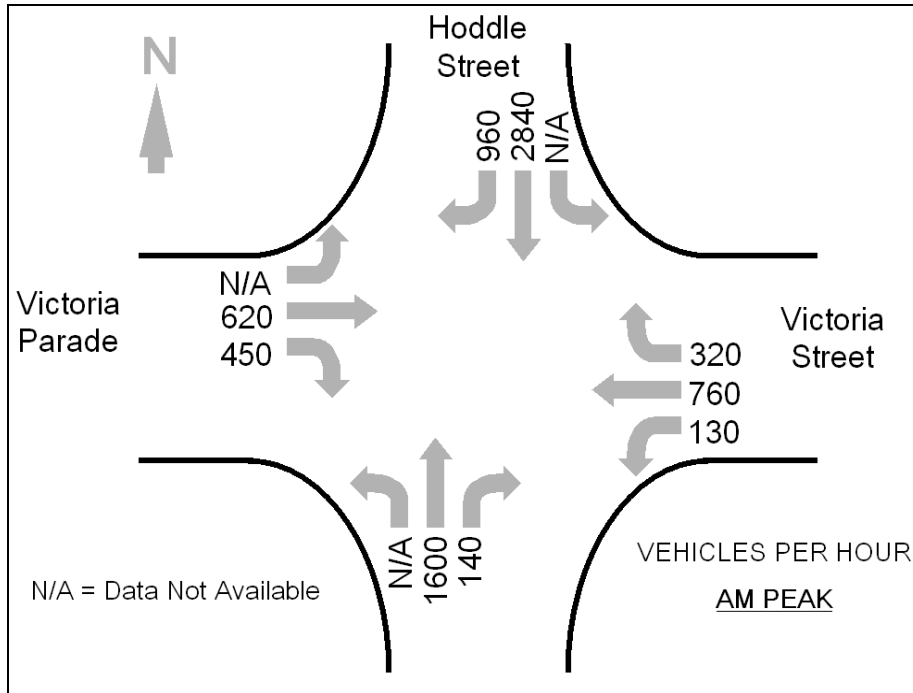


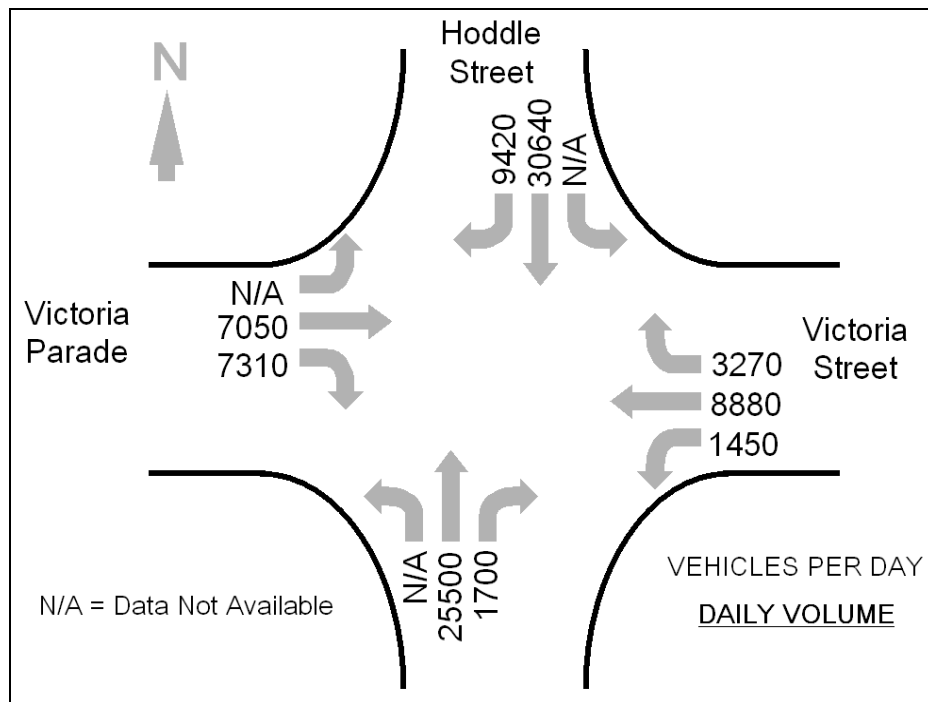
### ***Hoddle Street/Eastern Freeway/Alexandra Parade Intersection***



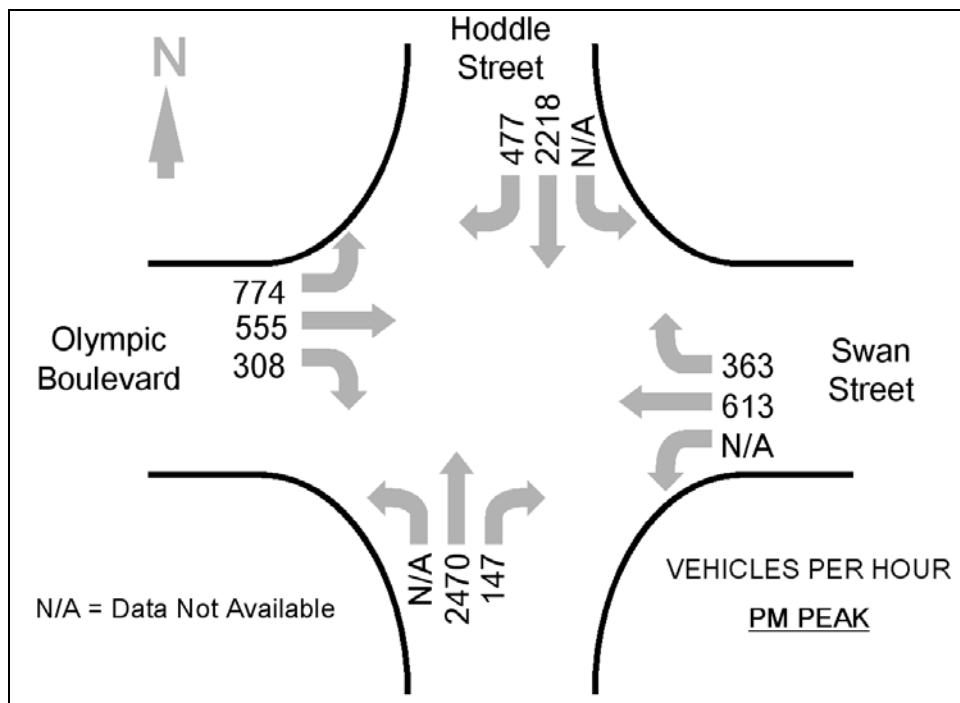
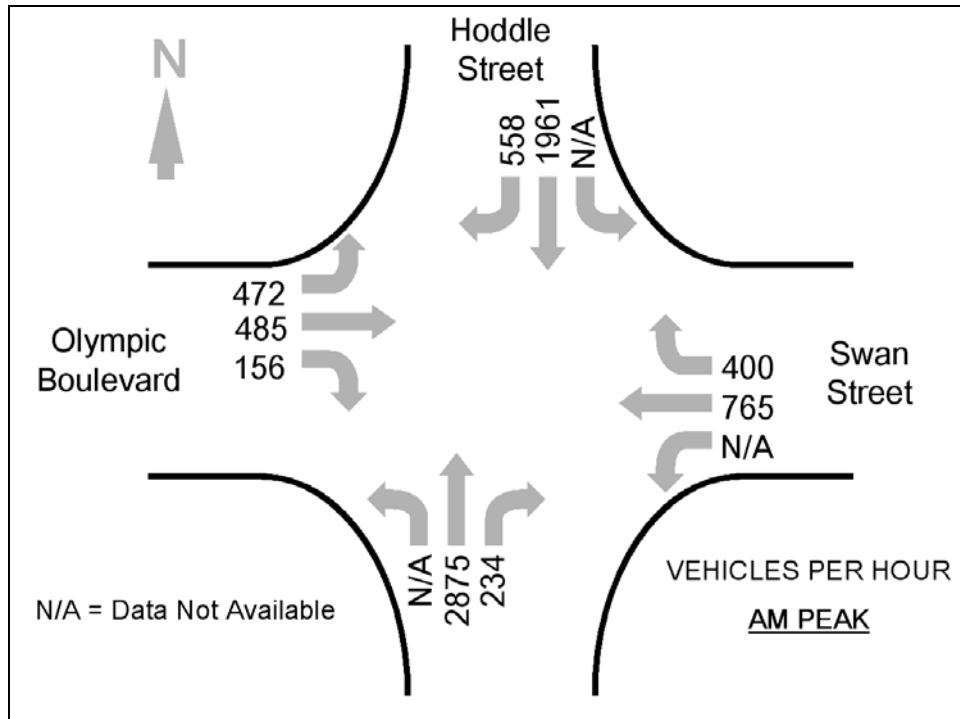


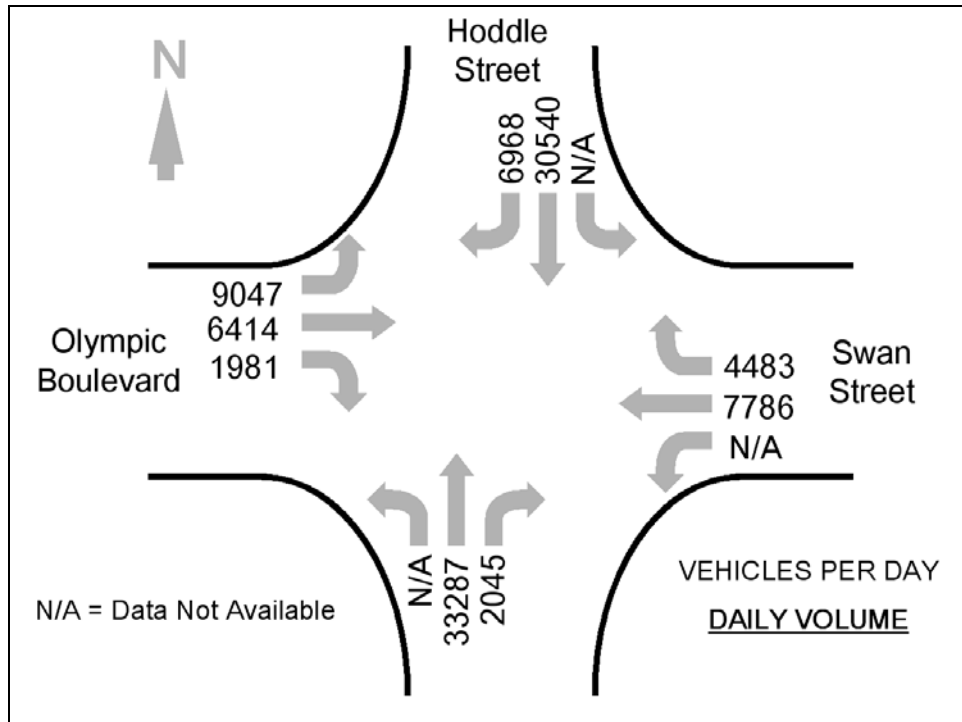
### Hoddle Street/Victoria Parade/Victoria Street Intersection





### Hoddle Street/Swan Street/Olympic Boulevard Intersection







## Appendix C

# Public Transport Summary



## Public Transport Route Summary

Route Number	Route Name	Direction	Length Travelled Along Hoddle Street	Number of Services on a Weekday	First Service Leaving Origin	Last Service Leaving Origin	AM Peak Frequency	Off Peak Frequency	PM Peak Frequency
Bus 200	City – Bulleen – Doncaster Shoppingtown	EB	Intersects at Johnston St	34	6:14 am	12:07 am	25-45 mins	30-60 mins	20-30 mins
		WB		32	5:19 am	11:19 pm	25-40 mins	30-60 mins	20-30 mins
Bus 201	City – Doncaster Shoppingtown via Belmore Rd	EB	Intersects at Johnston St	30	7:02 am	10:42 pm	25-45 mins	30-60 mins	25-30 mins
		WB		31	5:57 am	10:09 pm	25-40 mins	30-60 mins	30 mins
Bus 203	City – Doncaster Shoppingtown via Eastern Fwy, Kilby Rd, Thompsons Rd and Manningham Rd	NB	Between Johnston St and Eastern Fwy	20	9:06 am	6:25 pm	-	20-30 mins	25 mins
		SB		17	6:51 am	2:43 pm	20-30 mins	30 mins	-
Bus 205	Melbourne University – Doncaster Shoppingtown via Kew Junction and Bulleen	EB	Intersects at Johnston St	4	4:05 pm	5:35 pm	-	-	30 mins
		WB		4	6:55 am	8:32 am	30-40 mins	-	-
Bus 207	City – Donvale via Doncaster Rd	EB	Intersects at Johnston St	32	6:39 am	11:15 pm	30 mins	30-60 mins	20-30 mins
		WB		31	5:55 am	10:09 pm	30-45 mins	30-60 mins	25-30 mins
Bus 246	Elsternwick Station – La Trobe University via Clifton Hill, St Kilda Junction	NB	Between CityLink and Eastern Fwy	87	6:12 am	12:14 am	7-18 mins	10-30 mins	8-17 mins
		SB		88	5:30 am	11:36 pm	8-11 mins	10-30 mins	7-15 mins
Bus 301	City – The Pines via Eastern Fwy, Templestowe	NB	Between Victoria Pde and Eastern Fwy	28	7:50 am	6:26 pm	30 mins	30 mins	15-25 mins
		SB		31	6:20 am	7:34 pm	10-25 mins	30-40 mins	20-30 mins
Bus 302	City – Box Hill Central via Eastern Fwy	NB	Between Victoria Pde and Eastern Fwy	25	7:25 am	11:05 pm	Hourly	Hourly	15-30 mins
		SB		26	6:31 am	9:46 pm	7-10 mins	Hourly	20-30 min
Bus 303	City – Mitcham via Springfield Rd	NB	Between Victoria Pde and Eastern Fwy	2	7:40 am	8:03 am	23 mins	-	-
		SB		2	5:15 pm	5:45 pm	-	-	30 mins
Bus 304	City – Ringwood via The Pines	NB	Between Victoria Pde and Eastern Fwy	31	7:30 am	9:48 pm	30 mins	30-60 mins	10-25 mins
		SB		38	6:15 am	11:35 pm	5-20 mins	30-60 mins	Hourly
Bus 305	City – Deep Creek via Eastern Fwy, George St	NB	Between Victoria Pde and Eastern Fwy	33	7:45 am	10:18 pm	30 mins	30-60 mins	10-20 mins
		SB		32	5:50 am	9:37 pm	10-20 mins	30-60 mins	25-30 mins
Bus 306	City – North Ringwood via Wetherby Rd	NB	Between Victoria Pde and Eastern Fwy	6	4:57 pm	6:11 pm	-	-	15 mins
		SB		6	6:31 am	8:14 am	15-30 mins	-	-
Bus 307	City – Mitcham via Eastern Fwy, Doncaster Rd	NB	Between Victoria Pde and Eastern Fwy	33	8:10 am	9:07 pm	30 mins	30 mins	10-20 mins
		SB		37	6:23 am	7:59 pm	5-15 mins	30 mins	30 mins
Bus 308	City – Deep Creek via Eastern Fwy, King St	NB	Between Victoria Pde and Eastern Fwy	7	4:11 pm	6:11 pm	-	-	15-25 mins
		SB		8	6:27 am	8:18 am	10-20 mins	-	-





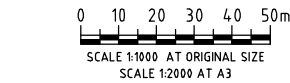
Route Number	Route Name	Direction	Length Travelled Along Hoddle Street	Number of Services on a Weekday	First Service Leaving Origin	Last Service Leaving Origin	AM Peak Frequency	Off Peak Frequency	PM Peak Frequency
Bus 309	City – Donvale via Eastern Fwy, Reynolds Rd	NB	Between Victoria Pde and Eastern Fwy	11	10:15 am	6:08 pm	-	Hourly	30 mins
		SB		12	6:40 am	3:00 pm	20-40 mins	Hourly	-
Bus 313	City (Russell St) – Templestowe via Eastern Fwy, Kilby Rd	NB	Between Victoria Pde and Eastern Fwy	2	5:20 pm	5:50 pm	-	-	30 mins
		SB		2	6:48 am	7:20 am	30 mins	-	-
Bus 315	City (Russell St) – Box Hill via Eastern Fwy, Greythorn Rd	NB	Between Victoria Pde and Eastern Fwy	1	7:54 am	7:54 am	-	-	-
		SB		1	6:30 pm	6:30 pm	-	-	-
Bus 316	City (Russell St) – Deep Creek via Eastern Fwy, Doncaster Rd	NB	Between Victoria Pde and Eastern Fwy	3	5:20 pm	6:10 pm	-	-	20-30 mins
		SB		3	7:00 am	7:45 am	20-30 mins	-	-
Bus 319	City – The Pines via Eastern Fwy, King St	NB	Between Victoria Pde and Eastern Fwy	7	9:45 am	3:38 pm	-	Hourly	-
		SB		7	9:30 am	3:30 pm	-	Hourly	-
Bus 340	City – La Trobe University via Eastern Fwy (All Stops)	NB	Between Victoria Pde and Eastern Fwy	19	6:29 am	3:25 pm	20-30 mins	30 mins	-
		SB		20	9:08 am	6:11pm	-	30 mins	20-30 mins
Bus 350	City – La Trobe University via Eastern Fwy (Limited Pick-Up and Set-Down)	NB	Between Victoria Pde and Eastern Fwy	7	3:45 pm	6:07 pm	-	40 mins	15-25 mins
		SB		9	6:24 am	8:40 am	15-20 mins	-	-
Bus 605	Gardenvale – City via Kooyong Rd	NB	Between City Link and Swan St	44	6:20 am	7:10 pm	15-20 mins	20-30 mins	15 mins
		SB		44	7:05 am	7:55 pm	15-20 mins	20-30 mins	10-15 mins
Tram 24	North Balwyn – City (Latrobe St West End)	EB	Intersects at Victoria Pde	7	4:31 pm	5:42 pm	-	-	10-15 mins
		WB		8	7:14 am	3:20 pm	10-15 mins	-	-
Tram 48	North Balwyn – Waterfront City, Docklands	EB	Intersects at Bridge Rd	106	5:35 am	1:01 am	8-10 mins	10-20 mins	6-10 mins
		WB		109	5:22 am	12:11 am	6-10 mins	10-20 mins	8-10 mins
Tram 70	Bourke St, Docklands – Wattle Park	EB	Intersects at Swan St	100	5:49 am	1:10 am	9-15 mins	10-20 mins	8-10 mins
		WB		103	5:13 am	12:14 am	7-10 mins	10-20 mins	8-15 mins
Tram 75	City (Spencer St) – Vermont South	EB	Intersects at Bridge Rd	107	5:54 am	12:57 am	10-15 mins	10-20 mins	8-10 mins
		WB		108	4:49 am	1:58 am	6-10 mins	10-20 mins	10 mins
Tram 109	Box Hill – Port Melbourne	EB	Intersects at Victoria Pde	139	5:33 am	1:16 am	4-8 mins	8-20 mins	4-6 mins
		WB		140	5:15 am	12:40 am	4-8 mins	8-20 mins	6-8 mins



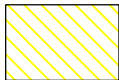
## Appendix D

# Johnston Street Intersection Treatments

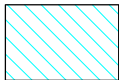




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CUT AND COVER  
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RAMP TO/FROM SUB  
LEVEL STRUCTURE



SURFACE ROADS

PRELIMINARY

rev	description	app'd	date
A	INITIAL ISSUE		

HODDLE STREET TRAFFIC ADVICE  
JOHNSTON ST INTERSECTION  
CUT AND COVER TUNNEL OPTION

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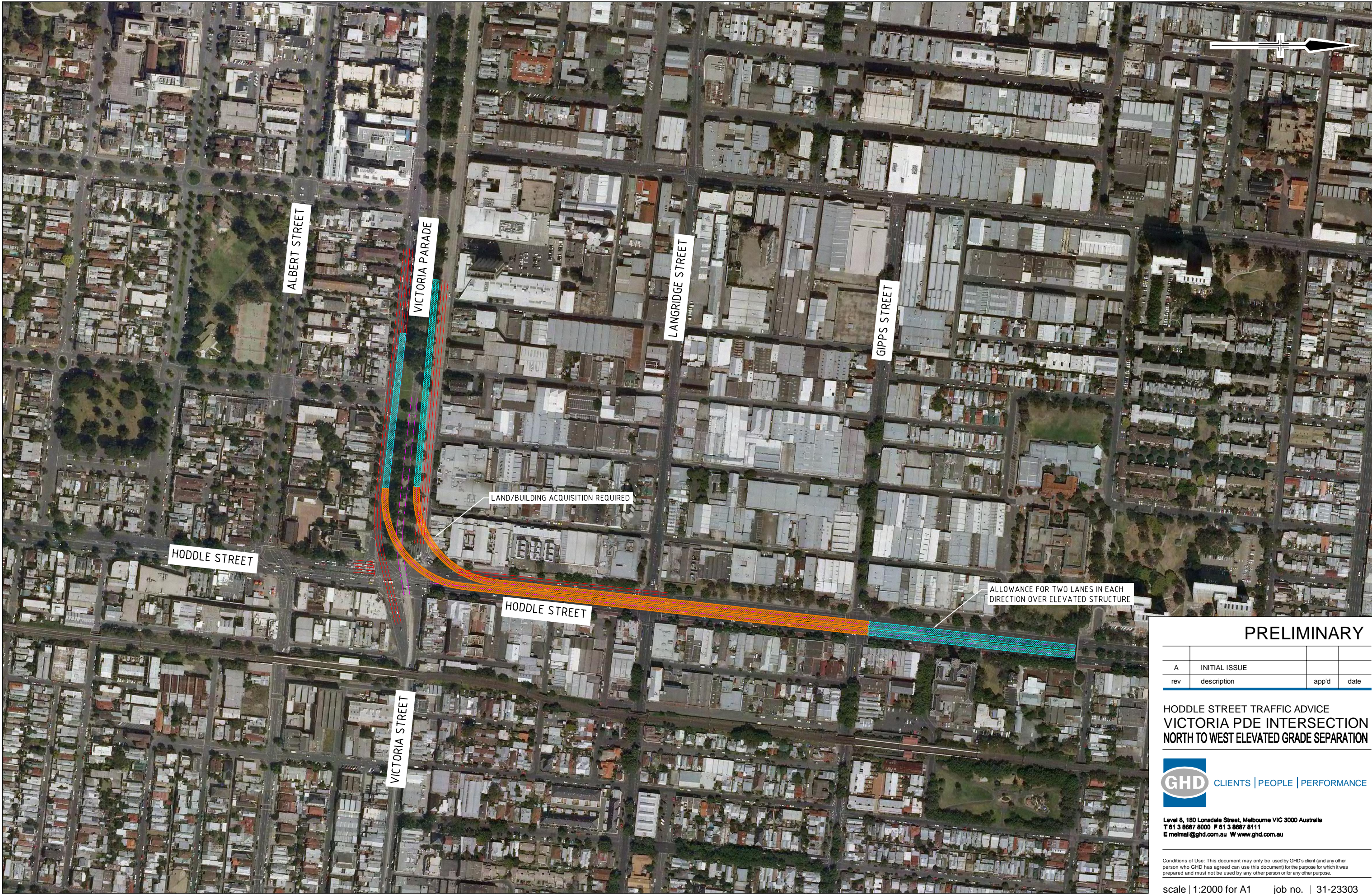




## Appendix E

# Victoria Parade Intersection Treatments





PRELIMINARY

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VICTORIA PDE INTERSECTION  
NORTH TO WEST ELEVATED GRADE SEPARATION

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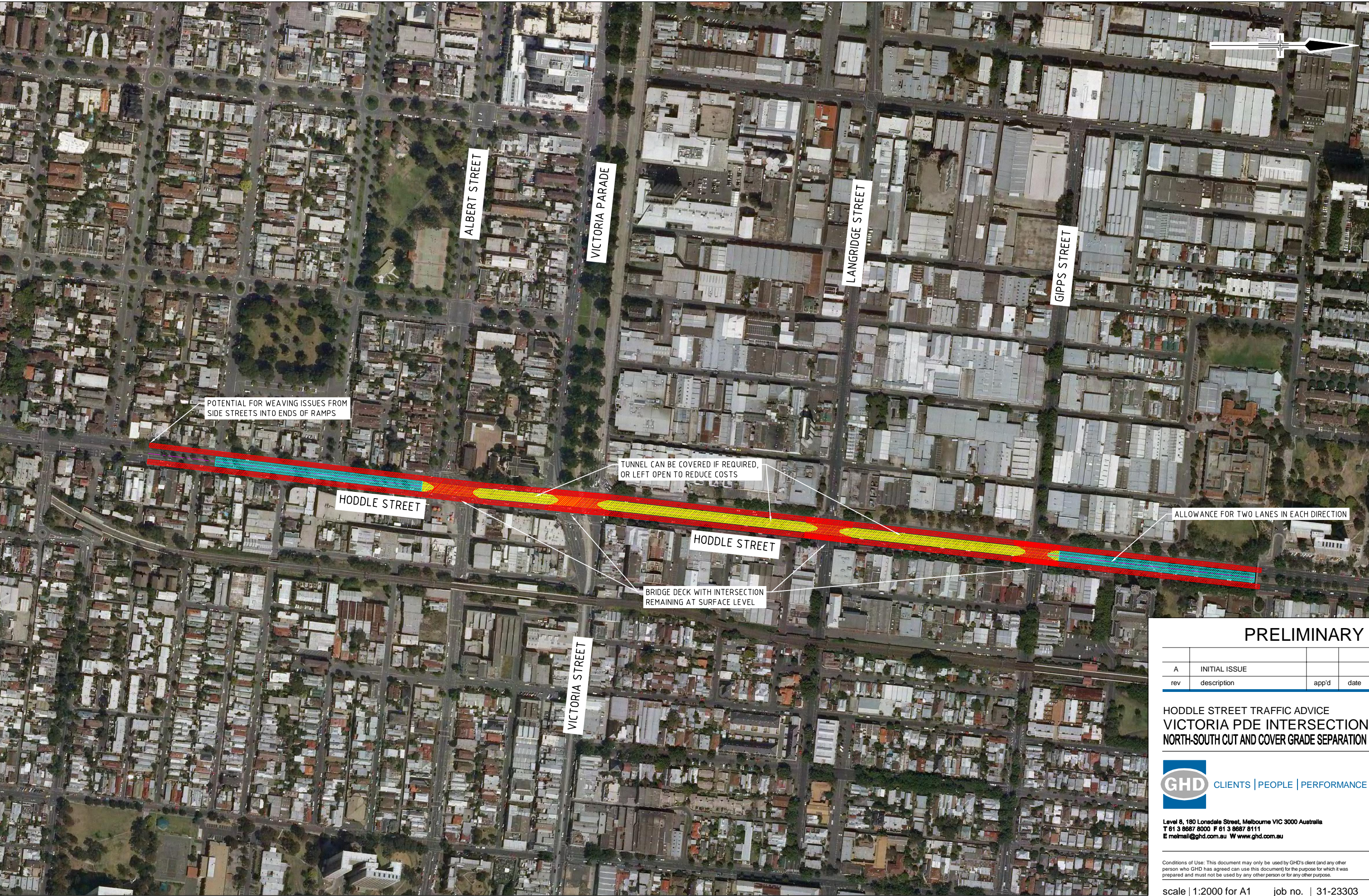
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HODDLE STREET TRAFFIC ADVICE  
VICTORIA PDE INTERSECTION  
NORTH-SOUTH CUT AND COVER GRADE SEPARATION

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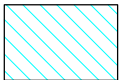
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date	OCT 2008	rev no.	A

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CUT AND COVER  
STRUCTURE



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SURFACE ROADS (2 LANES  
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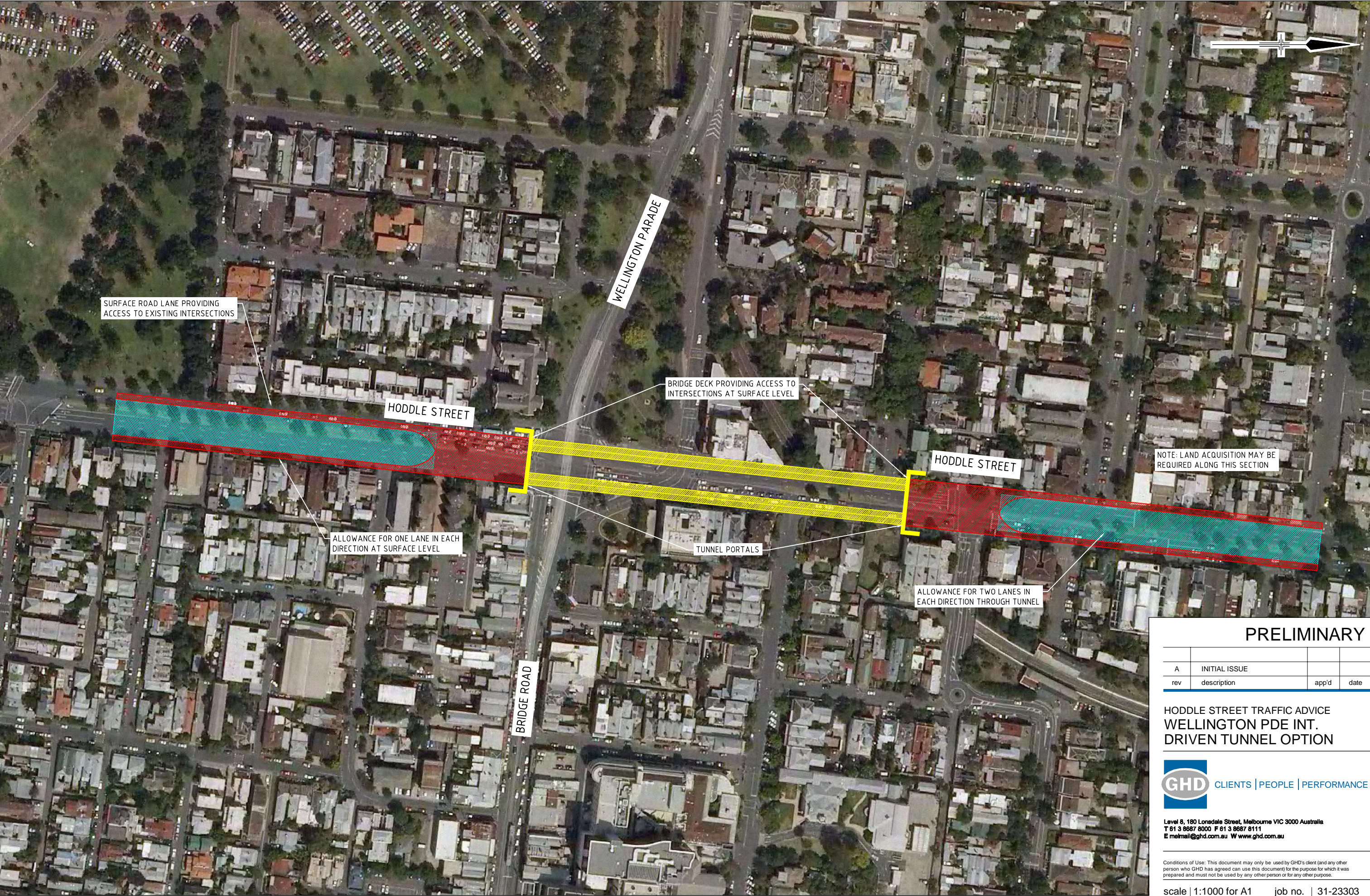




Appendix F

# Wellington Parade Intersection Treatments

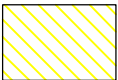




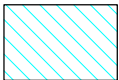
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SURFACE LEVEL



DRIVEN TUNNEL

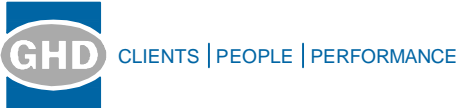


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## PRELIMINARY

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A	INITIAL ISSUE		

HODDLE STREET TRAFFIC ADVICE  
WELLINGTON PDE INT.  
DRIVEN TUNNEL OPTION



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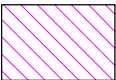
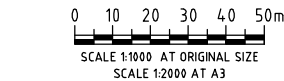
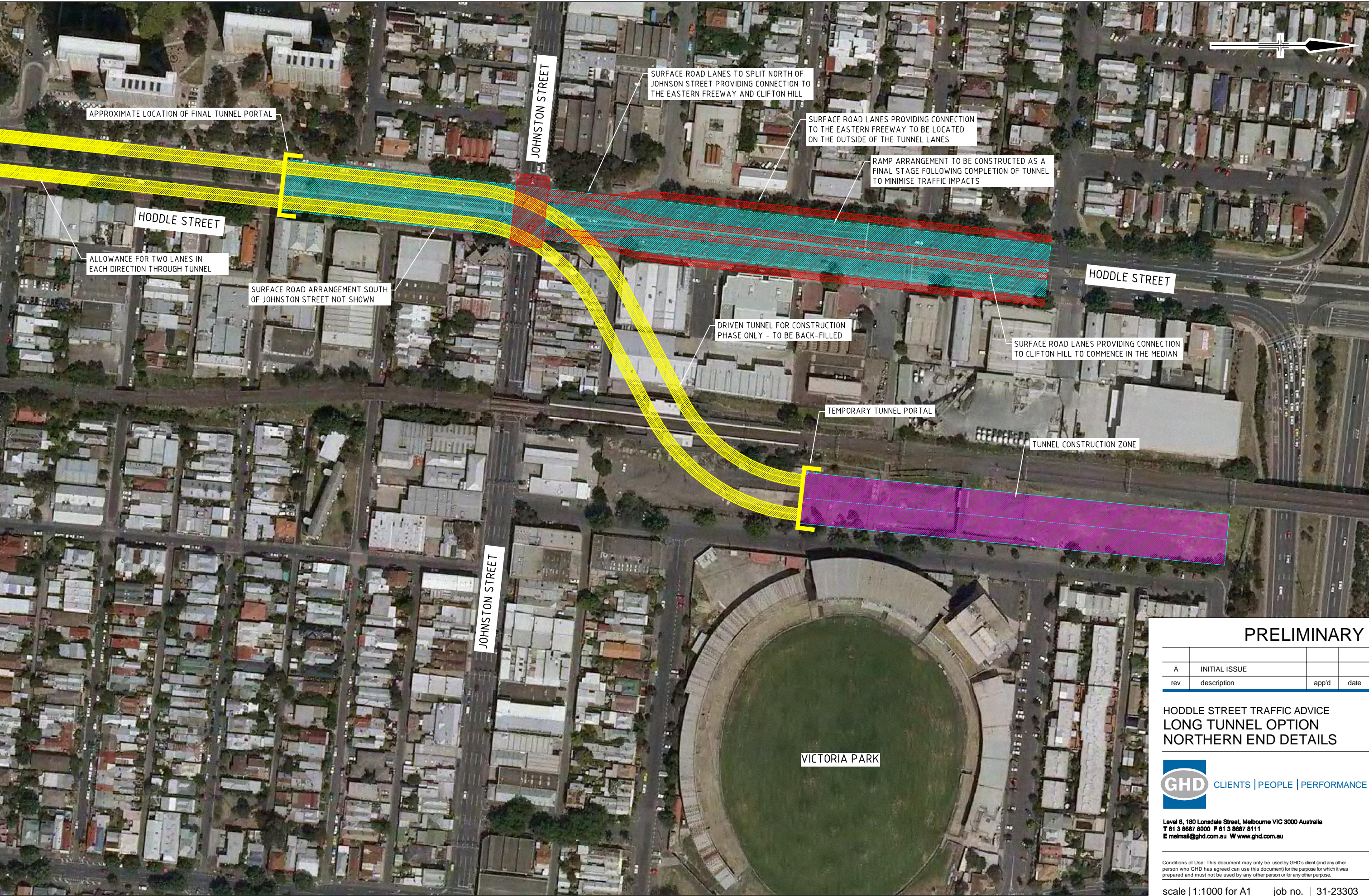




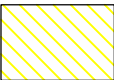
## Appendix G

# Long Tunnel Portals

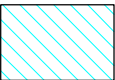




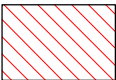
CONSTRUCTION ZONE



DRIVEN TUNNEL



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EXISTING SURFACE LEVEL

## PRELIMINARY

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### HODDLE STREET TRAFFIC ADVICE LONG TUNNEL OPTION NORTHERN END DETAILS



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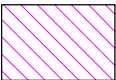
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date OCT 2008 rev no. A

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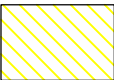




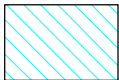
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CONSTRUCTION ZONE



DRIVEN TUNNEL



RAMP TO/FROM SUB LEVEL STRUCTURE



SURFACE LEVEL

PRELIMINARY

A	INITIAL ISSUE		
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HODDLE STREET TRAFFIC ADVICE  
LONG TUNNEL OPTION  
SOUTHERN END DETAILS

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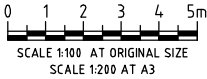
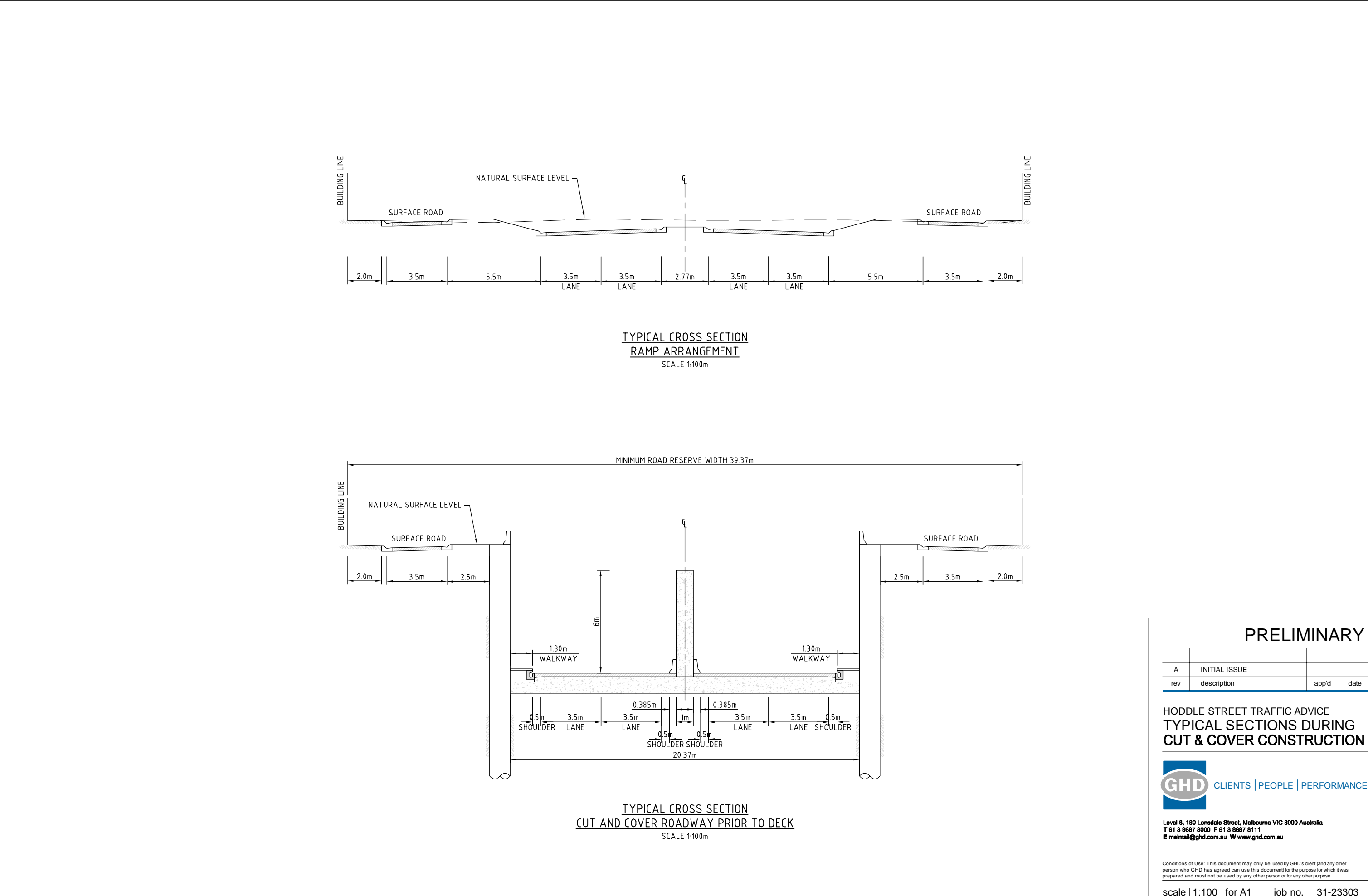
approved ..... SK106





## Appendix H

# Typical Sections During Construction



## PRELIMINARY

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HODDLE STREET TRAFFIC ADVICE  
TYPICAL SECTIONS DURING  
CUT & COVER CONSTRUCTION

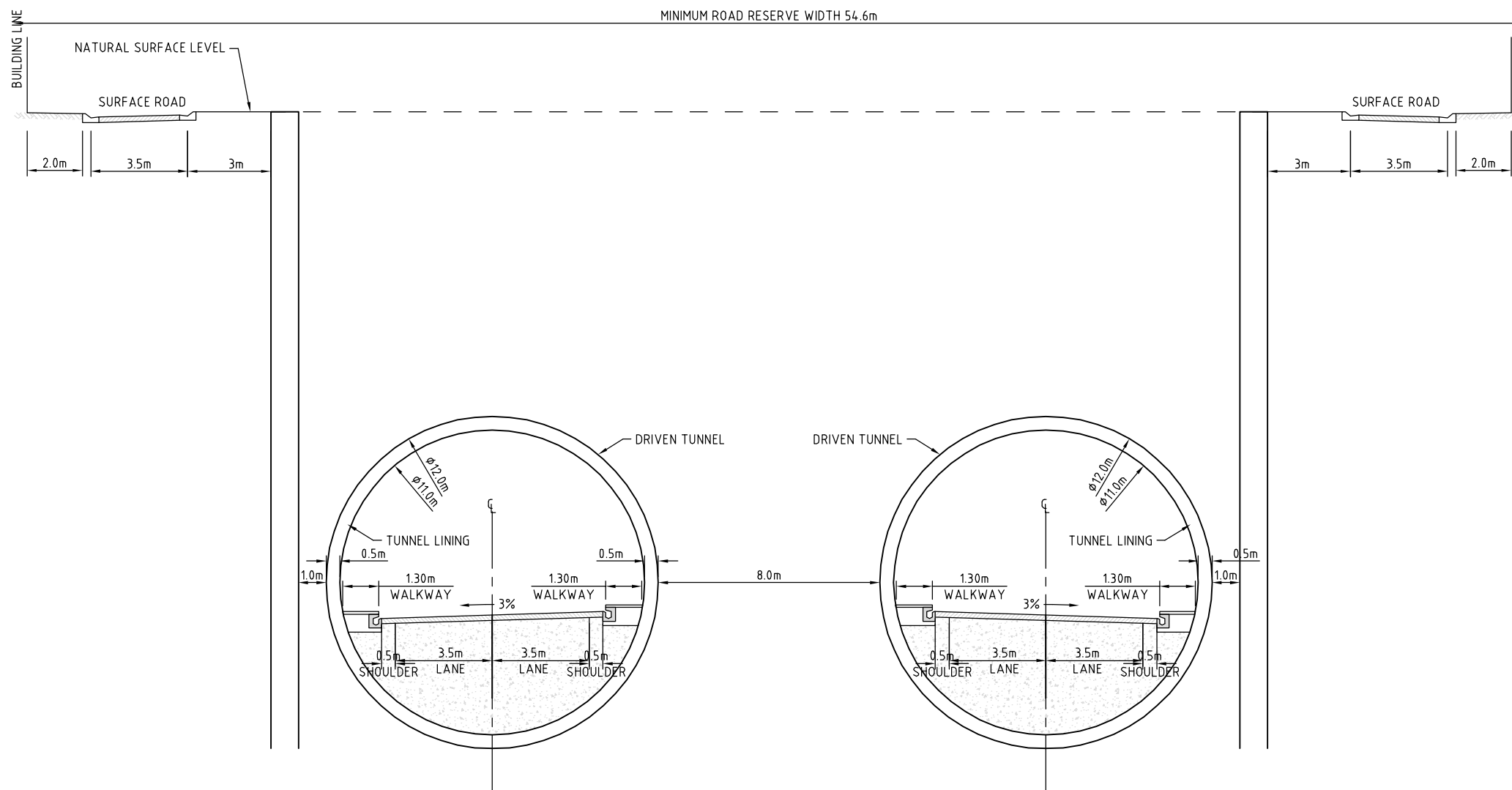


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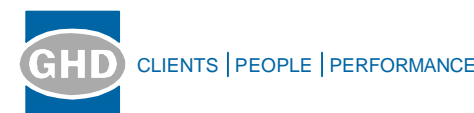
CONSTRUCTION FOOTPRINT  
AT TUNNEL PORTAL  
SCALE 1:100m



## PRELIMINARY

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A	INITIAL ISSUE		

HODDLE STREET TRAFFIC ADVICE  
DRIVEN TUNNEL PORTAL  
DURING CONSTRUCTION



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## **GHD**

180 Lonsdale Street  
Melbourne, Victoria 3000  
T: (03) 8687 8000 F: (03) 8687 8111 E: melmail@ghd.com.au

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## **Document Status**

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