

Bus Transit Lane between Kingston and

Hobart/Macquarie Street

Department of State Growth

Concept Options Report







Bus Transit Lane between Kingston and Hobart/Macquarie Street

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1. Executive Summary

The purpose of this report was to primarily look at options for providing a Bus Transit Lane on the Southern Outlet from Kingston to Hobart (**Project 1**). Although this project initially focused on a northbound bus lane only (*Option 1*), there was significant consideration given in the investigations to the impact on commuters heading south at peak times and the potential for the Bus Transit Lane to be centralised and operated as a full Tidal Flow opportunity (*Option 2*). A southbound bus lane from the Olinda Grove Overpass to Groningen Road overpass was also considered (Option 3). In addition, the scope of the project was expanded to include an early concept option for a bus lane on Macquarie Street from the bottom of the Southern Outlet through to the CBD (**Project 2**).

At the conclusion of the investigations for Project 1, Option 2 was preferred as it provided a more resourceful use of the investment by creating a versatile Bus Transit Lane for public transport in and out of the Hobart CBD from the southern suburbs.

The Options have been developed so they can be funded and constructed in either a staged approach or as one project. At this early stage, all options have been costed separately to provide different construction opportunities. There are cost savings that would be available to the overall project depending on the way that the project is delivered.

The overall options are listed in Table 1.1. Note Option 1 and Option 2 are alternatives (ie only 1 would be constructed). Option 3 is a separate project which may be implemented in addition to Option 1 or a modified Option 2 as Stage 2 of that option.

 Table 1.1 Project 1 - Southern Outlet from Kingston to Macquarie Street Summary of Options

Options for Project 1

Option 1 / Stage 1– left hand side (LHS) Bus lane, northbound from 900m south of Olinda Grove overpass to Macquarie Street

Alternative A - with at grade Macquarie/Davey Street Intersection

Alternative B with grade-separated Macquarie/Davey Street Interchange

Option 1 / Stage 2– LH Bus lane, northbound from Groningen Road overpass to 900m south of Olinda Grove overpass

Option 2 / Stage 1 – Tidal flow bus lane, from 900m south of Olinda Grove overpass to Macquarie Street

Alternative A - with at grade Macquarie/Davey Street Intersection

Alternative B - with grade-separated Macquarie/Davey Street Interchange

Option 2 / Stage 2 – Tidal flow bus lane, from Groningen Road overpass at Kingston to 900m south of Olinda Grove overpass

Option 3 – Southbound bus lane from Olinda Grove Overpass to Groningen Road Overpass at Kingston

Option 1 provides the dedicated bus lane service from Kingston all the way into the Macquarie Street intersection by creating a dedicated northbound bus lane on the left-hand side of the Southern Outlet. Option 1 also allows for the removal of the current on-ramp from Olinda Grove to the Southern Outlet and the construction of a new on-ramp from the newly constructed roundabout on Olinda Grove.

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Option 2 (preferred Southern Outlet option) provides a dedicated tidal flow bus lane that caters for morning and afternoon peak traffic flow in either direction, which is fully supported by an integrated Intelligent Transport System (ITS) to manage the tidal flow traffic.

Both Option 1 and Option 2 have been staged and costed to provide construction opportunities. Stage 1 has then been further divided into sub options 'A' and 'B' for the Macquarie/Davey Street intersection. Alternative 'A' is an at-grade intersection (preferred) and 'B' is a grade-separated possibility.

How the project is delivered will ultimately contribute to the decision of whether to construct Option 1 or Option 2 to satisfy the overall objective of this project. Regardless of which option is preferred, both will require the construction of an additional lane on the southern Outlet from Kingston through to Macquarie Street in Hobart.

Providing a dedicated bus lane will deliver travel time savings for buses on the Southern Outlet and will encourage people to use public transport rather than their private vehicles. This approach will form part of a broader strategy including a new Kingston Bus 'Park and Ride' interchange and upgraded buses with additional features.

To further reduce public transport travel times into Hobart CBD (from Kingston) during the morning peak, two alternative treatments for a dedicated Macquarie Street bus lane has been investigated (**Project 2**).

Table 1.2 Project 2 - Macquarie Street Bus Lane from Southern Outlet intersection to Hobart CBD

Alternative Treatments Project 2	
Alternative A - 3.2m wide general traffic lanes to allow parallel parking on right hand side	
Alternative B - 3.5m wide general traffic lanes and minimum kerb replacement (all parallel parking removed)	

Due to time constraints, no specific site based investigations were carried out, and the options have been developed using electronic data that was provided by 'theLIST' and other information provided by State Growth such as historic crash data, original design drawings, and traffic volume data from previous studies. Quantities have been determined using a 1m Digital Terrain Model (DTM) derived from the "Mount Wellington Lidar data set," January 20, 2011. Alignment options were considered using a combination of February 2016 aerial photography provided by DPIPWE and the existing drawings of the Southern Outlet.

Early high-level traffic modeling has been undertaken to confirm the viability of Options 1 and 2, but detailed modeling would need to carried out as the project progresses. No modelling has been undertaken to measure the impacts of including option 3. No modelling has been carried out to assess Project 2.

The proposed design for Elboden Street provides a number of advantages. Whilst the angle parking is removed in Elboden Street, changing Macquarie Street to one way between Elboden Street and the Southern Outlet increases the overall number of parking spaces available in this area. Traffic signals at both ends of Elboden Street will improve safety and mobility for pedestrians near the shopping strip. The signals at the Elboden Street/Davey Street intersection will allow for bus priority and safer access for students to the Jane Franklin Hall facility.

A new bus with WiFi facilities for commuters is an option that Metro Tasmania may consider to attract more bus patronage. The WiFi signal through the area can be variable. No improvement to the signal availability has been included in the costs for the Project.

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Given the high number of crashes on the Southern Outlet *(Section 2.3)* and the investment required to upgrade the entire route with a bus lane, the Option 2 cost estimates (tidal flow) have allowed for a variable speed limit Intelligent Transport System (ITS). This is expected to result in both travel time and crash cost savings.

Based on the existing drawings, the bridges at Shaw Road and Proctors Road on the northbound carriageway have been assessed as not requiring any widening. There is enough width to cater for the Bus Lane and therefore widening is not included in the cost estimates. The same bridges on the southbound lane for Option 3 would however require widening which has been included in the cost estimates for this Option.

There is a pedestrian underpass at Cats Eye Corner which will need to be extended, which has been included in the cost estimate.

As the project is progressed, further consideration will need to be given to project constraints such as heritage, geotechnical and stakeholders.

Concept Options have been developed along with high-level cost estimates.

Table 1.3 High Level Cost Estimates

Project 1		P50	P90
Option 1 – Stage 1	Alternative A	\$26.6m	\$31.0m
	AlternativeB	\$35.8m	\$41.1m
Option 1 – Stage 2	0	\$17.3m	\$21.0m
Option 2 – Stage 1	Alternative A	\$28.4m	\$32.9m
	Alternative B	\$37.6m	\$43.1m
Option 2 – Stage 2		\$20.4m	\$24.3m
Option 3		\$19.4m	\$23.3m
Project 2		P50	P90
	Alternative A	\$1.9m	\$2.1m
	Alternative B	\$1.6m	\$1.9m



2. Introduction

2.1 Task Appreciation

The Department of State Growth is investigating options for providing a Bus Transit Lane on the Southern Outlet from Kingston to Hobart. The bus lane is proposed to provide a high level of public transport service between Kingston and Hobart, with an aim to increase public transport patronage and reduce private car trips during commuter peak periods.

Although this project initially focused on a northbound bus lane only *(Option 1)*, there has been significant consideration given in the report to the impact on commuters heading south at peak times. An alternative design, which includes a centralised Bus Transit Lane which is operated as a full Tidal Flow opportunity *(Option 2)*, has also been investigated. Option 2 was ultimately adopted as the preferred option however; this report includes concept designs and costings for both options.

Option 1 and Option 2 were broken down into stages 1 and 2 to provide for construction alternatives and further subdivided into Alternatives 'A' and 'B' to investigate an 'at-grade' and a 'grade-separated' Macquarie/Davey Street intersection.

In addition, as a potential separate project, a southbound bus lane from the Olinda Grove Overpass to the Groningen Road overpass has been considered (Option 3).

Options 1 and 2 extend from the Groningen Road overpass at Kingston to Macquarie Street, a total length of around 9km. Option 3 is approximately 6.3km in length.

The options investigated are summarised in Table 2.1

Table 2.1 : Project 1 - Southern Outlet from Kingston to Macquarie Street Summary of Options

Options
Option 1 / Stage 1– left hand side (LHS), northbound from 900m south of Olinda Grove overpass to Macquarie Street Alternative A - with at grade Macquarie/Davey Street Intersection
Alternative B - with grade-separated Macquarie/Davey Street Interchange
Option 1 / Stage 2 – LH Bus lane, northbound from Groningen Road overpass to 900m south of Olinda Grove overpass
Option 2 / Stage 1 – Tidal flow bus lane, from 900m south of Olinda Grove overpass to Macquarie Street
Alternative A - with at grade Macquarie/Davey Street Intersection
Alternative B - with grade-separated Macquarie/Davey Street Interchange
Option 2 / Stage 2 – Tidal flow bus lane, from Groningen Road overpass to 900m south of Olinda Grove overpass

Alternative Treatments



Options

Option 3 – Southbound bus lane from Olinda Grove Overpass to Groningen Road overpass at Kingston

In addition, the scope of the project was expanded to include an early concept option for a bus lane on Macquarie Street from the bottom of the Southern Outlet through to the CBD (Project 2).

Table 2.2 Project 2 - Macquarie Street Bus Lane from Southern Outlet intersection to Hobart CBD

Alternative A - 3.2m wide general traffic lanes to allow parallel parking on right hand side

Alternative B - 3.5m wide general traffic lanes and minimum kerb replacement (all parallel parking removed)

The location of the projects and the potential staging is shown in Figure 2.1.



Figure 2.1 : Site Location –Bus/transit lane





2.2 Road Description

The Southern Outlet is classified as a "Category 1 Road" under the Tasmanian State Road Hierarchy. The function of Category 1 roads is as follows:

Trunk Roads are the State's major highways and are crucial to the effective functioning of Tasmanian industry, commerce, and the community. They carry large numbers of heavy freight and passenger vehicles and are the key links supporting future economic development in Tasmania.

The Southern Outlet carries a diverse range of traffic including commercial vehicles, commuters, and tourists.

Road conditions between Kingston and Hobart:

- The speed limit is 100 km/h from just north of the Groningen Road overpass to the 80km/h sign just south of the Olinda Grove interchange
- The annual average daily traffic (AADT) is approximately 35,000 vehicles per day (combined two-way traffic) near the Groningen Road overpass
- ⁿ The percentage of heavy vehicles is approximately 16% (near the Groningen Road overpass)
- ⁿ There are two lanes traveling in each direction with a divided carriageway for the majority of its length
- There are several intersections along its length: Kingston Interchange; Browns Road; Proctors Road (four separate at-grade accesses along the length of Southern Outlet); Olinda Grove (grade separated interchange); Davey Street/ Macquarie Street Couplet (at-grade)

The project also requires works on the Olinda Grove Interchange, Davey Street, Macquarie Street and Elboden Street.

Analysis of data, sourced through the Australian Road Research Board (ARRB) shows that during the morning peak period, the majority of vehicle movements from the Southern Outlet (74 per cent) ends up in the Hobart City Council area (CBD, North Hobart, South Hobart and Sandy Bay), with 18 per cent heading to the northern suburbs and beyond and 8 percent to the Eastern Shore. During the PM peak period 77 per cent of traffic travelling south on the Southern Outlet originates from the Hobart City Council area.

The Davey Street/ Macquarie Street Couplet comprise a 2-kilometre length of one-way roads that connect between Hobart's Cenotaph and the Southern Outlet. The Couplet provides an important link between the northern, southern and eastern shore suburbs through Hobart's CBD.

The majority of traffic utilising the Couplet during peak periods originates/terminates at the Southern Outlet. More than 8,000 vehicles enter the Couplet from the Southern Outlet during the extended morning peak period. This is more than 25% greater than the volume of traffic entering via the Tasman Highway (approximately 6,100 vehicles).

Elboden Street is a local access road in South Hobart that currently carries approximately 1,000 vehicles per day. It connects from Macquarie Street and forms a dead-end south of Davey Street. Hobart City Council has installed traffic management infrastructure to reduce unnecessary through traffic in the section between Davey and Macquarie Streets. This includes left-in/ left-out access at Davey Street and angle parking on the northern side.

Olinda Grove connects to the Southern Outlet at a grade separated interchange. A roundabout has recently been installed to improve road safety at the southbound interchange. Queueing regularly extends along the northbound off-ramp of the Southern Outlet as a result of the new roundabout. Designs have been prepared to extend the northbound off-ramp lane to improve capacity and safety at this location.



2.3 Crash History

The 5-year crash history of the network relevant to the concept design is provided in Table 2.3.

Table 2.3 : Crash History Summary

Location	Number of Crashes/ Number of Injury Crashes	Dominant Crash Type	Comments
Southern Outlet – Kingston Interchange to Olinda Grove Interchange	106 crashes 26 injury	Rear end, side swipe	
Southern Outlet – Olinda Grove Interchange to Davey Street	117 crashes 11 injury	Rear end, loss of control	
Southern Outlet – Davey Street to Macquarie Street	28 crashes 4 injury	Rear end, cross traffic, lane change	Majority of crashes on Davey Street intersection
Macquarie Street – Elboden St to Southern Outlet	8 Crashes 4 injury	Parking/ emerging	2 crashes involved cyclists (1 of these crashes involved 8 cyclists)
Davey Street – Elboden St to Southern Outlet	17 crashes 2 tojuty	Cross traffic, rear end	All crashes occurred at the Southern Outlet Intersection
Elboden Street (excluding Davey Street intersection)	4 crashes No injuries	Maneuvering/ parking	Relatively low crash rate, typical of a low volume urban road with high parking turnover.



3. Southern Outlet Bus Lane Concept Options Commentary (Project 1)

3.1 Option 1

This design option provides a dedicated northbound bus lane on the left-hand side of the carriageway along the existing Southern Outlet, from Groningen Road Kingston through to the Davey Street/Macquarie Street intersection in Hobart.

Option 1 is split into two stages. **Stage 1** starts approximately 900m south of the Olinda Grove overpass and runs through to Macquarie Street. Furthermore, Stage 1 is split into Alternatives 'A' and 'B', providing alternative 'at-grade' intersection and 'grade-separated' interchange options for the existing Davey Street/Macquarie Street intersection. Both alternatives provide a priority bus lane for the Davey/Macquarie Street intersection providing improvements to traffic flow for both public bus transport and regular traffic.

Stage 2, starts at the Groningen Road overpass at Kingston and runs for 5.3km to the beginning of stage 1 (900m south of the Olinda Grove overpass). The Stage 2 bus lane is located on the left-hand side for the full length of the northbound carriageway and preliminary investigations using the data available indicate the existing bridges do not require widening.

For a detailed description of the improvements offered for Davey Street/Macquarie Street intersection refer to *Section 5.2.2,* and drawings in *Appendix A* and *Appendix B*

Cats Eye Corner and the **Olinda Grove Interchange** locations offered various design challenges for Stage 1 and therefore a more thorough investigation was undertaken to decide the best design outcome from an operational, construction and economic perspective. The major challenge with Cats Eye Corner is to reduce the impact on adjoining properties.. The following were considered;

- Widening on the northbound carriageway of the outlet (preferred), cutting the rock wall back and providing kerb and gutter with pit and pipe drainage to allow for an additional lane on the left hand side of the Outlet from the start of Stage 1, to join in with the existing bus lane (north of Cats Eye Corner to Davey Street). The impact on property is significant; however, widening on this side has less impact on traffic during construction activities and maintains the location of the existing central retaining wall. It also doesn't impact on the existing two southbound lanes left hand side (LHS).
- Utilising the existing wide shoulder on the **southbound carriageway of Cats Eye Corner** and moving the central dividing retaining wall 2.5 m to the east. It was determined that this would have a greater impact on traffic during construction and the impact on private properties to the eastern side of the Southern Outlet was not significantly better than widening the northbound carriageway on the western side. In addition, there are challenges with the embankment on the southbound side of the Outlet south of Cats Eye Corner. The cost of construction was determined to be much higher with this concept as it would require the construction of two significant retaining walls.
- Applying a Dynamic Tidal Flow option from Davey Street to Olinda Grove using an existing southbound lane without any other changes to the current lane configuration was also considered. This was discounted early due to the southbound traffic being reduced to a single lane with a high potential of very slow moving heavy vehicles. The existing wide shoulder on the eastern side of the outlet from Davey Street stops south of Cats Eye Corner so a breakdown past this left hand side (LHS) point could potentially block the road. Continuing the wide shoulder for approximately 500m further south would require a substantial retaining wall on the bottom side of the Outlet. Starting the tidal flow option where the widened shoulder begins will not improve the northbound flow for public transport as the congestion starts prior to this point, south of the Olinda Grove overpass.





Figure 3.1: Grade Separated centralised bus lane option considered to improve safety

At the **Olinda Grove interchange**, removing the current onramp to the Southern Outlet for southbound traffic from the Mount Nelson/Tolmans Hill area provided an opportunity to utilise the additional lane under the Olinda Grove overpass and to shift all lanes to the east. This option assumed the right-hand northbound lane would then pass on the eastern side of the central bridge pier.

Figure 3.2: Enlargement showing compound alignment curves



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The current horizontal curve radius at this point is below standard and realignment around the pier would tighten the radius further and introduce compound curves into the alignment.

The relocation of the central bridge pier and a cantilevered design was considered that would allow for lanes in both directions to stay on their respective sides of the central pier but this was not considered a cost-effective solution.

Figure 3.3 : Northbound lane on the eastern side of bridge pier at Olinda Grove overpass.





Underpinning the western abutment and removing the rock between the abutment and footing and using the current slip lane will provide a minimum 3.5m northbound transit lane and is considered the best option at this stage. (*Refer to drawing no 2001 in Appendix A and Appendix B for preferred arrangement*)



3.2 **Option 2**

This design option provides a fully integrated Tidal Flow bus lane from Kingston through to Macquarie Street. The bus lane would run along the centre of the Southern Outlet and would be supported by an automated Intelligent Transport System (ITS) to manage lanes, potential incidents and provide commuters with important updated information. If required in emergency situations, the bus lane could also be used as a dedicated passageway for emergency services to quickly respond to incidents.

The centralised tidal flow bus lane would have barriers on either side to protect against oncoming traffic and prevent head-on collisions. Furthermore, <u>removable</u> safety barriers could be provided at strategic locations to allow emergency services and road maintenance crews to access the centralised tidal flow bus lane to divert traffic in and out of the centralised tidal flow bus lane in the event of a breakdown, accident or when road maintenance is required. Further investigation is required at subsequent design stages to determine the appropriate locations for removable safety barriers and how they would interact with the ITS.

3.3 Option 3

This option allows for the construction of a southbound bus lane from the Olinda Grove overpass to Kingston. This would allow for the removal of safety barriers on the northbound Tidal Flow lane from Kingston to the Olinda Grove overpass. Based on the existing drawings, the bridges a Shaw Road and Proctors Road for this Option would require bridge widening to accommodate the additional tane.

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4. Macquarie Street Bus Lane Options Commentary (Project 2)

Project 2 examined two possible configurations (A and B) for a dedicated bus lane from the intersection of the Southern Outlet with Macquarie Street through to the CBD of Hobart. Alternative A considered a 3.5m wide bus lane on the left-hand side of Macquarie Street with 3.2m wide general traffic lanes between Davey Street and Murray Street. Parallel parking is removed from the left-hand side of Macquarie Street to accommodate the bus lane, but is maintained on the right-hand side.

Alternative B looked at a 3.5m wide northbound bus lane on the left-hand side of Macquarie Street with 3.5m wide general traffic lanes between Davey Street and Murray Street. Parallel parking is removed from both sides of Macquarie Street to accommodate the wider lanes.

Minor kerb realignment is required to remove the kerb 'blisters' at Molle, Harrington and Murray Streets and long lengths of kerb would need to be replaced along Macquarie Street if as much parallel parking as possible is to be retained as shown in Alternative A.

There are a number of side roads and accesses along the western side of Macquarie Street. Other vehicles will need to use the bus lane for short lengths to access side roads and driveways.

The bus lane will need to be set back at intersections to allow other vehicles to turn left. Other vehicles will only be able to use the lane to turn left, while buses will be able to continue straight through the intersection. Priority phasing for buses at traffic signals can be implemented to further reduce travel time for buses.

Alternative B provides wider general traffic lanes than Alternative A which are more suitable for large heavy vehicles. Macquarie Street is a gazetted High Productivity Vehicle route.

Table 4.1 illustrates the impact of the existing parking on Macquarie Street for the two Alternatives. Total onstreet parking is approximately halved for Alternative A, whilst almost all on-street parking is removed for Alternative B. This loss of parking may potentially impact businesses and residences on Macquarie Street and alternative parking options will need to be considered for implementation of either of these options.

Location on Macquarie Street (between streets)	Existing Parking Numbers		Alternative 'A' Parking Numbers		Alternative 'B' Parking Numbers	
	Western Side	Eastern Side	Western Side	Eastern Side	Western Side	Eastern Side
Southern Outlet and Antill Street	7	15	0	5	0	5
Antill Street and Warneford Street	6	13	0	13	0	0
Warneford Street and Denison Lane	4	10	0	10	0	0
Denison Lane and Molle Street	7	15	0	15	0	0

Table 4.1 : Macquarie Street 'On-Street' Parking



Molle Street and Barrack Street	18	15	0	15	0	0
Barrack Street and Harrington Street	5	20	0	20	0	0
Harrington and Victoria Street	7	5	0	8	0	0
Victoria Street and Murray Street	16	12	0	12	0	0
Murray Street and Elizabeth Street	7	0	0	0	0	0
Total Parking Spacers	77	105	0	98	0	5

Table 4.1 notes and assumptions:

- 1. Parking spaces are all inclusive and include different parking types and timeframes e.g 15 minute parking, 1 hour parking, 2 hour parking, loading and disabled parking.
- 2. The number of on-street parking spaces may vary according to vehicle size.
- 3. Whilst conducting the existing parking spaces survey using aerial imagery, the parking on the eastern side of Macquarie Street adjacent to St Michael's Collegiate School had numerous vehicles parked illegally (not within dedicated parking spaces and in-front of driveways). These spaces have not been included.
- 4. Existing bus stops have not been included and consultation between Metro Tasmania, Hobart City Council and the Department of State Growth is required to determine the exact location of bus stops.

A comparison of Project 2 Alternatives A and B is provided in Table 4.2.

Table 4.2 : Comparison of Project 2 A and B

Alternative A		Alternative B		
Pros	Cons	Pros	Cons	
Retains parking on eastern side of Macquarie Street	Narrow lane width for general traffic (3.2m). Macquarie Street is a HPV route.	Wider traffic lane for general traffic is more suitable for large heavy vehicles.	Loss of parking on both sides of Macquarie Street will impact businesses and residences.	



5. Additional Considerations

The following table lists other options and issues which have been considering during this project.

Table 5 Table of other considerations

No.	Option/ Consideration	Comment
	INTERSEC	TION OPTIONEERING
1	Davey Street tunnel under Southern Outlet.	Ramp retaining wall will block residential accesses from Davey Street no's 251 to 267. This is likely to result in acquisition of these properties as they will not have a legal street access.
2	Diverting local left turning traffic from southern outlet down Elboden St just north of cats eye corner.	Very steep terrain from southern outlet and will impact on the local residential street character of Elboden Street.
3	Full tunnel realignment of Southern Outlet onto Macquarie Street under Davey Street.	Large, costly property acquisition between Davey St and Macquarie Street, and the expensive cost of 150m of tunneling.
4	Dedicated bus lane (only) from Southern Outlet onto McKellar Street (Adjacent Hobart Rivulet) that connects to Collins St.	Large, costly property acquisition of Bupa aged care facility and likely public backlash due to environmental impact to the Rivulet.
	BUS LAI	NE OPTIONEERING
5	Tidal flow from Olinda Grove to Davey Street using existing lanes only.	Discounted due to southbound uphill traffic reduced to a single lane with very slow moving heavy vehicles.
6	Dedicated bus lane (only) from Southern Outlet onto Proctors Road	The use of Proctors Road as a dedicated bus route was discounted as it is too steep, icy during winter and has a poor horizontal alignment with substandard curves. The residential streets from the bottom of Proctors Road are narrow in some areas and getting the buses back onto Macquarie Street would also be a significant challenge.
7	Connecting bus lane (only) onto Waterworks Road and running buses either down King St of Davey St.	Steep difficult road grades from the Southern Outlet onto Waterworks Road and then adding buses at Lynton Ave would require a signalised intersection. Adding a signalised intersection at the sag point on Lynton Ave is dangerous due to steep (15%) grades and in inclement weather conditions is likely to result in an increase in accidents
8	Bus lane with no southbound acquisition and using sloped grade separated median as extra lane	Extra lane does not fit in all the way easily and is likely to require the same number of property acquisitions as the southbound options with the additional cost of a central median retaining wall which would be difficult to construct with live traffic on both sides.
9	2.0m wide shoulder for breakdowns adjacent to new bus lane	Very costly when the bus lane can be used for breakdowns
10	Table drain instead of kerb and gutter for	Very costly due to additional earthworks in steep terrain.

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	selected preferred option	
11	Kingborough Council Park and ride not confirmed.	KMC Planning document shows old High School site with approx. 25 vehicles for "Park and Ride car park. This is clearly not in alignment with DSG expectations. Should be more like 300 – 600 vehicles based on 12 bus trips with 50 passengers per hour
12	Stage 2 widening preference is for left- hand side of northbound carriageway for Option 1	Requires significantly more excavation in high rock cuts. It may be possible for short lengths to widen on the eastern side but this will require weaving from west to east to avoid spilling onto southbound carriageway. If any widening is required into rock cuts the minimum width is 3.5m to establish a bench for an excavator to operate from. Therefore 3.5m wide cut on western side preferred
13	Stage 2 widening preference is for right- hand side of northbound carriageway for Option 2	Requires potentially less excavation to avoid high rock cuts.
		BRIDGES
14	Old Proctors Rd Bridge Option 1	The current configuration will require minor realignment to eastern side to accommodate new transit lane on the western side. Achievable without modifying bridge is 1.0 shoulder, 3.5m Transit lane, 2x3.5m traffic lanes and 1.0m shoulder
15	Shaws Rd Bridge Option 1	Current lane configuration will accommodate new transit lane without lane realignment. Current acceleration lane to become transit lane.
	OLINDA	GROVE OVERPASS
16	Option to realign eastern most northbound lane to pass on eastern side of central bridge piers	Current horizontal curve radius is below standard, and realignment would require below standard and compound curves to pass on the eastern side of the central pier.
17	Cantilevered central pier	Not cost effective (if achievable)
18	Current backlog from roundabout queuing down ramp and back onto western most lane of highway	Proposed solution to construct new southbound link from roundabout to southbound lanes of Southern Outlet
		TIDAL FLOW
19	Northbound Southern Outlet, Left-hand bus lane from Kingston to Olinda Grove	This option was considered. However, a left-hand bus lane creates merging problems with the general traffic turning left into Olinda Grove.
	MAC	QUARIE STREET
20	Right-hand side bus lane	Drawings were produced and presented to the Department of State Growth showing a dedicated bus lane option on the right- hand side down Macquarie Street on the 25/11/2016. The option was dismissed due to this option either requiring special 'right- hand side doors' or the road having to cater for a refuge for bus passengers.



5.1 Intelligent Transport System (ITS)

The following ITS infrastructure has been included in the Project 1 - Option 2 costs and is based on VicRoads guidelines.

ITS Assumptions;

Automatic Incident Detection (AID)

This will be based on a video incident detection technology (Traficon or Citilog). Ideally these cameras point at the rear of vehicles, however, can be used in either direction for the tidal flow.

The cameras should be mounted on rigid 10m poles and ideally are located on the median barrier for best performance. Shoulder mounting is possible, however the detection rate may be affected.

The cameras should be set up to detect both stopped and wrong way vehicles.

CCTV Cameras

Pan, tilt and zoom CCTV cameras mounted on 10m tilt poles and placed on alternating sides of the motorway at approximately 500m spacing.

Lane Use Management System (LUMS)

The LUMS should be mounted at nominal 500m spacing (400m to 600m) with a sight distance to other gantries/signage of 200m minimum.

LUMS can also be used in the Tidal Flow Lane to indicate lane closure.

LUMS need to be used in conjunction with the Freeway Data Stations which provide traffic data.

LUMS gantries are typically non-accessible

Freeway Data Stations

The data stations are placed at spacings no greater than 500m to provide traffic data which is used as part of the lane use management and variable speed limit.

The data stations can be selected from various technologies – in-pavement loops, wireless studs or TIRTL (infra- red) systems.

Variable Message Signs (VMS)

VMS are placed at either end of the bus transit lane zone to provide information to drivers. This is also used to indicate that the LUMS is operational, provide information on travel time, incidents and the operation of the bus tidal flow lanes. These can either be mounted on a cantilever or the full gantry. Typically VMS gantries are accessible.

Communications conduits/cabinets

These are not shown or designed and will need to be done at a subsequent design stage.

Busway Control Signs

These signs are typically a static sign with wig wags to indicate the closure of the bus lane for a particular direction.



Figure 5.1: Typical Busway Control Sign



In Pavement Lighting

These operate similar to runway lighting and can be used to reinforce the signage that the bus lane is closed.

Communications

Typically, ITS devices operate on a TCP/IP network. Electrical and communication conduits are installed up each side of the motorway.

Roadside cabinets are placed adjacent to equipment, with ITS devices no further than 100m from a roadside cabinet. Multiple devices may share a cabinet.

All ITS devices will have a small junction box/cabinet mounted either on the pole or gantry leg.

Typically, 2 x 100mm white communications conduits and 2 x 100mm orange electrical conduits will be installed as a trunk system along each side on the motorway. 1 x electrical and 1 x communication pit will be required every 100m, at junctions to devices and changes of direction.

Fibre Optic communications are used as the backbone communications, with copper (Ethernet) to roadside devices.

Power is typically sourced from multiple points of supply (rather than reticulated) along the motorway.

The fibre communications will need to extend back to the Traffic Control Centre.



5.2 Intersections

The concept option makes key changes at the following intersections:

- · Olinda Grove/ Southern Outlet Interchange
- · Southern Outlet/ Davey Street
- · Southern Outlet/ Macquarie Street
- · Elboden Street/ Davey Street
- · Elboden Street/ Macquarie Street
- Macquarie Street intersections

These junctions are detailed in the following sections.

5.2.1 Olinda Grove Interchange

A new southbound link from the roundabout is proposed that will connect to the southbound carriageway of the Southern Outlet. This new leg will reduce queuing on the western approach to the roundabout (Southern Outlet northbound off-ramp and Tolmans Hill area) through the provision of a more balanced intersection. Preliminary SIDRA modeling indicates that queuing will be dramatically reduced on this approach.

The reduction of queueing on this approach enables the off-ramp lane from the southern Outlet to be reduced to accommodate the proposed bus lane on the northbound carriageway.

The new on-ramp from the roundabout on Olinda Grove will have a maximum gradient of 12.5% and a design speed of 60 km/h.

5.2.2 Southern Outlet/ Davey Street/Macquarie Street

The overall design of this intersection relies on the transfer of traffic accessing Macquarie Street (to head south) from Davey Street via Elboden Street. The removal of the right turning traffic off Davey Street on the Southern Outlet between Davey Street and Macquarie Street improves efficiency and provides spare capacity to include the bus lane. Bus priority measures can be implemented at the Couplet intersections to improve flow for buses over cars.

Macquarie Street becomes one-way (northbound) from Elboden Street, thus removing the two-way flow in this section. As a result, better lane alignment can be achieved along Macquarie Street across the Southern Outlet junction. The loss of the southbound lane also increases on-street parking availability in Macquarie Street between Elboden St and the Southern Outlet. This will remove the left turn slip lane from the Southern Outlet to Macquarie Street. Macquarie Street will have a dedicated bus lane through to the existing bus mall on Elizabeth Street.

A new bus lane will extend along the Southern Outlet from Davey Street to Macquarie Street. Integrated traffic signal changes will be required to provide bus priority at the Davey Street junction.

The bus lane will utilise the existing left turn lane from the Southern Outlet to Macquarie Street. Traffic currently turning right from Davey Street and then immediately left onto Macquarie Street to go to South Hobart will in future travel up Davey Street and turn right at Elboden Street.

The Alternative A 'at-grade' intersection option has been developed to allow a future upgrade to a full 'gradeseparated' interchange (Alternative B) to accommodate future growth and economic capital expenditure requirements.

Alternative options considered for the Southern Outlet/Davey Street/Macquarie Street intersection are shown in Figure 5.2, Figure 5.3 and Figure 5.4.



5.2.3 Elboden Street

The changes to Southern Outlet will require Elboden Street to be upgraded to accommodate increased traffic flow. Traffic signals will be required at the Davey Street and Macquarie Street junctions. Providing new traffic lights at Davey Street will improve the safety of vehicles approaching from the south on Elboden street crossing Davey Street.

The existing angle parking on the northern side of Elboden Street will be removed to facilitate the increased traffic flow and signalisation of the intersections. The increase in parking spaces along Macquarie Street provides a suitable replacement for those spaces lost, and the signalisation of the intersection will improve pedestrian access to the shopping precinct.

5.2.4 Macquarie Street Intersections

It is noted that all the intersections along Macquarie Street will be impacted by the installation of a new bus lane on Macquarie Street. The key requirements for the bus lane installation include:

- Removal of on-street parking along the western side of Macquarie Street and minor parking on the eastern side for Alternative A
- Removal of on-street parking on both the western and eastern sides of Macquarie Street for Alternative B
- Removal or reduced size of kerb 'blisters' at key junctions
- Bus priority measures at traffic signals, to allow priority phasing for buses
- · Further transport planning investigations into traffic movements relating to Macquarie Street
- Investigate potential options for nearby off-street parking facilities to compensate for the loss of existing parallel parking on Macquarie Street

Refer to Appendix D for concept drawings of Project 2 to view bus lane configurations along Macquarie Street.

Figure 5.2: Alternative Option - Grade Separated with Southern Outlet under Davey Street



Concept Options Report





Figure 5.3: Alternative Option - Grade Separated with flyover linking Davey Street to Macquarie Street

Figure 5.4: Alternative Option - Grade Separated with Southern Outlet under Davey



5.3 Drainage

The pavement drainage system will be required to meet the requirements outlined in the Department of State Growth T8 and the Austroads drainage specifications. Stage 1 will require kerb and gutter and an underground piped system linked into the existing drainage network. Stage 2 will comprise a roadside table drain and possible extension of cross culverts under the existing Southern Outlet.



5.4 Geotechnical

5.4.1 Site Geology

The Bus /Transit lane is shown on the 1:25,000 Mineral Resources Tasmania (MRT), Geology of Southeast Tasmania map sheet, presented as Figure 5.5: 1:25,000 MRT Geology.

The project is predominantly in Dolerite (*Jurassic Dolerite* $-J_d$) with pockets of Mudstone (*Perriman Mudstone PU*). It is expected that there will be a considerable amount of blasting required.

Figure 5.5: 1:25,000 MRT Geology





5.4.2 Site investigations

No specific site investigations were undertaken as part of this Concept Options Report.

5.5 Traffic Facilities

An Intelligent Transport System (ITS) should be investigated further as part of the project. Variable speed limits may improve capacity and traffic flow and reduce the frequency of 'nose to tail' accidents caused by lane changing to avoid slower moving heavy vehicles.

5.6 Accesses

There are no direct property accesses coming off the Southern Outlet. There is a weighbridge layby approximately 600m north of Shaw Road on the northbound carriageway, but it is not expected that the site would be impacted by adding a transit bus lane.

Released under Ri



6. Project Constraints

6.1 Stakeholder Implications

Hobart City Council and residents are likely to have concerns regarding amenity, with increased traffic flow on Elboden Street. The design of the bus lane for the Southern Outlet between Davey Street and Macquarie Street will result in traffic flows increasing to approximately 5,000 vehicles per day in Elboden Street.

The design will also result in a net increase in on-street parking on Macquarie Street, between Elboden Street and the Southern Outlet. This is a positive outcome for the small South Hobart shopping strip. The installation of traffic signals at Elboden Street will also result in pedestrian accessibility improvements on Macquarie Street for the shopping strip.

Introducing a dedicated bus lane on Macquarie Street will require removal of a large amount of on-street parking. This is likely to have significant impacts on businesses and residences along the length of Macquarie Street between the Southern Outlet and Murray Street. The loss of parking used for drop off and pick up of students outside St Michael's Collegiate School for Alternative B is likely to be particularly concerning for the school. Implementation of either option for a bus lane on Macquarie Street will need to consider alternative options to off-set the loss of on-street parking.

6.2 Property Acquisitions

A total of eight (8) separate residential property acquisitions may be required. All properties are located on the western side (or top side of "Cats Eyes Corner") on the Southern Outlet. The acquisitions enable road widening of the northbound carriageway of the Southern Outlet for the installation of the bus lane.

6.3 Utilities

A Dial before you dig (DBYD) investigation was carried out to look at utility services within the project limits. The intersection of Davey Street/ Macquarie Street and the Southern Outlet has significant utilities that may require some repositioning depending on final design and likewise for the Elboden Street intersections.

As the project is not considering changing the alignment or grades of the Southern outlet for the balance of the project, there appears to be little to no impact on existing services such as Telstra, TasNetworks or TasWater. There are existing sewer and stormwater services at Cats Eye Corner crossing under the Outlet near the pedestrian underpass, but it is unlikely this will need to be changed. The pedestrian underpass will require a small extension to the west to cater for the wider lane.



7. Financial

7.1 Project 1 Southern Outlet Bus Lane P50/P90 Cost Estimation

The following tables provide indicative project cost estimates for all three options based on the Best Practice Cost Estimation Standard for Publicly Funded Road and Rail Construction.

 Option 1 / Stage 1 – left hand side (LHS), northbound from 900m south of Olinda Grove overpass to Macquarie Street

 Alternative A - with at grade Macquarie/Davey Street Intersection

 Alternative B - with grade-separated Macquarie/Davey Street Interchange

 Option 1 / Stage 2 – LH Bus lane, northbound from Groningen Road overpass at Kingston to 900m south of Olinda Grove overpass

 Option 2 / Stage 1 – Tidal flow bus lane, from 900m south of Olinda Grove overpass to Macquarie Street

 Alternative A - with at grade Macquarie/Davey Street Intersection

 Alternative B - with grade-separated Macquarie/Davey Street Intersection

 Alternative B - with grade-separated Macquarie/Davey Street Intersection

 Alternative B - Tidal flow bus lane, from Oroningen Road overpass at Kingston to 900m south of Olinda Grove overpass

 Option 2 / Stage 2 – Tidal flow bus lane, from Oroningen Road overpass at Kingston to 900m south of Olinda Grove overpass

 Option 3 – Southbound bus lane from Olinda Grove Overpass to Groningen Road overpass at Kingston



Table 3 Option 1 - Stage 1 – Alternative 'A' - Davey Street and Macquarie Street at Grade

			Fin	ancial Year		
P50 Cash Flow	2016 / 2017	2017/2018		2018 / 2019	2	2019 / 2020
Project Identification and Scoping	\$ -	\$ 400,000	\$		\$	12
Project Development	\$ -	\$ ×	\$	1,850,000	\$	(H)
Project Delivery (incll. CA)	\$ -	\$ 	\$	70	\$	17,720,000
Inherent Risk	\$ -	\$ 195,080	\$	780,321	\$	975,401
Contingent Risk	\$ -	\$ 225,510	\$	451,020	\$	1,578,570
Escalation costs (nominal)	\$-	\$ 28,721	\$	219,468	\$	2,204,143
Sub-Total (annual)	\$ -	\$ 850,000	\$	3,300,000	\$	22,480,000
Accumulative Total	\$ -	\$ 850,000	\$	4,150,000	\$	26,630,000

	Financial Year							
P90 Cash Flow	2016/2017	2017 / 2018		2018/2019		2019/2020		
Project Identification and Scoping	\$ -	\$	400,000.00	\$	-	\$		
Project Development	\$ -	\$	÷	\$	1,850,000.00	\$	5	
Project Delivery (incll. CA)	\$ -	\$	2	\$	20	\$	17,720,000.00	
Inherent Risk	\$ -	\$	388,705.48	\$	1,554,821.91	\$	1,943,527.38	
Contingent Risk	\$ -	\$	429,021.12	\$	858,042.23	\$	3,003,147.81	
Escalation costs (nominal)	\$ -	\$	42,620.43	\$	303,622.50	\$	2,464,272.76	
Sub-Total (annual)	\$ -	\$	1,260,000	\$	4,570,000	\$	25,130,000	
Accumulative Total	\$ -	\$	1,260,000	\$	5,830,000	\$	30,960,000	

Table 4Option 1 - Stage 1 – Alternative 'B' - Davey Street and Macquarie Street Grade Separated.

		Financial Year							
P50 Cash Flow	2016 / 2017	2017 / 2018	2018 / 2019	2019 / 2020					
Project Identification and Scoping	\$-	\$ 400,000	\$-	\$-					
Project Development	\$ -	\$ -	\$ 1,850,000	\$-					
Project Delivery (incll. CA)	\$ -	\$ -	\$-	\$ 25,440,000					
Inherent Risk	\$-	\$ 251,117	\$ 1,004,467	\$ 1,255,583					
Contingent Risk	\$-	\$ 227,971	\$ 455,942	\$ 1,595,796					
Escalation costs (nominal)	\$-	\$ 30,768	\$ 235,784	\$ 3,075,779					
Sub-Total (annual)	\$-	\$ 910,000	\$ 3,550,000	\$ 31,370,000					
Accumulative Total	\$ -	\$ 910,000	\$ 4,460,000	\$ 35,830,000					

	Financial Year								
P90 Cash Flow	2016 / 2017	2017	2017 / 2018		2017/2018 2018/2019		2018 / 2019		2019 / 2020
Project Identification and Scoping	\$-	\$	400,000.00	\$	-	\$	-		
Project Development	\$-	\$	-	\$	1,850,000.00	\$	-		
Project Delivery (incll. CA)	\$-	\$	-	\$	-	\$	25,440,000.00		
Inherent Risk	\$-	\$	534,669.77	\$	2,138,679.07	\$	2,673,348.84		
Contingent Risk	\$-	\$	428,669.44	\$	857,338.88	\$	3,000,686.08		
Escalation costs (nominal)	\$-	\$	47,716.87	\$	345,157.63	\$	3,382,651.76		
Sub-Total (annual)	\$-	\$	1,410,000	\$	5,190,000	\$	34,500,000		
Accumulative Total	\$ -	\$	1,410,000	\$	6,600,000	\$	41,100,000		



Table 5Option 1 – Stage 2 – Kingston to Olinda Grove

	Financial Year							
P50 Cash Flow	2016/2017		2017 / 2018		2018/2019 2019		019/2020	
Project Identification and Scoping	\$-	\$	250,000	\$	-	\$	-	
Project Development	\$-	\$	-	\$	600,000	\$	-	
Project Delivery (incll. CA)	\$-	\$	-	\$	-	\$	12,170,000	
Inherent Risk	\$ -	\$	96,122	\$	384,487	\$	480,608	
Contingent Risk	\$-	\$	166,182	\$	332,364	\$	1,163,273	
Escalation costs (nominal)	\$-	\$	17,931	\$	93,793	\$	1,501,816	
Sub-Total (annual)	\$-	\$	530,000	\$	1,410,000	\$	15,320,000	
Accumulative Total	\$-	\$	530,000	\$	1,940,000	\$	17,260,000	

	Financial Year							
P90 Cash Flow	2016 / 2017	2017 / 2018	2018 / 2019	2019 / 2020				
Project Identification and Scoping	\$-	\$ 250,000.00	\$-	\$-				
Project Development	\$-	\$-	\$ 600,000.00	\$-				
Project Delivery (incll. CA)	\$-	\$-	\$-	\$ 12,170,000.00				
Inherent Risk	\$-	\$ 244,691.86	\$ 978,767.45	\$ 1,223,459.32				
Contingent Risk	\$-	\$ 356,287.71	\$ 712,575.42	\$ 2,494,013.96				
Escalation costs (nominal)	\$-	\$ 29,784.29	\$ 163,200.90	\$ 1,727,252.33				
Sub-Total (annual)	\$-	\$ 880,000	\$ 2,450,000	\$ 17,610,000				
Accumulative Total	\$ -	\$ 880,000	\$ 3,330,000	\$ 20,940,000				

Table 6 Option 2 – Stage 1 – Alternative 'A' - Davey Street and Macquarie Street at Grade

	Financial Year								
P50 Cash Flow	2016 / 2017		2017 / 2018		2018 / 2019	2	019 / 2020		
Project Identification and Scoping	\$ -	\$	400,000	\$		\$	-		
Project Development	\$ -	\$	(L)	\$	1,850,000	\$	22		
Project Delivery (incll. CA)	\$ -	\$	2 9 1	\$	-	\$	19,200,000		
Inherent Risk	\$ -	\$	208,220	\$	832,878	\$	1,041,098		
Contingent Risk	\$ -	\$	225,514	\$	451,029	\$	1,578,601		
Escalation costs (nominal)	\$ -	\$	29,181	\$	223,213	\$	2,372,191		
Sub-Total (annual)	\$ -	\$	860,000	\$	3,360,000	\$	24,190,000		
Accumulative Total	\$ -	\$	860,000	\$	4,220,000	\$	28,410,000		

	Financial Year							
P90 Cash Flow	2016 / 2017	2017 / 2018	2018 / 2019	2019 / 2020				
Project Identification and Scoping	\$ -	\$ 400,000.00	\$ -	\$ -				
Project Development	\$ -	\$ -	\$ 1,850,000.00	\$ -				
Project Delivery (incll. CA)	\$ -	\$ -	\$ -	\$ 19,200,000.00				
Inherent Risk	\$ -	\$ 403,350.08	\$ 1,613,400.32	\$ 2,016,750.40				
Contingent Risk	\$ -	\$ 441,508.17	\$ 883,016.34	\$ 3,090,557.19				
Escalation costs (nominal)	\$ -	\$ 43,570.04	\$ 309,573.53	\$ 2,642,638.83				
Sub-Total (annual)	\$ -	\$ 1,290,000	\$ 4,660,000	\$ 26,950,000				
Accumulative Total	\$ -	\$ 1,290,000	\$ 5,950,000	\$ 32,900,000				



Table 7 Option 2 – Stage 1 – Alternative 'B' - Davey Street and Macquarie Street Grade Separated

	Financial Year								
P50 Cash Flow	2016/2017		2017/2018 2018/		2018 / 2019		2018 / 2019		.019 / 2020
Project Identification and Scoping	\$-	\$	400,000	\$	-	\$	-		
Project Development	\$-	\$	-	\$	1,850,000	\$	-		
Project Delivery (incll. CA)	\$-	\$	-	\$	-	\$	26,920,000		
Inherent Risk	\$-	\$	263,357	\$	1,053,428	\$	1,316,785		
Contingent Risk	\$-	\$	225,229	\$	450,457	\$	1,576,600		
Escalation costs (nominal)	\$ -	\$	31,100	\$	238,880	\$	3,241,248		
Sub-Total (annual)	\$-	\$	920,000	\$	3,590,000	\$	33,050,000		
Accumulative Total	\$ -	\$	920,000	\$	4,510,000	\$	37,560,000		

			Financial Year	
P90 Cash Flow	2016 / 2017	2017 / 2018	2018 / 2019	2019 / 2020
Project Identification and Scoping	\$-	\$ 400,000.00	\$-	\$-
Project Development	\$-	\$-	\$ 1,850,000.00	\$-
Project Delivery (incll. CA)	\$-	\$-	\$ -	\$ 26,920,000.00
Inherent Risk	\$-	\$ 559,572.37	\$ 2,238,289.49	\$ 2,797,861.86
Contingent Risk	\$-	\$ 427,781.94	\$ 855,563.88	\$ 2,994,473.59
Escalation costs (nominal)	\$-	\$ 48,557.40	\$ 352,125.96	\$ 3,556,415.60
Sub-Total (annual)	\$-	\$ 1,440,000	\$ 5,300,000	\$ 36,270,000
Accumulative Total	\$-	\$ 1,440,000	\$ 6,740,000	\$ 43,010,000
Table 8 Option 2 – Stage 2 – Kingston to Ol	inda Grove	de)	

Table 8	Option 2 – Stage 2 – Kingston to Olinda Grove

	Financial Year								
P50 Cash Flow	2016/2017		2017/2018		2018/2019	2	2019 / 2020		
Project Identification and Scoping	\$ -	\$	250,000	\$	223	\$	-		
Project Development	\$ -	\$: 4 8]	\$	600,000	\$	≓ 0		
Project Delivery (incll. CA)	\$ -	\$		\$	1.0	\$	14,740,000		
Inherent Risk	\$ -	\$	118,690	\$	474,760	\$	593,450		
Contingent Risk	\$ -	\$	166,920	\$	333,840	\$	1,168,439		
Escalation costs (nominal)	\$ -	\$	18,746	\$	100,327	\$	1,794,050		
Sub-Total (annual)	\$ -	\$	550,000	\$	1,510,000	\$	18,300,000		
Accumulative Total	\$ -	\$	550,000	\$	2,060,000	\$	20,360,000		

	Financial Year						
P90 Cash Flow	2016/2017		2017/2018		2018/2019		2019 / 2020
Project Identification and Scoping	\$ -	\$	250,000.00	\$		\$	-
Project Development	\$ -	\$	1.51	\$	600,000.00	\$	
Project Delivery (incll. CA)	\$ -	\$	120	\$	1	\$	14,740,000.00
Inherent Risk	\$ -	\$	279,999.36	\$	1,119,997.44	\$	1,399,996.80
Contingent Risk	\$ -	\$	359,056.37	\$	718,112.74	\$	2,513,394.60
Escalation costs (nominal)	\$ -	\$	31,116.95	\$	173,654.40	\$	2,027,957.07
Sub-Total (annual)	\$ -	\$	920,000	\$	2,610,000	\$	20,680,000
Accumulative Total	\$ -	\$	920,000	\$	3,530,000	\$	24,210,000



Table 9 Option 3 – Olinda Grove to Kingston

	Financial Year						
P50 Cash Flow	2016 / 2017		2017/2018 2018/2019		2	2019 / 2020	
Project Identification and Scoping	\$-	\$	250,000	\$	-	\$	-
Project Development	\$-	\$	-	\$	600,000	\$	-
Project Delivery (incll. CA)	\$-	\$		\$	-	\$	13,940,000
Inherent Risk	\$-	\$	113,935	\$	455,742	\$	569,677
Contingent Risk	\$-	\$	166,916	\$	333,833	\$	1,168,415
Escalation costs (nominal)	\$-	\$	18,580	\$	98,972	\$	1,704,489
Sub-Total (annual)	\$-	\$	550,000	\$	1,490,000	\$	17,380,000
Accumulative Total	\$-	\$	550,000	\$	2,040,000	\$	19,420,000

	Financial Year					
P90 Cash Flow	2016 / 2017	2017 / 2018	2018 / 2019	2019 / 2020		
Project Identification and Scoping	\$-	\$ 250,000.00	\$-	\$-		
Project Development	\$-	\$-	\$ 600,000.00	\$-		
Project Delivery (incll. CA)	\$-	\$-	\$-	\$ 13,940,000.00		
Inherent Risk	\$-	\$ 269,907.27	\$ 1,079,629.07	\$ 1,349,536.33		
Contingent Risk	\$-	\$ 362,042.63	\$ 724,085.25	\$ 2,534,298.38		
Escalation costs (nominal)	\$-	\$ 30,868.25	\$ 171,204.55	\$ 1,937,769.43		
Sub-Total (annual)	\$-	\$ 910,000	\$ 2,570,000	\$ 19,760,000		
Accumulative Total	\$ -	\$ 910,000	\$ 3,480,000	\$ 23,240,000		

Jacobs has exercised reasonable skill, care, and diligence in the preparation of the costs. Costs are based on limited information at this stage and subject to revision with further investigation and development of the concept options.

V

A detailed breakdown of the cost estimates are attached in Appendix F.

7.2 Project 2 Macquarie Street Eus Lane P50/P90 Cost Estimation

The following tables provide indicative project cost estimates for the alternatives considered based on the Best Practice Cost Estimation Standard for Publicly Funded Road and Rail Construction.

Table 10 Alternative A – Macquarie Stre

	Financial Year							
P50 Cash Flow	2016 / 2017	2017 / 2018 2018 / 2019		2019 / 2020				
Project Identification and Scoping	\$ -	\$ 90,000	\$-	\$ -				
Project Development	\$-	\$-	\$ 120,000	\$-				
Project Delivery (incll. CA)	\$-	\$-	\$-	\$ 1,250,000				
Inherent Risk	\$ -	\$ 12,209	\$ 48,834	\$ 61,043				
Contingent Risk	\$ -	\$ 10,539	\$ 21,077	\$ 73,771				
Escalation costs (nominal)	\$-	\$ 3,946	\$ 13,526	\$ 150,554				
Sub-Total (annual)	\$ -	\$ 120,000	\$ 200,000	\$ 1,540,000				
Accumulative Total	\$-	\$ 120,000	\$ 320,000	\$ 1,860,000				

	Financial Year								
P90 Cash Flow	2016 / 2017		2017 / 2018		2017 / 2018		2018 / 2019		2019 / 2020
Project Identification and Scoping	\$-	\$	90,000.00	\$	-	\$	-		
Project Development	\$-	\$	-	\$	120,000.00	\$	-		
Project Delivery (incll. CA)	\$-	\$	-	\$	-	\$	1,250,000.00		
Inherent Risk	\$-	\$	22,912.80	\$	91,651.19	\$	114,563.99		
Contingent Risk	\$-	\$	19,482.04	\$	38,964.07	\$	136,374.25		
Escalation costs (nominal)	\$-	\$	4,633.82	\$	17,850.07	\$	163,178.82		
Sub-Total (annual)	\$-	\$	140,000	\$	270,000	\$	1,660,000		
Accumulative Total	\$ -	\$	140,000	\$	410,000	\$	2,070,000		



Table 11 Alternative B - Macquarie Street

	Financial Year								
P50 Cash Flow	2016 / 2017		2017 / 2018		2017 / 2018		2018 / 2019		2019 / 2020
Project Identification and Scoping	\$-	\$	90,000	\$	-	\$	-		
Project Development	\$-	\$	-	\$	120,000	\$	-		
Project Delivery (incll. CA)	\$-	\$	-	\$	-	\$	1,030,000		
Inherent Risk	\$ -	\$	10,027	\$	40,107	\$	50,134		
Contingent Risk	\$-	\$	11,253	\$	22,506	\$	78,769		
Escalation costs (nominal)	\$ -	\$	3,895	\$	13,007	\$	125,993		
Sub-Total (annual)	\$-	\$	120,000	\$	200,000	\$	1,280,000		
Accumulative Total	\$-	\$	120,000	\$	320,000	\$	1,600,000		

	Financial Year						
P90 Cash Flow	2016 / 2017	2017 / 2018 2018 / 2019		2018 / 2019			2019/2020
Project Identification and Scoping	\$-	\$	90,000.00	\$	-	\$	-
Project Development	\$-	\$	-	\$	120,000.00	\$	-
Project Delivery (incll. CA)	\$-	\$	-	\$	-	\$	1,030,000.00
Inherent Risk	\$-	\$	21,251.63	\$	85,006.53	\$	106,258.17
Contingent Risk	\$-	\$	20,303.99	\$	40,607.99	\$	142,127.96
Escalation costs (nominal)	\$-	\$	4,604.45	\$	17,493.89	\$	138,983.42
Sub-Total (annual)	\$-	\$	140,000	\$	260,000	\$	1,420,000
Accumulative Total	\$ -	\$	140,000	\$	400,000	\$	1,820,000

Jacobs has exercised reasonable skill, care, and diligence in the preparation of the costs. Costs are based on limited information at this stage and subject to revision with further investigation and development of the concept options.

A detailed breakdown of the cost estimate is attached in Appendix F.

7.3 Cost Escalation

For the purpose of estimating the Total Outturn cost, the nominal escalation rate applied was 3.5%, made up of a real escalation of 1.5%, over and beyond a Consumer Price Index of 2% pa.



8. Project Risk Assessment

A high-level risk assessment has been undertaken for the Concept Options in this report.

At this stage, the residual risk ratings for most of the items are either Medium or High. A consolidated list of the identified risk events for the Options has been incorporated into the P50 / P90 cost estimate. The risk assessment for the project should be revisited at future stages of the project.

A summary of the identified risk events is shown below.

Figure 8.1: High-level Risk Assessment

Risk Description	Likelihood of occurring
Project funders hesitant about project support / vulnerability of support.	50%
Macquarie Street improvements not implemented in a suitable timeframe.	60%
Changes to Concept Design result in the need to do additional work.	50%
Special Interest Groups create unforeseen changes to project scope.	10%
Consultation happens too early in the process raising community expectation / concerns.	30%
Protracted landowner negotiations regarding the impact on property delay the project.	20%
Error or omission in Concept Design identified and required additional / changed work.	10%
Ensuring the stability of cut and embankment slopes requires additional investigation and design.	30%
Protracted Government approvals delay the project.	50%
Impact on local community / commuters creates a public backlash to the project.	70%
Environmental / heritage impacts require permits that are not approved in a timely manner.	60%
Planning consent / approvals create project delays.	10%
Unknown / untested ground conditions or latent conditions encountered during construction works.	30%
Unforeseen heritage item encountered during construction works.	10%
Construction complexity is not adequately anticipated, creating delays and additional costs.	20%



Appendix A. Concept Drawings Project 1 - Option 1

Released under Rth

















