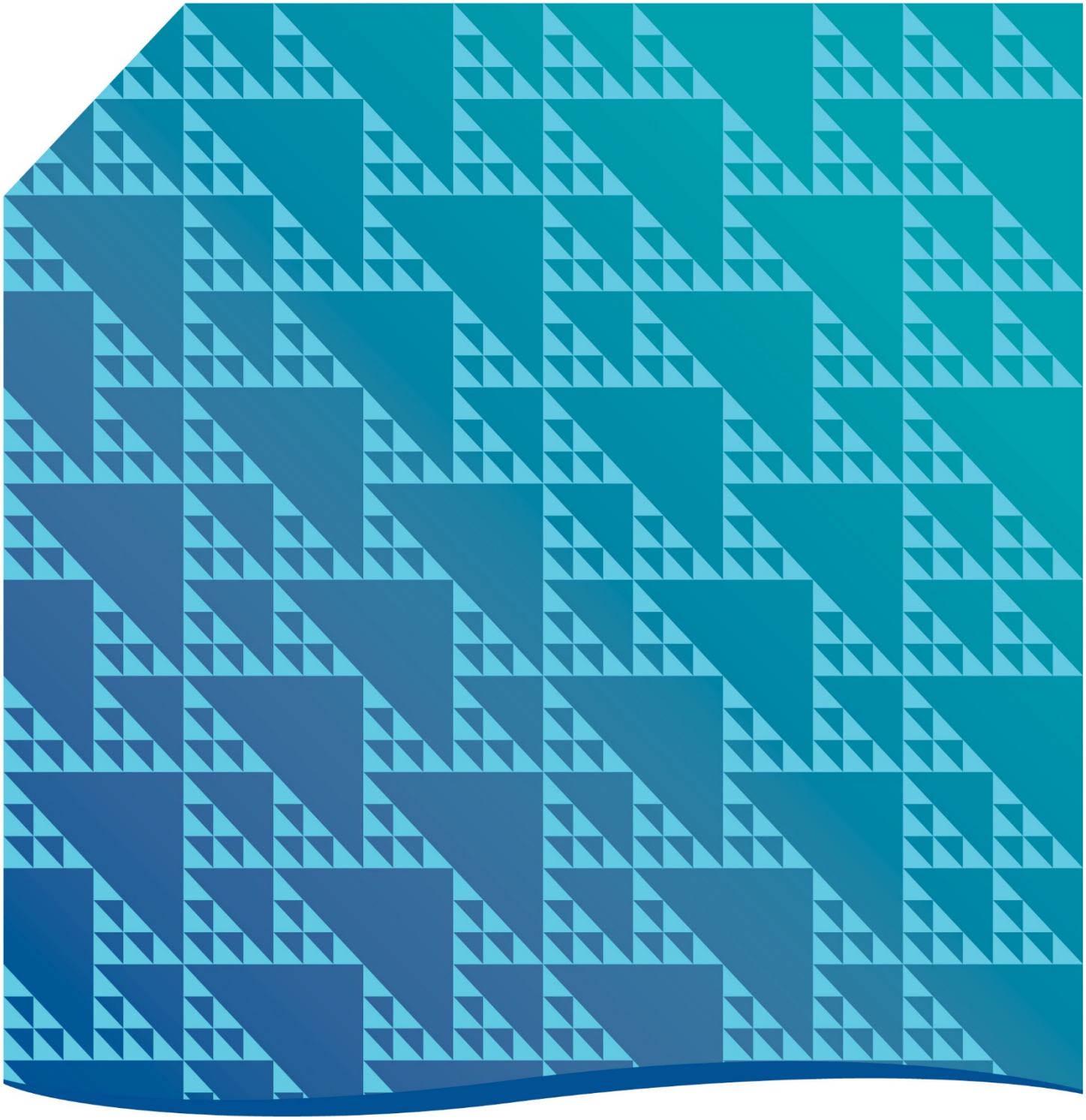
**Summary Report**

September 2020

# Hobart Western Bypass Feasibility Study



Department of State Growth

Tasmanian Government

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# Executive summary

In March 2019, the Tasmanian Government announced that it would investigate alternative traffic routes through Hobart considering all options including bypass roads and tunnels. A comprehensive feasibility study examining options for a Hobart Western Bypass has now been completed by consultants GHD. GHD are a respected multi-disciplinary engineering consultant involved in all phases of road tunnel delivery including providing feasibility advice to the Victorian, New South Wales and Queensland governments.

The feasibility study aim was not to recommend whether or not a bypass should be built or not, but rather to outline the costs, benefits and impacts of bypass construction, show people what the bypass infrastructure would look like and consider when conditions in Hobart might be suitable for this infrastructure. The study developed five different bypass options before shortlisting two of those options for a more detailed analysis of their technical and commercial feasibility. The two shortlisted options use a combination of tunnels, bridges, interchanges and ramps to bypass the CBD providing a free flowing connection between the Southern Outlet and the Brooker and Tasman Highways. The route and number of tunnels and interchanges differs between the two options investigated in detail. Three dimensional visualisations have been produced outlining the physical layout and construction impact zones of both options.

Traffic modelling found that the untolled bypass options were capable of reducing Macquarie-Davey traffic volumes by up to half, leading to travel time savings of up to four minutes. However with an estimated unescalated cost of over $3.3 billion, compared to these travel time savings, a bypass would be considered unfundable by both the Tasmanian and Australian Government.

This conclusion was reached after considering potential financing options including Public Private Partnerships (PPP) and tolling the use of the bypass over a 30 year period including five years for construction. The cost of using the bypass to the Tasmanian Government was found to be approximately $31 per one-way trip.

Traffic and financial modelling found that less than 2% of the annual cost of the bypass could be recovered by tolling leaving the tax payer to subsidise the remaining 98% of the capital and operating costs. Charging a toll that people would be prepared to pay (based on travel time savings) would only recover the cost of operating the tolling infrastructure and at the same time, would discourage around half the people who would otherwise use the bypass.

Additionally the significant and unprecedented impacts to Hobart's existing land use, heritage listed precincts and properties and visual amenity were considered to be prohibitive and likely to face legal challenges during the approval processes available to the Government.

While in many major urban centres, tunnels are a viable solution to managing CBD congestion, this feasibility study examined the specific traffic, geotechnical and heritage conditions present in Hobart and found that tunnels are unlikely to be a viable solution for our capital city in the foreseeable future. Even though construction of a bypass road was found to be unfeasible, the study has provided valuable information to the Government to allow it to make informed decisions about investing in infrastructure that better connects Hobart.

The Government's priority in the short to medium term remains the projects identified in the Hobart City Deal which forms the blueprint for the Tasmanian Government's coordinated plan to improve transport across Greater Hobart, now and into the future.

# Introduction

Since the 1960s, a number of bypass concepts have been proposed to improve congestion within Hobart CBD. These have included a range of concepts from ring road[1] options to tunnel alignments. Ring road proposals have included a western bypass starting in the south prior to Mount Nelson, skirting around inner Hobart and Glenorchy and connecting up to the Brooker Highway via Claremont Link Road. Most recently, a proposal prepared by the NCK Evers Network suggested a tunnel from the Southern Outlet to the Tasman Highway with interchanges along the route to provide improved connectivity to the CBD.

In response to these proposals and recognising the pressure on Hobart's roads, the Tasmanian Government announced in March 2019 that it would investigate alternative traffic routes through Hobart considering possible options including bypass roads and tunnels. A comprehensive feasibility study examining options for a Hobart Western Bypass has now been completed by consultants GHD.

GHD are a respected multi-disciplinary engineering consultant who have been involved in all phases of road project delivery including providing technical and commercial advice to other State governments on large road tunnel projects such as:

- Melbourne's East Link, North East Link, East West Link and West Gate Tunnel;
- Sydney's Westconnex, Northconnex, M6 and Lane Cove Tunnel; and
- Brisbane's Airport Link, Clem 7 and Legacy Way.

From a commuting perspective, Hobart is more dependent on private vehicles than other Australian capital cities, with approximately 84% of commuters using private vehicles even though the mean commuting distance is less than 9 km. The Macquarie-Davey Couplet is the key transport link for through traffic as well as trips ending within the Hobart CBD. In 2016, almost 70,000 vehicles used the Macquarie-Davey Couplet daily, with over 11,000 vehicles during the morning peak (7:00 am to 9:00 am) and 13,000 vehicles during the afternoon peak (4:00 pm to 6:00 pm). Previously, the effectiveness of bypass options has generally been challenged as demand surveys indicate that a large proportion of congestion on the Macquarie-Davey Couplet is not through traffic, but instead traffic which accesses the CBD.

[1] Road that encircles a particular area, often providing alternative travel routes into a city or town.

# Feasibility Study purpose

The Hobart Western Bypass Feasibility Study sought to identify bypass options with the greatest potential for relieving congestion along the Macquarie-Davey Couplet, with careful consideration given to minimising impacts to the sensitive CBD environment. The bypass options examined were those that provided traffic with a connection between the Southern Outlet and the Brooker Highway and/or the Tasman Highway. The study sought to inform the Tasmanian Government of the potential costs, benefits and impacts of a Hobart Western Bypass rather than to recommend whether a bypass should be built or not. This is because the study did not investigate other options for relieving Macquarie-Davey Couplet congestion and compare those to a bypass.

Specific objectives of the study were to:

- Show people what Hobart Western Bypass options would look like and understand their impact on Hobart's land use and heritage.
- Demonstrate the effect bypass options would have on Macquarie-Davey traffic volumes
- Estimate how much it would cost to build and operate a bypass
- Assess the commercial viability of implementing bypass options as tolled roads and procuring the development as a Public Private Partnership (PPP) compared to other finance options.

# Study approach and options

The study started by developing a list of five different bypass options and assessing these against traffic, planning, community, environmental, geological, design and economic considerations. Wider ring road options were not considered due to traffic modelling demonstrating that very few drivers (~30 vehicles per hour in each direction) would use them. The five options are shown below:

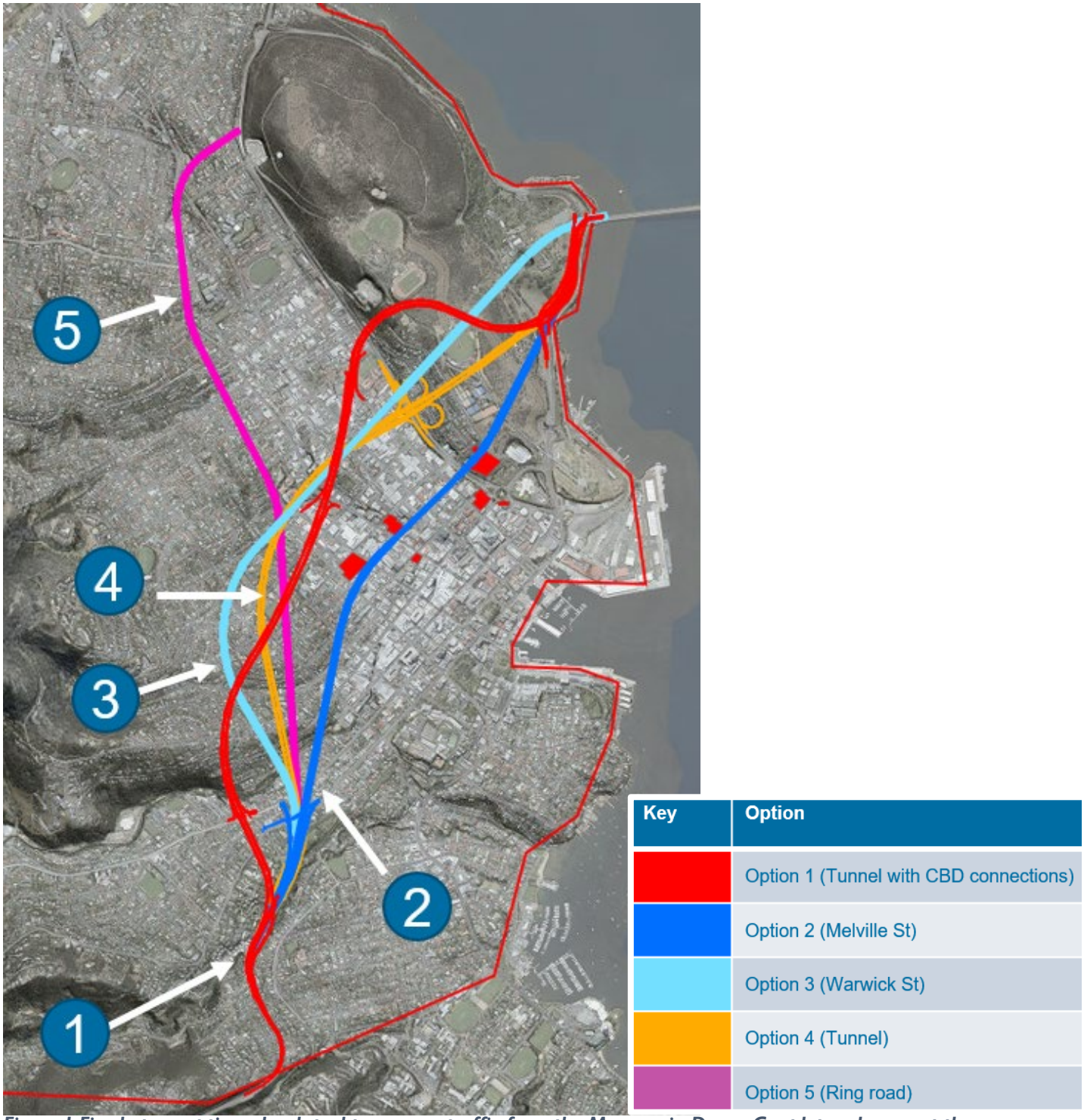



***Figure 1 Five bypass options developed to remove traffic from the Macquarie-Davey Couplet and connect the Southern Outlet to the Brooker and Tasman Highways.***

The options analysis shortlisted two options for assessment of feasibility:

- Option 1 – Tunnel Bypass with CBD Connections (4.7 km long)
- Option 4 –Tunnel Bypass (4.5 km long)

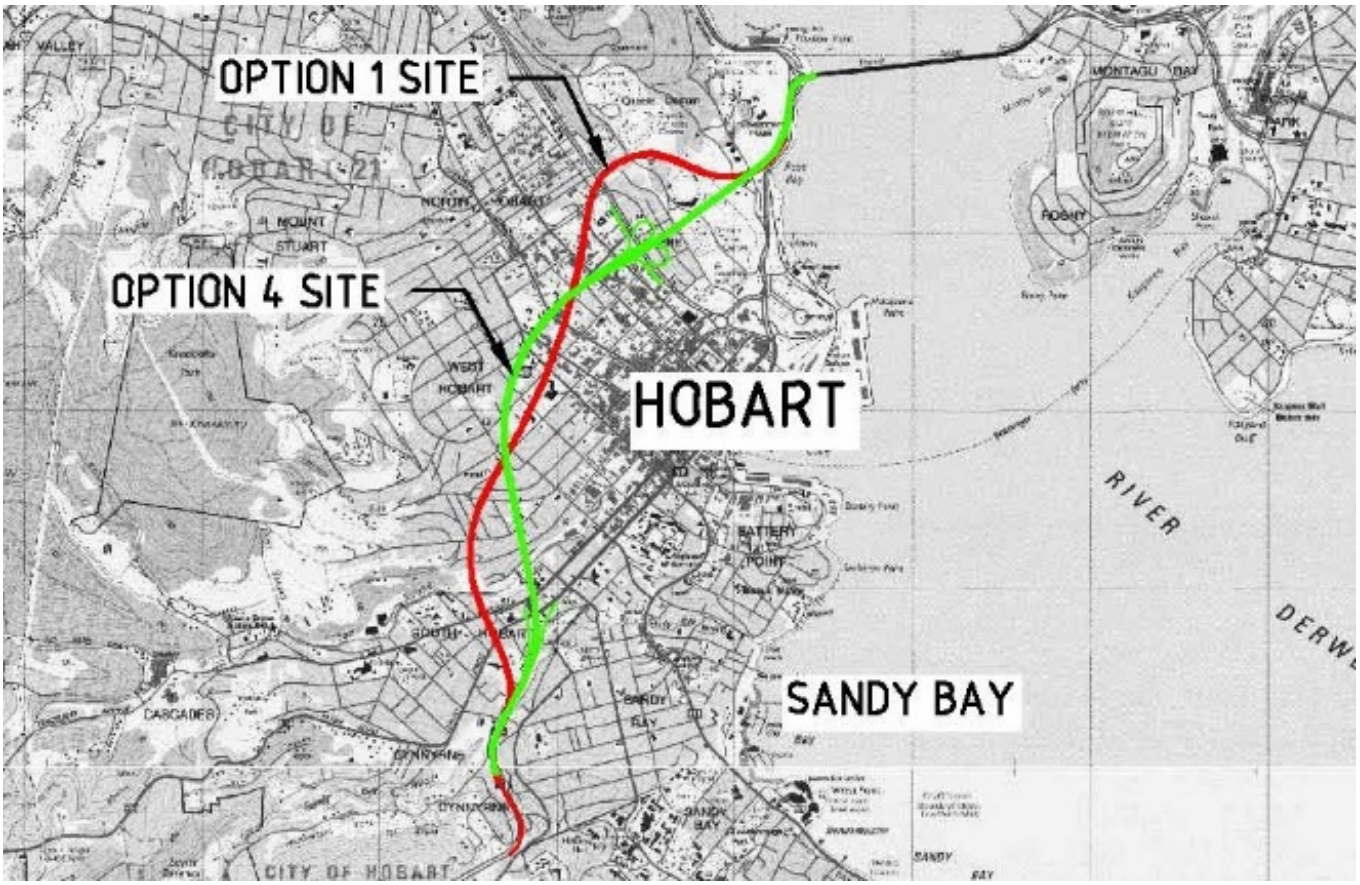



*Figure 2 Option 1 (red) and Option 4 (green) were selected for feasibility investigations.*

Both of these options provide a tunnel link between the Southern Outlet, the Brooker Highway and the Tasman Highway and were ranked highest with respect to the investment objective of improving congestion along the Macquarie-Davey Couplet. Additionally, the ability to minimise impacts to the CBD environment was a prominent benefit of both options. The other proposed options (2, 3 and 5) included significant sections of at-grade road which would result in significant temporary and permanent impacts to the urban environment, which were considered extremely detrimental to the neighbouring residences, businesses and civic institutions.

For both Option 1 and Option 4, the study then investigated:

- Traffic impacts on the Macquarie-Davey Couplet and the estimated travel time savings for the users of the bypass
- Engineering design including the selection of tunnelling methods, the layout of interchanges and ventilation and safety requirements.
- Planning, environmental and heritage impacts
- Development and construction risks
- Construction cost
- Operating cost
- Commercial assessment

Based on the concept designs produced by GHD, 3-D visualisations of Option 1 and Option 4 were developed that show what the tunnels and associated bridges and interchanges would look like. These are shown in Appendix A for Option 1 and Appendix B for Option 4.

# Traffic

Traffic engineers consider that the Macquarie-Davey Couplet is functioning with an acceptable transport efficiency for an urban arterial, however that may not be the full picture. In 2016, travel speeds along the Macquarie-Davey Couplet ranged between 25 km/h and 42 km/h, meaning it is performing at a Level of Service (LOS)[2] C, based on national industry standards. This LOS represents stable operations, but a restricted ability to manoeuvre and change lanes in between intersections. However, the Macquarie-Davey Couplet is on the border of LOS D, meaning that small increases in traffic can have significantly amplified impacts, affecting travel time reliability.

While the majority of vehicles using the Macquarie-Davey Couplet have an origin or destination within Hobart's CBD, up to 27% of vehicles still travel the entire length of the Macquarie-Davey Couplet and therefore might use a bypass if it were to be constructed. Considering all origins and destinations, over 17,000 vehicles daily are estimated to use the Macquarie-Davey Couplet to travel through and beyond the Hobart CBD; with over 2,000 in the morning peak and up to 1,500 in the afternoon peak.

State Road's Greater Hobart Urban Travel Demand Model (GHUTDM) was used to model traffic conditions for Option 1 and Option 4 in 2027 and 2037. Based on Government forecasts of population and employment, the traffic growth expected along the Couplet is below 1 % per annum.

For each option, the bypass was modelled with the following attributes:

- Two lanes each way
- 1,700 vehicles per lane per hour capacity
- 80 km/h posted speed

Both bypass options are forecast to provide a quicker travel time from the Southern Outlet to the Brooker Highway and Tasman Highway. Driving on the Option 1 bypass, it is forecast to be up to 2 minutes quicker between the Southern Outlet and the Brooker Highway and up to 4 minutes quicker to the Tasman Highway than using the Couplet. For Option 4, travel would also be 2 minutes quicker via the bypass to the Brooker Highway, however it would be 4.5 minutes quicker to the Tasman Highway. This is because Option 4 has a more direct route and fewer interchanges than Option 1. Strategic traffic modelling of Greater Hobart indicates that network wide travel time savings of up to 8s for the average commute would be experienced, although the impact on particular roads (such as reductions in queuing on the Southern Outlet) cannot be determined without more detailed traffic modelling.
The traffic modelling showed that without a toll, Option 1 would be well-utilised in both peak periods and cater to traffic volumes of over 36,000 vehicles daily. Because Option 4 does not have interchange options at Macquarie St and at the edge of North Hobart, it would be slightly less utilised in peak periods, but would still cater to over 32,000 vehicles daily.

If untolled, both bypass options would significantly reduce traffic volumes on the Macquarie-Davey Couplet. Under Option 1, the forecast daily traffic volume of the Macquarie-Davey Couplet roughly halves and under Option 4, it reduces by just over 40%. Similar reductions in Macquarie-Davey traffic volumes are also seen in both peak periods.

[2] Level of Service (LOS) ranks performance based on six levels, designated A to F, with LOS A representing the best operating condition and service quality from the users' perspective (i.e. free-flow conditions) and LOS F the worst conditions that most users would consider unsatisfactory (i.e. forced flow, such as gridlock). Typically, Level of Service D is the lowest acceptable performance level, with LOS E and F considered unacceptable

# Tolls

Toll roads are developed on the principle that people are prepared to pay a toll that reflects the time they save by using the bypass. Since the forecasted travel time savings are between two and four minutes, the willingness to pay is expected to be between $1 and $2 as a toll for a single, end-to-end trip.

Traffic modelling showed that demand for both bypasses was very responsive to small changes in toll prices, reflecting the low value of the potential travel time savings. Charging a $1.05 toll approximately halved the traffic expected to use the bypasses and charging a $2.10 toll reduced traffic volumes even further.

Introducing a toll to help pay for a bypass was found to be counter-productive. The estimated toll revenue received by charging a toll was around $6 million a year, which was estimated to be around the same cost as operating the tolling infrastructure. So while reducing the number of people prepared to use the bypass, a toll would not help the Tasmanian Government pay for the costs of the bypass.

# Design, geology and tunnelling

The concept road design for the bypass options is consistent with the connecting roads of the Southern Outlet and Tasman Highway. The adopted road layout is four 3.5m wide lanes, two in each direction, varying between at-grade sections, bridges and tunnels. As both Option 1 and Option 4 are predominately confined to tunnels, walking and cycling facilities were not included in the design. The internal diameter of a twin two-lane road tunnel (14m apart) will likely be in the range of 10.0 m to 11.5 m.

At tunnel portals (entrances and exits) significant land areas are required for electrical substations, fire services, water tanks and ventilation stations. Ventilation is required to manage air quality within the tunnels and smoke in emergencies. A tunnel ventilation assessment has been undertaken and found that large ventilation stations will be required to prevent horizontal portal emissions.

The geology of the ground beneath Hobart is complicated and challenging for road tunnel construction. It consists of layers of both rock (Permian age sandstone and mudstone and Jurassic age dolerite) and soils (Quaternary age alluvium and Paleogene-Neogene colluvium known as boulder beds) and numerous fault lines. The relative proportion of these rock and soil units differs for the two different bypass routes. Both the sandstone and dolerite rocks are abrasive to excavation equipment, but the sandstone and mudstone are weaker and easier to excavate than the dolerite. Mudstone beds between the sandstone may be acid generating when exposed. The boulder bed sections of soil are particularly difficult to excavate and may require temporary lowering of ground water levels and/or more time consuming and expensive pre-support works or other such ground improvement methods. The geology varies for the two routes, with Option 1 having to pass through more boulder beds and with Option 4 passing through more sandstone, mudstone and dolerite.

Because of the differing routes and underlying geology, Option 1 is likely to be constructed with sequential excavation methods (SEM) using machinery such as excavators, roadheaders and drill and blast (referred to as Mined Tunnel) and Option 4 is likely to use a tunnel boring machine (TBM). TBM

machines are used when mining long tunnels where the same cross-section is required. For the Brooker Highway interchange, Option 1 requires a 380 metre long bridge curving over the playing fields for Campbell Street Primary School along with a number of ramps, while Option 4 requires two 400 metre long underground caverns and two curved ramps under Glebe. Both Options require the use of cut and cover tunnelling at tunnel portals and at ramps until sufficient ground cover is available. Cut and cover tunnels require the removal of any existing buildings or other land uses at the surface.

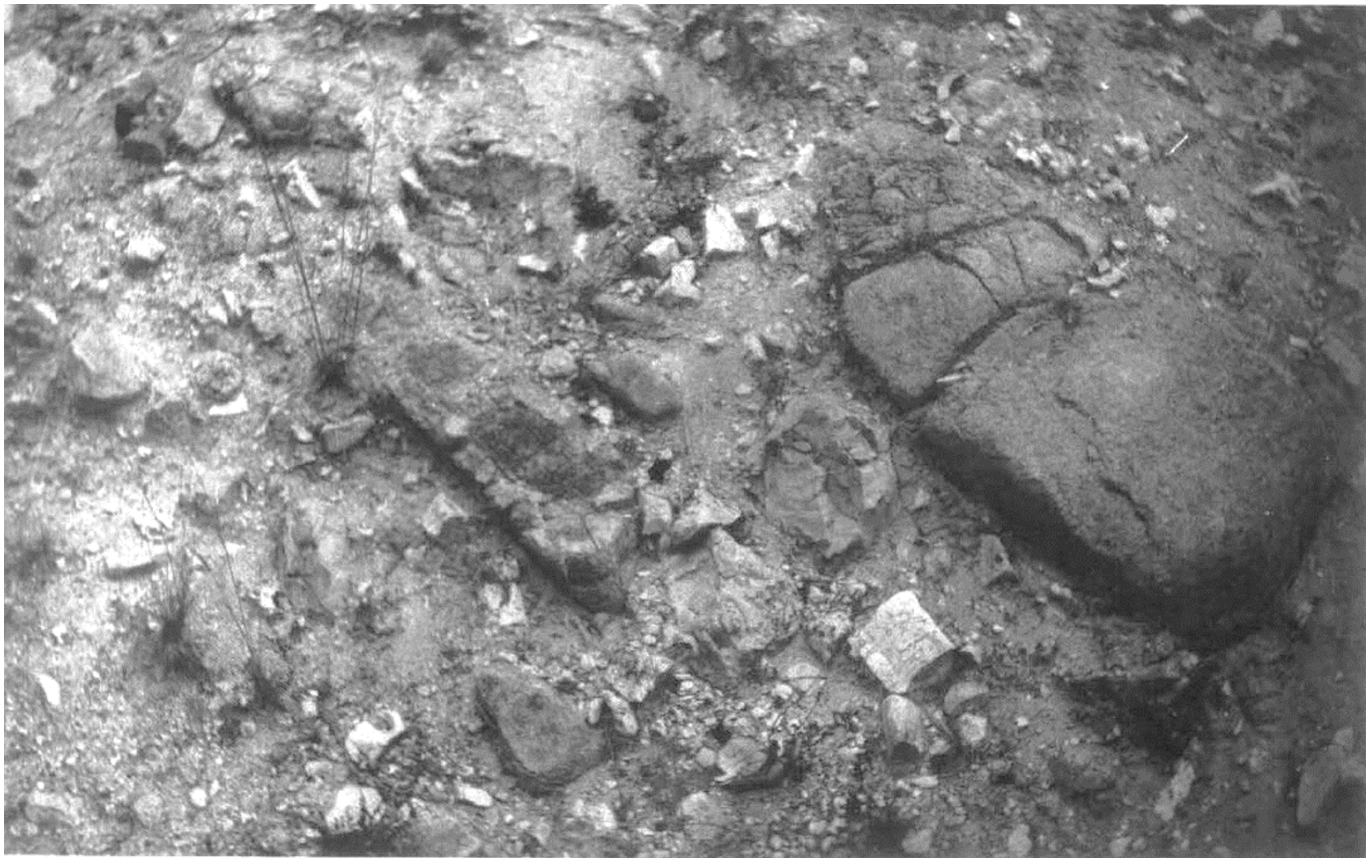


***Figure 3 Boulder beds consisting of soils and large boulders are common under Hobart and problematic for tunnelling. Source: Mineral Resources Tasmania***

# Planning, environmental and heritage

As shown in Figure 4, Hobart has hundreds of locally and State-listed heritage buildings as well as local heritage precincts and cultural landscape areas. Construction of either bypass options would have significant and unprecedented impacts on Hobart's heritage values.

For example, in terms of places listed on the Tasmanian Heritage Register, Option 1 could affect in the order of 40 land parcels and Option 4 could affect approximately 60 land parcels. Apart from heritage impacts, a large number of properties will need to be acquired with estimated costs of $99 million (Option 1) and $120 million (Option 4). Some sensitive environmental areas including sections of Queen's Domain would also be impacted.

Considering the above, planning approvals could be progressed using the proposed Major Projects Bill. The Major Projects Bill is specifically designed to deal with development proposals for projects that are typically larger, more complex, and have broader economic, environmental and social impacts beyond a single municipal area, than typical development proposals. However, approvals to remove state-listed heritage properties would be very difficult to obtain and would almost certainly face legal challenges. In practice, specific legislation would be needed should the Government want to build either bypass option. This would mean convincing Parliament that a bypass tunnel is the best option relative to all other options for managing Macquarie-Davey Couplet congestion.

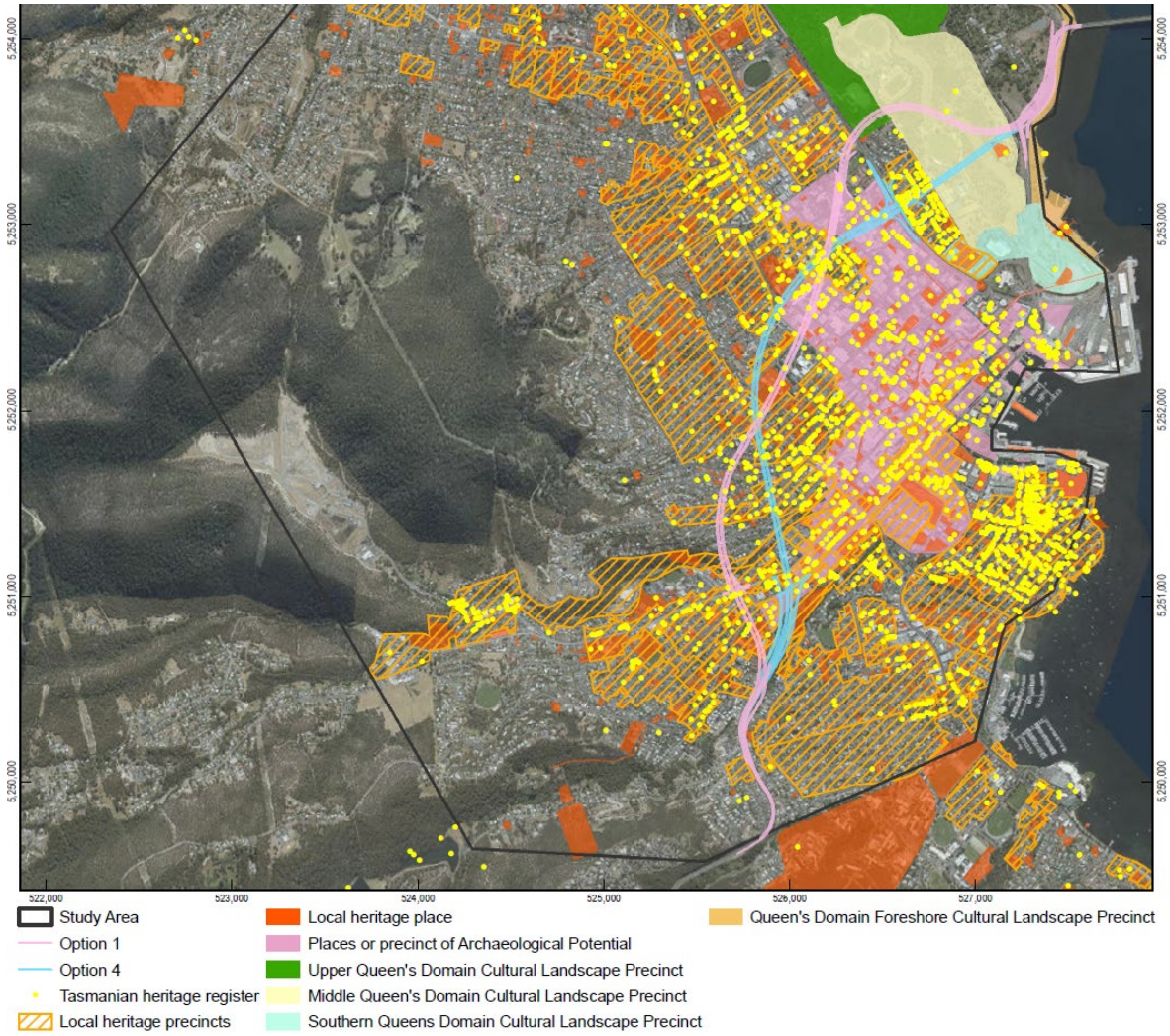



***Figure 4 Heritage places and precincts across Hobart with the overlay of Option 1 and Option 4.***

# Risk

Both of the bypass options investigated represent complex and significant road projects and consequently there are a number of major risks to consider with their delivery. These major risks include the degree of property acquisition required under each option, potentially significant impacts to heritage, commercial and residential properties, unknown geotechnical conditions, and traffic demand (especially in relation to the impact of tolls).

# Commercial assessment

GHD developed a detailed cost estimate of both options and found that either would require around $3.4 billion to design and construct as shown in Table 1 below. These costs reflect current construction rates in 2020 dollars and do not include escalation.

| Component | Option 1 | Option 4 |
|---|---|---|
| CBD connection Macquarie Street | $25,191,000 | $22,041,000 |
| CBD connection Murray / Patrick Street | $12,828,000 | N/A |
| Road construction between tunnel segments | $503,366,000 | $376,111,000 |
| Entry / exit ramps | $120,805,000 | $340,279,000 |
| Tunnel Portals | $15,530,000 | $157,530,000 |
| TBM tunnel | N/A | $2,336,497,000 |
| Cut & cover tunnel | $579,597,000 | $151,607,000 |
| Mined tunnel | $1,784,449,000 | N/A |
| Ventilation shafts and stations | $343,380,000 | $96,303,000 |
| **Total cost (Incl. P90 contingency)** | **$3,385,141,000** | **$3,480,364,000** |

All capital cost estimates for projects include contingency which reflects the unknowns, risks or more simply what could go wrong during the design and delivery of the project. At the feasibility study stage it is normal for cost estimates to contain a high level of contingency.

For this study, detailed investigations of ground conditions, such as drilling a significant number of boreholes and conducting ground water studies have not been conducted and therefore there are substantial construction cost risks to be accounted for as contingency. If a bypass was to progress and further investigations conducted, known costs would increase and contingency amounts will decrease.

The P90 level of contingency applied in the above table means that there is a 90% chance that the cost will not exceed the total cost shown.

Additionally, the expected operational costs of the bypass options if operated as a toll road are between $17 million to $34 million per annum. These operational costs include maintenance, the operation of electronic signage, ventilation and fire-life-safety systems as well as an allowance for the recurrent capital costs (refurbishment and re-fit out). In comparison, the maintenance budget for all of Tasmania's State roads, around 3700 kilometres, is in the order of $70 million per annum. Without tolls, the operation costs would be reduced by around $6 million per annum.

GHD undertook an assessment to understand the commercial viability of operating the bypass options as private toll roads. Under this arrangement known as a Public Private Partnership (PPP), a third party takes responsibility for construction and is allowed to charge for use of the road. Where toll revenue is insufficient for the operation to generate a typical rate of return, the Tasmanian Government would provide a contribution (subsidy) to the third party.

Financial modelling for the PPP arrangement used an evaluation period of 30 years (2020 to 2049), considering a five-year construction period and a 25-year operation period. The modelling showed that demand for the toll road would not reach a suitable level and a substantial government subsidy would be required to assist a private operator to meet a commercial return. This is typical for Australian toll roads, however in this case, the size of the subsidy, in the order of $320 million per annum or 98% of the bypass costs is much larger than on similar toll roads in Sydney or Melbourne.

Another finance option is for the Tasmanian Government to Build, Own and Operate (BOO) the bypass. While the PPP approach allows the risks associated with construction and operation to be transferred to a private company, a publically built and operated bypass sees these risks remaining with the Government. Because the public BOO option does not involve a party making a profit in return for risk taking, this option reduces the overall cost (construction and operation) to the government to around $320 million per annum.

Regardless of the finance option chosen, the commercial attractiveness of both bypass options was found to be poor. Even when operating the bypass without a toll to ensure the highest patronage, a single end to end trip would cost the tax payer at least $30.50 in subsidy, or across all daily trips for the bypass, over $800,000 per day.

# Conclusions

While in many major urban centres, tunnels are a viable solution to managing CBD congestion, this feasibility study examining the specific traffic, geotechnical and heritage conditions present in Hobart found that tunnels are unlikely to be a viable solution for Hobart in the foreseeable future.

Both of the shortlisted bypass options investigated were found to be technically feasible and would deliver estimated travel time savings of between 2 and 4 minutes, however neither option was found to be commercially attractive for a PPP investment nor, in the Department's view, fundable by the Tasmanian and Federal Governments.

This conclusion is largely due to the high construction cost of $3.4 billion, relatively low traffic volumes (based on the overall magnitude of Hobart's traffic volume) and a low forecast growth in traffic demand along the Macquarie Davey Couplet (less than 1% p.a.) over the 30 year assessment period.

It is also influenced by relatively low toll revenues due to high responsiveness in demand to changes in toll price – if tolls are set too high, people will not see the value in using the bypass, leading to lower overall revenue capture. The study found that under 2% of the cost of the bypass could be recovered by tolling leaving the tax payer to subsidise the remaining 98% of the capital and operating costs. Charging a toll that people would be prepared to pay (based on travel time savings) would only recover the cost of installing and operating tolling infrastructure and at the same time, would discourage around half the people who would otherwise use the bypass.

While broader network benefits, specifically queuing time savings (for instance for vehicles on the Southern Outlet on approach to Davey St), haven't been quantified by the study, broader network costs, typically incurred to integrate tunnels into the local road network, have also not been included.

Road tunnels are very expensive to build and the tunnel interchanges have a big impact on the surrounding environment and the community. This is why they are considered the last resort in managing urban congestion.

In Australia there are long road tunnels in Sydney, Brisbane and Melbourne. The first tunnels were built:

- in Sydney in 1992, when the population was 3.7 million people
- in Brisbane in 2010, when the population was 2.0 million people
- in Melbourne in 2000, when the population was 3.4 million people

By contrast the population of Greater Hobart is 250,000.

Additionally the significant and unprecedented impacts to Hobart's existing land use, heritage listed precincts and properties and visual amenity were considered to be prohibitive and likely to face legal challenges during the approval processes available to the Government.

While a bypass has been found to be unfeasible, the feasibility study has provided valuable information to the Tasmanian Government to allow it to make informed decisions about investing in infrastructure that better connects Hobart.

The Government's priority in the short to medium term remains the projects identified in the Hobart City Deal, which forms the blueprint for the Tasmanian Government's coordinated plan to improve transport across Greater Hobart, now and into the future.

# Appendix A – Visualisation of Option 1

Southern Outlet Interchange tunnel portals, ventilation station, substation (green buildings) and required construction zone (yellow outline).

Macquarie Street Interchange – left in, left out to the tunnels, ventilation stations, substations and bridge over the Hobart rivulet. Construction zones are outlined in yellow.

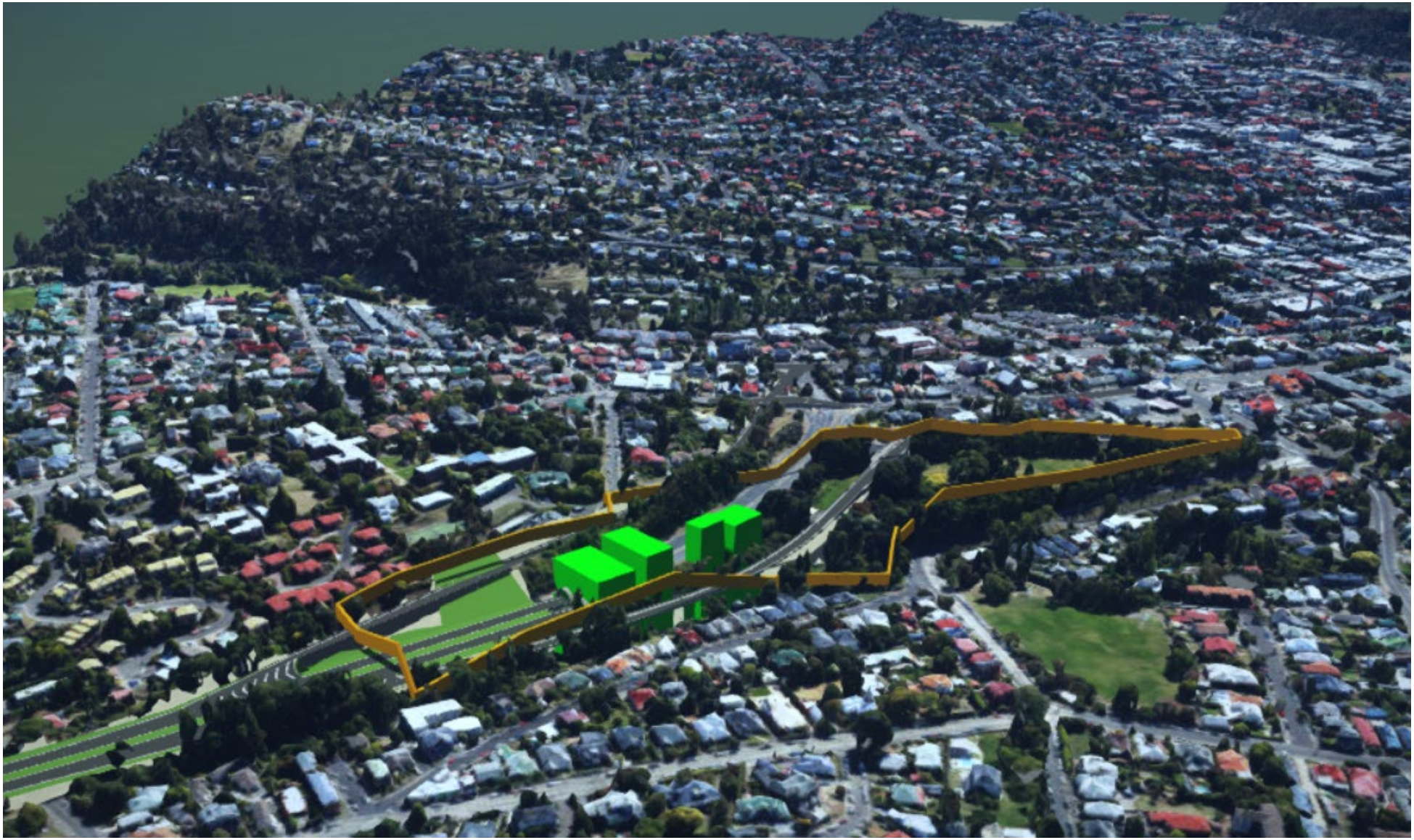
Mid-city Interchange incorporating a northbound on-ramp from Murray Street and a southbound on-ramp from Patrick Street. The yellow outline shows area for cut & cover tunnel construction in which all buildings would be demolished. Ventilation station and substations are also shown.

Brooker Interchange including ramps to Campbell and Burnett Streets, tunnel portals and ventilation stations. The school sports field for Campbell Street Primary school will be overshadowed by the overpass structures.

Tasman Highway Interchange ramps, tunnel portals, ventilation station and substation. Lower Domain Road must be raised to bridge over the tunnel portals.

# Appendix B – Visualisation of Option 4

Southern Outlet tunnel portals, ventilation station, substation and required construction zone (yellow outline) at Fitzroy Gardens for TBM launch, storage and portal construction area.



Brooker Interchange consisting of four underground ramps including large circular ramps under Glebe. The yellow outline shown below is the area of acquisition and property demolition required for cut and cover construction of the ramps.

Tasman Highway Interchange ramps tunnel portals, ventilation station and substations as well as the required construction zone (yellow outline) for TBM retrieval. Lower Domain Road must be raised to bridge over the tunnel portals.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