Outline Planning Study Report

PR-1267 – Outline Planning Study Report: Unley Road, Cross Road and Belair Road Intersection

IPP-AMJV-421-001-RP-OP-DO-0170

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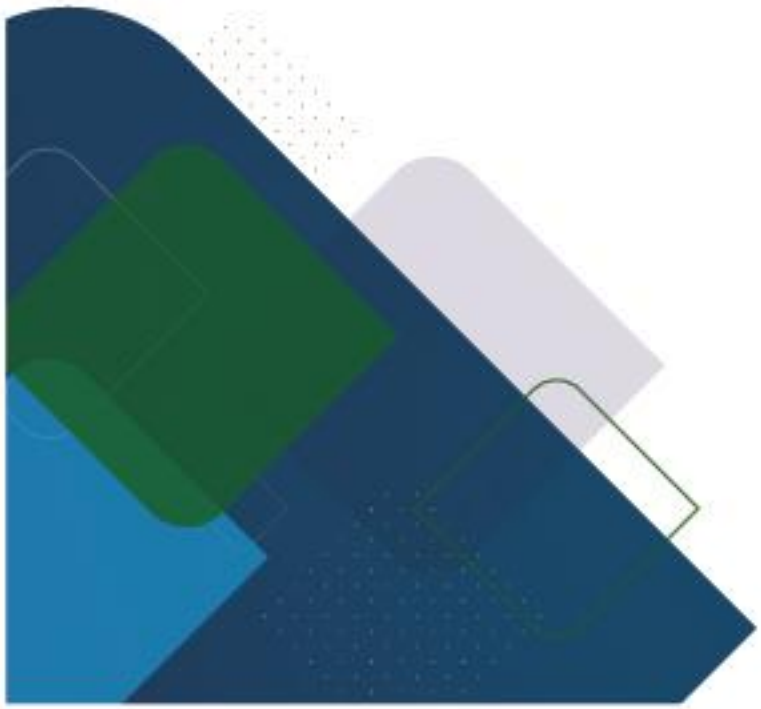

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Summary

The Department for Infrastructure and Transport (DIT) has engaged the Aurecon Mott Macdonald Joint Venture (AMJV), to deliver Packages D and E of the Network Planning Studies in conjunction with DIT under the Integrated Planning Partner (IPP) Contract. Package D comprises a number of Planning Studies on the Portrush Road and Cross Road corridors.

About this Planning Study

The Unley Road, Cross Road and Belair Road Intersection Planning Study (the Planning Study) investigated potential upgrades of the Unley Road, Cross Road and Belair Road intersection. This Planning Study aligns with Tasks 1–5 of DIT's *Framework for Planning Studies* and the requirements within their Master Specification *PC-PL1 Framework for Planning Studies* (Version 3, August 2020). This includes development of long list options, short list options, and 2 preferred options for the potential intersection upgrade.

The development of the preliminary long list, long list, short list and preferred options were informed primarily by impact assessment, costing, design, and intersection performance. The short timeframes of the Planning Study necessitated a focus on the risks associated with land acquisition, services impacts, costing, and heritage to facilitate option selection. This process has helped to inform the development of this *Outline Planning Study Report*, which represents the conclusion of this Planning Study.

Recommendation of 2 preferred options

Progression to 2 preferred options was undertaken using a Multi-criteria Assessment and Benefit-Cost Analysis in collaboration with DIT. Following the Multi-criteria Assessment and Benefit-Cost Analysis, an at-grade and a grade separation option were recommended, as listed in Table 1 below.

Table 1: Preferred options

Option name	Description
Option 3A – Cross Road Grade Separation (widen to north)	Cross Road layout and lane lengths based on design for Marion Road/Sir Donald Bradman Drive grade separation
Option 10 – At-Grade Widening on Cross only (3T Cross)	3 through lanes on Cross Road only No changes to Unley or Belair Roads
Key: T = Through	

An updated Level 3 cost estimate (estimate reference EST 600-2 2683 OE L3 R2) and Benefit-Cost Analysis were prepared for the preferred options in accordance with DIT's *Estimating Manual*, as summarised in Table 2. These cost estimates were developed with reference to the 10% Concept Designs, requirements for land acquisition, and the proposed constructability programs.

Each preferred option has been developed to a 10% level of design.

Table 2: Updated Level 3 cost estimate and benefit-cost analysis for preferred options

Option name	P50			P90		
	Updated L3 cost estimate*	NPV^{2021} ($)	BCR	Updated L3 cost estimate*	NPV^{2021} ($)	BCR
Grade separated (Option 3A)	$206.2M	-55.66	0.73	$236.5M	-84.74	0.65
At-Grade (Option 10)	$75.0M	-4.5	0.94	$87.8M	-15.93	0.82
***** Costs rounded to nearest $0.1M						

Next steps

The Cross Road Corridor Planning Study and Unley Road Corridor Planning Study are currently being developed and it has been recognised that, once completed, this study will directly influence the future of this intersection's function and purpose within the Cross Road and Unley Road corridors. Moving forward, the single preferred option for this intersection will need to be considered within the broader context of these planning studies.

A comprehensive stakeholder and community engagement on the preferred option(s) will form another important next step in validating and mitigating the potential impacts identified in this report. It will also be critical to 'close the loop' with stakeholders – to report back what we heard during engagement, inform them what was done with their feedback, and what the outcomes and next steps for the project are.

Further investigations will also be required to progress the design of the preferred options, including:

- engineering survey
- vegetation survey
- services potholing
- geotechnical investigations
- stormwater study
- completion of a climate change risk assessment
- completion of a green infrastructure assessment.

Critically, any future investment decisions for the project need to include assessment of alignment with the State's climate change commitments, including net zero emissions by 2050. To enable this, it is recommended that transport modelling be updated to allow accurate characterisation of all investment options' GHG emissions generating potential, for ease of identifying low-carbon options.

Additional investigations will be required to understand local street impacts where side streets are restricted or closed as a result of the project.

Furthermore, additional testing of the preferred option will be required following the updated future traffic demands that incorporate demand forecasts associated with the ultimate North–South Corridor design. Traffic modelling used for this study was based on approach growth rates. The traffic modelling and intersection options should be reviewed when new traffic volume forecasts are available that include the planned improvements to the North–South Corridor.

1 Introduction

1.1 Integrated Planning Partners

The Department for Infrastructure and Transport (DIT) has appointed two Integrated Planning Partners (IPP), consisting of Arup and AECOM and the Aurecon Mott MacDonald Joint Venture (AMJV), to deliver the Network Planning Studies Program of Work (the Program).

The AMJV was engaged to deliver Packages D and E of the Program in conjunction with DIT. Package D comprises a number of planning studies on the Portrush Road and Cross Road corridors.

1.2 About this Outline Planning Study Report

The Unley Road, Cross Road and Belair Road Intersection Planning Study (the Planning Study) is for the upgrade of the Unley Road, Cross Road and Belair Road intersection, which generally follows Tasks 1–5 of DIT's *Framework for Planning Studies*, as shown in Figure 1, and the requirements of DIT's Master Specification *PC-PL1 Framework For Planning Studies* (Version 3, dated August 2020).

This *Outline Planning Study Report* represents the conclusion of this Planning Study. This report summarises why this intersection has been examined, the current conditions and future problems expected at the intersection, the process of developing and assessing options for this site, the preferred options that have been recommended, and the next steps that will need to be undertaken should any improvements at this intersection be pursued.

The 2 preferred options have been developed to a 10% level of design, and they are supplemented by accompanying Level 3 cost estimates and project management documentation, in addition to other deliverables.

The information presented in this report, its appendices and all supporting documentation represent a point in time with respect to the Planning Study and is reported as relevant to Tasks 1–5 of the Master Specification.

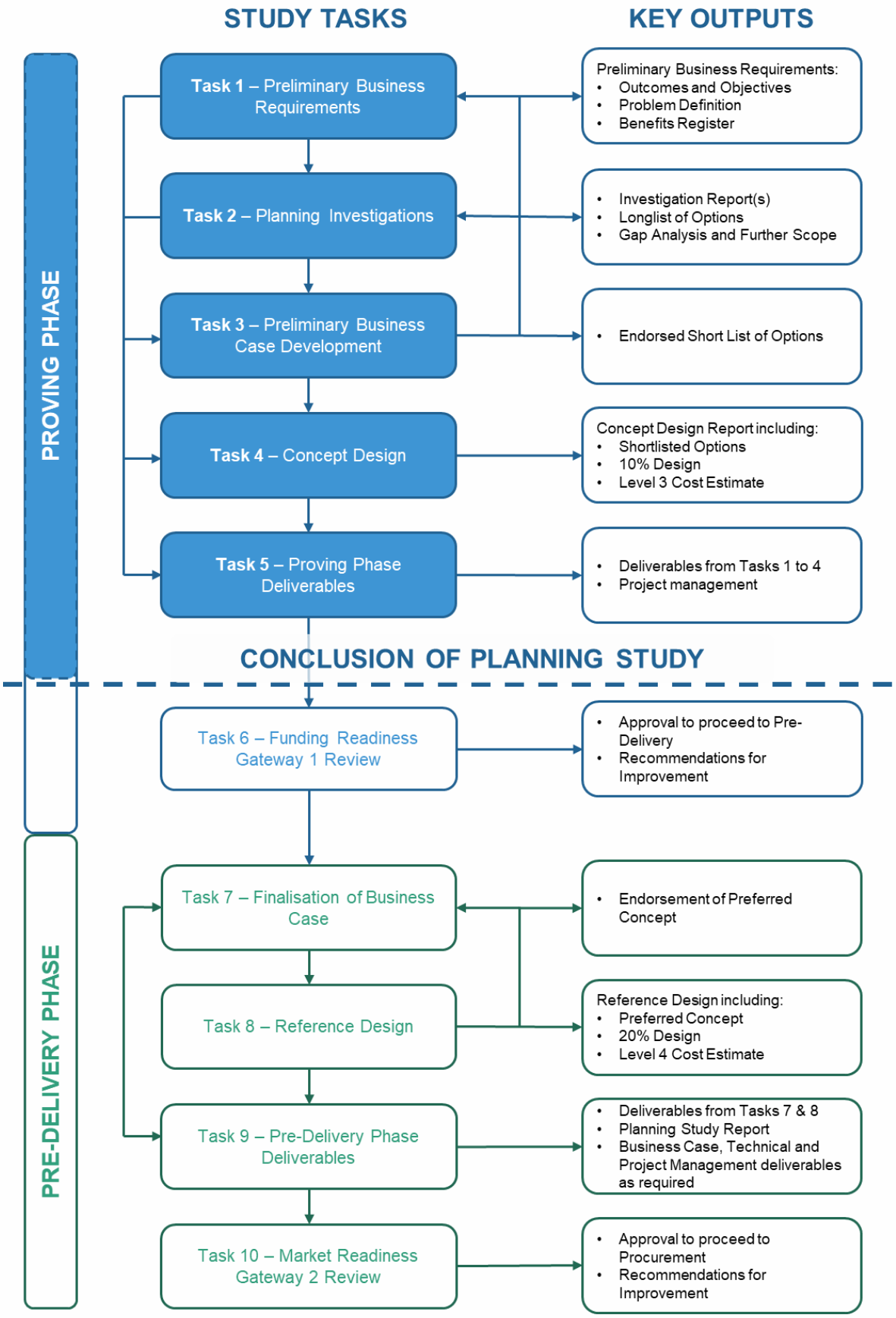


Figure 1: DIT's *Framework for Planning Studies*

1.3 Project background

Cross Road is a major east–west arterial road located within the inner southern suburbs of Greater Metropolitan Adelaide used by both general commuter and freight traffic. Cross Road extends from Anzac Highway to the junction of the South Eastern Freeway, Portrush Road and Glen Osmond Road and spans across 7 key intersections, 3 at-grade level crossings and 3 local government areas, including the City of Marion, City of Unley and City of Mitcham. Cross Road forms part of Adelaide's Outer Ring Route which plays an important role in the metropolitan Adelaide road network, providing a cross-city travel route without the need to pass through the central city precinct. The Outer Ring Route also functions as a key freight route, providing connectivity between the city's urban arterials, export/import gateways and intermodal terminals.

The Cross Road, Unley Road and Belair Road intersection carries approximately 26,000 to 31,000 vehicles per day on each leg, with a freight task of approximately 4%. Unley Road/Belair Road is a high frequency north–south public transport corridor (i.e. Go Zone). Cross Road is identified as a standard frequency public transport corridor. A number of previous transport planning studies undertaken by DIT have identified that future traffic volumes will saturate the key signalised intersections and mid-block sections along the length of the Cross Road Corridor and along the intersecting north–south arterials, including at Unley Road/Belair Road.

1.4 Study area

The study area is located at the intersection of Unley Road, Cross Road and Belair Road on the southern side of metropolitan Adelaide approximately 4.3 km south of Adelaide's CBD, as shown in Figure 2. The intersection is located within the jurisdiction of the City of Unley and the City of Mitcham, and in the suburbs of Unley Park, Malvern, Hawthorn and Kingswood.

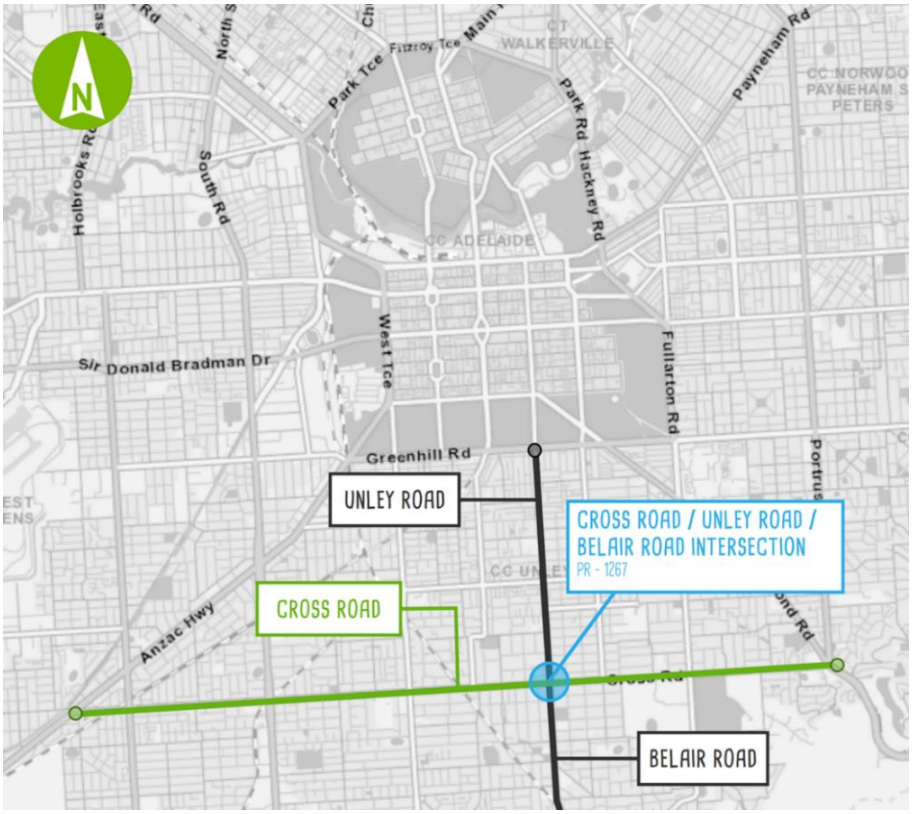


Figure 2: Study area and surrounding context

1.5 Planning Study program

The Planning Study has been progressed in a short timeframe to meet the requirements of DIT's funding submissions.

The Planning Study tasks undertaken to date include:

- project inception and data collection, October 2020
- preliminary business requirements and problem definition preparation, December 2020–March 2021
- initial fast-track long list to short list development, October–December 2020
- planning investigations gap analysis, March 2021
- long list development, February–March 2021
- short list development, March 2021
- short list costing, May 2021
- preferred development, April–July 2021
- finalisation of deliverables, August 2021.

Due to the constraints of the Planning Study timeframes, the development of options focussed on key risks associated with land acquisition, services, and impact on non-Indigenous heritage properties to inform the option selection process.

Following discussions with DIT it was agreed that the 2 preferred options will represent the conclusion of the Unley Road, Cross Road and Belair Road Intersection Planning Study. As such, no single option will be progressed to a 20% Reference Design at this stage.

The Cross Road Corridor Strategy is currently being developed and it has been recognised that, once completed, this strategy will directly influence the future of this intersection's function and purpose within the Cross Road Corridor. Moving forward, the single preferred option for this intersection will need to be considered within the broader context of the Cross Road Corridor Strategy.

1.6 Project governance

Project governance for the Planning Study included establishing an IPP Steering Committee, which was formed with senior DIT officers, as shown in Figure 3.

The function of the IPP Steering Committee was to guide, add value to, and facilitate the decision-making process throughout the project. The IPP Steering Committee met in accordance with key Planning Study milestones to review the progress of this Planning Study and provide endorsement at crucial decision points. Separate meeting minutes were prepared and issued to the IPP Steering Committee.

Due to the short timeframes of the Planning Study, the IPP Steering Committee meetings with DIT were held as needed.

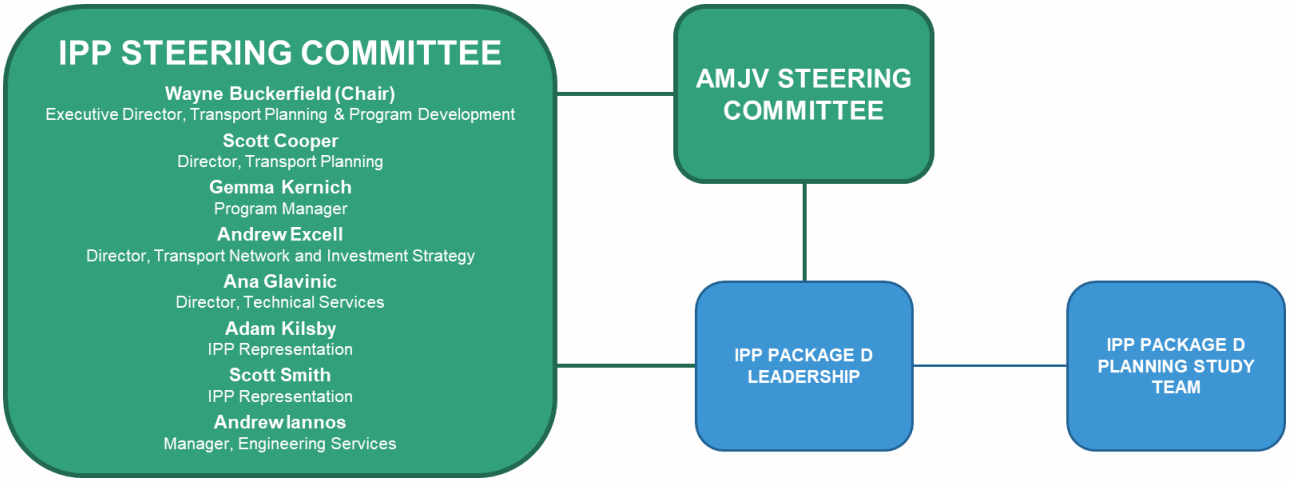


Figure 3: Project governance structure

1.7 Stakeholder and community engagement

An ‘engagement plan’ for the intersection was initially prepared and approved. The plan outlined an approach for stakeholder engagement – primarily with local government and transport associations – and focused on gathering information from these stakeholders in a forum of issues and opportunities. However, since this project overlapped with the corridor studies (and linked to adjacent intersection investigations) an overlap of stakeholders was identified. To mitigate the risk of confused messaging between sites and avoid stakeholder fatigue, engagement for the intersection was broadly included within a series of workshops undertaken for the Cross Road Corridor and Portrush Road Corridor Planning Studies (PR-1255 and PR-1266).

The workshops were used to gather information of a more general nature, focussing on current function, issues and opportunities. It is noted that no options, including the preferred options, have been presented to stakeholders for feedback.

Community engagement specific to this Planning Study was not undertaken, and due to timing, relevant information and feedback from the community, gained as part of the broader community engagement process, has not been incorporated into this Planning Study.

There exists the opportunity to undertake additional and more comprehensive stakeholder and community engagement on the preferred options. This would form an important next step in validating and mitigating the potential impacts identified in this report.

It will also be critical to ‘close the loop’ with stakeholders – to report back what we heard during engagement, inform them what was done with their feedback, and what the outcomes and next steps for the project are.

2 Case for change

2.1 Existing intersection

2.1.1 Functional hierarchy

The functional hierarchy for South Australia's land transport[1] has been identified as follows:

- Cross Road's role as a Freight Route, Standard Frequency Public Transport Corridor, Major Cycling Route (metro) and Major Traffic Route
- Unley and Belair Roads' role as a High Frequency Public Transport Corridor, Major Cycling Route (metro), High Activity Pedestrian Area and Peak Hour Traffic Route.

2.1.2 Existing movements

The existing movements within the intersection of Unley Road, Cross Road and Belair Road are shown in Figure 4.

Currently, the western and eastern approaches of Cross Road each comprise 3 general traffic lanes: 2 through lanes and 1 (one) right turn lane (approximately 140 m on the western approach and 130 m on the eastern approach). The kerbside general traffic through lane allows vehicles to enter a short separate lane for high entry left turn movements. A continuous unidirectional bicycle lane is located kerbside on both approaches.

The Unley Road and Belair Road approaches are relatively similar. They comprise 4 general traffic lanes: 2 through lanes and 2 short right turn lanes. The kerbside general traffic lane allows vehicles to enter the high entry left turn lane. Narrow continuous kerbside bicycle lanes exist on the Belair and Unley Road approaches. Narrow bike lanes are also present on Cross Road. On the eastern approach this is placed between a left turn and through lane, but on the western approach, the bike lane ends at the start of the left turn lane and recommences adjacent to the left turn splitter island.

The existing traffic volumes at this intersection are presented in Table 3, as per data from the 2019 Unley Road/Belair Road/Cross Road intersection survey.

Table 3: Existing traffic volume estimates (2019)

Intersection Leg	Traffic Volumes
Cross Road (west)	31,500
Cross Road (east)	30,100
Unley Road	26,400
Belair Road	27,600

[1] Department of Planning Transport and Infrastructure, *A Functional Hierarchy for South Australia's Land Transport Network*, 2013

With Cross Road, Unley Road and Belair Road all designated as major cycling routes, a total of 210 cyclists were recorded over an 11-hour survey period[2] in August 2019, with just over half of those on Cross Road. In addition, 20 cyclist movements were recorded on the crosswalks. During the same survey, and with Unley and Belair Roads identified as High Activity Pedestrian Areas, a total of 279 pedestrian crossing movements were recorded over Cross Road and 76 pedestrian crossing movements over Unley and Belair Roads.

Cross Road is a key arterial road for both general commuter and freight traffic. Congestion on Cross Road is currently impacting on efficient movements in both the AM and PM peak periods, with average travel speeds under 30 km/h[3]. With up to 20% of commercial vehicles using Cross Road comprising of articulated or B-double trucks[4], the slow start-stop nature of the heavy vehicles is a key contributor to the low average travel speeds observed.

The upgrade of this intersection must consider the implications of the forthcoming North–South Corridor (Torrens to Darlington). The transformation of South Road as part of the North–South Corridor could potentially see changes in the broader metropolitan freight network, including the potential redirection of freight traffic away from Portrush Road across to the North–South Corridor via Cross Road, the extent of which is yet to be defined.

The upgrade of the Unley Road, Cross Road and Belair Road intersection is cognisant of this both in the short and long term. In the short term it helps to reduce the traffic disruption caused from vehicles avoiding the North–South Corridor construction works as they try to access the city. In the long term it provides enhanced access for vehicles wanting to access the North–South Corridor from the South Eastern Freeway.

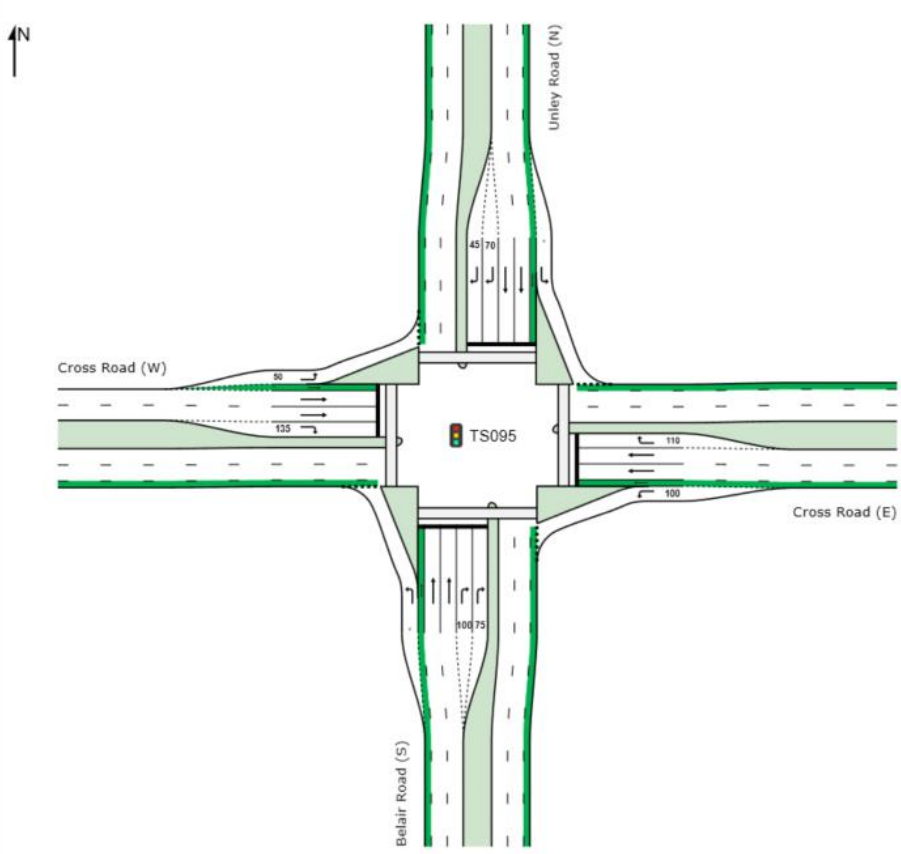


Figure 4: Existing intersection arrangement

[2] DIT, *Vehicle Turning Movement Survey TG816290_20190822,* 2019
[3] AddInsight Bluetooth data sets 2019
[4] DIT, *Vehicle Turning Movement Survey TG816290_20190822*, 2019

2.1.3 Public transport

This location is well-served by a variety of public transport services. Public transport bus services through the intersection include city-centric services along Unley Road/Belair Road, suburban connector and school services primarily using Cross Road. Unley Road/Belair Road is part of a high frequency public transport corridor linking the City of Adelaide and the City of Mitcham. Cross Road is a standard frequency corridor servicing a range of cross-city commuters. There are currently no bus priority lanes at the intersection. The current public transport services at the intersection are shown in Figure 5.

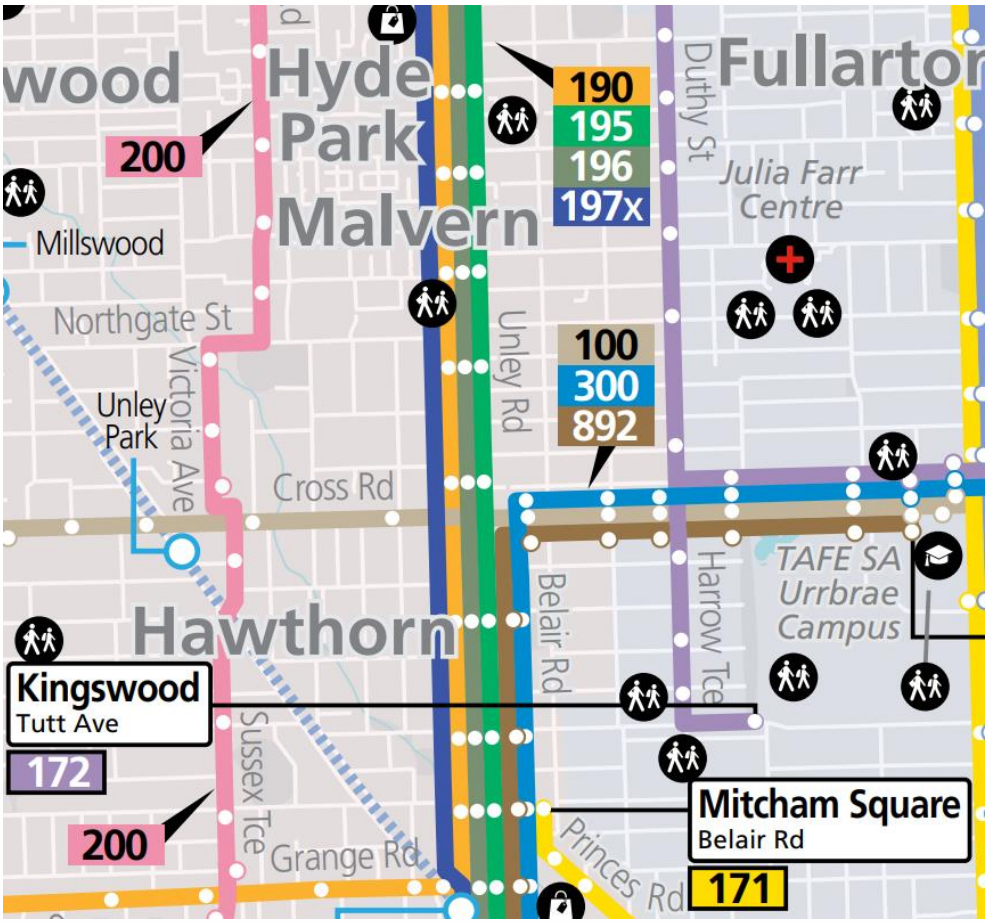


Figure 5: Public Transport Network at the intersection of Cross Road, Unley Road and Belair Road

A review of bus service performance found that most bus services are currently running behind schedule as they approach the intersection and there is an increase in delays of north–south and east–west routes of 20 to 45 seconds as bus services move through the intersection. More information on bus service delays is contained in the *Strategic Business Case (IPP-AMJV-421-001-RP-OA-DO-0067)* issued separately to DIT.

With this intersection forming an interchange point and the high use of adjacent stops by school groups, convenient and safe connectivity for pedestrians accessing public transport services is a core goal for improved user experience.

Future intersection designs will need to enhance pedestrian access to bus stops and interchange movements, maintain flexible network options, seek network reliability and be cognisant of travel times.

2.1.4 Road safety

In the 5-year period between 2015 to 2019, 55 crashes were reported at the intersection of Cross Road and Unley Road/Belair Road, resulting in 23 minor injury casualties. With an average crash rate of 11 crashes (with 4.6 casualties) per year, this intersection is classified as a 'Black Spot'[5].

Of the 55 crashes, 38 (or 69%) occurred at the intersection, with the remaining 17 crashes on the approaches in close proximity to the intersection. The eastern approach along Cross Road accounted for 15% of the recorded crashes between 2015 and 2019. Four crashes involved cyclists and 5 involved heavy vehicles.

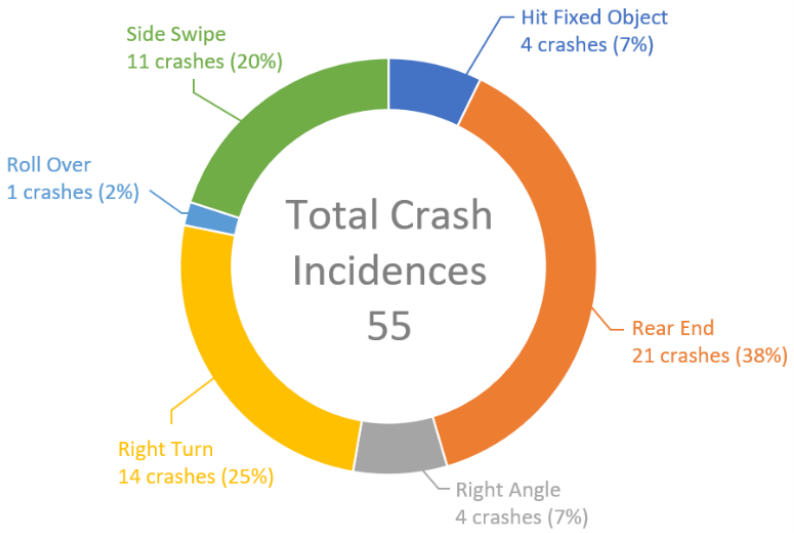


Figure 6: Number of crash incidences by type, between 2015 to 2019

As can be seen in Figure 6, rear end crashes were the predominate vehicle crash type, followed by right turn and side swipe crashes.

- Rear end crashes are typically caused by unexpected stopping and could be related to short turn lane lengths and long queues.
- Right turn crashes were primarily due to failure to stand or disobeying traffic signals and appear to be associated with the filter right turn movements from Cross Road.
- Side swipe crashes at the intersection largely involved trucks and one involved a cyclist.

The intersection upgrade should include full control of right turns, improve storage space for turning movements and widening of bike and kerbside traffic lanes wherever corridor widening is proposed.

[5] https://investment.infrastructure.gov.au/infrastructure_investment/black_spot/

2.1.5 Active transport

Cross Road, Unley Road and Belair Road are all designated as Major Cycling Routes. Unley Road and Belair Road are designated High Activity Pedestrian Areas.

A turning movement survey undertaken on a weekday in August 2019 between the hours of 6.30 am and 7 pm identified a total of 210 on-road cyclists traversing the intersection, with 118 approaching from Cross Road (east or west) and 92 approaching from Unley Road or Belair Road. Over the same period, 279 pedestrian crossing movements were recorded over Cross Road and 76 pedestrian crossing movements were recorded over Unley Road/Belair Road. Twenty (20) cyclists were recorded crossing on the crosswalks.

The weather on the day of the survey was 14.2°C with some light rainfall recorded. Additional bicycle and pedestrian movements would be expected during warmer and drier weather.

Cross Road has narrow (1.2 m) kerbside bicycle lanes adjacent to 3 m traffic lanes along much of its length. The eastbound bicycle lane is presently interrupted through the intersection at the left turn lane for traffic turning onto Unley Road. Cross Road is a freight route and heavy vehicle movements present a heightened risk to cyclists, particularly without adequate clearance or separation. It is anticipated that additional freight movements will be attracted between the South Eastern Freeway and South Road via Cross Road, which will increase the exposure to such risks for cyclists. Bicycle push buttons present for the Cross Road bicycle lanes require cyclists to progress over the stop bar to access the push buttons.

The bicycle lanes on Unley Road and Belair Road are narrow and adjacent to 3 m traffic lanes accommodating frequent bus movements. The bicycle lanes are approximately one (1) metre wide measured from the kerb face, less than the acceptable range in the *Cycling Aspects of Austroads Guides*. Frequent hazards encountered within the water table reduce the effective width of these lanes to 0.6 m, significantly less than the standard cyclist envelope. The narrow lane widths pose a significant risk for side swipe collisions to occur. However, no side swipes involving cyclists have been recorded at the intersection in the past 5 years.

Cycling Aspects of Austroads Guides describes a minimum requirement of 1.0 m clearance and a preferred 1.5 m clearance between the cyclist and where heavy vehicles could be expected. (The cyclist envelope is taken as 1.0m wide and clear of the water table). Minimum bicycle lane widths under Austroads, which should be measured from the lip of channel/edge of bitumen (so that the running width is clear of hazard), is 1.2 m with 1.5 m desirable (1.2–2.5 m acceptable range with actual width selection to account for function and use). As this is an identified major cycling route, overtaking should ideally be incorporated into design. The minimum cross section for overtaking is 2.4 m.

Footpaths surrounding the intersection currently offer only limited accessibility, with key issues including:

- narrow path segments
- uneven surfaces
- objects in footpaths impacting path width and interrupting shoreline for cane users
- trip hazards
- conflicts and width constraints with verge parking
- small left turn splitter islands limiting use with some mobility assistance devices and providing limited storage for student groups.

A minimum of 1.8 m clear width should be provided for all footpaths with a minimum of 1.5 m clear width behind pedestrian ramps to allow for wheelchair manoeuvring. All bus stops and connecting pathways through the interchange area must comply with the *Disability Standards for Accessible Public Transport 2002*.

2.1.6 Constraints

The intersection is constrained by the following (refer Figure 7):

- Mercedes-Benz businesses on both NE and NW corners of Unley Road
- service station on the SE corner (potential contamination)
- Walford Parks Playing Fields, with newly renovated facilities SW corner
- 15+ significant gum trees surrounding Walford Parks Playing Fields
- local heritage dwellings at 170, 174 and 176 Cross Road
- SAPN substation at corner of Cambridge Terrace and Cross Road.

Figure 7: Key constraints at the intersection of Unley Road, Cross Road and Belair Road

2.2 Problem statements

Two (2) problem statements have been defined for the current operation of the Unley Road, Cross Road and Belair Road intersection:

PROBLEM 1

High traffic volumes and competing transport priorities are compromising the efficient movement of people and goods from all approaches.

PROBLEM 2

High traffic volumes and growth in freight volumes on Cross Road are compromising the safe movement of people.

Refer to the *Strategic Business Case (IPP-AMJV-421-001-RP-OA-DO-0067)* issued separately to DIT for further details about the problem statements.

2.3 Business requirements

2.3.1 General

The business requirements of this project have been drafted in collaboration with DIT. The business requirements document the agreed-upon objectives, principles, outcomes, and measures required by the project in alignment with DIT's integrated business perspective.

For further details, refer to Appendix A for the *Business Requirements*.

2.3.2 Objectives

The primary objective of this project is:

1	**Safe, reliable and efficient movements** - Transport networks are developed, regulated and managed to maximise accessibility and enable safe, integrated, reliable and efficient movement of people, goods and services, balancing demand with capacity.

The secondary objectives of this project are:

2	**Economic Growth** – Land use policy and transport network infrastructure, policy settings, regulation and management enables appropriate uses that support economic growth and job creation in key industry sectors across the state.
3	**Customer and community centred** – All aspects of operation and service delivery are centred on making best use of available resources to meet customer needs and take into account community issues and expectations.
4	**Successful places** – Land use and transport policy settings, planning and program delivery enable more liveable, better connected, safer, healthier and more sustainable communities.

2.3.3 Benefits and outcomes

The key outcomes and benefits of the project were developed as part of the Investment Logic Map for this intersection. The benefits, should the problems above be addressed, are shown in the Benefits Map (refer Figure 8).

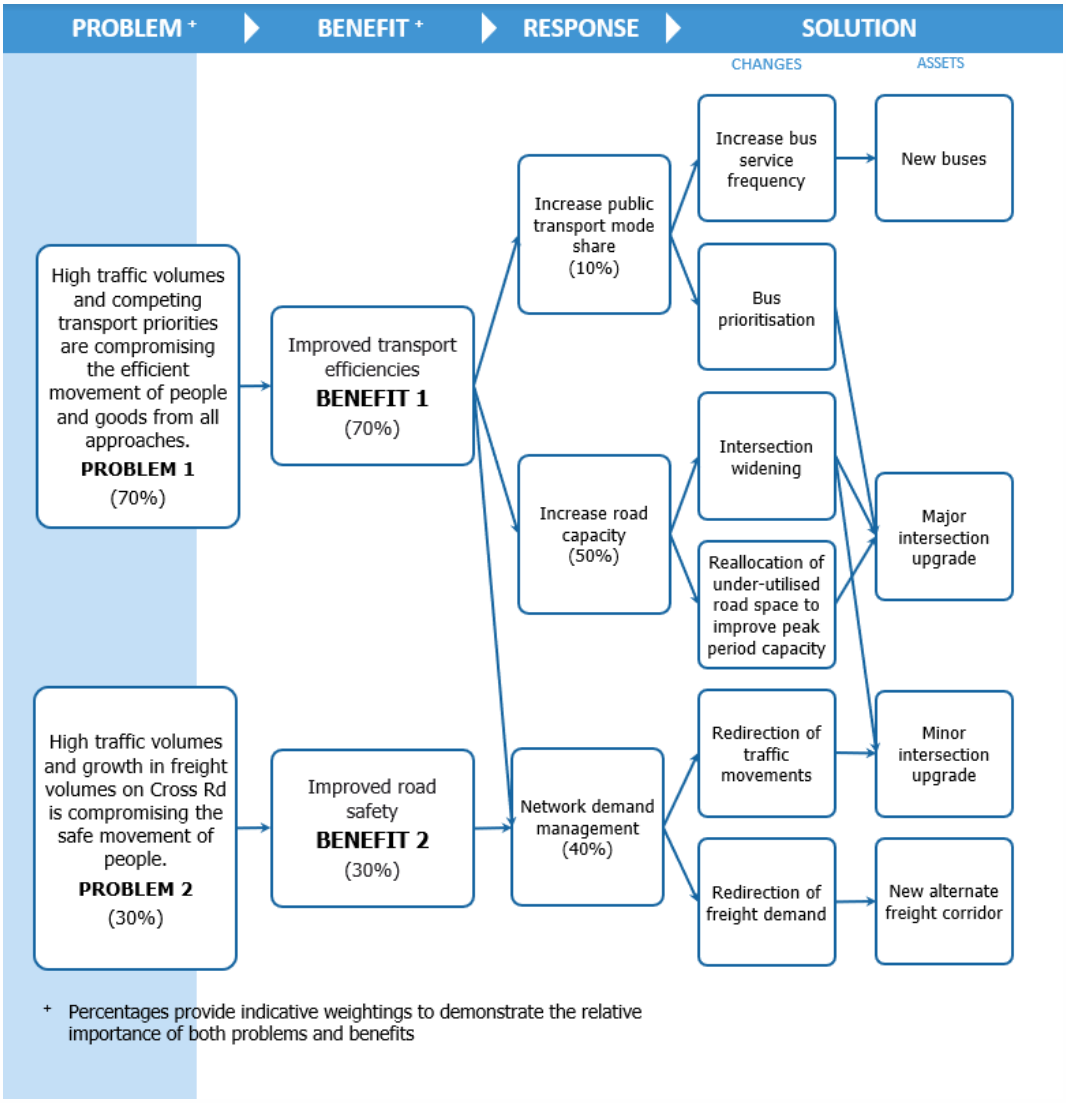


Figure 8: Benefits map

3 Initial desktop studies for this intersection

Several desktop studies were undertaken to understand the challenges and opportunities of the Unley Road, Cross Road and Belair Road intersection, including:

- desktop geotechnical study
- preliminary hydrological assessment
- *EBS Ecology Cross Road, Unley Road and Belair Road Intersection Upgrades Desktop Flora and Fauna Report 2021 (EBS Ecology Report)*
- heritage desktop assessment.

The following sections detail the key considerations concerning each discipline or speciality area.

3.1 Desktop geotechnical study

A high-level desktop study was completed to provide a preliminary assessment of the key geotechnical issues at this intersection.

The desktop study indicated that key geotechnical issues which need to be considered for this intersection are as follows:

- reactivity of clay soils at this site is very high and this has implications on the design of drainage, landscaping and services
- soft soils may be encountered within the site
- non-engineered fills are likely to be encountered on site
- soil removed in excavations is likely to be unsuitable for re-use as engineering fill
- previous geotechnical investigations suggest that groundwater would be encountered at a depth of between 5 and 20 m.

A site-specific geotechnical investigation including interpretive report will be required to inform the pavement design and design of associated infrastructure for the upgraded intersection and to provide relevant construction recommendations.

Refer to Appendix B for the complete *Geotechnical Desktop Report*.

3.2 Preliminary hydrology assessment

A preliminary hydrology assessment was undertaken to review the existing site conditions and identify key site constraints, including flood-prone areas and underground stormwater infrastructure.

The site is located within proximity of two major water courses: Brown Hill Creek and Keswick Creek. Typically, the site grades from the east to the west towards Brown Hill Creek.

There is currently a 1200 mm stormwater drain running through the intersection along Cross Road.

The average slope of the catchment is approximately 2%. Substantial widenings will create challenges in resolving levels for overland flow, footpaths and driveway connections.

The *Flood Inundation and Hazard Mapping Study for Brown Hill and Keswick Creeks* (2003)[6] indicates that flooding during a 1 (one) in 500 year flood event does not enter the intersection. There is no 1 (one) in 100 year flood event data available.

Based on the available data, it is expected that the intersection has a minimal risk of flooding and additional hydrological studies are not recommended for any at-grade or over-road grade separation upgrades. It is recommended that a stormwater study is completed as a part of a reference design.

3.3 EBS Ecology Report

In May 2021, EBS Ecology (EBS) was engaged to conduct a desktop flora and fauna assessment for the intersection of Cross Road (RN6215), Unley Road (RN6191) and Belair Road (RN6191), metropolitan Adelaide.

The key objectives of the ecological assessment were to:

- identify potential ecological constraints and sensitive areas for the project
- identify the potential for threatened flora, fauna and ecological communities to occur within the project area.

The EBS Ecology Report helped inform the following flora and fauna findings for the site.

- The Protected Matters Search Tool identified a nationally endangered ecological community, but which is unlikely to occur in the project area due to urbanisation - *Grey Box (Eucalyptus macrocarpa) Grassy Woodlands and Derived Native Grasslands of South-east Australia.*
- Three (3) nationally listed threatened flora that are known to occur within 5 km of the project area - *Caladenia behrii* (Pink-lipped Spider-orchid), *Prasophyllum pallidum* (Pale leek-orchid) and *Prasophyllum pruinosum* (Plum leek-orchid).
- Regulated and Significant trees under the *Planning, Development and Infrastructure Act 2016* may be present.
- Additional trees not identified as Regulated or Significant that have high habitat value may be present, including trees with hollows that may be used by threatened species or those that provide a valuable food source for threatened species.
- Grey-headed Flying-foxes (nationally vulnerable and rare in South Australia) and Yellow-tailed Black Cockatoos (vulnerable in South Australia) have been recorded within proximity of the project area.

To minimise impacts, the project should:

- avoid and minimise impacts to native vegetation
- avoid impacting significant, regulated or hollow-bearing trees
- consider impacts to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *National Parks and Wildlife Act 1972* for threatened fauna species

The complete *EBS Ecology Report* can be found as an appendix to the *Preliminary Environmental and Heritage Impact Assessment Report* (refer to Appendix C).

[6] Patawalonga Catchment Water Management Board, *Flood Inundation and Hazard Mapping Study for Brown Hill and Keswick Creeks*, 2003. Further information on this study is available from the Department for Environment and Water (DEW).

3.4 Heritage Desktop Assessment

In May 2021, Independent Heritage Consultants (IHC) completed a heritage desktop assessment for this intersection. The heritage assessment included relevant heritage register searches of both DPC-AAR Taa Wika (site register) and the State Heritage Register. The report identified all national, state and local heritage items in the project area, and provided mitigation measures appropriate for each. It also provided a risk assessment for encountering unknown Aboriginal heritage sites/objects.

The IHC report identified 5 non-Aboriginal heritage items in the project area, all of which are local heritage items.

The complete Heritage Desktop Assessment can be found as an appendix to the *Preliminary Environmental and Heritage Impact Assessment Report* (refer to Appendix C).

4 Outline of options assessment process

This section outlines the overarching process and methodology of options development and assessment for upgrades to the intersection throughout the preliminary long list, long list, short list and preferred stages.

4.1 Options development and assessment framework

The methodology for the development and assessment of the intersection options, outlined in Figure 9, comprises a three-staged decision-making process:

- Strategic Merit Test – used to assess preliminary long list options
- Rapid Multi-criteria Assessment – used to assess long list options
- Multi-Criteria Assessment and Benefit-Cost Analysis – used to assess short list options.

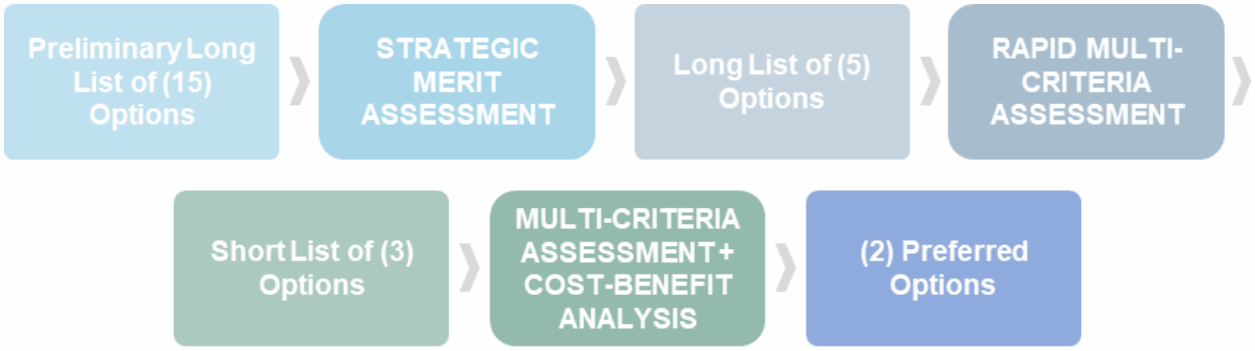


Figure 9: Options development and assessment framework

Each stage of assessment was underpinned by the development of value criteria grounded by evidence-based metrics. The value criteria defined generally aligned with the following (non-monetised) categories:

- strategic alignment
- economic
- socio-economic
- environment
- deliverability.

For more details about the decision-making process, refer to the *Strategic Business Case (IPP-AMJV-421-001-RP-OA-DO-0067)* issued separately to DIT.

The development of the preliminary long list, long list, short list, and finally, preferred options, were informed primarily by impact assessment, costing, design, and intersection performance. The short timeframes of the Planning Study necessitated a focus on the risks associated with land acquisition, services impacts, costing, and heritage to facilitate option selection.

4.1.1 Strategic Merit Assessment

The preliminary long list options were qualitative assessed using a Strategic Merit Assessment in order to identify the long list of options. Assessment criteria focused solely on both economic and strategic alignment value criteria to ensure the broader outcomes of the initiative would ultimately be met. Economic (non-monetised) scores were attributed to indicative capital costs based on a comparative 'order-of-magnitude' judgement. Each preliminary long list option was assessed against a 5-point cost/benefit scale.

4.1.2 Rapid Multi-criteria Assessment

The long list of options undertook a Rapid Multi-criteria Assessment which included an expanded list of non-monetised criteria compared to the Strategic Merit Test. Each long list option was assessed against a 5-point cost/benefit scale. Each long list option was then attributed indicative capital and operational costs based on a comparative order of magnitude judgement. Again, economic (non-monetised) scores were attributed to indicative capital and operational costs based on a comparative 'order-of-magnitude' judgement. From this, the short list of options was identified.

4.1.3 Multi-criteria Assessment and Benefit-Cost Analysis

The short list of options was assessed against the value criteria using the Multi-criteria Assessment, excluding any monetised metrics, with each short list option assessed against a 7-point cost/benefit scale. The monetised metrics were instead assessed using the Benefit-Cost Analysis. The outcomes of the (non-monetised) Multi-criteria Assessment and the (monetised) Benefit-Cost Analysis were then considered concurrently in order to recommend 2 preferred options.

4.2 Overview of options development

The intersection has been through 2 revisions of preliminary long list to short list.

The first preliminary long list of 11 options developed in 2020 was taken through a Strategic Merit Test to refine the list to 6 long list options. These 6 options were further developed and assessed through a Rapid Multi-criteria Assessment to obtain a short list. Since the only short list options that addressed traffic capacity to meet the objective was a significantly large at-grade solution or a grade separation, the intersection was re-examined to identify if any lower impact options could be identified to meet the criteria.

As such, a second preliminary long list was developed and included a range of options with reduced land and cost impacts, whilst substantially improving traffic conditions. This new preliminary long list included 15 options, comprising the previous list of 11 plus 4 new options. The Strategic Merit Test was improved to include greater emphasis on the functional road hierarchy and road safety strategy and was used to refine the list to 5 long list options.

The identified long list options were further analysed prior to going through a Rapid Multi-criteria Assessment to identify a short list of options. The Rapid Multi-Criteria Assessment identified some common themes of issues with the options to date, including design for vulnerable road users and impacts on constraining sites with high heritage, environmental or community value. Design development of the short list options aimed to address these themes and further focus on traffic modelling performance and vehicle swept paths.

An overall summary of the options development and assessment process throughout this second revision is presented in Figure 10.

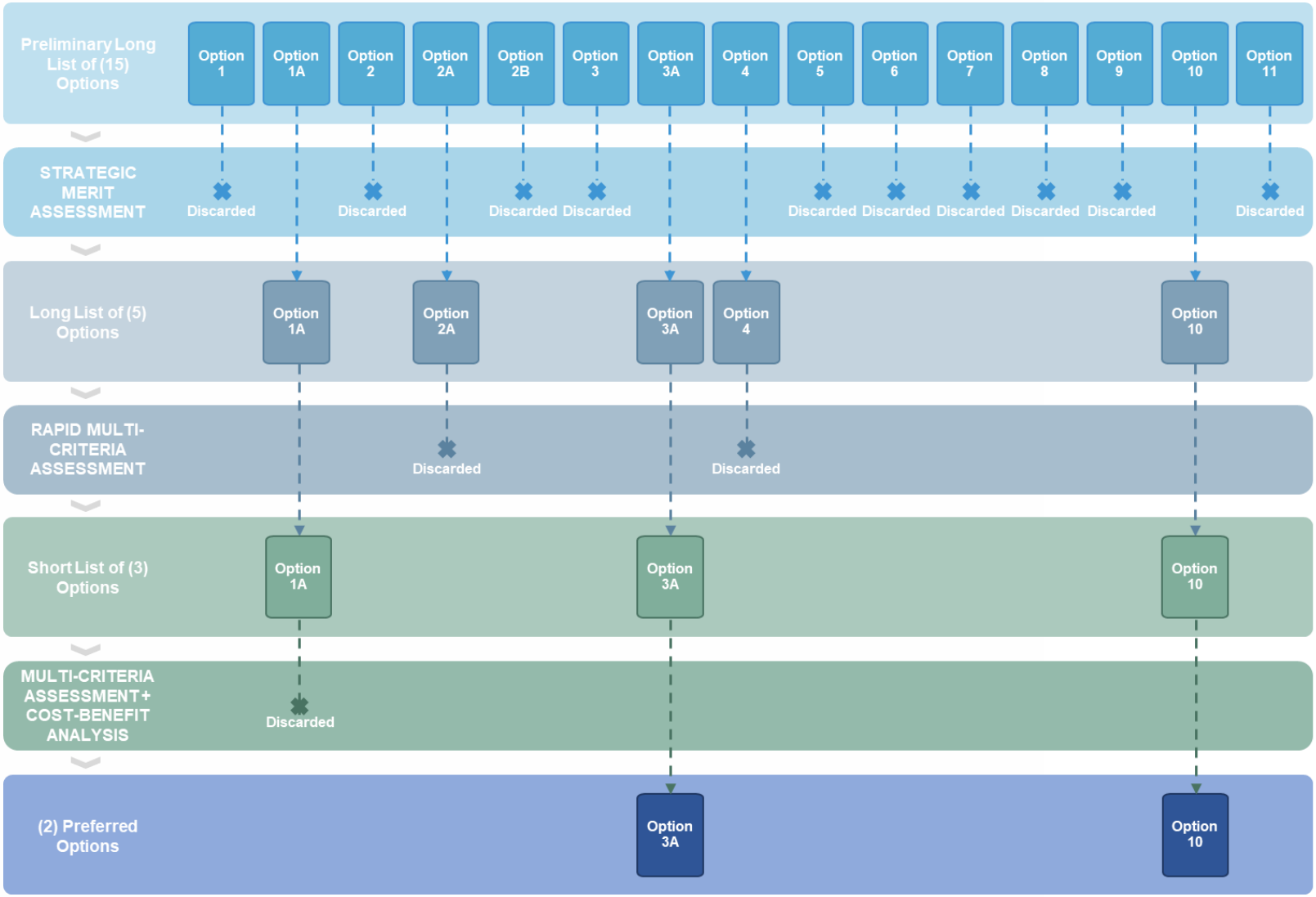


Figure 10: Summary of options development and assessment process

5 Assessment of preliminary long list options

5.1 Preliminary long list of options

Following the re-examination of an initial short list of options (see Section 0 for relevant discussion), a second preliminary long list of 15 options (see Table 4), including a range of low, medium and high impact infrastructure solutions, was developed.

Table 4: Preliminary long list of options

Preliminary long list options	Option description
Option 1	At-Grade 3T + 2RT Cross (widen to south)
Option 1A	At-Grade 3T + 2RT Cross (widen to north)
Option 2	At-Grade Ban RT from Cross + 3T Cross (widen to south)
Option 2A	At-Grade Ban RT from Cross + 3T Cross (widen to north)
Option 2B	At-Grade Ban RT from Cross + 3T Cross + Left turn slip lanes
Option 3	Cross Road Grade Separation (widen to south)
Option 3A	Cross Road Grade Separation (widen to north)
Option 4	At-Grade 3T Cross and Unley
Option 5	Explore options with full acquisition of the SE corner
Option 6	At-Grade Ban RT from Unley
Option 7	Contraflow for Unley / Belair approach
Option 8	Unley / Belair Grade Separation
Option 9	At-Grade Ban RT from Unley and Belair + 3T Cross + 3T Unley and Belair
Option 10	Widening on Cross only (3T Cross)
Option 11	At-Grade 3T Cross + convert RT to T on Unley and Belair
Key:	**T = Through** **RT = Right Turn**

5.2 Preliminary long list options considerations

The preliminary long list options were developed with a primary focus on traffic efficiency and reliability, as well as addressing identified road safety issues. The initial preliminary long list (8 options) was developed based on brainstorming ideas to achieve right turn control and improved traffic capacity, with the core aim to achieve future intersection operation with a Degree of Saturation (DoS) of 0.9 or lower. The initial timeframes gave little time for contextual appreciation of the intersection or a finer consideration of current issues and future goals. This generally resulted in a range of turn ban and large-scale intersection expansions, including grade separations. A second tranche of preliminary long list options (adding Options 9, 10 and 11 and removing Option 5) was developed to seek a reduced intersection footprint and with a somewhat improved consideration of current gaps and contextual setting.

5.3 Strategic merit assessment

The 15 preliminary long list options were assessed using a Strategic Merit Assessment. Option 5 was removed from consideration in the second strategic merit assessment since it was the only option that achieved scores of neutral benefit or disbenefit for every category in the first assessment. When compared to the first assessment, the second strategic merit assessment was expanded to better examine the options for a broader range of road users, considering the functional road hierarchy.

For further details of scoring, refer to Appendix D for the *Preliminary Long List to Long List Strategic Merit Assessment*.

Five (5) options were selected to progress to the long list: 1A, 2A, 3A, 4 and 10.

Those that did not progress:

- Option 1, Option 2, Option 3 and Option 5 were eliminated as they would all require significant acquisition of land to the south, alienating the Walford playing fields.
- Option 6 was eliminated because it does not provide priority for public transport and the banning of right turns limits future bus routes.
- Option 7 was eliminated due to the contraflow increasing the risk of head-on crashes from inattentive drivers and pedestrians crossing mid-block.
- Option 8 was eliminated because it provides no bus priority and reduces the permeability for pedestrians.
- Option 9 was eliminated because it results in ‘rat running’ (traffic shortcutting the arterial road network by using the local road network), compromises safety and provides no bus priority.
- Option 11 was eliminated because the banning of right turns would result in local ‘rat running’ through local streets.

The recommended long list of 5 options is provided in Table 5.

Table 5: Long list of options

No.	Option name	Description
1A	At-Grade 3T and 2RT Cross (widen to north)	Widening to north Dual right turn lanes from Cross Road 3 through lanes on Cross Road Short left turn lane from Belair Road (south approach)
2A	At-Grade Ban RT from Cross and 3T Cross (widen to north)	Widening to north Ban right turns from Cross Road 3 through lanes on Cross Road Short left turn lane from Belair Road (south approach) Existing right turn traffic from Cross Road added to through movement
3A	Cross Road Grade Separation (widen to north)	Cross Road layout and lane lengths based on design for Marion Road/Sir Donald Bradman Drive grade separation
4	At-Grade 3T Cross and Unley	Extension of Option 1A to achieve satisfactory operation in 2036: • 3 through lanes (170 m) for both Belair Road and Unley Road • dedicated left turn lanes (150 m) for both Cross Road approaches
10	At-Grade widening on Cross only (3T Cross)	3 through lanes on Cross Road only No changes to Unley or Belair Roads
Key:	**T = Through**	**RT = Right Turn**

6 Assessment of long list options

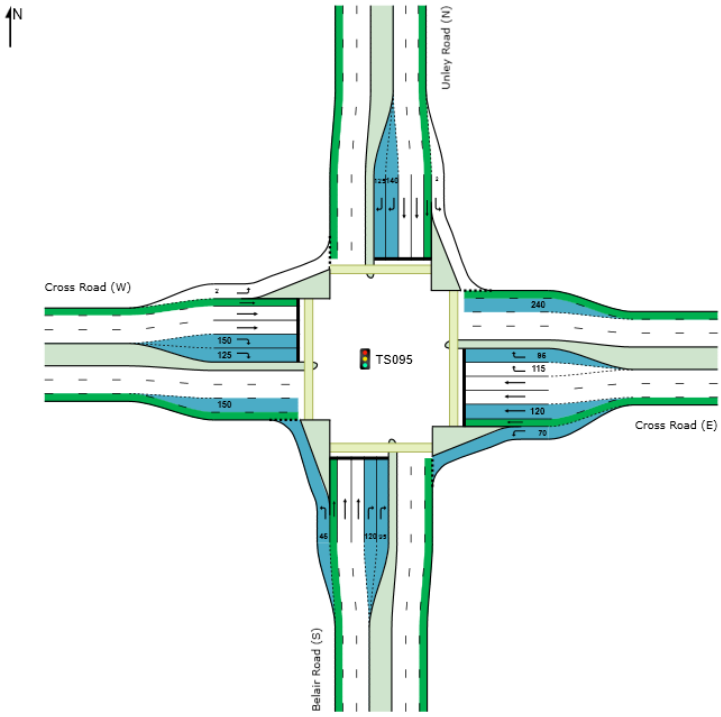
6.1 Development of long list options

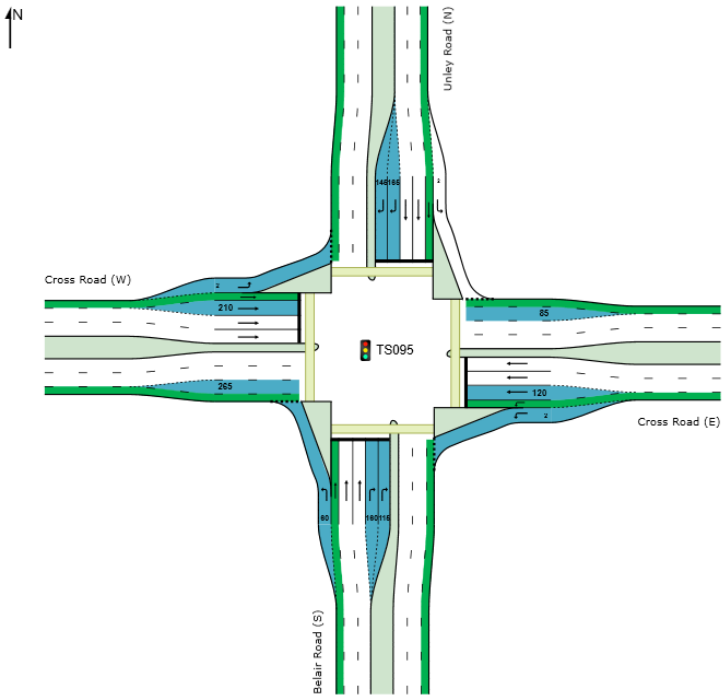
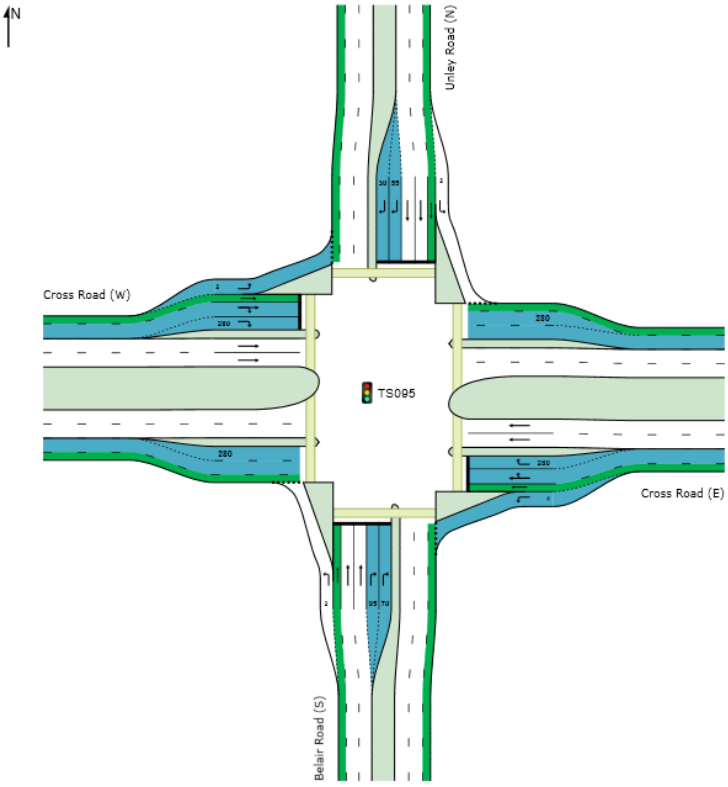
Due to the rapid progression from long list to short list within a restricted timeframe, the development of the long list options was limited. Minor updates to the long list options mostly comprised drafting corrections, including adjustments to the extent of road widening, and minor updates to traffic modelling in order to account for modifications such as changed lane arrangements and adjusted lane lengths.

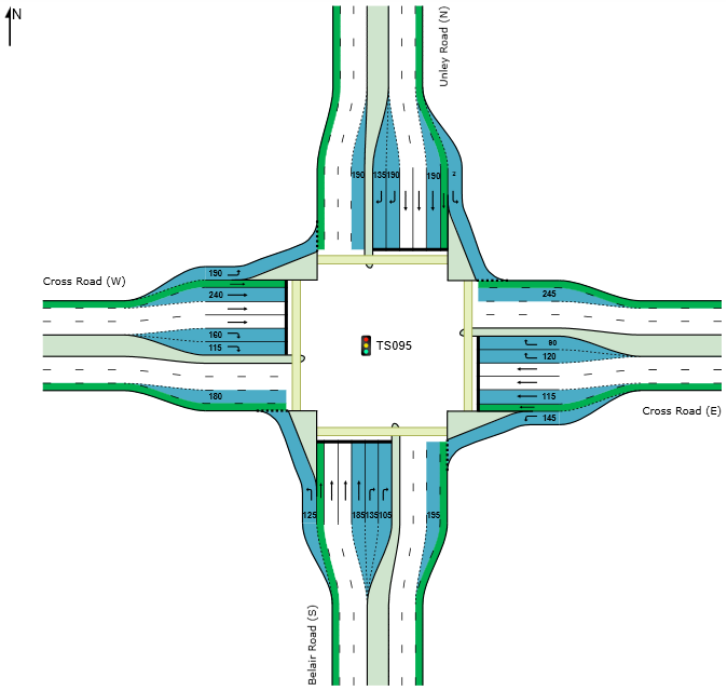
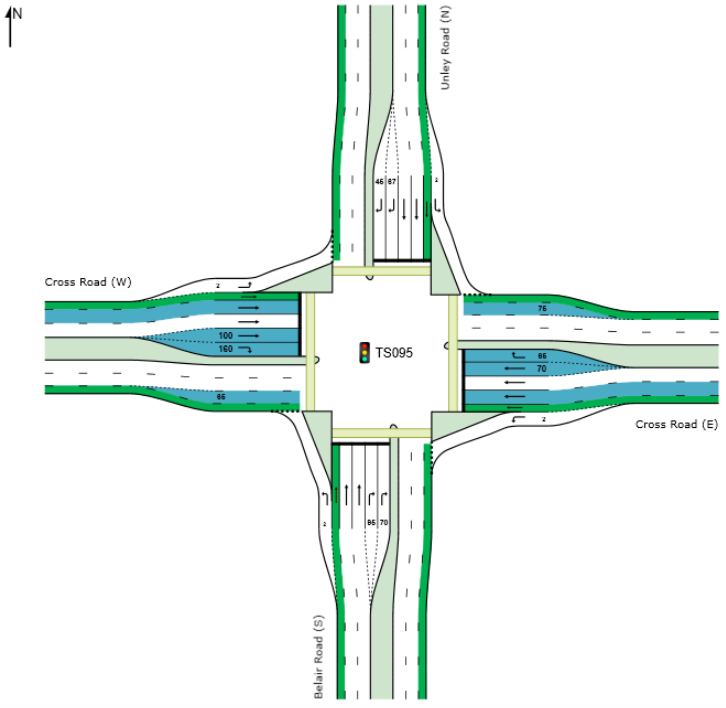
6.2 Long list options

Indicative layouts are provided for each long list option in Table 6 below. For further details of each option layout, refer to Appendix E for the *Long List 5% Engineering Sketches*. For further details of the long list to short list considerations, refer to Appendix F for the *Long List Technical Notes*.

Table 6: Long list option layouts

No.	Option name and description	Layout
1A	**At-Grade 3T and 2RT Cross (widen to north)** • widening to north • dual right turn lanes from Cross Road • 3 through lanes on Cross Road • short left turn lane from Belair Road (south approach)	
Key:	**T = Through**	**RT = Right Turn** **EW = East West**
Note: Changes to existing general traffic lanes are highlighted blue		

No.	Option name and description	Layout
2A	**At-Grade Ban RT from Cross and 3T Cross (widen to north)** • widen to north • ban right turns from Cross Road • 3 through lanes on Cross Road • short left turn lane from Belair Road (south approach) • existing right turn traffic from Cross Road added to through movement	
3A	**Cross Road Grade Separation (widen to north)** • Cross Road layout and lane lengths based on design for Marion Road/Sir Donald Bradman Drive grade separation	
Key: **T = Through** **RT = Right Turn** **EW = East West** **Note: Changes to existing general traffic lanes are highlighted blue**		

No.	Option name and description	Layout
4	**At-Grade 3T Cross and Unley** • extension of Option 1A to achieve satisfactory operation in 2036: 3 through lanes (170 m) for both Belair Road and Unley Road • dedicated left turn lanes (150 m) for both Cross Road approaches	
10	**At-Grade widening on Cross only (3T Cross)** • 3 through lanes on Cross Road only • No changes to Unley or Belair Roads	

Key: **T = Through** **RT = Right Turn** **EW = East West**

Note: Changes to existing general traffic lanes are highlighted blue

6.3 Long list options considerations

6.3.1 Traffic modelling

Option 4 provided the most significant benefits to road users and freight due to additional capacity on Cross Road (west, east) and Unley Road. It was anticipated that Option 4 would achieve satisfactory performance compared to the base case, providing a DoS of less than 0.9 in 2036.

Option 3A provided benefits to the overall efficiency and predicted delays at the intersection. However, further design refinement was necessary to cater for forecast traffic demand in 2036, as the intersection was predicted to reach a DoS of over 0.9 in the AM peak period.

Options 1A and 2A provided benefits the overall efficiency and predicted delays at the intersection. However, further upgrades were necessary for these options to cater for predicted traffic demand in 2036, as the intersection was forecast to reach of DoS of almost 1.0. Furthermore, the proposed right turn ban from Cross Road in Option 2A would lead to poor connectivity for local road users, thereby likely increasing traffic on alternative routes. As a result, this may cause lengthier delays to adjacent intersections and may trigger the need for further works beyond this intersection.

Option 10 provided only minor benefits to predicted delays at the intersection. The intersection was oversaturated in 2036, exacerbated by the inclusion of short through lanes on the Cross Road (west, east) exits. However, controlled (signalised) right turns in a new signal phase were anticipated to enhance safety for road users.

It is noted that traffic modelling results were indicative only at this stage and were subject to further refinement during the next stage of the design development.

6.3.2 Cost estimates

Formal cost estimates were sought for the initial long list of options. However, upon review, these cost estimates were scaled up based on engineering judgement to match the costs experienced in practice relative to the scale of each option. The new and previous options were thus attributed indicative capital and operational costs based on a comparative order-of-magnitude judgement.

6.4 Rapid Multi-criteria Assessment

The long list options were assessed using a Rapid Multi-criteria Assessment. For details of the rapid Multi-criteria Assessment process, refer to the *Strategic Business Case (IPP-AMJV-421-001-RP-OA-DO-0067)* issued separately to DIT.

Three (3) options were selected to progress to short list: Options 1A, 3A, and 10. A summary of the recommended 3 short list options is provided in Table 7 below.

Table 7: Short list options

No.	Option name	Description
1A	At-Grade 3T and 2RT Cross (widen to north)	Widening to north Dual right turn lanes from Cross Road 3 through lanes on Cross Road Short left turn lane from Belair Road (south approach)
3A	Cross Road Grade Separation (widen to north)	Cross Road layout and lane lengths based on design for Marion Road/Sir Donald Bradman Drive grade separation
10	At-Grade widening on Cross only (3T Cross)	3 through lanes on Cross Road only No changes to Unley or Belair Roads
Key:	**T = Through**	**RT = Right Turn**

Amendments of these 3 options were further considered as part of the design development process. Refer to Section 6.5 in this document for more information on the final short list of options assessed in this report.

Those that did not progress to the short list:

- Option 2A was eliminated because the ban on right turns from Cross Road results in poor connectivity and reduced safety on local streets.
- Option 4 was eliminated as it would have the greatest impact on local businesses (24 businesses impacted, including 19 that wouldn't be able to function). It was also the only option that impacted on the Vogue Theatre.

6.5 Refinement of short list options

Comments throughout the rapid Multi-criteria Assessment process reflected that more should be considered for intersection options with widened road corridors to avoid constraining sites with high heritage, environmental or community value, and include improvements to walking and cycling. As such, options were updated to provide improvements to cycling facilities, remove walking squeeze points and provide more consistency in land acquisitions, to avoid constraining sites as far practicable.

Traffic modelling was undertaken in parallel with design to help determine the relative merit of options and recommend alternate design features to improve traffic efficiency outputs.

A Design Basis Report was drafted to provide greater consistency and comparability of options. Verge and footpath widths were considered with a 3 m verge width allowance wherever road widening was considered.

Median islands were considered where they would improve safety at side streets, where centre signal poles would be appropriate and to improve permeability for pedestrians choosing to cross mid-block.

Option 1A was amended to include:

- optimised lane lengths for traffic performance
- realignment of land acquisition to avoid the old trees surrounding the Walford Playing Fields
- changes to median islands to permit placement of centre signal poles and improve safety
- improved vehicle accommodation for turning movements
- widened bicycle lanes with line marked separation on Cross Road
- widened traffic and bicycle lanes on Unley and Belair Roads.

Option 3A was amended to include:

- further detail on the Cross Road and Belair Road intersection approaches
- the at-grade intersection arrangement and the Rugby Street bicycle and pedestrian crossing
- further analysis and refinement for longitudinal grades on the overpass, merge and diverge distances and vehicle swept path requirements
- widened bicycle lanes through the at-grade intersection
- widened bicycle lanes with line marked separation included on the overpass
- applied greening through conflict zones
- more thorough design of the pedestrian walkways and crossings.

Option 10 was amended to optimise traffic performance, whilst maintaining the existing approach alignments of Unley Road and Belair Road, and includes:

- additional dual right turn lanes from Cross Road and an additional left turn lane on the western approach of Cross Road
- further refinement to avoid intrusion into the Walford Playing Fields
- changes to median islands to permit the placement of centre signal poles and improve safety
- improved vehicle accommodation for turning movements
- widened bicycle lanes with line marked separation on Cross Road
- widened traffic and bicycle lanes on Unley and Belair Roads.

Including an option that maintained the current alignments of Unley and Belair Roads was considered strategically important since a corridor plan is currently being developed for these roads and one possible outcome could involve a downgrading in the traffic role of these roads.

7 Assessment of short list options

7.1 Design development of short list options

7.1.1 Design basis

For further details of the short list option design basis, refer to Appendix G for the *Design Report*.

7.1.2 Grade separation considerations

If a grade separation option (Option 3A) is considered beyond the short list stage, a detailed assessment of an road-over versus an road-under grade separation will be required. This would be informed by ground investigations of the site, in particular the impacts of Brown Hill Creek (located to the west of the intersection).

In the meantime, a high-level, preliminary investigation of the viability of grade separation was undertaken for the Unley Road, Cross Road and Belair Road intersection, as well as for the Goodwood Road and Cross Road intersection. To the west of the Unley Road, Cross Road and Belair Road intersection, the rail level crossing for the Belair line has been identified for possible future grade separation upgrades. Given the relative proximity of these 3 intersections, the possibility of treating each of these three grade separations as individual structures was investigated to ensure they do not create a noncompliant geometry.

A 500 m distance can be maintained between the critical point of a road over rail overpass and an overpass over Unley/Belair Road (see Table 8 and Figure 11 below). However, only a 40 m distance can be maintained between the critical point of an overpass over Goodwood Road and a road over rail overpass. Therefore, it is possible for each of these 3 grade separations to be designed individually to the relevant design standards and requirements, without compromising potential adjacent structures.

Notwithstanding, designing and implementing individual grade separations will result in an undulating arrangement and it would be advisable to decide on a corridor approach to improve the vertical geometry, safety, driver experience and interfaces for side roads and vulnerable road users.

Table 8: Assumptions for grade separation structures

Overpass interaction	Distance between existing intersection	Distance between adjacent overpasses	Does overpass intersection affect compliance?
Unley Road to rail level crossing	1,000 m	500 m	No
Goodwood Road to rail level crossing	600 m	40 m	No

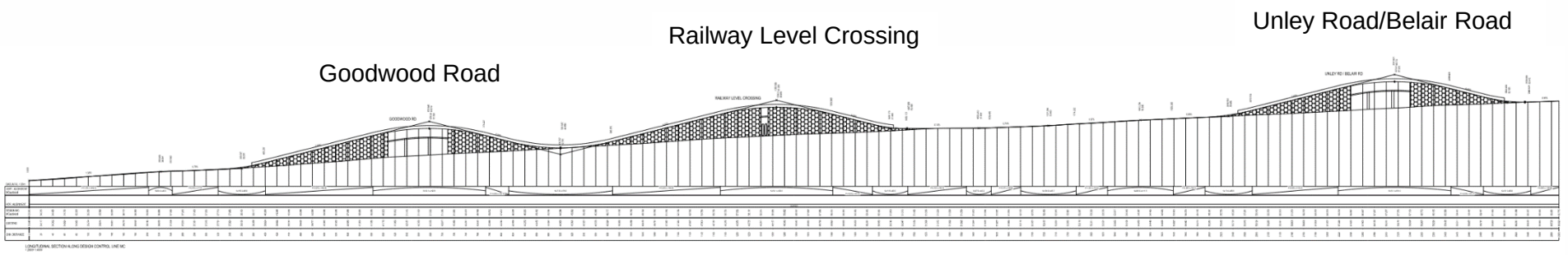


Figure 11: Longitudinal section of three consecutive grade separation structures

7.2 Short list option descriptions

Indicative schematics are provided for each option in the subsequent sections. The Short List 10% Engineering Sketches, which provide further details of each option layout, can be found as appendices to the *Short List Technical Note* (refer to Appendix H).

7.2.1 Option 1A

Option 1A, as shown in Figure 12, includes the following changes to the existing intersection:

- 3 through lanes on Cross Road (west, east) approaches (widening to north)
- 2 right turn lanes from Cross Road (west, east) approaches
- extended high entry left turn auxiliary lane from Cross Road (east)
- road reserve areas of 3 m width where widening is proposed
- widened traffic lanes, bicycle lanes and median islands on Unley and Belair Roads
- bicycle lane widening and line marked separation on Cross Road (west, east) approaches and exits.

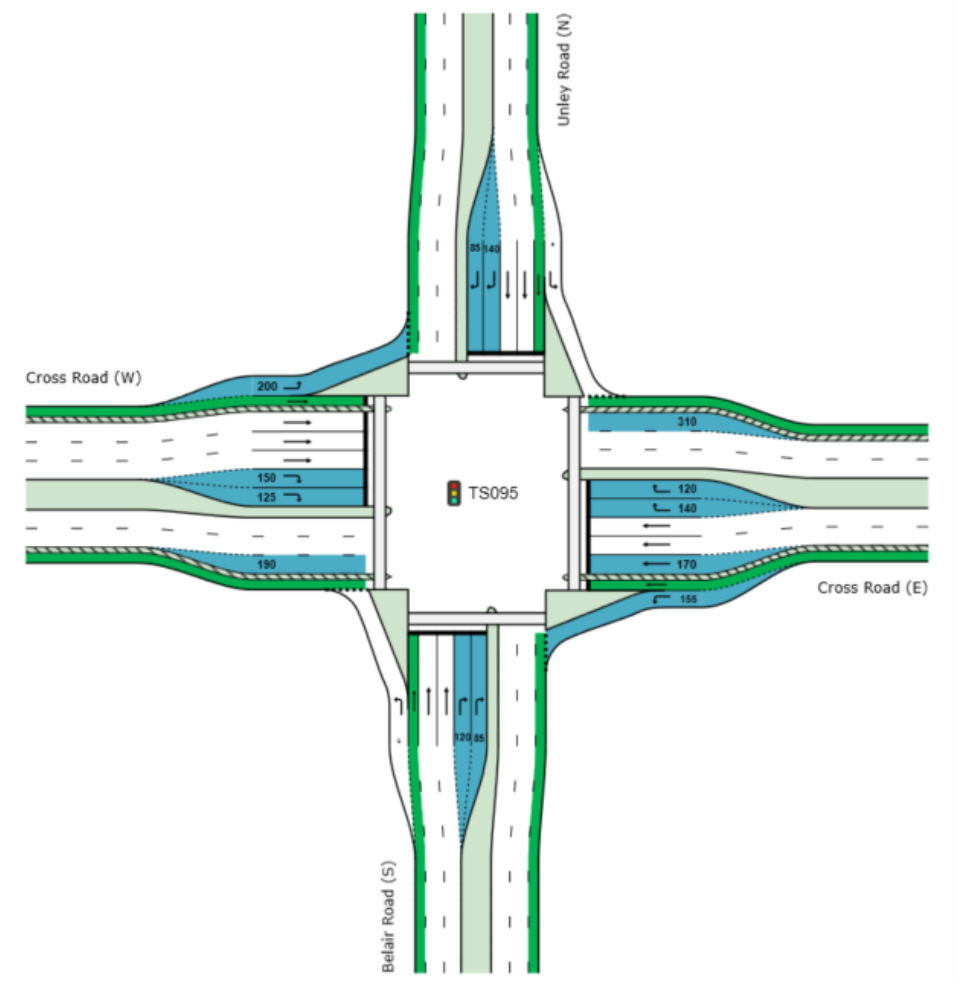


Figure 12: Short List Option 1A

7.2.2 Option 3A

Option 3A, as shown in Figure 13, includes the following changes to the existing intersection:

- grade separation of Cross Road (dual lane, both directions) between George Street/Clifton Street and Cambridge Terrace (widening to north)
- at-grade U-turn movements on Cross Road
- road reserve areas of 3 m width where widening is proposed
- bicycle lanes widened on Cross Road with line marked separation on overpass
- bicycle lanes, traffic lanes and median islands widened on Unley and Belair Roads
- turning movements from Unley and Belair Roads retained.

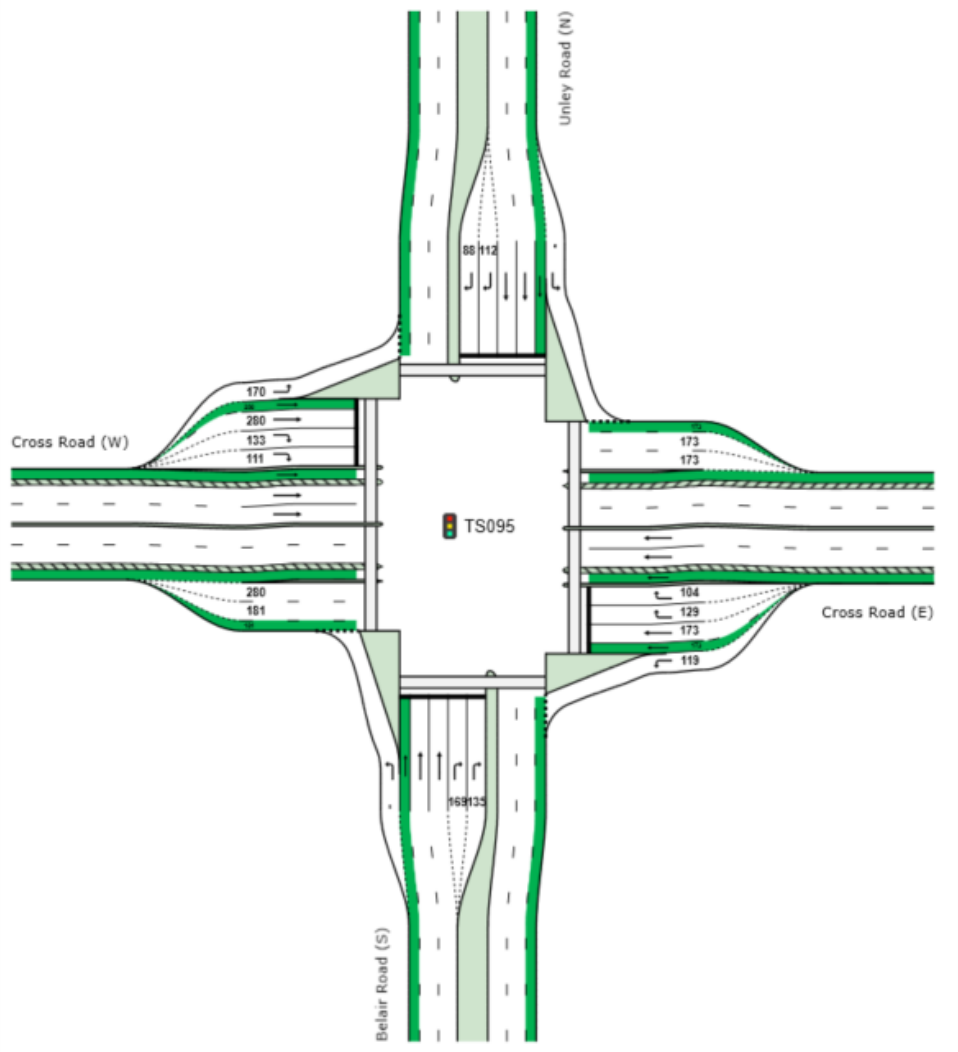


Figure 13: Short List Option 3A

7.2.3 Option 10

Option 10, as shown in Figure 14, includes the following changes to the existing intersection:

- 3 through lanes on Cross Road (west, east) approaches (widening to north)
- 2 right turn lanes from Cross Road (west, east) approaches
- extended high entry left turn auxiliary lane on Cross Road (east)
- added extended high entry left turn lane on Cross Road (west)
- widened traffic lanes, bicycle lanes and median islands on Unley and Belair Roads
- bicycle lane widening and line marked separation on Cross Road (west, east) approaches and exits.

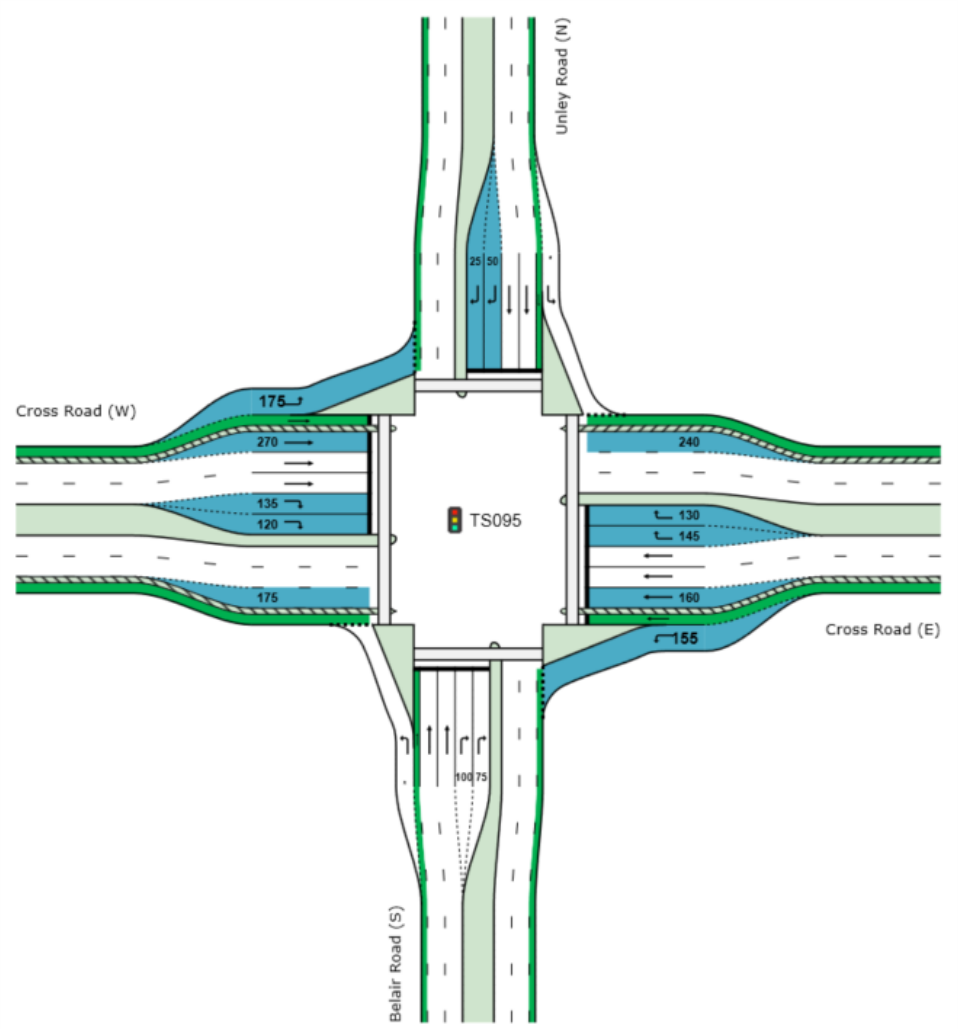


Figure 14: Short List Option 10

7.3 Short list options considerations

This section provides a summary of each key impact and individual discipline considerations for the 3 short list options.

Refer to the *Short List Technical Note* in Appendix H for more detailed discussions with reference to each short list option consideration.

7.3.1 Land acquisition

Each option has been assessed to determine the extent of residential land or dwellings and commercial land or buildings/tenancies impacted with reference to each respective 10% Engineering Sketch. The extent of impacts for each of the 3 short list options can be found in Table 9.

Table 9: Extent of residential and commercial land acquisition impacts for short list options

Option	Residential Impacts	Commercial Impacts
Option 1A	12 parcels requiring whole acquisition 23 parcels requiring partial acquisition	9 businesses impacted over 8 parcels, including: • 4 which will no longer be viable • 5 with partial impacts only
Option 3A	30 parcels requiring whole acquisition 16 parcels requiring partial acquisition	10 businesses impacted over 21 parcels, including: • 7 which will no longer be viable • 3 with partial impacts only
Option 10	13 parcels requiring whole acquisition 17 parcels requiring partial acquisition	3 businesses impacted over 8 parcels, including: • 2 which will no longer be viable • 1 with partial impacts only

7.3.2 Traffic performance

The short list options aimed to address the problem statements and improve intersection performance compared to the future base case. The overall safety and modelled performance of these options is summarised in the subsequent sections.

Safety

For all options, the fully controlled dual right turn lanes from Cross Road remove the safety risk which the existing filter right turns pose.

Performance

The modelled performance for these options in the interim (2026) and horizon (2036) forecast year is shown in Table 10 and Table 11 respectively. The results suggest that all options provide some benefits to the efficiency and delays experienced at the intersection.

Both the interim and horizon performance suggest that only Option 3A can perform with DoS ≤ 0.9. Option 3A can also perform with the shortest average delays.

It is to note that Option 10, while cannot achieve the performance criteria of DoS ≤ 0.9, it is able to performance with a DoS just under 1.

Table 10: Model intersection performance summary, short list options (2026)

Scenario Modelling	AM Peak Hour				PM Peak Hour			
Design Options	**DOS**	**Avg. Delay (sec)**	**LOS**	**95%ile Queue (m)**	**DOS**	**Avg. Delay (sec)**	**LOS**	**95%ile Queue (m)**
Current performance	1.06	76	E	415	1.03	65	E	352
Future Base Case (2026)	1.14	122	F	606	1.15	118	F	567
Option 1A	1.01	65	E	423	0.97	61	E	314
Option 3A	0.77	25	C	243	0.73	22	C	196
Option 10	0.99	65	E	413	0.99	66	E	386

Table 11: Model intersection performance summary, short list options (2036)

Scenario Modelling	AM Peak Hour				PM Peak Hour			
Design Options	**DOS**	**Avg. Delay (sec)**	**LOS**	**95%ile Queue (m)**	**DOS**	**Avg. Delay (sec)**	**LOS**	**95%ile Queue (m)**
Current performance	1.06	76	E	415	1.03	65	E	352
Future Base Case (2036)	1.24	169	F	755	1.26	175	F	852
Option 1A	1.10	79	E	469	1.05	73	E	390
Option 3A	0.77	25	C	250	0.74	22	C	201
Option 10	1.04	74	E	449	1.05	78	E	373

7.3.3 Active and intermodal public transport

Active transport

Cross Road short list designs included a 1.8 metre bicycle lane and a 0.8–1.0 metre buffer zone. This layout was expected to reduce the risk of cyclists being knocked around by trucks' side wind forces and improve ease of access, reduce stress (for cyclists and drivers in lane) as well as encourage cycling as a legitimate form of transport on Cross Road. Improved bicycle lane widths were also included on Unley and Belair Roads where road widening was proposed on those roads (in options 1A and 3A). Where road widening was required within options, a 3-metre verge width was included to improve footpath capacity and wheelchair manoeuvrability and provide greater consistency in the pedestrian environment. Very long crossing distances were created for pedestrians where additional vehicle lanes were added.

Option 3A included widened and continuous bicycle lanes at-grade and bicycle lanes with a buffer separation on the overpass on Cross Road. It also included 3-metre verges on all approaches. Several conflict zones were created for cyclists in the long merge and diverge zones, and on long interfaces where the bicycle lanes were positioned between through and left turn lanes. The size of at-grade intersection created a risk of cyclists getting caught in the intersection when the next traffic phase commenced. Likewise, very long crossing distances were created for pedestrians, though the option provided improvements to wayfinding for people with a vision impairment traversing Cross Road. The overpass, merge and diverge zones presented a significant barrier to cyclists and pedestrians seeking to traverse Cross Road, and whilst the Rugby Street bicycle and pedestrian crossing was maintained, an existing pedestrian median refuge was removed by the option.

The removal of uncontrolled right turn movements at the intersection and into side roads improved safety for pedestrians and cyclists in each of the short list options.

Intermodal public transport

There are no separate bus lanes proposed for the 3 short list options. The improved performance of the intersection would lead to improved public transport trip times and reliability.

Connectivity between buses along the Cross Road corridor and the Unley Road/Belair Road corridor was generally expected to be retained. No significant changes to bus stop locations are expected for Option 1A and Option 10.

The increased intersection footprint and grade separation in Option 3A would result in longer crossing delays and greater distances for customers to walk to and from and between bus stops, which will limit accessibility for some customers

7.3.4 Engineering

Civil and roads

The existing pavement conditions have been assessed for the intersection, and the approach roads leading into the intersection as per the latest Google Maps imagery.

Pavement condition within the intersection and on each of the 4 intersection legs appears to be of reasonable condition, with only some minor transverse and longitudinal cracking evident, particularly evident on south-bound Belair Road leg adjacent to the On The Run Kingswood service station (OTR Kingswood). There is also minor rutting at the hold lines on all 4 approaches.

As part of the project, the existing pavement will require redesign in all short list options, in accordance with current Master Specifications and increased traffic volumes. This may take the form of a Plane and Reinstate treatment pending the outcomes of a rehabilitation design and changes to traffic assumptions. Areas of road widening will require new pavement designs. The over-road Cross Road grade separation proposed in Option 3A will require more extensive pavement treatment due to the wider extents of the upgrades.

Appropriate ground remediation works are likely to be required to address the removal of large underground fuel tanks (likely to be present at the OTR Kingswood site) for Options 1A and 3A.

Utilities

Option 3A is anticipated to have more extensive impacts on existing utilities due to the construction of the grade separated overpass compared to Options 1A and 10. However, all options are likely to impact major utility services, including:

- 66 kV High Voltage underground SAPN power cabling
- high pressure gas mains (70–350 kPa)
- various communications services.

It is noted that SAPN typically have long lead times associated with any 66 kV High Voltage works, including preliminary advice and guidance.

Drainage and hydrology

All 3 short list options are anticipated to impact on several side entry pits and drains existing within the intersection and intersection legs.

Drainage at the intersection will be impacted more significantly by the Option 3A over-road Cross Road grade separation than the at-grade upgrades proposed in Options 1A and 10.

A complete redesign of the drainage will be required for Option 3A due to the extent of excavation required at the intersection.

Structures

All 3 short list options are likely to impact upon the following:

- existing gantries for road direction signs
- an existing speed camera on the eastern side of the Cross Road and Rugby Street intersection (if impacted, the camera's viability will need to be assessed against the new road alignments)
- existing lighting poles
- pedestrian fencing on the northern and southern sides of Cross Road at the Rugby Street pedestrian actuated crossing (PAC)
- existing roadside bus stops.

The grade separation proposed in Option 3A is anticipated to have more significant impacts on the abovementioned structures than the at-grade upgrades proposed in Options 1A and 10.

Option 3A will also require the significant construction of structural elements to elevate the road corridor for approximately 600 m on Cross Road. No concept bridge design has been undertaken to date for Option 3A.

7.3.5 Constructability

A high-level constructability review has been completed for each of the short list options.

Options 3A and 10 will require clearing and site preparation of the residential property and adjacent businesses along the Cross Road corridor, whilst Option 1A will only require clearing and site preparation. Construction south of Cross Road can be undertaken behind concrete barriers on day shift, allowing traffic to flow through the intersection as well as from both Cross Road and Belair Road to Unley Road. The traffic can then be switched so that the northern side of Cross Rd can be constructed during day shift.

Road widening activities proposed in Options 1A and 10 along the Unley Road/Belair Road corridor can then be constructed in the same manner whereby the corridor is divided into an eastern and western zone, with the intersection to remain open at all times. Weekend closures and road diversion can be staged such that critical service relocations and cut-ins as well as finishing activities such as pavements and traffic signalling can be completed.

Construction of the bridge deck in Option 3A can either occur on site in 2 halves, or off site and transported in and installed with road closures. Surface road construction activities, such as service installation, communications, ITS, traffic signalling, lighting, kerbing, footpaths and pavements will also need to be staged along both corridors as well the intersection using various day shift and night shift traffic staging options.

7.3.6 Sustainability and environmental impacts

Sustainability

The anticipated sustainability impacts of the short list options are as follows:

- Option 3A will contribute significant GHG emissions in comparison to the other options, requiring:
  - significant materials, particularly concrete and steel, and energy usage to construct the bridge structure
  - substantial vegetation clearance
  - operational lighting will be required to illuminate the under-croft area
  - large volumes of demolition waste.
- Options 1A and 10 will involve a considerably reduced construction effort compared to Option 3A, requiring:
  - materials and energy usage to construct including pavements and sub-base
  - vegetation clearance
  - demolition waste.

Flora and fauna

The *EBS Ecology Report* helped inform the following flora and fauna findings for the site.

Mature large London plane trees are the dominant flora (vegetation) along both sides of Cross Road between Fullarton and South Roads. Whilst offering limited habitat value, the trees have high amenity and shade (canopy cover) value. There are also a high number of large eucalypts (including regulated and significant tree size) offering habitat value, and large non–native amenity trees within private residences/businesses along both Cross Road and Belair Road, most notably and significantly, the stand of trees along the frontage of the Walford Anglican School for Girls sports fields.

Due to the extent of the grade separation works, Option 3A is anticipated to have more significant flora and fauna impacts than Options 1A and 10.

Noise and air quality

Noise exposure and air quality impacts are anticipated to be similar for Options 1A and 10. Compared to the other options, Option 3A poses the potential for increased adverse impacts to local air quality and significant changes to noise conditions in the local area due to the overpass bridge.

DIT's Road Traffic Noise Guidelines (RTNG) will apply to all options given the proposal moves traffic closer to the sensitive receivers by at least one lane width and the demolition of buildings or structures as part of the proposal potentially increases road traffic noise exposure at the sensitive receivers located behind. The RTNG is also triggered for Option 3A because the proposal produces noise at sensitive receivers from a different direction (i.e. from the elevated overpass) that makes a 'significant' contribution to existing noise.

7.3.7 Planning and social impacts

Land use planning

This intersection lies within 2 council areas – City of Unley and City of Mitcham – and consists of a mixture of Community Facilities, Established Neighbourhood, Urban Corridor (Living) and Business Neighbourhood Zones in accordance with South Australia's *Planning and Design Code*. There are no significant current or recently approved development applications for adjacent land to this project area.

All options will impact on the 2 Mercedes-Benz dealerships on the northern side of Cross Road which may result in making these land uses redundant. There may be potential to reorientate the showrooms, however, this would require an application to re-zone the adjacent properties, which may not be permitted and pose a significant time delay.

Impacts on existing carparking spaces at OTR Kingswood (for Options 1A and 2A only) will require significant consideration and consultation with the council and land use operator to determine if the development is still functional.

Any remaining residential properties post-construction will need to consider council requirements under the *Planning and Design Code* for setback requirements. For instance, the acquisition of properties should not result in inadequate lot sizes for the relevant zones.

Aboriginal and non-Aboriginal heritage

Considering the Aboriginal heritage context for the project area, the environmental landforms, and the level of previous development, the Heritage Desktop Assessment identified a low risk of works encountering unknown Aboriginal heritage sites/objects for all 3 short list options.

All 3 short list options are anticipated to directly impact on the following local heritage listed items (with varying levels of impact):

- dwelling and fence at 176 Cross Road, Malvern (Heritage no. 3814)
- dwelling (Longer Crendon) and fence at 174 Cross Road, Malvern (Heritage no. 3813).

Urban design and visual effect

Through the acquisition of land (particularly a large number of properties on the north side of Cross Road), there are opportunities to expand upon greenspaces, as well as reconfigure residential or commercial land uses to revitalise urban impacts from the development. To assist with noise attenuation concerns, greenspace would be beneficial to explore in this scenario.

Further exploration will be required through Green Infrastructure initiatives once a single preferred option has been selected.

All options would benefit from softening through greening initiatives. Additional consideration is required for Option 3A in order to mitigate the impacts of overlooking into properties from the grade separation.

Socio-economic

All short list options are anticipated to have some degree of negative impact on the following:

- local residents' homes
- local business operation
- local amenity (including tree removal)
- local vehicle access
- local pedestrian access (including vulnerable road users from the Walford School and Mitcham Girls High School)
- Local public transport network access (including nearby bus lines).

The community surrounding the intersection are generally of a higher socio-economic standing and are known for uniting behind causes opposing development not viewed favourably (such as the Hyde Park Place multistorey apartment building on Unley Road opposite the Cremorne Hotel), and particularly around issues such as large established tree removal.

7.3.8 Updated Level 3 cost estimate

Following the short-to-preferred evaluation, the costings were further reviewed for all options to better reflect the cost of impacts to businesses and further refined land acquisition. An updated Level 3 cost estimate was prepared for the short list options by Costplan in accordance with DIT's *Estimating Manual*.

The Level 3 cost estimate provides an in-depth cost analysis of the options progressed to the short list. The purpose of the Level 3 cost estimate are outlined in DIT's *Estimating Manual* as follows:

- 'Undertaken during the Proving Phase
- Provides cost analysis of specific options of an initiative being considered
- Based on minimal assumed project scope and initial design details relative to each option
- Prepared using a combination of benchmark (nominally 40%) and first principles (nominally 60%) methods
- Includes risk values which are commensurate to the nature, scale, requirements etc. of the project and the level of design upon which it is based
- Expressed as P50 and P90 values, inclusive of escalation based on assumed delivery dates
- Used to provide a more detailed cost assessment of options short listed from the previous estimate level
- May be used to seek project funding'.

An updated Level 3 cost estimate summary with P50 and P90 values for each short list option is provided in Table 12.

Table 12: Updated Level 3 cost estimate

Estimate Reference	Short List Option	P50*	P90*
EST 600-2 2684 OE L3 R2	Option 1A	$103.4M	$119.8M
EST 600-2 2684 OE L3 R2	Option 3A	$206.2M	$236.5M
EST 600-2 2684 OE L3 R2	Option 10	$75.9M	$87.8M
* Costs rounded to nearest $0.1M			

Refer to Appendix I for further details of the *Updated Level 3 Cost Estimate*.

7.4 Multi-criteria Assessment and Benefit-Cost Analysis

The short list options were assessed using a (non-monetised) Multi-criteria Assessment and a (monetised) Benefit-Cost Analysis. A summary of the Benefit-Cost Analysis is provided in Table 13. The results of the Multi-criteria Assessment are provided in Table 14.

Refer to the *Strategic Business Case (IPP-AMJV-421-001-RP-OA-DO-0067)* provided separately to DIT for further details of the assessment process.

Table 13: Monetised benefit-cost analysis

Indicator		Option		
		1A	3A	10
P50	Cost ($M)	103.4	206.2	75.0
	NPV^{2021} ($M)	-15.55	-55.66	-4.5
	BCR	0.85	0.73	0.94
P90	Cost ($M)	119.8	236.5	87.8
	NPV^{2021} ($M)	-31.21	-84.74	-15.93
	BCR	0.74	0.65	0.82

Table 14: Non-monetised multi-criteria assessment for short list of intersection options

Category	Criteria description	Option 1A	Option 3A	Option 10
Strategic Alignment	Make strategic investments (freight)			
	Make strategic investments (public transport)			
	Make strategic investments (cycle)			
	Make strategic investments (traffic)			
	Alignment with Road Safety Strategy			
Economic	Road user benefits (travel time reliability)			
Socio-Economic	Residual land opportunity			
	Property acquisition (residential)			
	Property acquisition (commercial)			
	Local vehicle movement and accessibility			
	Public transport user benefits			
	Cycle user benefits (connectivity)			
	Cycle user benefits (safety)			
	Pedestrian user benefits			
Environment	Aboriginal Heritage			
	Non-Aboriginal Heritage			
	Flora, fauna and waterways			
	Urban design			
	Greenhouse Gas Emissions			
	Air quality and noise impacts			
Deliverability	Design complexity			
	Utility services			
	Implementation timeframe			
	Project complexity			
	Operational impact			

Indicates options selected as Preferred Options.

HIGH DISBENEFIT	MOD DIS-BENEFIT	LOW DISBENEFIT	NEUTRAL	LOW BENEFIT	MOD BENEFIT	HIGH BENEFIT
1	2	3	4	5	6	7

Two (2) options were selected to progress as preferred options:

- **Option 3A** was selected as a **grade separation option** for the intersection since it provides the greatest outcomes in terms of traffic capacity, reduced delay and fewer stops for freight connecting to South Road.
- **Option 10** was selected as an **at-grade option** for the intersection. It provides a good level of improvement for traffic on Cross Road, whilst being lower in cost and maintaining corridor flexibility along Unley and Belair Roads to support future placemaking and active transport opportunities.

No.	Option name	Description
3A	Cross Road Grade Separation (widen to north)	Cross Road layout and lane lengths based on design for Marion Road/Sir Donald Bradman Drive grade separation
10	At-Grade Widening on Cross only (3T Cross)	3 through lanes on Cross Road only No changes to Unley or Belair Roads
Key:	**T = Through**	**RT = Right Turn**

8 Preferred options

8.1 Preferred Options design basis

A design basis was established for the preferred options to maintain consistency for comparison between the options. These elements included:

- cross section requirements (traffic lane widths, bicycle facility widths and verge widths)
- design and check vehicles and clearances
- design speed
- geometric design parameters
- horizontal alignment and clearances
- vertical alignment and clearances.

Summaries of the key cross section geometry requirements and the design and checking vehicles used for the short list option designs are provided in Table 15 and Table 16 respectively.

Table 15: Key cross section geometry requirements for short list options

Criteria	Minimum Design Requirement
Number of lanes in each roadway	Road specific
Through Lane Widths	Preferred 3.5 m Minimum 3.0 m
Turn Lane Widths	Preferred 3.5 m Minimum 3.0 m
Verge Width (including footpath)	Minimum 3.0 m Unless in constrained areas
Footpath Width	Minimum 1.8 m
Bicycle Lane Width (from edge of bitumen)	Preferred 1.8 m Minimum 1.2 m
Median Widths	Dependant on the surroundings
Bus Lane Width	Minimum 3.5 m
Indented Bus Bay Width	Minimum 3.0 m

Table 16: Design and checking vehicles for short list options

Road	Design Vehicle PBS Level	Check Vehicle
Unley Road	Level 1A (19 m HML vehicle) 14.5 m and 19 m articulated buses	PBS Level 2A (26 m B-double HML Vehicle) 14.5 m and 19 m articulated buses
Cross Road	Level 2B (26 m B-double fitted with quad axel groups HML vehicle) 14.5 m and 19 m articulated buses	PBS Level 3A (36 m Double road train [type I] HML vehicle) 14.5 m and 19 m articulated buses (conservative approach – see *Design Report* for more details)
Belair Road	Level 1A (19 m HML vehicle) 14.5 m and 19 m articulated buses	PBS Level 2A (26 m B-double HML Vehicle) 14.5 m and 19 m articulated buses
Turning movements	Level 1A (19 m HML vehicle) 14.5 m and 19 m articulated buses	PBS Level 2A (26 m B-double HML Vehicle) 14.5 m and 19 m articulated buses
Key: PBS = Performance Based Standard		**HML = Higher Mass Limits**

Critical issues such as utility services impacts have also been examined as a part of the preferred options' designs.

Refer to the *Design Report (IPP-AMJV-421-001-RP-CC-DO-0171)* issued separately to DIT for further details.

8.2 Design development

8.2.1 At-grade option (Option 10)

Following the Multi-criteria Assessment, the at-grade preferred option was further developed as follows:

- swept path modelling with refinement of stop line positions and left turn slip lanes
- merge and diverge lengths further resolved
- refinement of median island design and alignment
- increased extent of solid white lines on left turn lane approaches to reduce conflict zone for cyclists.

8.2.2 Grade separated option (Option 3A)

Following the Multi-criteria Assessment, the grade separated preferred option was further developed as follows:

- lane widths were rationalised to reduce land acquisition extent and encourage slower speeds
- safe cycling treatments were included for on and off ramp merge and diverge zones
- merge and diverge lengths further resolved
- an additional pedestrian actuated crossing was added to the west of the crossing
- at-grade intersection design refined
- bus stop locations identified and indented bus stops added.

8.3 Description of upgrades

8.3.1 At-grade option (Option 10)

The at-grade option, as shown in Figure 15, includes the following:

- 3 through lanes and 2 right turn lanes on Cross Road (west, east) approaches
- separated and extended high entry left turn auxiliary lanes on Cross Road (west, east) approaches
- existing bicycle lanes on Cross Road (west, east) widened to 1.8 m with 1.0 m line-marked separation and applied greening through conflict zones
- 2 through lanes and 2 right turn lanes on Unley Road and Belair Road approaches
- short high entry left turn lanes on Unley and Belair Road approaches
- existing bicycle lanes on Unley Road and Belair Road retained with added applied greening through conflict zones
- all existing pedestrian intersection movements retained with increased crossing distances on Cross Road (west, east) due to road widening
- pedestrian-and-cyclist-access-only at Rugby Street from Cross Road (east) retained with minor modifications
- midblock 2 stage pedestrian crossing at View Street on Cross Road (west) removed due to safety concerns (increased road width and multiple diverge areas)
- widened medians on Cross Road (west, east)
- road reserve areas of 3 m width where widening is proposed
- access at View Street on Cross Road (west) restricted to pedestrian-and-cyclist-only to avoid intersections at a merge/diverge area.

The *Preferred At-Grade Option 10% Engineering Sketch* is provided in Appendix J.

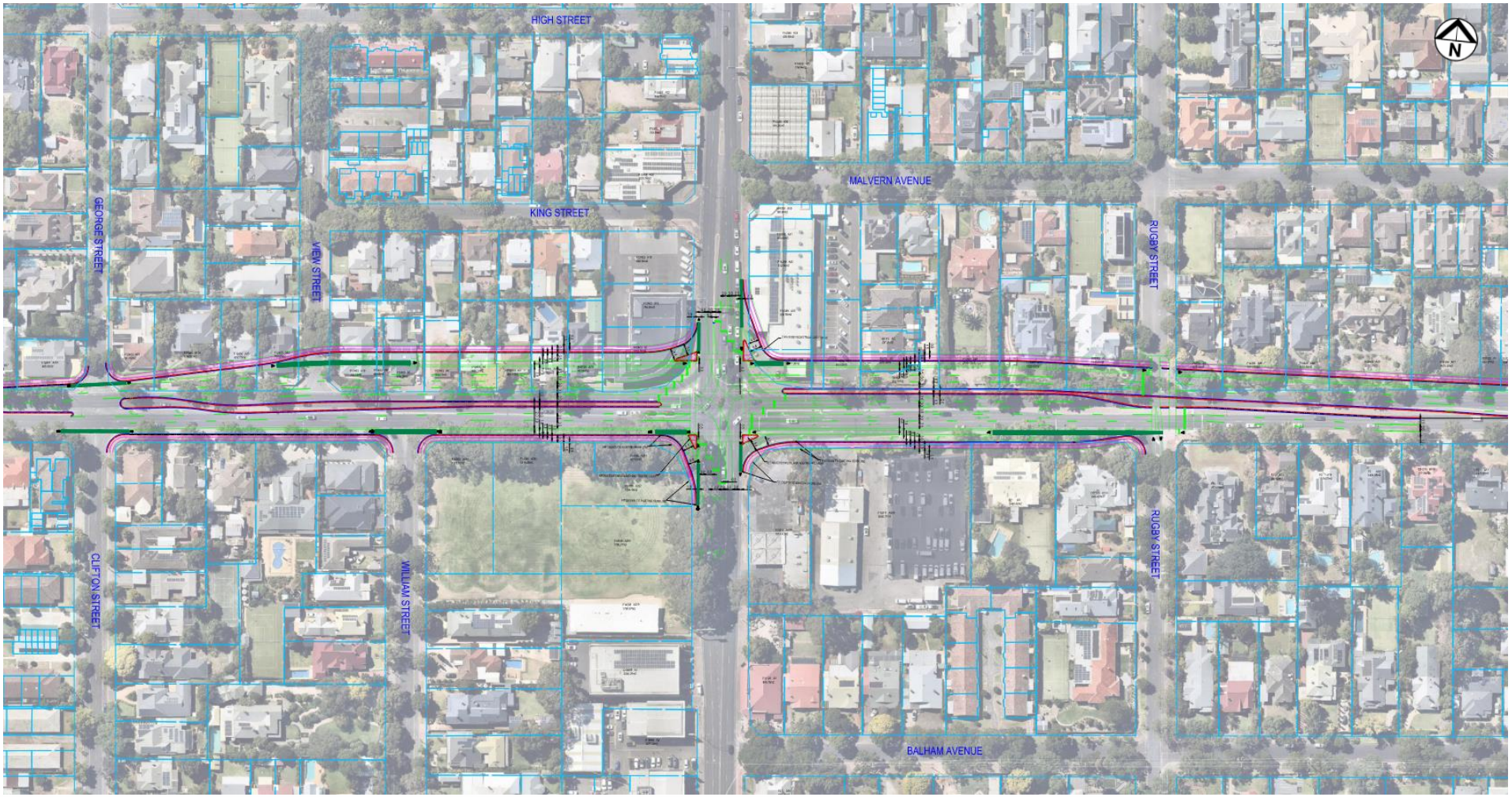


Figure 15: Preferred At-Grade Option – 10% Concept Design

8.3.2 Grade separated option (Option 3A)

The grade separated option, as shown in Figure 16, includes the following:

- grade separation of Cross Road (dual lane, both directions, with bicycle lanes) via overpass between George Street/Clifton Street and Cambridge Terrace (widening to north)
- at-grade 1 (one) through lane, 2 right turn lanes and 1 (one) U-turn movement lane on Cross Road (west, east) approaches
- at-grade separated and extended high entry left turn auxiliary lanes on Cross Road (west, east) approaches
- existing at-grade bicycle lanes on Cross Road (west, east) widened to 1.8 m with applied greening through conflict zones
- 2 through lanes and 2 right turn lanes on Unley Road and Belair Road
- short high entry left turn lanes on Unley Road and Belair Road
- existing bicycle lanes on Unley Road and Belair Road retained with added greening through conflict zones
- road reserve areas of 3 m width where widening is proposed
- added 4 indented bus stops on Cross Road (west, northern side; and east, northern and southern sides) and on Belair Road (eastern side)
- all existing pedestrian intersection movements retained with 2 stage crossings across Cross Road (west, east) and increased crossing distances on all legs due to road widening
- pedestrian and cyclist access only at Rugby Street from Cross Road (east) retained with modifications as 2 stage crossing under grade separation structure
- midblock 2 stage pedestrian crossing at View Street on Cross Road (west) retained with modifications as 2 stage crossing under grade separation structure
- widened medians on Unley Road and Belair Road
- access at View Street, George Street, Clifton Street and Kent Street on Cross Road (west) and Cambridge Terrace on Cross Road (east) restricted to pedestrian-and-cyclist-only to avoid having intersections at a merge/diverge area.

The *Preferred Grade Separated Option 10% Engineering Sketch* is provided in Appendix K.

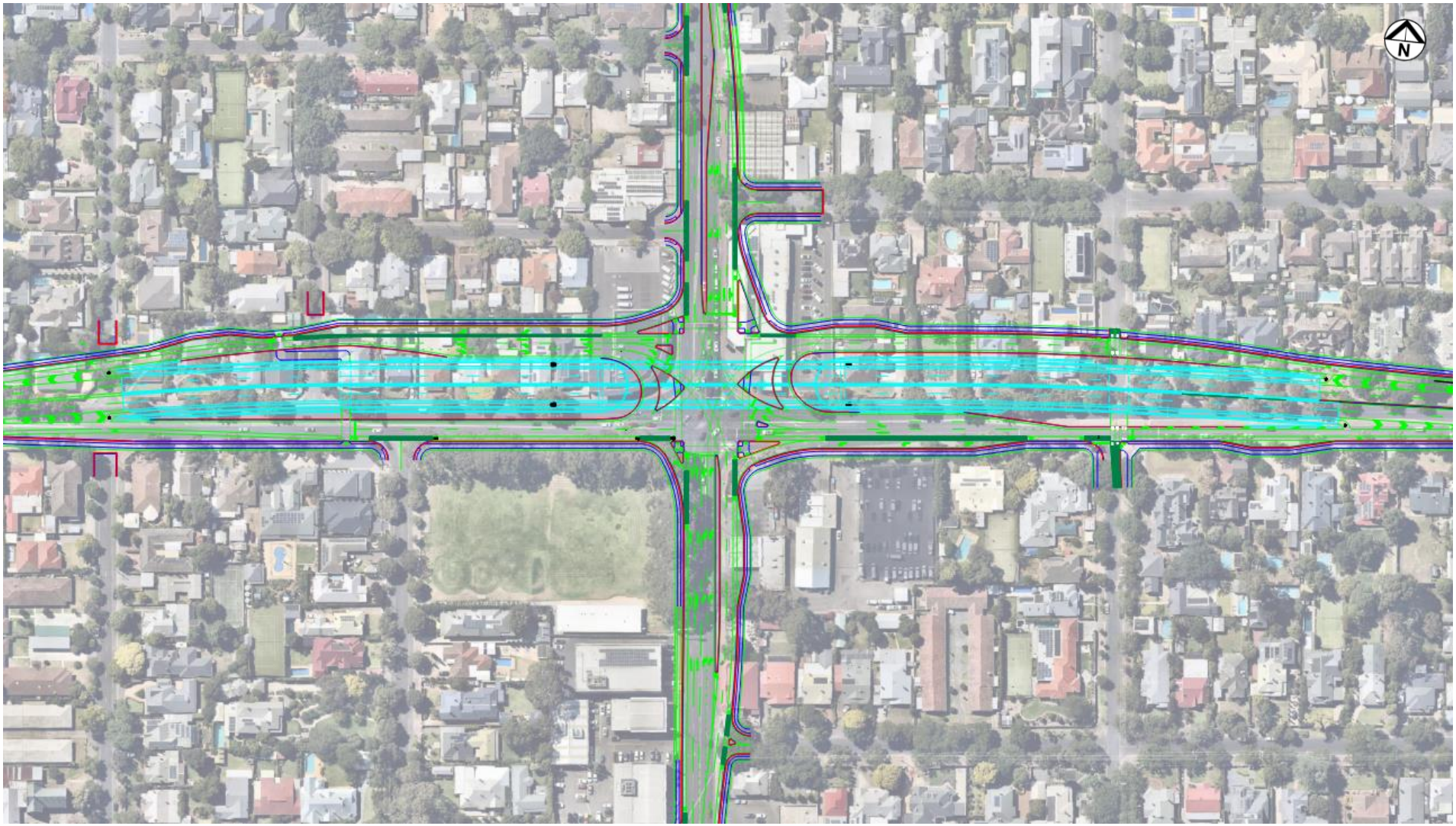


Figure 16: Preferred Grade Separated Option – 10% Concept Design

8.4 Traffic modelling

Future volumes and detailed traffic modelling analysis can be found in the *Traffic Modelling Report* in Appendix L.

8.4.1 At-grade option (Option 10)

The at-grade option builds on Short List Option 10, with minor changes to the detailed geometry of the intersection due to the progression of the design.

The results (refer Table 17) show the intersection operates close to capacity under existing demand, with DoS 0.94 and 1.00 for AM and PM peaks respectively. In 2036, the intersection is operating at capacity with DoS above 1.0 during both peaks.

Table 17: Model intersection performance summary, at-grade option

Scenario Modelling	AM Peak Hour				PM Peak Hour			
Design Options	**DOS**	**Avg. Delay (sec)**	**LOS**	**95%ile Queue (m)**	**DOS**	**Avg. Delay (sec)**	**LOS**	**95%ile Queue (m)**
Current performance	1.06	76	E	415	1.03	65	E	352
At-grade option (current)	0.94	55	D	345	1.00	66	E	351
Future Base Case (2026)	1.14	122	F	606	1.15	118	F	567
At-grade option (2026)	1.05	73	E	462	1.04	81	F	361
Future Base Case (2036)	1.24	169	F	755	1.26	175	F	852
At-grade option (2036)	1.06	86	F	486	1.09	101	F	411

8.4.2 Grade separated (Option 3A)

The grade separated option builds on Short List Option 3A, with minor changes to the detailed geometry of the intersection due to the progression of the design.

The results (refer Table 18) show that the proposed changes provide immediate benefits to the intersection performance under existing demand, with DoS of 0.73 and 0.71 for the AM and PM peaks respectively. In 2036, the intersection performs satisfactorily with DoS of 0.78 and 0.77 for AM and PM peaks respectively.

Table 18: Model intersection performance summary, grade separated option

Scenario Modelling	AM Peak Hour				PM Peak Hour			
Design Options	**DOS**	**Avg. Delay (sec)**	**LOS**	**95%ile Queue (m)**	**DOS**	**Avg. Delay (sec)**	**LOS**	**95%ile Queue (m)**
Current performance	1.06	76	E	415	1.03	65	E	352
Grade separated option (current)	0.73	24	C	212	0.71	22	C	186
Future Base Case (2026)	1.14	122	F	606	1.15	118	F	567
Grade separated option (2026)	0.77	24	C	241	0.73	22	C	188
Future Base Case (2036)	1.24	169	F	755	1.26	175	F	852
Grade separated option (2036)	0.78	24	C	248	0.77	22	C	190

8.5 Land acquisition

A high-level estimate of land acquisition compensation value was obtained for the preferred options from the Office of the Valuer-General (OVG), with whole and partial acquisition parcels determined by the AMJV to inform the updated Level 3 cost estimate.

Each preferred option has been assessed to determine the extent of residential land or dwellings and commercial land or buildings/tenancies impacted with reference to the 10% Engineering Sketch. The extent of impacts, including number of residential and commercial land parcels and total area required for acquisition is provided in Table 19.

Table 19: Extent of land acquisition required for at-grade option

Option	Total Properties Acquired	Partial Acquisitions	Whole Acquisitions	Residential	Commercial/ Other
At-grade (Option 10)	34	20	14	28	6
Grade separated (Option 3A)	86	43	43	63	23

Refer to Appendix M for the *Land Acquisition Technical Note* which includes further details of the extent of required land acquisition.

8.6 Updated Level 3 cost estimate

An updated Level 3 cost estimate summary was completed for both preferred options to reflect the design modifications and refinements explained in Section 8.2.

The updated Level 3 cost estimate for the at-grade option with P50 and P90 values is provided in Table 20.

Table 20: Updated Level 3 cost estimate for at-grade option

Estimate Reference	Preferred Option	P50*	P90*
EST 600-2 2684 OE L3 R2	At-grade option (Option 10)	$75.9M	$87.8M
EST 600-2 2684 OE L3 R2	Grade separated option (Option 3A)	$206.2M	$236.5M
***** Costs rounded to nearest $0.1M			

Refer to Appendix I for details of the *Updated Level 3 Cost Estimate*.

8.7 Preliminary Environmental and Heritage Impact Assessment Report

A *Preliminary Environmental and Heritage Impact Assessment Report* (EHIAR) has been prepared for this stage of the Planning Study. The EHIAR provides an overview of the key aspects for consideration across multiple disciplines to progress this at-grade preferred option with relation to the next or subsequent phases.

During the Planning Study, a number of technical investigations were completed (refer Table 21). Additionally, an Environmental Gap Analysis was undertaken.

Key recommendations for mitigation requirements to be considered throughout the development of a single preferred option and the subsequent design development phase are provided in Table 21.

Refer to Appendix C for complete details of key findings from the *Preliminary EHIAR*.

Table 21: Completed and required technical investigations

Investigation	Required (Y/N)	Completed (Y/N)	Timing (PPMF Phase) Proving/ Pre-Delivery/ Procurement/ Delivery
Flora and Fauna Survey	N	N	Pre-Delivery (Concept design development)
Arborist Assessment	Y	N	Pre-Delivery (Concept design development)
EPBC Significant Impact Assessment against MNES	Y	Y	Pre-Delivery (Concept design development)
Preliminary Noise and Vibration Assessment	Y	N	Pre-Delivery (Concept design development)
Preliminary Air Quality Assessment	Y	Y	Pre-Delivery (Concept design development)
Non-Aboriginal Heritage Desktop Assessment	Y	Y	Pre-Delivery (Concept design development)
Aboriginal Heritage Desktop Assessment	Y	Y	Pre-Delivery (Concept design development)
Heritage Impact Assessments (HIA) for specific state heritage items	TBC	N	Delivery (detailed design)
Early works/enabling ground investigation for both geotechnical and groundwater	TBC	N	Delivery (detailed design)
Spoil Disposal Management Plan (SDMP)	Y	N	Procurement
Noise and Vibration Assessment Study	Y	N	Delivery (detailed design)
Construction Vibration Assessment	Y	N	Delivery (detailed design)
Air Quality Study (including air dispersion modelling assessment)	N	N	Delivery (detailed design)
Hydrological investigations for the reference design	Y	N	Delivery (detailed design)
Water Quality Risk Assessment	Y	N	Delivery (detailed design)

8.8 Socio-economic impacts

A *Socio-Economic Impact Assessment* (SEIA) has been prepared for this stage of the Planning Study. The SEIA report provides a description and analysis of the socio-economic impacts that are anticipated as a result of proposed changes to the Unley Road, Cross Road and Belair Road intersection. It outlines the likely impacts of the 2 preferred options, which broadly include movement impacts, place impacts, and impacts during the construction phase.

For details of the key socio-economic impacts at the intersection, refer to Appendix N for the complete *SEIA*.

8.9 Preliminary sustainability assessment

Sustainability encompasses a broad range of outcomes in the areas of environmental, social and economic. DIT is committed to the delivery of state government sustainability strategies including the South Australian Government's *30-Year Plan for Greater Adelaide* and *Climate Change Action Plan*.

The *Preliminary Sustainability Assessment Report* is a high level desktop assessment and has been completed in consideration to, but not strictly in accordance with, Task 9 of DIT's Master Specification planning document PC-PL1 (revision August 2020) and PC-PL2 (revision August 2020), DIT's *Sustainability Manual* (revision F, December 2020), and DIT's *Climate Change Adaptation Guideline* (version 8, February 2021).

The assessment focuses on the sustainability impacts and considerations for two preferred options, including:

- whole of life greenhouse gas emissions (energy and materials)
- applying the waste hierarchy
- whole of life water use
- sustainable procurement
- green infrastructure
- identification of climate change risks.

Option 3A has been identified as posing the most significant sustainability risks given the larger extent of impacts, but it also offers greater opportunities for green infrastructure associated with increased areas of land acquisition.

Refer to Appendix O for the full *Preliminary Sustainability Assessment Report*.

South Australia has had a goal since 2015 to reach net zero emissions by 2050, but in February 2020 an interim goal of more than 50% reduction on 2005 emissions levels by 2030 was introduced. To support achieving this goal, and other sustainability outcomes, the *South Australian Government Climate Change Action Plan 2021–2025* (Action Plan) was released in December 2020, which describes government-led objectives and actions to help to build a strong climate-smart economy, further reduce greenhouse gas emissions and support South Australia to adapt to a changing climate. Implementation of the Action Plan will deliver the 'Directions for a Climate Smart South Australia' policy that was released in December 2019.

Ensuring alignment of infrastructure investment with the Government's Climate Change commitments, including net zero emissions by 2050, requires assessment of whether the initiative supports:

- aligning transport planning with net zero emissions outcomes
- delivering low emission infrastructure and operations
- increasing the use of public transport and active travel
- accelerating strategic urban greening
- assessing and addressing climate change risk in government infrastructure decisions
- achieving Net Zero Emissions in South Australia by 2050.

DIT currently uses an in-house transport model to simulate transport demand for infrastructure projects. The model takes a dynamic view of how the value and utilisation of an infrastructure asset is expected to evolve over 30 years, the same timeframe over which South Australia has committed to achieving net zero emissions. DIT acknowledges that the transport model currently used for transport planning assessments is based on outdated assumptions (noting work is currently being undertaken by DIT to investigate required changes to the transport model), and assumes little or no change over the next 30 years (i.e. behaviour, technology, investment, government commitment). It does not incorporate any economic, social or environmental changes as South Australia transitions to net zero emissions over this time.

This means there is currently a gap between the net zero future we are seeking to achieve and the tools we are using to plan for it. Estimated benefits of a project designed to increase road capacity (in terms of travel time savings multiplied by the projected number of vehicles) are high, whereas the benefits of a project designed to improve public transport efficiency and which will result in lower carbon emissions (in terms of travel time savings multiplied by the projected number of patrons) are comparatively low – and the road project attracts the investment.

Accordingly, it is recommended any future investment decisions for the project need to include assessment of alignment with the state's climate change commitments, including net zero emissions by 2050. To enable this, we recommend transport modelling be updated to allow accurate characterisation of all investment options' GHG emissions generating potential, for ease of identifying low-carbon options.

8.10 Land use and development study

A desktop analysis was undertaken using current and applicable zoning provisions, strategic land use policies, infrastructure plans and planning legislation for both preferred options.

The **preferred at-grade option** limits land acquisition along the Cross Road corridor. As a result, there are limited opportunities for residual land use for this option, primarily comprising the potential implementation of Green Infrastructure solutions.

The **preferred grade separation option** has more significant land acquisition requirements due to the scale of the proposed bridge structure, and therefore presents more extensive opportunities for residual land use. Impacts, and therefore residual land use opportunities, are mainly concentrated on the northern side of Cross Road, where road widening will occur to accommodate the proposed bridge structure. A range of commercial and residential properties will be impacted. Critically, the existing Mercedes-Benz vehicle dealerships on the north-western and north-eastern corners of the intersection will require whole acquisition and demolition. These commercial properties will likely be available for redevelopment, however, on a much smaller property size and may not be suitable for the existing business to continue operation. Where whole acquisition of residential property occurs, residual land is unlikely to be viable for residential redevelopment due to shallow allotments and proximity to the intersection. In these scenarios, residual land use opportunities include Green Infrastructure solutions or sound/privacy walls for remaining residential properties.

For further details of the land use, planning and zoning impacts at this intersection, refer to Appendix P the *Land Use and Development Study*.

8.11 Strategic Business Case

The development of this *Outline Planning Study Report* is complemented by a separate preliminary (high-level) rapid economic evaluation.

The details of this evaluation are presented in the *Strategic Business Case (IPP-AMJV-421-001-RP-OA-DO-0067)* provided separately to DIT.

8.12 Constructability

A high-level constructability review was undertaken as part of the Preliminary Design Stage by TSA Projects which engaged experience construction managers to provide advice.

For further details, refer to Appendix Q for the *Constructability Report*.

8.13 Risk register

A Risk Register is a 'living' project document used to record the identified risks at all stages of a project. Each identified risk is rated to describe the likelihood of occurrence, seriousness of impact on the project, and actions that may be taken to mitigate the risk. As the project progresses, the risk register is continually updated to include any new risks that have been identified, and to reflect re-grading of risk due to actions taken within the project design.

The *Planning Study Risk Register* has been prepared in accordance with DIT's *Risk Register Template*. The risk register has been developed in parallel with the preliminary long list, long list and short list stages in collaboration with DIT.

Refer to Appendix R for the complete *Planning Study Risk Register*.

8.14 Decision register

A Decision Register is a project document used to capture and communicate project decision-making to key stakeholders. It includes details of how each decision was made, whether any alternatives were considered and who is accountable for each decision. The register not only helps to inform the current project team, but also provides a comprehensive record of decision-making that will aid future phases of the project.

The *Planning Study Decision Register* has been prepared to document all key decisions made throughout the Planning Study thus far.

Refer to Appendix S for the complete *Planning Study Decision Register*.

9 Next steps

Three key next steps have been identified as a part of future works for this Planning Study.

1. Networks modelling and planning
2. Stakeholder engagement
3. Further investigations

Network modelling and planning

The Cross Road Corridor Planning Study and Unley Road Corridor Planning Study are currently being developed and it has been recognised that, once completed, this study will directly influence the future of this intersection's function and purpose within the Cross Road and Unley Road corridors. Moving forward, the single preferred option for this intersection will need to be considered within the broader context of these planning studies.

Due to its proximity to this intersection and, in particular, the Goodwood Road and Cross Road intersection, an additional planning study will also need to be completed to investigate opportunities and challenges related to the Unley Park Level Crossing. The outcomes of this Planning Study would therefore inform the key decisions at both these intersections for the grade separation options.

The traffic modelling used for this study was based on approach growth rates and the traffic modelling. Review of the options and traffic modelling should be undertaken using revised demand forecasts associated with the ultimate North–South Corridor design and any revisions to the strategic model to align to the state's climate change commitments.

Stakeholder engagement

Community engagement was not undertaken specific to this Planning Study and, due to timing, relevant information and feedback from the community gained as part of the broader community engagement process has not been incorporated into this Planning Study.

Stakeholders have not been presented with any intersection options at the time of writing this report.

A plan for additional and more comprehensive stakeholder and community engagement on the preferred option(s) will need to be developed and actioned as a critical next step in validating and mitigating the potential impacts identified in this report. It will also be critical to 'close the loop' with stakeholders – to report back what we heard during engagement, inform them what was done with their feedback, and what the outcomes and next steps for the project are.

Further investigations

Further investigations will be required to progress the design of the preferred options, including:

- engineering survey
- vegetation survey
- services potholing
- geotechnical investigations
- stormwater study
- completion of a climate change risk assessment
- completion of a green infrastructure assessment.

Critically, any future investment decisions for the project need to include assessment of alignment with the state's climate change commitments, including net zero emissions by 2050. To enable this, it is recommended that transport modelling be updated to allow accurate characterisation of all investment options' GHG emissions generating potential, for ease of identifying low-carbon options.

Additional investigations will be required to understand local street impacts where side streets are restricted or closed as a result of the project.

Appendix A – Business Requirements

Appendix B – Geotechnical Desktop Report

Appendix C – Preliminary Environmental and Heritage Impact Assessment

Appendix D – Preliminary Long List to Long List Strategic Merit Test

Appendix E – Long List 5% Engineering Sketches

Appendix F – Long List Technical Notes

Appendix G – Design Report

Appendix H – Short List Technical Note

Appendix I – Updated Level 3 Cost Estimate

Appendix J – Preferred At-Grade Option 10% Engineering Sketch

Appendix K – Preferred Grade Separated Option 10% Engineering Sketch

Appendix L – Traffic Modelling Report

Appendix M – Land Acquisition Technical Note

Appendix N – Socio-Economic Impact Assessment

Appendix O – Preliminary Sustainability Assessment

Appendix P – Land Use and Development Study

Appendix Q – Constructability Report

Appendix R – Planning Study Risk Register

Appendix S – Planning Study Decision Register