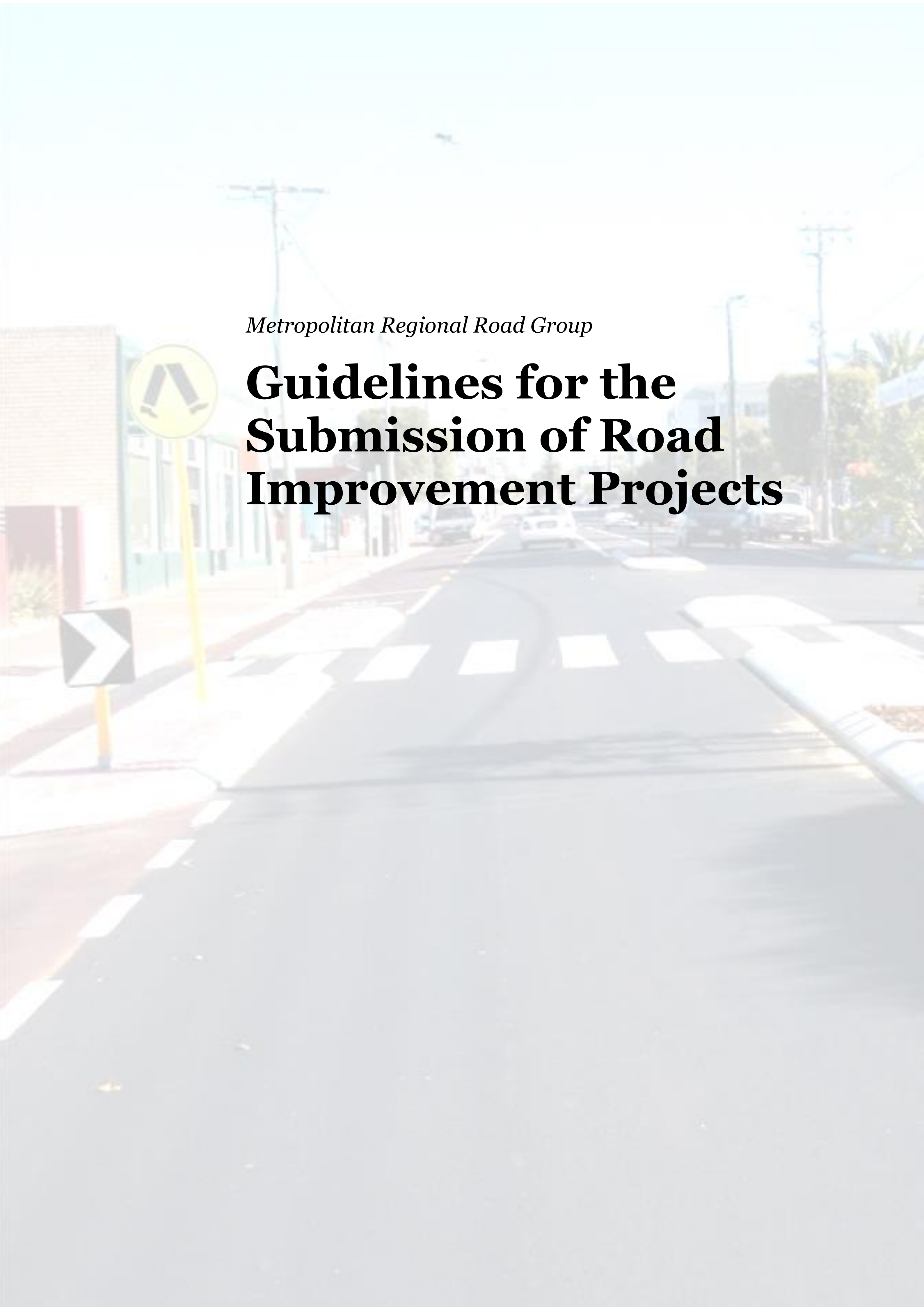


Metropolitan Regional Road Group

Guidelines for the Submission of Road Improvement Projects

Revision Number	Date	Summary of Update/Revision
1	Feb 2016	Update to Section 2.4 – Road Safety Audits Addition of Section 2.5 – Agreements in Principle Update to Section 8.1 – Reference to current PTA Guidelines/requirements Addition of Section 10 – Summary worksheet included
2	Feb 2018	Update to Section 10 – Summary worksheet updated
3	Feb 2023	Update of economic evaluation unit costs to reflect current values in Road Improvement worksheet, indexing applied from 2011 to 2022.
4	Feb 2023	Update ROM traffic modelling requirements in Road Improvement worksheet

Preface

Guidelines for the submission of Metropolitan Regional Road Group (MRRG) funding applications for road improvement (upgrade/new) projects were originally established in 1996. Subsequently revised a number of times, the MRRG submission process allows Perth Metropolitan Councils to potentially receive up to $2 million dollars for improvement submissions per annum.

In 2008 the MRRG Technical Committee identified that there were deficiencies in the previous Guidelines and that in particular, the improvement scheme process no longer aligned to modern day sustainable transport policies and planning. Furthermore, member Councils had raised concerns over perceived deficiencies and biases towards the allocation of funds – which frequently end up funding major road upgrades/new schemes.

Following a review of the Guidelines in 2009 and a series of recommendations, the MRRG Technical Committee agreed that the Guidelines needed to be re-developed to ensure funding is directed at those projects that are consistent and support regional (and local) objectives in terms of the movement of people, goods and services. As part of this, it was recognised that there was a need to prioritise projects primarily through a simple but robust evaluation process utilising tangible benefits (road user costs associated with travel time, vehicle operating costs and crash savings) relative to the project cost (construction and maintenance). It was acknowledged that a number of assumptions as part of such a process would need to be made to enable an individual with minimal experience in transport economics to undertake the analysis. Furthermore, some allowance for intangible benefits, outside of monetary value in the form of a simplified evaluation process were also considered necessary.

This updated version of the MRRG *Guidelines for the Submission of Road Improvement Projects* is intended to provide guidance to Local Government with respect to seeking funding for road improvement grants using a highly simplified evaluation of tangible/intangible benefits and costs in order to determine an overall rating or score for a proposed project.

It is intended that the base costs used in the Guidelines be updated as and when required following agreement by the MRRG Technical Committee.

Assistance

Contact details relating to any assistance with respect to the use of these Guidelines should be directed to the Main Roads WA Metropolitan Regional Road Group Programme Officers, contact number 138 138.

Acknowledgements

The Metropolitan Regional Road Group (MRRG) *Guidelines for the Submission of Road Improvement Projects* has been developed with guidance from a technical working group representing local government and Main Roads WA. They were assisted by the contracted authors from Opus International Consultants.

Contents

1 Introduction

1.1 Purpose

The purpose of this document is to set out the user operational instructions for preparing a road improvement (upgrade/new) project submission to the Metropolitan Regional Road Group (MRRG). In particular, it details how to use the associated assessment Excel spreadsheet in the form of a user manual to ensure users understand the information that needs to be entered into the spreadsheet. The assessment spreadsheet will form the bulk of a road improvement project submission.

The assessment spreadsheet is intended to allow an overall score for a road improvement (upgrade/new) project, or project components to be determined for inclusion in a Local Government's application for MRRG funding.

2 Road Improvement Project Requirements

2.1 Strategic Alignment

In order to help maximise the benefits associated with the funding of road improvement projects across the Perth Metropolitan Region, proposed projects should be able to demonstrate that they are aligned with documented priorities, for instance as set down in state, regional or local planning or transport strategies. A number of relevant strategic documents exist to help guide decision makers (for example the MRRG and the supporting Technical Committee) with respect to the above:

- Perth Metropolitan Transport Strategy 1995-2020;
- Public Transport Plan for Perth 2012-2031;
- Perth CBD Transport Plan 2012;
- WA Bicycle Network Plan 2012-2021: draft for consultation (or updated version);
- Metropolitan Regional Scheme;
- State Planning Framework Policy;
- Perth Urban Corridor Strategy (2007);
- Directions 2031 and Beyond (2010); and
- Local planning strategies, local transport strategies and/or bike plans.

2.2 Roads Eligible for MRRG Funding

The 'State Road Funds to Local Government Procedures' (Issue 6.0 – Main Roads WA) indicates that funds made available by the State for local government roads should, amongst other things, maximise benefits to the community and preserve, improve and extend the road system. Furthermore, the State Road Funds to Local Government Agreement 2011/12 – 2015/16 notes that funds for road related projects should be of 'Regional significance' and 'prioritised against other road projects within the Region.'

Roads within the Perth Metropolitan Region, managed by various local governments, vary considerably in function ranging from providing efficient mobility on relatively high volume, fast moving traffic distributors, to roads which have low traffic volumes and are pedestrian and cyclist friendly residential streets. The Metropolitan Functional Road Hierarchy, developed by Main Roads in consultation with all Perth metropolitan local governments designates the function of all roads within the region and encourages uniform traffic management practices across roads of a similar function. Four functional types exist:

- Primary Distributors;
- District Distributors (types A and B);
- Local Distributors; and
- Access Roads.

Whilst Primary Distributors provide for major regional and inter-regional traffic movements and carry large volumes of generally fast moving traffic, they are managed by Main Roads WA with separate funding sources, and are not under the control of local government. Conversely, Local Distributors and Access Roads tend to carry low volumes of traffic within a specific local area. These are low in the road hierarchy and such roads are unlikely to play a strategic role in the movement of people and goods from the perspective of the entire Perth Metropolitan Region. Compared to District Distributors (A and B) roads which typically carry higher volumes of traffic between industrial, commercial and residential areas (not through them) and generally connect to Primary Distributors, they are unlikely to warrant MRRG program funding.

Accordingly, whilst all roads where the annual average daily traffic exceeds 2,000 vehicles per day or the design exceeds 10,000,000 Equivalent Standard Axles (ESA) for a 20 year design life can be considered for funding[1], only those schemes which impact on District Distributors (A or B) should preferably be considered for funding as these will have the greatest Regional significance/benefits (given higher volumes of traffic) and are managed by local government.

2.4 Road Safety Audits

It is mandatory for projects that are awarded funding to be subject to a formal, independent road safety audit in accordance with the Austroads Guide to Road Safety. Such road safety audits should be undertaken during the design process, for instance at the preliminary and/or detailed design stages. Costs associated with such road safety audits should be incorporated into the project costs.

2.5 Agreements in Principle

Where proposed road improvement projects have an impact on other key stakeholders (for example Main Roads WA, other adjacent Local Governments and/or the Public Transport Authority) which and therefore potentially requires their agreement in principle upgrade, evidence of their agreement must be supplied as part of the submission process. Such examples include Main Roads WA Agreement in Principle for the installation of traffic signal controls and/or agreements to any changes that impact on bus movements from the Public Transport Authority.

[1] The 'State Road Funds to Local Government Procedures' (Issue 6.0 – Main Roads WA)

3 Evaluation Methodology

3.1 Do Minimum and Project Option

The evaluation process essentially compares a proposed Project Option against a Do Minimum scenario with respect to both tangible benefits/costs as well as intangible benefits.

- The Do Minimum is the least amount of work that is needed to take place if the preferred option is not progressed. It should be noted that it is not normally practical to do absolutely nothing as there as a minimum level of expenditure is required for maintenance and operational costs to maintain a basic level of service.

- Project Options are developed to address the current road network deficiencies such as capacity problems at congested intersections and midblock section lengths.

3.2 Road Improvement Types

The simplified MRRG evaluation procedures can be used for the following basic project types/elements:

- Individual midblock improvements (e.g. road reconstruction, new road, geometric improvements, road widening to increases capacity, safety improvements); and
- Individual intersection improvements (e.g. change of intersection control form, or increases in stop line capacities), using intersection modelling software such as SIDRA to determine delays, average speed and fuel usage;

Route improvements comprising a combination of mid-block and intersection improvements can be undertaken utilising individual link and/or node improvements. <u>This requires each individual midblock section or intersection to be evaluated separately before being combined and averaged.</u> Whilst this may in reality slightly over/under estimate the tangible benefits associated with a particular project, it should be noted that all projects are subject to the same process resulting in an unbiased assessment process. Accordingly, in each instance, individual elements forming a longer route improvement will need their specific costs and benefits to be identified and separated out in order to allow the evaluation to occur.

Whilst the procedures can best be utilised for upgrading existing midblock lengths and intersections (and hence route lengths through a combination of these nodes and links), the procedures can also be used for the construction of a new road (asset creation). For example, the process can be used to evaluate a new bypass which reduces the route length and/or travel time/vehicle operating costs for traffic between two fixed points. Details relating to calculating the benefits of such new schemes within the context of these broader Guidelines are contained in Appendix A.

3.3 Project Costs

Project costs are those incurred by the road controlling authority in constructing as well as maintaining and operating the road under consideration.

For the purpose of this evaluation process, these costs are for the physical works to either maintain and operate the do-minimum situation (such as routine maintenance/periodic rehabilitation) or to construct, maintain and operate the preferred option. These costs typically comprise the following:

- Planning, investigation and design fees including road safety audits;
- Costs of property required for the project;
- Construction costs, including pre-construction and supervision;
- Maintenance and renewal costs, including repair and reinstatement;
- Operating costs;
- Risk management costs;
- External impact mitigation costs;
- Service relocation; and
- Provisional costs.

For the purpose of the amount sought for funding from the MRRG program however, the submitted project cost as part of any application should exclude the maintenance and renewal costs of the option. Costs for land and/or property resumption should only be included within the funding submission when funds for this are being requested from the program – otherwise, these should also be excluded. The cost shown should be the cost for the whole project or the cost of each stage. Projects that are awarded funding and consist of a number of stages receive funding for all stages.

3.4 Project Benefits

3.4.1 Tangible Benefits

The tangible benefits utilised as part of the MRRG simplified evaluation process are associated with:

- Travel Time Cost (TTC) savings – relating to vehicles travelling through the mid-block or intersection more quickly due to shorter distances or less delays compared to the Do Minimum;

- Vehicle Operating Cost (VOC) savings with CO_2 reductions – related to improved vehicle operating costs and lower CO2 emissions compared to the Do Minimum; and

- Crash Cost savings – related to enhanced road safety due to the proposed improvements compared to the Do Minimum.

Assessment Time Periods and Future Years

The simplified evaluation methodology has been developed for projects to be evaluated over a 30 year time period whereby there is a 1 year construction period and a 29 year benefit. With the project timings defined, the discounting of benefits and costs become standardised. As part of this, four future years: 2, 8, 15 and 30 are to be assessed for the specified time periods with midpoint benefits to be derived and used to calculate Present Value Travel Time and Vehicle Operating Cost savings.

Notwithstanding the above, by allowing unconstrained growth to occur beyond Year 15, testing of the process identified that unrealistic levels of benefit were being derived by proposed Options when compared to the Do Minimum, particularly at intersections with high levels of existing congestion. By allowing unconstrained growth to occur at such locations, any evaluation would effectively ignore the fact that road users would choose an alternative route/different travel time to avoid a particularly heavily congested location. Rather than cap growth and/or delays at locations, (which would involve process complications), whilst still seeking to derive longer term benefits over 30 years, the travel speeds, total delay and total travel distance values that help derive costs for Year 30 have been assumed to be the same as in Year 15.

Travel Time and Vehicle Operating Costs vary by time of day and day of week. For the evaluation, data is required for either a day long period; or for the weekday morning (AM), inter and evening (PM) peak periods. Off peak, weekend peak and weekend off peak time period data is forecast using the inter-peak model results multiplied by a flow factor. Typically, for intersections and congested mid-block sections, the full range of time periods will be required rather than using a day long period. (However, in some cases, it may be permissible to model mid-block over a day long period only.)

Base Date

It should be noted for future updating of these guidelines that the base date used to identify dollar values the various benefits has been fixed at 01/07/2022.

3.4.2 Intangible Benefits

Intangible benefits are assessed against the following criteria:

- Public Transport – related to the extent the proposed improvements assist public transport movements;
- Walking – related to the extent the proposed improvements assist walking;
- Cycling – related to the extent the proposed improvements assist cycling;
- Street Lighting – related to the extent street lighting has been provided to assist safety and personal security; and
- Road Safety – related to the extent that the proposed measures maintain or improve future road safety where minimal existing road safety problems exist.

3.5 Assessment Process

3.5.1 Assessment Spreadsheet Data Entry

Throughout the assessment spreadsheet, a number of fields have been fixed, whilst other 'inputs' into the evaluation are automatically calculated based on original evaluator inputs. In general, those cells with:

- An <u>orange background require data to be entered</u>;
- A <u>red background is a drop down menu with a input to be chosen</u>; and
- A <u>light grey background with orange text is an automatically calculated value</u>.

Depending upon the project type component (mid-block or intersection) and time period analysed, non-applicable cells within the spreadsheet will be 'greyed-out'. Only those cells with an orange or red background will be capable of having data entered.

3.5.2 Work Sheets

The following worksheets set out in Table 3.1 need to be completed for each element of the project. Sections 4 to 10 provide a step-by-step process to complete each of the Worksheets. Each Worksheet should be completed in numerical order.

Table 3.1 Worksheets within the Spreadsheet (see Tabs at bottom of Spreadsheet)

Worksheet	Description
1	Project Description (Section 4)
2	Cost of Do Minimum (Section 5)
3	Cost of Option (Section 6)
4	Travel Time (TT) cost savings (Section 7.1)
5	Vehicle Operating Cost (VOC) savings (Section 7.2)
6	Crash Cost savings (Section 7.3)
7	Intangible Benefits (Section 8)
8	Overall Score and Rating (Section 9)
-	Project Summary (Section 10)

3.5.3 Overall Element Rating

The Overall Rating Score is obtained through a combination of the tangible benefits (relative to cost) and intangible benefits.

The Present Value of the net unconstrained benefits are divided by the net costs to produce a ratio of unconstrained benefits to cost, with a maximum score of 50 permissible. Similarly, a maximum score of 50 can be obtained for the intangible benefits.

Due the importance of the ratio of unconstrained benefits to cost compared to the intangible benefits, a 75/25 weighting has been applied to the scores of the above respectively. Once this weighting has been applied, the scores are summed together to obtain the overall rating for the element/project type (i.e. intersection or midblock).

3.5.4 Combining Intersection/Midblock Elements for a Route Improvement

As indicated in Section 3.2, route improvements comprising of a combination of mid-block and intersection improvements can be undertaken utilising individual link and/or node improvements. In each instance, individual elements forming a longer route improvement will need their specific components relating to project costs and benefits to be identified and separated out in order to determine the ratio of unconstrained benefits to cost as well as the intangible benefits scores.

As part of this process of combining intersection and mid-block improvement, it will be necessary to ensure that the base time periods used for the evaluation (AM/Inter/PM peak or all day) are the same for both intersection and mid-block sections.

For each element (midblock or intersection) making up the route, list the element and associated ratings, sum the ratings and calculate the average to determine the overall route score.

3.6 Before You Get Started - Required Data/Information

Prior to undertaking the evaluation, assessors should collate the following information to assist with the process:

- Confirm that the project meets strategic requirements according to documented future needs;
- Obtain any necessary Agreements in Principle from affected stakeholders;
- For a route assessment, split the route into intersections and mid-block lengths;
- Determine the road class and speed limit;
- Obtain forecast daily traffic volumes from Main Roads WA Regional Operations Model (ROM) for 2021 and 2036;
- Obtain annual and periodic maintenance costs along with any operating costs (broken down by intersection and midblock lengths as appropriate);
- Determine the Option cost (broken down by intersections and mid-block lengths as appropriate);
- Obtain AM, Inter and PM Peak (and daily if appropriate) traffic flows for mid-block sections and turning movements for intersections;
- For intersections, undertake a SIDRA analysis of the Do Minimum and Option for existing and stipulated future years (2, 8 and 15) and obtain Summary Outputs;
- Identify the street light/luminaire type for your area as well as existing numbers;
- Establish crash numbers and reductions using Main Roads WA Crash Analysis Reporting System (CARS); and
- Identify any public transport, walking, cycling, street lighting and road safety measures.

WORKSHEETS

4 Project Description

Worksheet 1 provides a summary of the general data used for the evaluation and the analysis results. The listed points below are to be read in conjunction with **Worksheet 1 – Evaluation Summary** print out shown at the end of this section.

1 Applicant's Details

- Enter the name of the Local Authority or organisation making the submission.
- Provide the MRRG or Local Authority reference number/details (as appropriate).
- Enter the name and position of the person undertaking the assessment.
- Enter the name and position of the person reviewing the assessment.

2 Project Overview

- Provide the overall project name including details of its extent (e.g. from intersection to intersection).
- Select whether the particular individual site being evaluated is a midblock or intersection (from the drop-down menu). Note: as indicated previously, individual midblock and/or intersections need to be evaluated separately as part of a route improvement.
- Provide details of the mid-block or intersection under consideration e.g. names of intersecting roads or mid-block section between specified intersections
- Select the road type from the dropdown menu. For intersections, use the higher road type.

3 Problem Description

- Provide a general description of the problem/issue with the existing route, midblock or intersection, including evidence of any community support – for instance if consultation has been undertaken with respect to the raised concerns and/or the identified proposed improvements.

4 Location Details

- Provide a location reference of the site; attach a location map if necessary to the submission document.

5 Project Strategic Alignment

- Provide specific details (document and page number) relating to the proposed projects alignment to state/regional/local strategies and policies – see Section 2.1. A copy of the relevant page(s) of the supporting documentation should be attached to the hard copy of the Submission.

6 Project Details

- Describe the Do Minimum. This is usually the lowest cost option to maintain the road midblock or intersection, e.g. routine and periodic maintenance.
- Describe the options considered/assessed to improve the problem and how the preferred option will improve the current situation ahead of other options.

<u>For MIDBLOCK lengths only</u>:

- Enter the length for the Do Minimum and Option.
- Enter the total number of traffic lanes (both directions) for the Do Minimum and Option.

- From the drop down menu, enter the location context of the Do Minimum and Option:
  - Rural: very high speed roads with speed limit/operational speeds in excess of 70km/h and very low levels of adjacent roadside development with minimal pedestrian activity;
  - Semi-rural: high speed roads with speed limits/operational speeds typically in the order of 70km/h and low to medium levels of adjacent roadside development with limited pedestrian activity depending on the location;
  - Sub-urban: roads with speed limits/operational speeds typically in the order of 60km/h and medium to high levels of adjacent roadside development in built-up areas with pedestrian activity expected; and
  - Urban: roads with speed limits/operational speeds typically in the order of 50km/h and very high levels of adjacent roadside development in built-up areas with higher levels of pedestrian activity.
- From the drop down menu, enter the prevailing speed limit for the Do Minimum and Option.

7 *Construction Details*

For the economic evaluation, the construction start date is assumed to be the 1 July of the financial year in which the activity is submitted for a commitment to funding. Time zero is the date all benefits and cost are to be discounted to. As an example, an activity submitted for funding in the financial year 2015/16, time zero would be 1st July 2015. When projects are being re-submitted for funding, time zero should be updated to reflect the financial year the work is committed for. For the purposes of the simplified evaluation procedures, construction duration has been fixed at 12 months.

- Enter the date of the assumed Time Zero.

8 Time Frame Information

- Enter the date of the evaluation process.

9 Traffic Growth

To provide a consistent approach to forecasting traffic growth, whilst recognising different parts of the Metropolitan area will have different rates of growth and development, traffic data should be obtained from the Main Roads WA Regional Operations Model (ROM) for forecast daily traffic volumes on the roads under consideration. For intersections, traffic volumes along the main road/route under consideration should be used as the basis for calculating traffic growth.

- Enter daily traffic volumes from ROM for 2016.
- Enter daily traffic volumes from ROM for 2031.
- Annual geometric traffic growth between 2016 and 2031 will be calculated automatically.

For new roads, a request should be made to Main Roads WA to create a new link within ROM in order to determine forecast traffic volumes in 2016 and 2031 as a result of traffic re-assignment to the new link, with subsequent traffic growth calculated in the same way as above.

Worksheet 1 - Project Description

1 Applicant's Details

Organisation Name	WA Metro City
MRRG Reference	MRRG1
Assessor(s) name and position	Joe Royle
Reviewer(s) name and position	Earl Barratt

Legend
- *Calculated value*
- *Free-text user input*
- *Dropdown selection*

2 Project Overview

Project Name	Metro Street Upgrade between Summer Road and Winter Lane
Project Type	Mid-block/mid-block as part of route improvement
Mid-block section/intersection under consideration	Summer Road to Tyne Street
Road Type	District Distributor A

3 Problem Description

Describe issue/problems to be addressed	Extensive congestion along Metro Street due to limited capacity at both intersections and narrow, single lane mid-block sections. Footpath on one side only. Business community have lobbied for upgrade and preferred option developed following consultation.

4 Location Details

Brief description of location	Midblock section along Metro Street between Judd Street and McParlane Street

5 Project Strategic Alignment — Yes

Justification	Upgrade identified in the Strategic Community Plan (page 34), local planning strategy (Section 3) and forms part of Local Bike Plan

6 Project Details

Describe the do-minimum	Existing alignment/intersection arrangements with continued maintainance
Summarise options assessed	Improved intersection measures plus widening of mid-block lengths and shared path

	Do Minimum	Option	
Length	1.00	1.00	*km*
Total number of traffic lanes	2.00	2.00	
Urban/rural	Urban Road	Urban Road	
Speed limit	60.00	60.00	*km/h*

7 Construction Details

Time zero	1/07/2012	*(dd/mm/yyyy)*

8 Time Frame Information

Date of economic evaluation	1/06/2013	*(dd/mm/yyyy)*

9 Traffic Growth

ROM daily traffic flow 2016	1000	*vehicles per day*
ROM daily traffic flow 2031	2000	*vehicles per day*
Annual geometric traffic growth	4.73%	

5 Do Minimum Cost

Worksheet 2 is used to calculate the Present Value (PV) cost of the Do Minimum. The Do Minimum is the lowest level of expenditure necessary to keep a road midblock or intersection open, and generally consists of maintenance work. The listed points below are to be read in conjunction with the **Worksheet 2 – Cost of the Do Minimum** screen print out at the end of this Section. Details of the equations and calculations used to determine the Present Value Do Minimum costs can be found in Appendix B.

1 Road Type

- The road type for the project will be automatically copied from **Worksheet 1**.

2 Present Value of Annual Maintenance Costs

- Enter the annual maintenance costs. These maintenance costs relate to routine costs such as potholing rather than periodic rehabilitation – which are captured separately (see Step 3 below). If typical annual maintenance costs for the intersection or mid-block are not known, enter zero.
- The PV of the annual maintenance costs will be calculated automatically.

3 Present Value of Periodic Maintenance Costs

- The proposed rehabilitation treatment measure for the issue will be filled in automatically depending upon the road type selected e.g. District Distributor A/B – 40mm SMA Overlay.
- Enter the site treatment area in square metres (from SLK to SLK).
- The rehabilitation cost will be calculated automatically based on the treatment type and area.
- The years and cost for periodic maintenance will be filled in automatically based on the road type selected (e.g. District Distributor A/B: every 15 years over the 30 year period).
- The PV of the periodic maintenance costs for relevant years will be calculated automatically.
- The sum of the PV of the periodic maintenance costs will be calculated automatically.

4 Present Value of Annual Associated Operating Costs

Operating cost includes elements such as power costs to run street lighting for a mid-block or signalised intersection. They are any costs that are incurred in day-to-day operations that are not considered part of a maintenance costs and are costs that would likely be billed by a supplier to operate. It is reasonable to have the operational cost at zero if there is no operating cost, or if they are common in the Do Minimum and option - as they will cancel each other out. It is therefore only to be included if there are particular operating saving opportunities (i.e. reduction or increase in lighting in the option).

- Select the appropriate Western Power tariff code and wattage that is appropriate for the luminaires (street lights) - within drop down menu.
- Enter the number of luminaires (street lights) that currently exist within the study section.
- Enter the number of days the luminaries (street lights) are lit for (usually 365).
- The total annual operating cost will be calculated automatically based on the supplied data.
- The PV of the total operating costs will be calculated automatically.

5 Present Value of Do Minimum Maintenance Costs

- The total PV of the maintenance costs for the Do Minimum will be calculated automatically using the present values of the annual and periodic maintenance as well as operating costs.

Worksheet 2 - Cost of the Do-minimum

1	**Road Type**	District Distributor A	

2	**PV of annual maintenance costs**		
	$12,000.00	*x 11.7023*	$140,427.60 **(a)**

3 PV of periodic maintenance costs

Proposed Rehab treatment measure	40mm SMA overlay
Rehab treatment cost	$21.50
Site treatment area (from SLK to SLK)	10000.00 *m2*
Rehab cost	$215,000.00

Periodic maintenance will be required in the following years:

Year	Type of Maintenance	Required?	Estimated Cost	SPPWF	PV
5	40mm SMA overlay	N/A	$215,000.00	0.680	N/A
10	40mm SMA overlay	N/A	$215,000.00	0.464	N/A
15	40mm SMA overlay	Yes	$215,000.00	0.320	$68,800.00
20	40mm SMA overlay	N/A	$215,000.00	0.210	N/A
25	40mm SMA overlay	N/A	$215,000.00	0.150	N/A
30	40mm SMA overlay	Yes	$215,000.00	0.100	$21,500.00

Sum of PV maintenance $90,300.00 **(b)**

4 PV of annual associated operating cost

Luminaire Type	ZE02C - 80W
Number of luminaires within study section	50 *units*
Number of days luminaires are lit	365 *days*
Total operating cost	$7,221.85

PV of total operating cost

$7,221.85 *x 11.7023* $84,512.30 **(c)**

5 PV total Do-minimum maintenance costs

(a) + (b) + (c) $315,239.90 **A**

6 Option Cost

Worksheet 3 is used to calculate the PV cost of the proposed option. The option cost includes capital expenditure cost, future maintenance cost and operational costs. This essentially will calculate the whole life cost of the option for the analysis period. The listed points below are to be read in conjunction with **Worksheet 3 – Cost of the Option** screen print out at the end of this Section. Details of the equations and calculations used to determine the Present Value Option costs can be found in Appendix C.

1 Road Type

- The road type for the project will be automatically copied from **Worksheet 1**.

2 Present Value of Project Construction

- Enter the capital costs (see Section 3.3 of these Guidelines) of the proposed option. <u>The option cost is to be estimated separately on an estimate sheet that should be attached to the hard copy of the Submission.</u>
- The PV of the Option cost will be calculated automatically.

3 Present Value of Routine Maintenance Costs

- Enter the routine maintenance costs. These maintenance costs relate to routine costs such as potholing rather than periodic rehabilitation – which are captured separately (see step 5 below). If typical annual maintenance costs for the intersection or mid-block are not known, enter zero.
- The PV of the annual maintenance costs will be calculated automatically.

4 Present Value of Maintenance Cost in Year 1

- The PV of maintenance cost in Year 1 will be automatically completed based on data in Work Sheet 2 for the Do Minimum maintenance strategy, as this is assumed to be the year that the proposed option works are carried out.

5 Present Value of Periodic Maintenance Costs

- The proposed rehabilitation treatment measure for the issue will be filled in automatically depending upon the road type selected e.g. District Distributor A/B – 40mm SMA Overlay $21.50.
- Enter the site treatment area in square metres (from SLK to SLK).
- The rehabilitation cost will be calculated automatically based on the cost treatment type and area.
- The years and cost for periodic maintenance will be filled in automatically based on the road type selected (e.g. District Distributor A/B: every 15 years over the 30 year period).
- The PV of the periodic maintenance costs for relevant years will be calculated automatically.
- The sum of the PV of the periodic maintenance costs will be calculated automatically.

6 Present Value of Annual Associated Operating Costs

Operating cost includes elements such as power costs to run lighting for a mid-block or signalised intersection. They are any costs that are incurred in day-to-day operations that are not considered part of a maintenance costs and are costs that would likely be billed by a supplier to operate. It is reasonable to have the operational cost at zero if there is no operating cost, or if they are common in the Do Minimum and option - as they will cancel each other out. It is therefore only to be included if there are particular operating saving opportunities (i.e. reduction or increase in lighting in the option).

- Select the appropriate Western Power tariff code and wattage that is appropriate for the luminaires (street lights) - within drop down menu.
- Enter the number of luminaires (street lights) that are proposed (existing and/or new) within the study section.
- Enter the number of days the luminaries (street lights) are lit for (usually 365).
- The total annual operating cost will be calculated automatically based on the supplied information.
- The PV of the total operating costs will be calculated automatically.

7 *Present Value of Do Minimum Maintenance Costs*

- The total PV of the maintenance costs for the Do Minimum will be calculated automatically using the present values of the proposed project cost, plus routine, Year 1 and periodic maintenance as well as operating costs.

Worksheet 3 - Cost of the Option

1 Road Type — District Distributor A

2 PV of estimated cost of proposed work (as per attached estimate sheet)

$15,000.00 x 0.9259 — $13,888.50 (a)

3 PV of routine maintenance costs following completion of the work

$15,000.00 x 10.7398 — $161,097.00 (b)

4 PV of maintenance cost in year 1

$128,877.60 (c)

5 PV of Option periodic maintenance cost

Proposed Rehab treatment measure	40mm SMA overlay
Rehab treatment cost	$21.50
Site treatment area (from SLK to SLK)	400.00 m2
Rehab cost	$8,600.00

Periodic maintenance will be required in the following years:

Year	Type of Maintenance	Required?	Estimated Cost	SPPWF	PV
5	40mm SMA overlay	N/A	$8,600.00	0.680	N/A
10	40mm SMA overlay	N/A	$8,600.00	0.464	N/A
15	40mm SMA overlay	Yes	$8,600.00	0.320	$2,752.00
20	40mm SMA overlay	N/A	$8,600.00	0.210	N/A
25	40mm SMA overlay	N/A	$8,600.00	0.150	N/A
30	40mm SMA overlay	Yes	$8,600.00	0.100	$860.00

Sum of PV maintenance — $3,612.00 (d)

6 PV of Annual associated operating cost

Luminaire Type	ZE02C - 80W
Number of Luminaires within study section	50 units
Number of days luminaires are lit	365 days
Total operating cost	$7,625.95

PV of annual operating costs (separate to maintenance costs)

Total $7,625.95 x 10.7398 — $81,901.12 (e)

7 PV total costs of the preferred option

(a)+(b)+(c)+(d)+(e) — $389,376.22 B

7 Tangible Benefit Procedure

Tangible benefits are assessed against the following criteria:

- Travel Time Cost savings – whether the project results in vehicles travelling through the mid-block or intersection more quickly due to shorter distances or less delays compared to the Do Minimum;

- Vehicle Operating Cost savings – whether the project results in improved vehicle operating costs and lower CO2 emissions compared to the Do Minimum; and

- Crash Cost savings – does the project result in additional road safety due to the proposed improvements compared to the Do Minimum.

Worksheets 4, 5 and 6 should be utilised to assess each Option against the above tangible criteria. Details of the equations and calculations used to determine the Present Value cost savings for each of the tangible benefits can be found in Appendix D.

7.1 Travel Time Costs

Travel Time Cost (TTC) benefits relate to those time savings as a result of reduced travel distances and/or less congestion. **Worksheet 4** is used to calculate the PV of Travel Time Cost savings from midblock and intersection improvements. The listed points below are to be read in conjunction with the **Worksheet 4 – Travel time Cost Savings** screen print out at the end of this Section.

Required inputs for travel time cost calculations vary according to whether the assessment is for a mid-block section or an intersection.

- For midblock modelling, the calculation uses data related to mid-block vehicle speeds, traffic volume and section length.

- For intersections, the calculation primarily uses SIDRA Intersection Summary outputs related to a vehicle's Control Delay (Total) as an external input into the process.

INTERSECTION SUMMARY — **Site: 2011 AM Peak Opt B5**

SH6 Boyce Street AM Peak Opt B5
29.08.11 Revised Forecast Flows
Signals - Fixed Time Cycle Time = 40 seconds (Optimum Cycle Time - Minimum Delay)

Intersection Performance - Hourly Values

Performance Measure	Vehicles	Persons
Demand Flows (Total)	1596 veh/h	1915 pers/h
Percent Heavy Vehicles	4.9 %	
Degree of Saturation	0.515	
Practical Spare Capacity	74.6 %	
Effective Intersection Capacity	3097 veh/h	
Control Delay (Total)	5.49 veh-h/h	6.59 pers-h/h
Control Delay (Average)	12.4 sec	12.4 sec
Control Delay (Worst Lane)	24.9 sec	
Control Delay (Worst Movement)	24.9 sec	24.9 sec
Geometric Delay (Average)	3.0 sec	
Stop-Line Delay (Average)	9.4 sec	
Level of Service (Aver. Int. Delay)	LOS B	
Level of Service (Worst Movement)	LOS C	
Level of Service (Worst Lane)	LOS C	

7.1.1 Intersections

1 Road Type

- Select the road type for the project – automatically copied from **Worksheet 1**.

2 Project Type

- Select the project type for the project – automatically copied from **Worksheet 1**.

3 Modelling Period

- From the drop down menu, select the morning (AM)/Inter-Peak (IP)/evening (PM) peak modelling periods. (All Day modelling periods should not be used for intersections.)

4 Traffic Volumes

- Not required for Intersections.

5B and 6B Control Delay

- Model the intersection performance for the Do Minimum for Time Zero in SIDRA and apply the growth factor to the modelling in SIDRA for Years 2, 8 and 15. The SIDRA outputs should be attached to the hard copy of the Submission.
- Enter the SIDRA modelling Control Delay (Total) from the Intersection Summary output (see above) for the Do Minimum for the weekday AM/Inter/PM peak periods for the Years 2, 8 and 15. Weekday off-peak and weekend results, along with Year 30 data will be automatically entered based on the supplied data.
- Model the intersection performance for the Option for Time Zero in SIDRA and apply the growth factor to the modelling in SIDRA for Years 2, 8 and 15. The SIDRA outputs should be attached to the hard copy of the Submission.
- Enter the SIDRA modelling Control Delay (Total) from the Intersection Summary output (see above) for the Option for the weekday AM/Inter/PM peak periods for the Years 2, 8 and 15. Weekday off-peak and weekend results, along with Year 30 data will be automatically entered based on the supplied data.

5D and 6D Annual Travel Time

- Annual travel time will be automatically calculated based on the Control Delay, travel time periods and Travel Time Costs for each time period and future years.

7, 8 and 9 PV Travel Time Cost Savings (C)

- The TTC midpoint values for the Do Minimum and Option will be automatically calculated by averaging the TTC at the start and end of each of the four modelled periods.
- The mid-point benefits will be automatically calculated by subtracting Option TTC midpoint from the Do Minimum TTC midpoint to obtain m1, m2 and m3.
- The PV Travel Time Cost savings will be automatically calculated.

7.1.2 Mid-Block Sections

1 Road Type

- The road type for the project will be automatically copied from **Worksheet 1**.

2 Project Type

- The project type for the project will be automatically copied from **Worksheet 1**.

3 *Modelling Period*

- From the drop down menu, select the morning (AM)/Inter-Peak (IP)/evening (PM) peak or All Day modelling periods. (If the mid-block section is part of a route assessment including intersections, then the AM/Inter/PM peak modelling period should be used for consistency along the route.)

4 *Traffic Volumes*

- For both the Do Minimum and Option (for midblock sections only), enter the total two-way traffic flow along the length under consideration at Time Zero for each of the AM/Inter/PM peak periods (vehicles per hour); or the average daily traffic for a day long period.
- Traffic volumes will be automatically calculated for the four future assessment years using this data as well as for the weekday off-peak and weekend periods.

5C and 6C *Control Delay*

- Midblock Control Delays will be automatically calculated based on the traffic volumes, project length and forecast vehicle speeds (related to traffic flow) for each time period and future years.

5D and 6D *Annual Travel Time*

- Annual travel time will be automatically calculated based on the Control Delay, travel time periods and Travel Time Costs for each time period and future years.

5E and 6E *Annual Travel Time*

- Midblock Control Delays and annual travel time will be automatically calculated using the time Zero daily traffic volumes if the day long modelling period has been chosen.

7, 8 and 9 *PV Travel Time Cost Savings (C)*

- The annual TTC for the Do Minimum and Option will be automatically transposed.
- The TTC midpoint values for the Do Minimum and Option will be automatically calculated by averaging the TTC at the start and end of each of the four modelled periods.
- The mid-point benefits will be automatically calculated by subtracting Option TTC midpoint from the Do Minimum TTC midpoint to obtain m1, m2 and m3.
- The PV Travel Time costs savings will be automatically calculated.

Worksheet 4 - Travel Time Cost Savings

1	Road Type	District Distributor A
2	Project Type	Mid-block/mid-block as part of route improvement
3	Modelling Period Type	AM / PM peak periods
4	Midblock Assessment - Traffic Volumes	

	DO MINIMUM					OPTION				
	Time Zero (veh/hr)	Year 2	Year 8	Year 15	Year 30	Time Zero (veh/hr)	Year 2	Year 8	Year 15	Year 30
AM Peak	1700	1865	2460	3400	3400	1700	1865	2460	3400	3400
Interpeak	1000	1097	1447	2000	2000	1000	1097	1447	2000	2000
PM Peak	1800	1974	2605	3600	3600	1800	1974	2605	3600	3600
AADT All periods	17520	19216	25356	35040	35040	17520	19216	25356	35040	35040

5	Do-minimum Modelling																		
	5A Project Timings from Annualisation Factors					5B Isolated Intersection				5C Road Midblock Improvement				5D Annual Travel Time Cost ($/year)					
			Time Periods		TTC	Modelling Results Inputs (veh.hr/hr)				Modelling Results Inputs (veh.hr/hr)									
	Time Period	Flow Factor	hours/day	days/year	TTC Table 6 ($/hr)	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30		
	Weekday AM Peak	1	2	245	$22.54	2.43	3.77	14.60	14.60	24.49	32.32	44.69	44.69	$270,451.07	$356,963.34	$493,601.62	$493,601.62	(a)	
	Weekday Interpeak	1	8	245	$27.01	1.96	2.59	5.22	5.22	24.48	32.31	44.65	44.65	$1,295,961.26	$1,710,227.85	$2,363,886.33	$2,363,886.33	(b)	
	Weekday PM Peak	1	2	245	$22.30	3.73	6.10	14.59	14.59	24.49	32.32	44.69	44.69	$267,571.38	$353,162.49	$488,345.88	$488,345.88	(c)	
	Weekday Off Peak	0.25	12	245	$22.91	0.49	0.65	1.31	1.31	3.60	4.75	6.56	6.56	$242,424.72	$319,888.21	$442,073.14	$442,073.14	(d)	
	Weekend Peak	0.45	8	120	$25.55	0.88	1.17	2.35	2.35	6.48	8.55	11.82	11.82	$158,914.29	$209,697.41	$289,803.79	$289,803.79	(e)	
	Weekend Off Peak	0.15	16	120	$24.80	0.29	0.39	0.78	0.78	2.16	2.85	3.94	3.94	$102,824.65	$135,679.63	$187,501.19	$187,501.19	(f)	
5E	All periods	N/A	24	365	$25.70	10	10	10	10	10.51	13.87	19.17	19.17	$2,366,379.80	$3,122,691.90	$4,315,857.29	$4,315,857.29	(g)	
	(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)	(V)	(W)	(X)	(Y)	$2,338,147.38	$3,085,618.94	$4,265,211.94	$4,265,211.94	Total for All Day Periods	
														$2,366,379.80	$3,122,691.90	$4,315,857.29	$4,315,857.29	Total for Day Long	

6	Option Modelling																		
	6A Project Timings from Annualisation Factors					6B Isolated Intersection				6C Road Midblock Improvement				6D Annual Travel Time Cost ($/year)					
			Time Periods		TTC	Modelling Results Inputs (veh.hr/hr)				Modelling Results Inputs (veh.hr/hr)									
	Time Period	Flow Factor	hours/day	days/year	TTC Table 4.2 ($/hr)	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30		
	Weekday AM Peak	1	2	245	$22.54	2.49	2.94	3.94	3.94	23.35	30.87	43.72	43.72	$257,884.31	$340,897.50	$482,891.92	$482,891.92	(a)	
	Weekday Interpeak	1	8	245	$27.01	2.19	2.58	3.43	3.43	23.31	30.79	42.58	42.58	$1,234,248.82	$1,629,870.77	$2,254,339.39	$2,254,339.39	(b)	
	Weekday PM Peak	1	2	245	$22.30	3.23	3.87	5.46	5.46	23.35	30.87	43.72	43.72	$255,138.43	$337,267.71	$477,750.22	$477,750.22	(c)	
	Weekday Off Peak	0.25	12	245	$22.91	0.55	0.65	0.86	0.86	3.43	4.52	6.25	6.25	$230,880.68	$304,655.44	$421,022.04	$421,022.04	(d)	
	Weekend Peak	0.45	8	120	$25.55	0.99	1.16	1.54	1.54	6.17	8.14	11.25	11.25	$151,346.95	$199,711.82	$276,003.61	$276,003.61	(e)	
	Weekend Off Peak	0.15	16	120	$24.80	0.33	0.39	0.51	0.51	2.06	2.71	3.75	3.75	$97,928.24	$129,218.70	$178,572.56	$178,572.56	(f)	
6E	All periods	N/A	24	365	$25.70	10	10	10	10	10.01	26.42	36.51	36.51	$2,253,695.05	$5,947,984.58	$8,220,680.56	$8,220,680.56	(g)	
	(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)	(V)	(W)	(X)	(Y)	$2,227,427.44	$2,941,621.94	$4,090,579.74	$4,090,579.74	Total for All Day Periods	
														$2,253,695.05	$5,947,984.58	$8,220,680.56	$8,220,680.56	Total for Day Long	

7	Annual Travel Time Cost for Modelled Years					

	Annual Travel Time Cost ($/year) for modelled years					
	Start Year 2	End Year 7	Start Year 8	End Year 14	Start Year 15	End Year 30
Travel Time Cost Do-minimum	$2,338,147.38	$3,085,618.94	$3,085,618.94	$4,265,211.94	$4,265,211.94	$4,265,211.94
Travel Time Cost Option	$2,227,427.44	$2,941,621.94	$2,941,621.94	$4,090,579.74	$4,090,579.74	$4,090,579.74
Midpoint at end of year	Year 4		Year 11.5		Year 22	
Duration Years	6		7		16	
Do-minimum TTC at midpoint	$2,711,883.16		$3,675,415.44		$4,265,211.94	
Option TTC at midpoint	$2,584,524.69		$3,516,100.84		$4,090,579.74	
8 *Midpoint Benefits*	$127,358.47		$159,314.60		$174,632.20	
	m1		m2		m3	

9	PV Travel Time Cost Savings	
[(m1 x 6 x 0.7416) + (m2 x 7 x 0.4511) + (m3 x 16 x 0.1958)]	$1,616,849.73	C

7.2 Vehicle Operating Costs and CO2

Vehicle Operating Costs (VOC) are those incurred by motorists due to fuel and vehicle deterioration costs. Such costs are primarily a function of road gradients, surface roughness, vehicle operating speed, and vehicle kilometres travelled (although for the purposes of this simplified procedure, gradient and surface roughness are not used in this instance). The purpose of this Guideline, VOC also includes a component for CO_2 costs, which typically make up 4% of VOC. For simplicity however, the term VOC has been used to mean both sets of costs.

Required inputs for Vehicle Operating Cost calculations vary according to whether the assessment is for a mid-block section or an intersection:

- For midblock modelling, the calculation uses data related to mid-block vehicle speeds, traffic volume and section length.
- For intersections, the calculation primarily uses SIDRA Intersection Summary outputs related to a vehicle's Travel Distance (Total) and Travel Speed as an external input into the process.

INTERSECTION SUMMARY **Site: 2011 AM Peak Opt B5**

SH6 Boyce Street AM Peak Opt B5
29.08.11 Revised Forecast Flows
Signals - Fixed Time Cycle Time = 40 seconds (Optimum Cycle Time - Minimum Delay)

Intersection Performance - Hourly Values

Performance Measure	Vehicles	Persons
Demand Flows (Total)	1596 veh/h	1915 pers/h
Percent Heavy Vehicles	4.9 %	
Degree of Saturation	0.515	
Practical Spare Capacity	74.6 %	
Effective Intersection Capacity	3097 veh/h	
Control Delay (Total)	5.49 veh-h/h	6.59 pers-h/h
Control Delay (Average)	12.4 sec	12.4 sec
Control Delay (Worst Lane)	24.9 sec	
Control Delay (Worst Movement)	24.9 sec	24.9 sec
Geometric Delay (Average)	3.0 sec	
Stop-Line Delay (Average)	9.4 sec	
Level of Service (Aver. Int. Delay)	LOS B	
Level of Service (Worst Movement)	LOS C	
Level of Service (Worst Lane)	LOS C	
95% Back of Queue - Vehicles (Worst Lane)	3.8 veh	
95% Back of Queue - Distance (Worst Lane)	26.6 m	
Total Effective Stops	1024 veh/h	1229 pers/h
Effective Stop Rate	0.64 per veh	0.64 per pers
Proportion Queued	0.69	0.69
Performance Index	41.4	41.4
Travel Distance (Total)	919.3 veh-km/h	1103.2 pers-km/h
Travel Distance (Average)	576 m	576 m
Travel Time (Total)	24.3 veh-h/h	29.1 pers-h/h
Travel Time (Average)	54.7 sec	54.7 sec
Travel Speed	37.9 km/h	37.9 km/h

7.2.1 Intersections

1. Road Type

- The road type for the project will automatically copied from **Worksheet 1**.

2. Project Type

- The project type for the project will be automatically copied from **Worksheet 1**.

3. Modelling Period

- From the drop down menu, select the morning (AM)/Inter-Peak (IP)/evening (PM) peak modelling periods. (All Day modelling periods should not be used for intersections.)

4 and 5 MIDBLOCK ONLY: Traffic Volumes

- Not required for Intersections

6 and 7 Vehicle Speeds and VOC – Do Minimum

- Model the intersection performance for the Do Minimum for Time Zero in SIDRA and apply the growth factor to the modelling in SIDRA for Years 2, 8 and 15. The SIDRA outputs should be attached to the hard copy of the Submission.
- Enter the SIDRA modelling Travel Distance (Total) and Travel Speed data from the Intersection Summary outputs in Tables 6A and 6C respectively (see above) for the Do Minimum for the weekday AM/Inter/PM peak periods for the Years 2, 8 and 15. Weekday off-peak and weekend results, along with Year 30 data will be automatically entered based on the supplied data. The minimum permitted travel speed that can be entered is 10km/h - any value less than this will be highlighted and users will be requested to enter 10km/h instead of the SIDRA output value.
- VOC (cents/km) and Annual VOC will be automatically calculated based on entered data.

8 and 9 ***Vehicle Speeds and VOC – Option***

- Model the intersection performance for the Option for Time Zero in SIDRA and apply the growth factor to the modelling in SIDRA for Years 2, 8 and 15. The SIDRA outputs should be attached to the hard copy of the Submission.
  - Enter the SIDRA modelling Travel Distance (Total) and Travel Speed data from the Intersection Summary outputs in Tables 8A and 8C respectively (see above) for the Option for the weekday AM/Inter/PM peak periods for the Years 2, 8 and 15. Weekday off-peak and weekend results, along with Year 30 data will be automatically entered based on the supplied data. The minimum permitted travel speed that can be entered is 10km/h - any value less than this will be highlighted and users will be requested to enter 10km/h instead of the SIDRA output value.
- VOC (cents/km) and Annual VOC will be automatically calculated based on entered data.

10, 11 and 12 Present Value of Vehicle Operating Costs

- The annual VOC for the Do Minimum and Option will be automatically transposed.
- The VOC midpoint values for the Do Minimum and Option will be automatically calculated by averaging the VOC at the start and end of each of the four modelled periods
- The mid-point benefits will be automatically calculated by subtracting Option VOC midpoint from the Do Minimum VOC midpoint to obtain m1, m2 and m3.
- The PV Vehicle Operating Cost savings will be automatically calculated.

7.2.2 Mid-Block Sections

1 Road Type

- Select the road type for the project – automatically copied from **Worksheet 1**.

2 Project Type

- Select the project type for the project – automatically copied from **Worksheet 1**.

3 Modelling Period

- From the drop down menu, select the morning (AM)/Inter-Peak (IP)/evening (PM) peak or All Day modelling periods. (If the mid-block section is part of a route assessment including intersections, then the AM/Inter/PM peak modelling period should be used for consistency along the route.)

4 and 5 MIDBLOCK ONLY: Traffic Volumes

- Traffic volumes for different modelling periods and future years will be automatically copied from Worksheet 4 for both the Do Minimum and Options.

6 and 7 Vehicle Speeds and VOC – Do Minimum

- The mean speed will be calculated automatically based on previously entered data relative to the traffic flow in Table 6B for the Do Minimum for the weekday AM/Inter/PM peak or All Day modelling periods for the Years 2, 8 and 15. Similarly, weekday off-peak and weekend results, along with Year 30 data will be automatically entered based on the supplied data.
- The total travel distance will be calculated automatically based on previously entered data relative to the traffic flow and midblock length in Table 6D for the Do Minimum for the weekday AM/Inter/PM peak or All Day modelling periods for the Years 2, 8 and 15. Similarly, weekday off-peak and weekend results, along with Year 30 data will be automatically entered based on the supplied data. The minimum permitted travel speed that can be entered for mid-block sections is 10km/h – any value less than this will be automatically increased to 10km/h.
- VOC (cents/km) and Annual VOC will be automatically calculated based on entered data.

8 and 9 ***Vehicle Speeds and VOC – Option***

- The mean speed will be calculated automatically based on previously entered data relative to the traffic flow in Table 8B for the Option for the weekday AM/Inter/PM peak or All Day modelling periods for the Years 2, 8 and 15. Similarly, weekday off-peak and weekend results, along with Year 30 data will be automatically entered based on the supplied data.
- The total travel distance will be calculated automatically based on previously entered data relative to the traffic flow and midblock length in Table 8D for the Option for the weekday AM/Inter/PM peak or All Day modelling periods for the Years 2, 8 and 15. Similarly, weekday off-peak and weekend results, along with Year 30 data will be automatically entered based on the supplied data. The minimum permitted travel speed that can be entered for mid-block sections is 10km/h – any value less than this will be automatically increased to 10km/h.
- VOC (cents/km) and Annual VOC will be automatically calculated based on entered data.

10, 11 and 12 Present Value of Vehicle Operating Costs

- The Annual VOC for the Do Minimum and Option will be automatically transposed.
- The VOC midpoint values for the Do Minimum and Option will be automatically calculated by averaging the VOC at the start and end of each of the four modelled periods

- The mid-point benefits will be automatically calculated by subtracting Option VOC midpoint from the Do Minimum VOC midpoint to obtain m1, m2 and m3.
- The PV Vehicle Operating Cost savings will be automatically calculated.

Worksheet 5 - VOC and CO2 Cost Savings

1	Road Type	District Distributor A
2	Project Type	Mid-block/mid-block as part of route improvement
3	Modelling Period Type	AM / PM peak periods
4	Do-minimum Traffic Flow	MID BLOCK ONLY

4A Project timings from Annualisation Factors				4B Traffic Flow Data (veh/hr)				
		Time periods						
Time Period	Flow Factor	Time periods (hrs/day)	Days/year	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	1	2	245	1701	1703	1705	1705	(a)
Weekday Interpeak	1	8	245	1000	1002	1003	1003	(b)
Weekday PM Peak	1	2	245	1801	1803	1805	1805	(c)
Weekday Off Peak	0.25	12	245	250	250	251	251	(d)
Weekend Peak	0.45	8	120	450	451	451	451	(e)
Weekend Off Peak	0.15	16	120	150	150	150	150	(f)
				AADT (veh/day)				
All periods	N/A	24	365	17527	17548	17573	17573	(g)
(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	

5	Option Traffic Flow	MID BLOCK ONLY

5A Project timings from Annualisation Factors				5B Traffic Flow Data (veh/hr)				
		Time periods						
Time Period	Flow Factor	Time periods (hrs/day)	Days/year	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	1	2	245	1100	1102	1103	1103	(a)
Weekday Interpeak	1	8	245	1000	1002	1003	1003	(b)
Weekday PM Peak	1	2	245	1801	1803	1805	1805	(c)
Weekday Off Peak	0.25	12	245	250	250	251	251	(d)
Weekend Peak	0.45	8	120	450	451	451	451	(e)
Weekend Off Peak	0.15	16	120	150	150	150	150	(f)
				AADT (veh/day)				
All periods	N/A	24	365	17527	17548	17573	17573	(g)
(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	

6 Vehicle Speeds and VOC costs - Do-minimum

	# of Lanes	Interval	Hr	t0	Speed	Q	JA	tf (min/km)	rf	0.25*rf
Akcelik Link Parameters	2.00	10.00	60.00	0.75	80	1850	2.31	0.75	80	20

	Isolated intersection/intersection as part of route				Mid-block/mid-block as part of route								
	6A Mean Speed (km/hr)				6B Mean Speed (km/hr)				7A VOC Cost (cents/km)				
Year / Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	47	47	47	47	79.95	79.93	79.88	79.88	29.6	29.6	29.6	29.6	(a)
Weekday Interpeak	47	47	55	47	79.98	79.97	79.95	79.95	29.6	29.6	29.6	29.6	(b)
Weekday PM Peak	47	47	47	47	79.95	79.93	79.88	79.88	29.6	29.6	29.6	29.6	(c)
Weekday Off Peak	47	47	55	47	79.99	79.99	79.99	79.99	29.6	29.6	29.6	29.6	(d)
Weekend Peak	47	47	55	47	79.99	79.99	79.98	79.98	29.6	29.6	29.6	29.6	(e)
Weekend Off Peak	47	47	55	47	80.00	80.00	79.99	79.99	29.6	29.6	29.6	29.6	(f)
All periods	47	47	47	47	79.98	79.98	79.97	79.97	29.6	29.6	29.6	29.6	(g)

	Isolated intersection/intersection as part of route				Mid-block/mid-block as part of route								
	6C Total Travel Distance (veh.km/hr)				6D Total Travel Distance (veh.km/hr)				7B Annual VOC Cost ($/year)				
Year / Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	6	6	6	6	1958	2583	3570	3570	$283,964.04	$374,692.80	$517,792.80	$517,792.80	(a)
Weekday Interpeak	6	6	6	6	1152	1520	2100	2100	$668,150.68	$881,630.11	$1,218,336.00	$1,218,336.00	(b)
Weekday PM Peak	6	6	6	6	2073	2735	3780	3780	$300,667.81	$396,733.55	$548,251.20	$548,251.20	(c)
Weekday Off Peak	1.5	1.5	1.5	1.5	288	380	525	525	$250,556.50	$330,611.29	$456,876.00	$456,876.00	(d)
Weekend Peak	2.7	2.7	2.7	2.7	518	684	945	945	$147,265.86	$194,318.47	$268,531.20	$268,531.20	(e)
Weekend Off Peak	0.9	0.9	0.9	0.9	173	228	315	315	$98,177.24	$129,545.65	$179,020.80	$179,020.80	(f)
All periods	2	2	2	2	841	1109	1533	1533	$2,179,943.66	$2,876,453.17	$3,975,007.68	$3,975,007.68	(g)
									$1,748,782.13	$2,307,531.86	$3,188,808.00	$3,188,808.00	Total for All Day periods
									$2,179,943.66	$2,876,453.17	$3,975,007.68	$3,975,007.68	Total for day long

8 Vehicle Speeds and VOC costs - Option

	# of Lanes	Interval	Hr	t0	Speed	Q	JA	tf (min/km)	rf	0.25*rf
Akcelik Link Parameters	2.00	10.00	60.00	0.75	80	1850	2.31	0.75	80	20

	Isolated intersection/intersection as part of route				Mid-block/mid-block as part of route								
	8A Mean Speed (km/hr)				8B Mean Speed (km/hr)				9A VOC Cost (cents/km)				
Year / Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	45	45	45	45	79.86	79.71	77.76	77.76	29.6	29.6	29.6	29.6	(a)
Weekday Interpeak	45	45	45	45	79.98	79.91	79.84	79.84	29.6	29.6	29.6	29.6	(b)
Weekday PM Peak	45	45	45	45	79.86	79.71	77.76	77.76	29.6	29.6	29.6	29.6	(c)
Weekday Off Peak	45	45	45	45	79.99	79.99	79.99	79.99	29.6	29.6	29.6	29.6	(d)
Weekend Peak	45	45	45	45	79.99	79.99	79.98	79.98	29.6	29.6	29.6	29.6	(e)
Weekend Off Peak	45	45	45	45	80.00	80.00	79.99	79.99	29.6	29.6	29.6	29.6	(f)
All periods	35	35	35	35	79.98	79.98	79.97	79.97	29.6	29.6	29.6	29.6	(g)

	Isolated intersection/intersection as part of route				Mid-block/mid-block as part of route								
	8C Total Travel Distance (veh.km/hr)				8D Total Travel Distance (veh.km/hr)				9B Annual VOC Cost ($/year)				
Year / Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	5	5	5	5	1865	2460	3400	3400	$270,441.94	$356,850.28	$493,136.00	$493,136.00	(a)
Weekday Interpeak	5	5	5	5	1097	1447	2000	2000	$636,333.98	$839,647.72	$1,160,320.00	$1,160,320.00	(b)
Weekday PM Peak	5	5	5	5	1974	2605	3600	3600	$286,350.29	$377,841.47	$522,144.00	$522,144.00	(c)
Weekday Off Peak	1.25	1.25	1.25	1.25	274	362	500	500	$238,625.24	$314,867.90	$435,120.00	$435,120.00	(d)
Weekend Peak	2.25	2.25	2.25	2.25	494	651	900	900	$140,253.20	$185,065.21	$255,744.00	$255,744.00	(e)
Weekend Off Peak	0.75	0.75	0.75	0.75	165	217	300	300	$93,502.14	$123,376.81	$170,496.00	$170,496.00	(f)
All periods	5	5	5	5	801	1057	1460	1460	$2,076,137.01	$2,739,479.21	$3,785,721.60	$3,785,721.60	(g)
									$1,665,506.80	$2,197,649.39	$3,036,960.00	$3,036,960.00	Total for All Day periods
									$2,076,137.01	$2,739,479.21	$3,785,721.60	$3,785,721.60	Total for day long

10	Annual Vehicle Operating Cost for Modelled Years

	Annual Vehicle Operating Cost ($/year) for modelled years					
	Start Year 2	End Year 7	Start Year 8	End Year 14	Start Year 15	End Year 30
Annual VOC Cost - Do-minimum	$1,748,782.13	$2,307,531.86	$2,307,531.86	$3,188,808.00	$3,188,808.00	$3,188,808.00
Annual VOC Cost - Option	$1,665,506.80	$2,197,649.39	$2,197,649.39	$3,036,960.00	$3,036,960.00	$3,036,960.00

Midpoint at end of year	Year 4	11.5	22
Duration Years	6	7	16
Do-minimum VOC at midpoint	$2,028,157.00	$2,748,169.93	$3,188,808.00
Option VOC at midpoint	$1,931,578.09	$2,617,304.70	$3,036,960.00
11 *Midpoint Benefits*	$96,578.90	$130,865.23	$151,848.00
	m1	m2	m3

12	PV Vehicle Operation Cost Savings

[(m1 x 6 x 0.7416) + (m2 x 7 x 0.4511) + (m3 x 16 x 0.1958)] $1,318,680.06 D

7.3 Crash Costs

Crash Cost savings are determined using the MRWA Crash Analysis Reporting System (CARS) using crash data over the most recent last five years. Similar to the SIDRA results for the Travel Time Costs and Vehicle Operating Costs, the Net Present Value (NPV) outputs from CARS are treated as an external input into the MRRG procedures. It is necessary to manipulate the NPV of crash cost saving because the MRRG economics is based on a 30 year analysis period. Additionally, CARS does not consider traffic growth and the increases in crashes over time as a result of this.

Only those intersections or mid-block sections with crash numbers meeting the State Black Spot program for Local Roads criteria for the most recent five year period should be assessed for crash cost benefits. Where less than five crashes at an intersection/short midblock section up to 3 kilometres in length, or an average of less than 2 crashes per kilometre for mid-block lengths in excess of 3 kilometres over a five year period have been recorded, a score of zero (0) should be entered for the NPV of Crash Cost savings.

Similarly, some treatments may not have, nor are intended to have, any impact on existing crash numbers and types. An example of this may be the duplication of a single carriageway road (single lane in each direction) due to capacity constraints but without any head-on collisions to a dual carriageway (with a central median or barrier). In such an instance, the proposed improvement will have no impact on head-on collisions – as no such crashes exist. Accordingly, this may result in a negative NPV calculated by CARS despite the proposed arrangement meeting good practice and a reduction in the risk of future head-on collisions. Where an improvement to address a capacity or congestion concern is proposed but no existing road safety problems (common crash types) exist, a score of zero (0), rather than a negative value (see below) should be entered for the NPV of Crash Cost savings. To encourage the practice of providing appropriate road safety engineering measures whilst acknowledging the costs associated with such treatments, an additional score can be entered for road safety within the Intangible benefit worksheet **(Worksheet 7)** where a score of zero (0) has been entered for the NPV of Crash Cost savings.

Notwithstanding the above, due to the nature of some treatments, the potential to increase crashes compared to the Do Minimum may exist – for instance an increase in rear-end shunts following the installation of traffic signals at an intersection. As a result, a negative NPV may be calculated in CARS. Where this happens, the negative value should be transposed into the MRRG spreadsheet in the same manner as would occur if a positive value is calculated.

Given the nature of calculating Crash Cost savings, the process is unable to determine potential road safety benefits associated with a new road (such as a bypass) due to a reduction in exposure and risk once road users transfer to the new road. In the same vein however, any potential increase in crash numbers on the new road are not considered as part of the evaluation process.

Worksheet 6 is used to calculate the PV of Crash Cost savings for midblock, and intersection improvements projects. The points below are to be read in conjunction with the **Worksheet 6 – Crash Cost savings** screen print out at the end of this Section.

1. Project Types

- Select the project type for the project – automatically copied from **Worksheet 1**.

2. *Crash Summary*

- Provide a breakdown of crash numbers, factors, road user movements and patterns over the most recent five year period. In particular, provide comment on any crashes affected by the proposed improvements (either positively or negatively). Note, the outputs from CARS should be attached to a hard copy of the Submission. Over the most recent five year period, where less than five crashes at an intersection/short midblock section up to 3 kilometres in length, or an average of less than 2 crashes per kilometre for mid-block lengths in excess of 3 kilometres have been recorded, this should be noted and a score of zero (0) should be entered for the NPV of Crash Cost savings.

3. *Countermeasures*

- Utilising the countermeasure list in CARS, enter the recognised treatments into the spreadsheet. The costs of these countermeasures should match/tie in with the Option costs entered in Worksheet 3. Note, the outputs from CARS should be attached to a hard copy of the Submission.

4. *Net Present Value of Crash Cost savings*

- Enter the NPV derived from CARS – if less than five fatal or injury crashes have been recorded or where an improvement is proposed but no existing road safety problems (common crash types) exist, zero (0) should be entered.

5. Annual Crash Cost savings

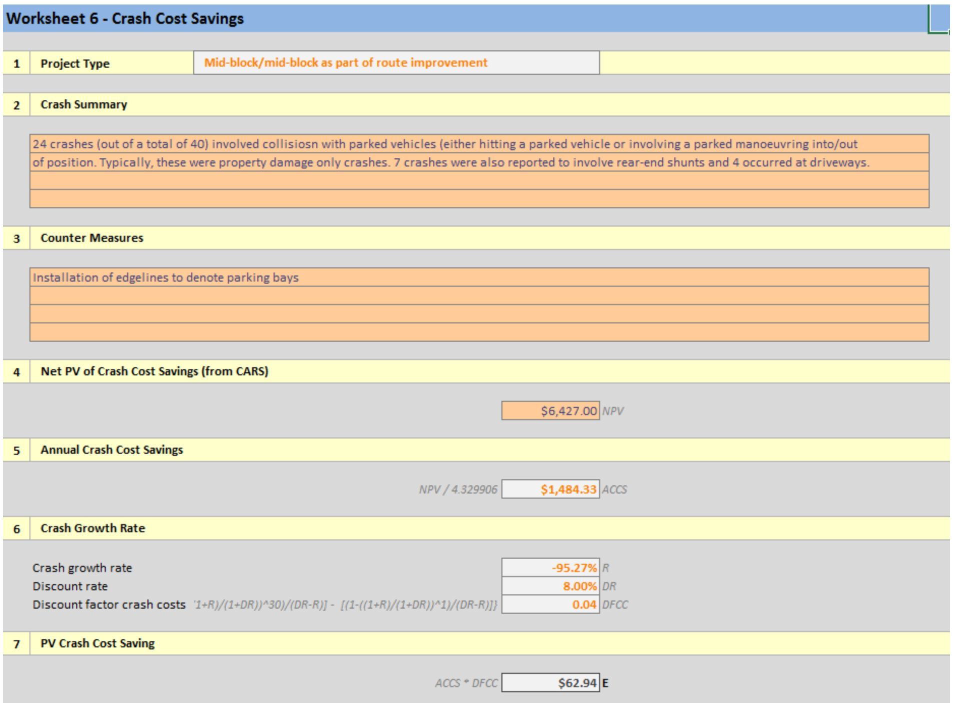
- The annual Crash Cost savings will be calculated automatically.

6. Crash Growth Rate

- The crash growth rate will be calculated automatically.

7. Present Value of Crash Cost Saving

- The PV of Crash Cost savings will be automatically calculated.


Worksheet 6 - Crash Cost Savings

1	Project Type	Mid-block/mid-block as part of route improvement	
2	Crash Summary		
	24 crashes (out of a total of 40) involved collisiosn with parked vehicles (either hitting a parked vehicle or involving a parked manoeuvring into/out of position. Typically, these were property damage only crashes. 7 crashes were also reported to involve rear-end shunts and 4 occurred at driveways.		
3	Counter Measures		
	Installation of edgelines to denote parking bays		
4	Net PV of Crash Cost Savings (from CARS)		
		$6,427.00	NPV
5	Annual Crash Cost Savings		
	NPV / 4.329906	$1,484.33	ACCS
6	Crash Growth Rate		
	Crash growth rate	-95.27%	R
	Discount rate	8.00%	DR
	Discount factor crash costs '1+R)/(1+DR))^30)/(DR-R)] - [(1-((1+R)/(1+DR))^1)/(DR-R)]}	0.04	DFCC
7	PV Crash Cost Saving		
	ACCS * DFCC	$62.94	E

8 Intangible Benefit Procedure

Intangible benefits are assessed against the following criteria:

- Public Transport – Does the project have a significant benefit for public transport through the provision of supported infrastructure improvements?
- Walking – Does the project make specific exclusive provision for pedestrians to improve accessibility and safety?
- Cycling – Does the project make specific exclusive provision for cycling to improve accessibility and safety?
- Street Lighting – Does the street lighting meet Australian Standard AS1158?
- Road Safety – Where the project does not have any existing crash savings but the proposed improvements are intended to address future safety performance and a construction cost associated with this exists.

The following tables should be utilised to assess each future project against the intangible criteria with the assessed scores and a justification of the effect to be provided in **Worksheet 7 – Intangible Benefits**.

8.1 Public Transport Measures

Bus priority measures can improve the operating efficiency and reliability of the bus based public transport network as well as providing a better service to the travelling public. These benefits that are not necessarily covered within the main tangible benefit worksheets. Whilst these Guidelines are based primarily on road improvements, the potential to assist public transport operations as part of any project should not be overlooked in order to enhance the integrated transport network.

Bus priority improvements that can be considered include those contained in the *Public Transport Authority's 'Bus Planning and Design Guidelines for Efficient People Movement' (2015)*. They do not include the provision of a bus embayment (either as a positive or negative effect) and/or bus stop facilities.

To claim any point score within this assessment criteria, written confirmation from the PTA indicating their support for the indicated bus priority measure MUST be provided with the submission. Similarly, any proposed improvement involving Intelligent Transport System (ITS) solutions (including traffic signal systems) MUST be supported by Main Roads WA with written confirmation confirming their Approval in Principal provided with the submission. It is noted that any proposed intersection improvement catering for public transport should be modelled as such with the data included within the appropriate tangible worksheets.

All proposed measures must be shown and provided on a Schematic Plan supporting the application.

Effect	Description	Score
Major positive	Provision of facilities intended to enhance service reliability and reduce bus journey times over the majority of the length of the project or at specific intersections over its length (rather than isolated improvements) with measures meeting the PTA Guidelines. Such measures include those priority treatments set out in the Guideline meeting the desirable minimum Transit levels, including: • Bus/Transit lanes (including contra-flow bus lanes). • Intersection bypass lanes – queue jump facility. • ITS Active/passive bus priority.	15
Positive	Provision of facilities intended to enhance service reliability and reduce bus journey times over sections of the route or at isolated intersections with measures meeting the PTA Guidelines. Such measures include bus priority treatments identified in the PTA Guideline not meeting the desirable minimum Transit level and/or the use of other localised measures listed in the Guideline such as: • Bus only movements. • Banned turns. • Removal or minor re-timing of traffic signals to better favour bus movements. • Parking controls. • Bus stop clearways.	8
Neutral	No expected change on overall public transport performance with no specific new/upgraded public transport infrastructure provided or removed.	0
Negative	Existing public transport routes (with greater than 6 services per hour) unduly affected causing reduced service reliability and increased bus travel times, for instance due to some increased delays for buses from side roads.	-8
Major negative	Removal of any existing public transport priority measures having an impact on service reliability and increased bus travel times. Alternatively, existing public transport routes (greater than 15 bus services per hour) significantly affected causing reduced service reliability and increased travel times and/or PTA objections.	-15

Use the drop down menu to indicate the effect for the particular component (intersection or mid-block) under consideration. The associated score for public transport measures will be automatically entered. Use the 'Justification' box to describe the public transport improvements at this location to support the reported effect.

8.2 Pedestrian Facilities

High quality pedestrian facilities can encourage a mode shift from private motor cars to walking for shorter journey's as well as providing enhanced access to public transport for longer trips, thereby assisting with reducing congestion. They can also improve road safety for pedestrians, which may not be fully captured as part of the road safety tangible benefit worksheets. Whilst these Guidelines are based primarily on road improvements, the potential to assist walking as part of any project should not be overlooked in order to enhance the integrated transport network.

Pedestrian facilities include those measures intended to assist movement along and across roads.

All proposed measures must be shown and provided on a Schematic Plan supporting the application.

Effect	Description	Score
Major positive	Provision of enhanced high quality pedestrian facilities along/across the road (over the route length/meeting pedestrian desire lines and connecting to other facilities) exceeding minimum standards set out in appropriate MRWA and Austroads design guidelines. Any provided crossing facilities demonstrated to be appropriate based on demand and safety as well as meeting DDA requirements. High levels of existing (or expected) pedestrian activity due to adjacent land uses and/or routes along a pedestrian desire line.	10
Positive	Demonstrated enhancement of existing pedestrian facilities to assist walking either along or across the road with measures meeting absolute minimum standards set out in appropriate MRWA and Austroads design guides with isolated facilities to meet existing demand. Low to moderate levels of pedestrian activity adjacent to or crossing the road length.	5
Neutral	No expected change on overall pedestrian levels of service with no specific walking infrastructure improvements provided or existing facilities removed.	0
Negative	Existing pedestrian routes and facilities with low to moderate levels of pedestrian activity unduly affected causing reduced level of service along or across roads compared to existing facilities – for instance due to increased traffic/additional lanes but no complimentary crossing facilities or a reduction in footpath widths.	-5
Major negative	Removal of any existing pedestrian facilities along and/or across the road without alternative measures of at least the same standard. Existing pedestrian routes along or across roads significantly affected causing reduced accessibility with high levels of pedestrian activity in the area due to associated land use.	-10

Use the drop down menu to indicate the effect for the particular component (intersection or mid-block) under consideration. The associated score for pedestrian facilities will be automatically entered. Use the 'Justification' box to describe the pedestrian facility improvements at this location to support the reported effect.

8.3 Cycling Facilities

Cycling facilities encourage healthier living as well as having a lower environmental impact compared to motorised modes of transport. High quality facilities can encourage a mode shift from private motor cars (including better access to public transport such as to train stations), thereby assisting with reducing congestion. They can also improve road safety for cyclists, which may not be fully captured as part of the road safety tangible benefit worksheets. Whilst these Guidelines are based primarily on road improvements, the potential to assist cycling as part of any project should not be overlooked in order to enhance the integrated transport network.

Cycle facilities should fundamentally be denoted as being provided along cycle routes within the Council's Local Bike Plan/Strategy and be designed and cater/meet the requirements for the identified cycle user types as a minimum in order to have a positive/major positive effect.

All proposed measures must be shown and provided on a Schematic Plan supporting the application.

Effect	Description	Score
Major positive	High levels of existing (or expected) cycling activity along a recognised designated existing cycling route or a route denoted as such within a Council's Local Bike Plan. Provision of enhanced high quality cycling facilities along/across the road length (connecting to other facilities) exceeding minimum standards set out in appropriate MRWA and Austroads design guides. Such facilities can include the provision of on-road or off-road facilities that meet as a minimum the desired standards. Any provided crossing facilities demonstrated to be appropriate based on demand and safety.	10
Positive	Low to moderate levels of existing (or expected) cycling activity along a recognised designated existing cycling route or a route denoted as such within a Council's Local Bike Plan. Demonstrated enhancement of existing cycling facilities either along or across the road length under consideration with measures connecting to other facilities and meeting minimum standards set out in appropriate MRWA and Austroads design guides.	5
Neutral	No expected change on overall cycling levels of service with no specific cycling infrastructure improvements provided or existing facilities removed.	0
Negative	Existing signed/marked cycle routes and facilities with low to moderate levels of activity unduly affected causing reduced level of service along or across roads compared to existing facilities – for instance due to increased traffic/speed above expected guidelines for on-road facilities or a reduction in cycle lane/path widths.	-5
Major negative	Removal of any existing cycle facilities along and/or across the road without alternative measures of at least the same standard from a safety and efficiency perspective. Existing cycle routes along or across roads significantly affected causing reduced accessibility with high levels of cycle activity in the area.	-10

Use the drop down menu to indicate the effect for the particular component (intersection or mid-block) under consideration. The associated score for cycling facilities will be automatically entered. Use the 'Justification' box to describe the cycle facility improvements at this location to support the reported effect.

8.4 Street Lighting

It is recognised that the cost of maintaining and/or supplying street lighting is included as part of the Do Minimum and Option costing worksheets with benefits associated with the provision of such facilities recognised through the crash cost calculation where such problems exist.

Notwithstanding this, it is noted that for new roads and/or significant road/intersection upgrades, any road safety benefits supporting their inclusion within the project scope may not gain any scored benefits within this process, whilst still attracting a cost – thereby potentially discouraging street lighting from being included within a project scope and cost. The provision and/or improvement of street lighting can assist with both road safety as well as personal security.

Existing condition	Service Level
No street lighting provided.	0
Street lights provided but not meeting AS1158 requirements.	1
Street lights meeting AS1158 requirements.	2

Effect	Description	Point Score
Major positive	Change from service level 0 to service level 2.	3
Positive	Change from service level 1 to service level 2. (Note: any upgrade should meet AS1158 requirements, therefore upgrades from service level 0 to 1 receives no score.)	1
Neutral	No change in service level.	0
Negative	Existing lighting standard is reduced.	-3

The Point Score will apply to:

- Every 250m of road with traffic exceeding 8,000 vehicles per day.

OR

If not covered within the above, the Point Score will apply to:

- Every intersection;
- Every bridge;
- Every formal pedestrian crossing facility (including refuge islands) or per 100m of road with significant adjacent pedestrian activity; and
- Every potential hazard within or along the road (e.g. traffic islands or severe curves) that can be justified/supported as requiring street lighting from a road safety perspective.

A maximum/minimum point score for street lighting of +9/-9 is permissible.

Use the drop down menu to indicate the score for street lighting for the particular component (intersection or mid-block) under consideration. Use the 'Justification' box to describe the street lighting improvements and calculations to support the street lighting score used in the drop down box.

8.5 Road Safety

Similar to street lighting, new roads and/or proposed improvements can or may have intended/unintended road safety benefits (or dis-benefits) in the future that are not fully accounted for based on the previous crash history. By simply relying on previous crash history, the inclusion of measures intended to address road safety within the project scope may not gain any scored benefits whilst still attracting a cost – thereby potentially discouraging road safety measures from being included within a project scope and cost.

The provision of a road safety score as an intangible benefit is intended to reward or take into account future road safety issues that are not reflected in the crash cost benefits due to the lack of an existing road safety problem, but which the proposed measure may improve (or make worse) in the future.

In order to minimise any double counting of road safety benefits, this intangible score is ONLY possible if a zero (0) NPV has been entered in **Worksheet 6.**

All proposed measures must be shown and provided on a Schematic Plan supporting the application.

Effect	Description	Score
Positive	The proposed measures and design are intended to minimise the overall number and severity of crashes. A road safety audit has already been undertaken and any concerns have been addressed and mitigated against as part of the design.	6
Neutral	A positive (+) or negative (-) NPV score has been entered into Worksheet 6 – Crash Costs, or the proposed measures have negligible impact on road safety overall.	0
Negative	The proposed measures may result in an overall reduction in road safety performance compared to the Do Minimum. A road safety audit has already been undertaken but concerns cannot be fully addressed and/or mitigated against for various reasons as part of the design.	-6

Use the drop down menu to indicate the effect for the particular component (intersection or mid-block) under consideration. The associated score for road safety will be automatically entered. Use the 'Justification' box to describe the road safety improvements or deficiency at this location to support the reported effect.

As indicated in Section 2, projects that are successfully awarded funding must be subject to a formal, independent road safety audit at an appropriate stage of design.

8.6 Non Tangible Scores

When combined, each of the intangible criteria results in the option obtaining an Overall Non Tangible Score ranging from 50 to -50.

Worksheet 7 - Non Tangible Benefits

1 Public Transport

Effect	Description	Score
Neutral	No expected change on overall public transport performance with no specific new/upgraded public transport infrastructure provided or removed.	0
Justification	No new facilities to improve public transport	

2 Pedestrian Facilities

Effect	Description	Score
Positive	Demonstrated enhancement of existing pedestrian facilities to assist walking either along or across the road with measures meeting absolute minimum standards set out in appropriate MRWA and Austroads design guides with isolated facilities to meet existing demand. Low to moderate levels of pedestrian activity adjacent to or crossing the road length.	5
Justification	New shared path provided as part of proposed upgrade, albeit with some pinchpoints. Pedestrian refuge provided on main pedestrian desire line.	

3 Cycling Facilities

Effect	Description	Score
Positive	Low to moderate levels of existing (or expected) cycling activity along a recognised designated existing cycling route or a route denoted as such within a Council's Local Bike Plan. Demonstrated enhancement of existing cycling facilities either along or across the road length under consideration with measures connecting to other facilities and meeting minimum standards set out in appropriate MRWA and Austroads design guides.	5
Justification	New shared path provided as part of proposed upgrade, albeit with some pinchpoints.	

4	**Street Lighting**

Score
0

Justification	No improvement in street lighting necessary.

5	**Road Safety**

Effect	Description	Score
Positive	The proposed measures and design are intended to minimise the overall number and severity of crashes. A road safety audit has already been undertaken and any concerns have been addressed and mitigated against as part of the design.	6

Justification	Concept design road safety audit carried out. Recommendations to address identified road safety problems accepted and incorporated into the final concept design.

6	**Overall Score**

16	F

9 Overall Score and Rating

The Present Value costs and benefits associated with the Do Minimum and Option calculated in each of the worksheets as well as the intangible benefit score will be automatically copied through from **Worksheets 2 to** 7 into **Worksheet 8.**

Worksheet 8 is used to calculate the overall scores and rating for midblock, and intersection improvements projects. The points below are to be read in conjunction with the **Worksheet 8 – Overall Score** screen print out at the end of this Section.

1 PV Cost of the Do Minimum

- Use **Worksheet 2** (refer to Section 5) to calculate the Present Value (PV) cost of the Do Minimum. This gets automatically transferred into the relevant cell.

2 PV Cost of the Option

- Use **Worksheet 3** (refer to Section 6) to estimate the preferred Option PV cost. This gets automatically transferred into the relevant cell.

3 Unconstrained Benefit Savings

- Use Worksheet 4 (Travel Time – TT savings, Section 7.1), Worksheet 5 (Vehicle operating cost – VOC savings, Section 7.3) and **Worksheet 6** (Crash Cost savings, Section 7.4) to estimate the various cost savings. These get automatically transferred into the relevant cells.
- To bring the benefits up to the base year values year, use appropriate update factors – done automatically.

4 Ratio of Unconstrained Benefits to Costs

- Calculate the Ratio of Unconstrained Benefits to Cost by dividing the PV of the net unconstrained benefits by the PV of net costs. This is automatically calculated as part of the spread sheet and is capped at a maximum of 50.

5 First Year Rate of Return

- First Year Rate of Return (FYRR) is calculated as the benefits in the first full year following completion, divided by the activity costs. This is calculated automatically. In the event that the total overall score of different projects are ties, the ratio of unconstrained benefits to costs and/or the first year rate of return may be used as part of the prioritisation process.

6 Intangible Benefit Score

- Use **Worksheet 7** to calculate the Intangible Benefit Score. This gets automatically transferred into the relevant cell, and has a maximum score of 50.

7 Total Score

- The overall score for the Option is automatically determined by summing a 75% contribution from the capped ratio of unconstrained benefits to cost and a 25% contribution from the Non Tangible Benefit score to get a total score out of 50.

For route length improvements, the total scores from each individual midblock and intersection elements must be summed together and averaged to obtain the final score (with the potential exception of the scenario for a new link as discussed in Appendix A).

Worksheet 8 - Overall Score

1 Present Value (PV) cost of Do-minimum

	$315,239.90	A worksheet 2

2 Present Value (PV) cost of Option

	$686,978.29	B worksheet 3

3 Unconstrained Benefit values

PV travel time cost savings	$1,863,177.87	C worksheet 4	x update factor TTC	1	$1,863,177.87	W
PV VOC and CO2 savings	$13,299.85	D worksheet 5	x update factor VOC	1	$13,299.85	Y
PV Crash cost savings	$371,416.37	E worksheet 6	x update factor AC	1	$371,416.37	Z

4 Ratio of Unconstrained Benefit to Cost

PV net unconstrained benefits / PV net costs	(W + Y + Z) / (B - A)	6.05
Score		6.05

5 FYRR

Discount Factor VOC	{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}	10.79316763	
Discount Factor TTC	{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}	10.79316763	
Discount Factor CC	{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}	10.75931503	
PV 1st Year benefits / PV net costs	[(W+Y)/DF(voc&ttc)+Z/DFcc)] x 0.93 / (B - A)	52.13	%

6 Non Tangible Benefit Score

19	F worksheet 7

7 Total Score

9.29	out of a possible score of 50

10 Project Summary

The Project Summary worksheet is used to provide an overall summary of the proposed road improvement project including project details and description, scoring and cost information. This should be included at the front of each submission for quick reference.

The Project Summary worksheet allows more details relating to the staging of the work to be provided, for example any detailed design and road safety audit costs in the first year with construction the following year(s) as well as confirmation as to the total overall funding request.

In addition, a checklist of potential supporting information for inclusion in the submission is provided.

MRRG Road Improvement Project Summary

TO BE INCLUDED AT THE FRONT OF EACH SUBMISSION

1 General Details

Local Authority		Blue Sky City
Project Name		Main Street Upgrade
Proposed Improvement		Duplication of existing narrow carriageway with intersection upgrades at either end in line with the City's Strategic Plan
SLK	From	3.11
	To	4.61
Road Type		District Distributor A

2 Score and Funding

Final score	16
Total Estimated Cost	$1,500,000
Total Requested Funding	$1,000,000

3 Staging

Staged Project Cost - Year 1	$150,000 - Detailed Design
Staged Project Cost - Year 2	$850,000 - Construction
Staged Project Cost - Year 3	
Staged Project Cost - Year 4	

4 Submission Inclusions?

Cost breakdown	Yes
Milestone and Project Complexity Form	Yes
Worksheets	Yes
Concept Design	Yes
Traffic Counts	Yes
ROM Data	Yes
CARS reports	Yes
SIDRA reports	Yes
Agreements in Principle (eg. traffic signals, PTA)	Yes
Evidence of project's strategic alignment	Yes

11 Worked Examples

The following worked examples have been provided for an isolated intersection, a mid-block section and a combination of the midblock and intersection elements as part of a route improvement.

Worked Example 1 – Gnangara Road, Swan (Existing Road Improvements)

Existing route improvements comprising a combination of mid-block and intersection improvements.

Worked Example 2 – Southern Link Road, Cannington (New Road)

Construction of a new road (asset creation) between two fixed points.

11.1 Worked Example 1 – Gnangara Road, Swan (Existing Road Improvements)

Beechboro Road North / Gnangara Road Intersection

Worksheet 1 - Project Description

1	**Applicant's Details**		
	Organisation Name	City of Swan	**Legend**
	MRRG Reference	1	*Calculated value*
	Assessor(s) name and position	Kevin de Silva	*Free-text user input*
	Reviewer(s) name and position	Tim Selby	*Dropdown selection*
2	**Project Overview**		
	Project Name	Gnangara Road MRRG Improvement Submission	
	Project Type	Isolated intersection/intersection as part of route improvement	
	Mid-block section/intersection under consideration	Gnangara Road 4.24 SLK to 4.80 SLK	
	Road Type	District Distributor A	
3	**Problem Description**		
	Describe issue/problems to be addressed	Intersection performance / capacity issues with vehicles turning in and out of the intersection	
4	**Location Details**		
	Brief description of location	Beechboro Road North / Gnangara Road Intersection, Swan.	
5	**Project Strategic Alignment**	Yes	
	Justification	The project is listed under the EMRC's Regional Integrated Transport Strategy Action Plan 20120-2013	
6	**Project Details**		
	Describe the do-minimum	T - Intersection	
	Summarise options assessed	Traffic Signal Controlled Seagull Intersection	

		Do Minimum	Option	
	Length	0.56	0.56	*km*
	Total number of traffic lanes	2.00	4.00	
	Urban/rural	Rural Road	Rural Road	
	Speed limit	90.00	90.00	*km/h*

7	**Construction Details**		
	Time zero	1/07/2012	*(dd/mm/yyyy)*
8	**Time Frame Information**		
	Date of economic evaluation	5/02/2014	*(dd/mm/yyyy)*
9	**Traffic Growth**		
	ROM daily traffic flow 2016	32600	*vehicles per day*
	ROM daily traffic flow 2031	44500	*vehicles per day*
	Annual geometric traffic growth	2.10%	

Worksheet 2 - Cost of the Do-minimum

1	**Road Type**	District Distributor A	

2	**PV of annual maintenance costs**

$1,737.68 *x 11.7023* $20,334.85 **(a)**

3	**PV of periodic maintenance costs**

Proposed Rehab treatment measure	40mm SMA overlay	
Rehab treatment cost	$21.50	
Site treatment area (from SLK to SLK)	5992.00	*m2*
Rehab cost	$128,828.00	

Periodic maintenance will be required in the following years:

Year	Type of Maintenance	Required?	Estimated Cost	SPPWF	PV
5	40mm SMA overlay	N/A	$128,828.00	0.680	N/A
10	40mm SMA overlay	N/A	$128,828.00	0.464	N/A
15	40mm SMA overlay	Yes	$128,828.00	0.320	$41,224.96
20	40mm SMA overlay	N/A	$128,828.00	0.210	N/A
25	40mm SMA overlay	N/A	$128,828.00	0.150	N/A
30	40mm SMA overlay	Yes	$128,828.00	0.100	$12,882.80

Sum of PV maintenance $54,107.76 **(b)**

4	**PV of annual associated operating cost**

Luminaire Type	ZE02C - 80MV	
Number of luminaires within study section	6	*units*
Number of days luminaires are lit	365	*days*
Total operating cost	$866.62	

PV of total operating cost

$866.62 *x 11.7023* $10,141.48 **(c)**

5	**PV total Do-minimum maintenance costs**

(a) + (b) + (c) $84,584.09 **A**

Worksheet 3 - Cost of the Option

1	**Road Type**	District Distributor A	

2 PV of estimated cost of proposed work (as per attached estimate sheet)

$3,253,496.00 *x 0.9259* — $3,012,411.95 **(a)**

3 PV of routine maintenance costs following completion of the work

$3,166.80 *x 10.7398* — $34,010.80 **(b)**

4 PV of maintenance cost in year 1

$1,737.68 **(c)**

5 PV of Option periodic maintenance cost

Proposed Rehab treatment measure	40mm SMA overlay
Rehab treatment cost	$21.50
Site treatment area (from SLK to SLK)	10920.00 *m2*
Rehab cost	$234,780.00

Periodic maintenance will be required in the following years:

Year	Type of Maintenance	Required?	Estimated Cost	SPPWF	PV
5	40mm SMA overlay	N/A	$234,780.00	0.680	N/A
10	40mm SMA overlay	N/A	$234,780.00	0.464	N/A
15	40mm SMA overlay	Yes	$234,780.00	0.320	$75,129.60
20	40mm SMA overlay	N/A	$234,780.00	0.210	N/A
25	40mm SMA overlay	N/A	$234,780.00	0.150	N/A
30	40mm SMA overlay	Yes	$234,780.00	0.100	$23,478.00

Sum of PV maintenance $98,607.60 **(d)**

6 PV of Annual associated operating cost

Luminaire Type	ZE20C - 70ML
Number of luminaires within study section	20 *units*
Number of days luminaires are lit	365 *days*
Total operating cost	$5,210.87

PV of annual operating costs (separate to maintenance costs)

Total $5,210.87 *x 10.7398* — $55,963.72 **(e)**

7 PV total costs of the preferred option

(a) + (b) + (c) + (d) + (e) **$3,202,731.74 B**

Worksheet 4 - Travel Time Cost Savings

1	Road Type	District Distributor A
2	Project Type	Isolated intersection/intersection as part of route improvement
3	Modelling Period Type	AM / Inter / PM peak periods

4 Midblock Assessment - Traffic Volumes

	DO MINIMUM					OPTION				
	Time Zero (veh/hr)	Year 2	Year 8	Year 15	Year 30	Time Zero (veh/hr)	Year 2	Year 8	Year 15	Year 30
AM Peak	1700	1772	2007	2321	2321	1700	1772	2007	2321	2321
Interpeak	1000	1042	1181	1365	1365	1000	1042	1181	1365	1365
PM Peak	1800	1876	2125	2457	2457	1800	1876	2125	2457	2457
AADT All periods	17520	18262	20683	23915	23915	17520	18262	20683	23915	23915

5 Do-minimum Modelling

	5A Project Timings from Annualisation Factors					5B Isolated Intersection				5C Road Midblock Improvement				5D Annual Travel Time Cost ($/year)				
			Time Periods		TTC	Modelling Results Inputs (veh.hr/hr)				Modelling Results Inputs (veh.hr/hr)								
	Time Period	Flow Factor	hours/day	days/year	$/HR	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
	Weekday AM Peak	1	2	245	$22.54	21.87	46.61	113.51	113.51	12.42	14.08	16.29	16.29	$241,545.40	$514,788.81	$1,253,672.55	$1,253,672.55	(a)
	Weekday Interpeak	1	8	245	$27.01	8.83	25.62	42.62	42.62	12.41	14.06	16.26	16.26	$467,456.67	$1,356,312.55	$2,256,285.75	$2,256,285.75	(b)
	Weekday PM Peak	1	2	245	$22.30	92.52	312.71	1159.23	1159.23	12.42	14.08	16.29	16.29	$1,010,966.04	$3,416,982.17	$12,666,906.21	$12,666,906.21	(c)
	Weekday Off Peak	0.25	12	245	$22.91	2.21	6.41	10.66	10.66	1.82	2.07	2.39	2.39	$148,687.05	$431,411.34	$717,671.79	$717,671.79	(d)
	Weekend Peak	0.45	8	120	$25.55	3.97	11.53	19.18	19.18	3.28	3.72	4.30	4.30	$97,462.01	$282,783.31	$470,422.51	$470,422.51	(e)
	Weekend Off Peak	0.15	16	120	$24.80	1.32	3.84	6.39	6.39	1.09	1.24	1.43	1.43	$63,067.39	$182,988.29	$304,409.09	$304,409.09	(f)
5E	All periods	N/A	24	365	$25.70	10	10	10	10	5.33	6.04	6.98	6.98	$2,251,320.00	$2,251,320.00	$2,251,320.00	$2,251,320.00	(g)
	(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)	(V)	(W)	(X)	(Y)	$2,029,184.56	$6,185,266.47	$17,669,367.90	$17,669,367.90	Total for All Day Periods
														$2,251,320.00	$2,251,320.00	$2,251,320.00	$2,251,320.00	Total for Day Long

6 Option Modelling

	6A Project Timings from Annualisation Factors					6B Isolated Intersection				6C Road Midblock Improvement				6D Annual Travel Time Cost ($/year)				
			Time Periods		TTC	Modelling Results Inputs (veh.hr/hr)				Modelling Results Inputs (veh.hr/hr)								
	Time Period	Flow Factor	hours/day	days/year	$/HR	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
	Weekday AM Peak	1	2	245	$22.54	12.81	16.73	26.22	26.22	12.41	14.06	16.26	16.26	$141,481.33	$184,776.16	$289,589.41	$289,589.41	(a)
	Weekday Interpeak	1	8	245	$27.01	5.3	6.37	8.02	8.02	12.41	14.05	16.25	16.25	$280,579.88	$337,225.25	$424,575.59	$424,575.59	(b)
	Weekday PM Peak	1	2	245	$22.30	10.19	12.99	18.32	18.32	12.41	14.06	16.26	16.26	$111,346.13	$141,941.73	$200,182.64	$200,182.64	(c)
	Weekday Off Peak	0.25	12	245	$22.91	1.33	1.59	2.01	2.01	1.82	2.07	2.39	2.39	$89,245.91	$107,263.47	$135,047.58	$135,047.58	(d)
	Weekend Peak	0.45	8	120	$25.55	2.39	2.87	3.61	3.61	3.28	3.72	4.30	4.30	$58,499.28	$70,309.51	$88,521.55	$88,521.55	(e)
	Weekend Off Peak	0.15	16	120	$24.80	0.80	0.96	1.20	1.20	1.09	1.24	1.43	1.43	$37,854.72	$45,497.09	$57,282.05	$57,282.05	(f)
6E	All periods	N/A	24	365	$25.70	10	10	10	10	5.33	6.03	6.98	6.98	$2,251,320.00	$2,251,320.00	$2,251,320.00	$2,251,320.00	(g)
	(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)	(V)	(W)	(X)	(Y)	$719,007.24	$887,013.21	$1,195,198.82	$1,195,198.82	Total for All Day Periods
														$2,251,320.00	$2,251,320.00	$2,251,320.00	$2,251,320.00	Total for Day Long

7 Annual Travel Time Cost for Modelled Years

		Annual Travel Time Cost ($/year) for modelled years					
		Start Year 2	End Year 7	Start Year 8	End Year 14	Start Year 15	End Year 30
	Travel Time Cost Do-minimum	$2,029,184.56	$6,185,266.47	$6,185,266.47	############	############	############
	Travel Time Cost Option	$719,007.24	$887,013.21	$887,013.21	$1,195,198.82	$1,195,198.82	$1,195,198.82
	Midpoint	Year 4		Year 11.5		Year 22	
	Duration Years	6		7		16	
	Do-minimum TTC at midpoint	$4,107,225.51		$11,927,317.18		$17,669,367.90	
	Option TTC at midpoint	$803,010.23		$1,041,106.02		$1,195,198.82	
8	Midpoint Benefits	$3,304,215.28		$10,886,211.16		$16,474,169.07	
		m1		m2		m3	

9 PV Travel Time Cost Savings

[(m1 x 6 x 0.7416) + (m2 x 7 x 0.4511) + (m3 x 16 x 0.1958)] | $100,688,102.18 | C

Worksheet 5 - VOC and CO_2 Cost Savings

1	Road Type	District Distributor A
2	Project Type	Isolated intersection/intersection as part of route improvement
3	Modelling Period Type	AM / Inter / PM peak periods
4	Do-minimum Traffic Flow	MID BLOCK ONLY

4A Project timings from Annualisation Factors				4B Traffic Flow Data (veh/hr)				
		Time periods						
Time Period	Flow Factor	Time periods (hrs/day)	Days/year	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	1	2	245	1772	2007	2321	2321	(a)
Weekday Interpeak	1	8	245	1042	1181	1365	1365	(b)
Weekday PM Peak	1	2	245	1876	2125	2457	2457	(c)
Weekday Off Peak	0.25	12	245	261	295	341	341	(d)
Weekend Peak	0.45	8	120	469	531	614	614	(e)
Weekend Off Peak	0.15	16	120	156	177	205	205	(f)
				AADT (veh/day)				
All periods	N/A	24	365	18262	20683	23915	23915	(g)
(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	

5	Option Traffic Flow	MID BLOCK ONLY

5A Project timings from Annualisation Factors				5B Traffic Flow Data (veh/hr)				
		Time periods						
Time Period	Flow Factor	Time periods (hrs/day)	Days/year	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	1	2	245	1772	2007	2321	2321	(a)
Weekday Interpeak	1	8	245	1042	1181	1365	1365	(b)
Weekday PM Peak	1	2	245	1876	2125	2457	2457	(c)
Weekday Off Peak	0.25	12	245	261	295	341	341	(d)
Weekend Peak	0.45	8	120	469	531	614	614	(e)
Weekend Off Peak	0.15	16	120	156	177	205	205	(f)
				AADT (veh/day)				
All periods	N/A	24	365	18262	20683	23915	23915	(g)
(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	

6 & 7	Vehicle Speeds and VOC costs - Do-minimum	

	# of Lanes	Interval	Hr	t0	Speed	Q	JA	tf (min/km)	rf	0.25*rf
Akcelik Link Parameters	2	10.00	60.00	0.75	80	1850	2.31	0.75	80.00	20.00

	Isolated intersection/intersection as part of route improvement				Mid-block/mid-block as part of route improvement								
Year	6A Mean Speed (km/hr)				6B Mean Speed (km/hr)				7A VOC Cost (cents/km)				
Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	37.8	26.2	15.7	15.7	79.87	79.83	79.76	79.76	30.01	35.22	42.82	42.82	(a)
Weekday Interpeak	45.7	26.9	21.3	21.3	79.95	79.94	79.92	79.92	29.2	35.22	38.44	38.44	(b)
Weekday PM Peak	14	10	10	10	79.87	79.83	79.76	79.76	42.82	48.69	48.69	48.69	(c)
Weekday Off Peak	45.7	26.9	21.3	21.3	79.99	79.99	79.99	79.99	29.2	35.22	38.44	38.44	(d)
Weekend Peak	45.7	26.9	21.3	21.3	79.98	79.98	79.97	79.97	29.2	35.22	38.44	38.44	(e)
Weekend Off Peak	45.7	26.9	21.3	21.3	79.99	79.99	79.99	79.99	29.2	35.22	38.44	38.44	(f)
All periods	47	47	47	47	79.97	79.96	79.95	79.95	29.2	29.2	29.2	29.2	(g)

	Isolated intersection/intersection as part of route improvement				Mid-block/mid-block as part of route improvement								
Year	6C Total Travel Distance (veh.km/hr)				6D Total Travel Distance (veh.km/hr)				7B Annual VOC Cost ($/year)				
Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	1456.6	1750.6	2176.6	2176.6	992	1124	1300	1300	$214,191.57	$302,115.05	$456,689.86	$456,689.86	(a)
Weekday Interpeak	842.6	991.5	1198.9	1198.9	584	661	764	764	$482,236.83	$684,444.35	$903,280.03	$903,280.03	(b)
Weekday PM Peak	1548.2	1848.8	2296.3	2296.3	1051	1190	1376	1376	$324,840.23	$441,088.55	$547,853.55	$547,853.55	(c)
Weekday Off Peak	210.65	247.875	299.725	299.725	146	165	191	191	$180,838.81	$256,666.63	$338,730.01	$338,730.01	(d)
Weekend Peak	379.17	446.175	539.505	539.505	263	297	344	344	$106,288.93	$150,857.12	$199,090.29	$199,090.29	(e)
Weekend Off Peak	126.39	148.725	179.835	179.835	88	99	115	115	$70,859.29	$100,571.41	$132,726.86	$132,726.86	(f)
All periods	2	2	2	2	426	483	558	558	$5,115.84	$5,115.84	$5,115.84	$5,115.84	(g)
									$1,379,255.67	$1,935,743.11	$2,578,370.61	$2,578,370.61	Total for All Day periods
									$5,115.84	$5,115.84	$5,115.84	$5,115.84	Total for day long

8 & 9 Vehicle Speeds and VOC costs - Option

	# of Lanes	Interval	Hr	t0	Speed	Q	JA	tf (min/km)	rf	0.25*rf
Akcelik Link Parameters	4	10.00	60.00	0.75	80	1850	2.31	0.75	80.00	20.00

	Isolated intersection/intersection as part of route improvement				Mid-block/mid-block as part of route improvement								
	8A Mean Speed (km/hr)				8B Mean Speed (km/hr)				9A VOC Cost (cents/km)				
Year / Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	43.3	41.5	36.8	36.8	79.96	79.95	79.94	79.94	29.2	30.0	31.2	31.2	(a)
Weekday Interpeak	49.3	48.9	48.2	48.2	79.98	79.97	79.97	79.97	28.7	28.7	28.7	28.7	(b)
Weekday PM Peak	48	46.6	44.3	44.3	79.96	79.95	79.94	79.94	28.7	29.2	29.2	29.2	(c)
Weekday Off Peak	49.3	48.9	48.2	48.2	80.00	79.99	79.99	79.99	28.7	28.7	28.7	28.7	(d)
Weekend Peak	49.3	48.9	48.2	48.2	79.99	79.99	79.99	79.99	28.7	28.7	28.7	28.7	(e)
Weekend Off Peak	49.3	48.9	48.2	48.2	80.00	80.00	80.00	80.00	28.7	28.7	28.7	28.7	(f)
All periods	35	35	35	35	79.98	79.98	79.98	79.98	31.2	31.2	31.2	31.2	(g)

	Isolated intersection/intersection as part of route improvement				*Mid-block/mid-block as part of route improvement*								
	8C Total Travel Distance (veh.km/hr)				*8D Total Travel Distance (veh.km/hr)*				9B Annual VOC Cost ($/year)				
Year / Time period	Year 2	Year 8	Year 15	Year 30	*Year 2*	*Year 8*	*Year 15*	*Year 30*	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	1353.8	1593.1	1926.2	1926.2	992	1124	1300	1300	$193,701.70	$234,263.76	$294,477.46	$294,477.46	(a)
Weekday Interpeak	785.5	924.3	1117.6	1117.6	584	661	764	764	$441,859.46	$519,937.24	$628,672.35	$628,672.35	(b)
Weekday PM Peak	1439.7	1694.2	2048.5	2048.5	1051	1190	1376	1376	$202,465.01	$242,406.14	$293,099.38	$293,099.38	(c)
Weekday Off Peak	196.375	231.075	279.4	279.4	146	165	191	191	$165,697.30	$194,976.46	$235,752.13	$235,752.13	(d)
Weekend Peak	353.475	415.935	502.92	502.92	263	297	344	344	$97,389.43	$114,598.41	$138,564.52	$138,564.52	(e)
Weekend Off Peak	117.825	138.645	167.64	167.64	88	99	115	115	$64,926.29	$76,398.94	$92,376.35	$92,376.35	(f)
All periods	5	5	5	5	426	483	558	558	$13,665.60	$13,665.60	$13,665.60	$13,665.60	(g)
									$1,166,039.19	$1,382,580.95	$1,682,942.18	$1,682,942.18	Total for All Day periods
									$13,665.60	$13,665.60	$13,665.60	$13,665.60	Total for day long

10 Annual Vehicle Operating Cost for Modelled Years

	Annual Vehicle Operating Cost ($/year) for modelled years					
	Start Year 2	End Year 7	Start Year 8	End Year 14	Start Year 15	End Year 30
Annual VOC Cost - Do-minimum	$1,379,255.67	$1,935,743.11	$1,935,743.11	$2,578,370.61	$2,578,370.61	$2,578,370.61
Annual VOC Cost - Option	$1,166,039.19	$1,382,580.95	$1,382,580.95	$1,682,942.18	$1,682,942.18	$1,682,942.18

11

Midpoint	Year 4	11.5	22
Duration Years	6	7	16
Do-minimum VOC at midpoint	$1,657,499.39	$2,257,056.86	$2,578,370.61
Option VOC at midpoint	$1,274,310.07	$1,532,761.57	$1,682,942.18
Midpoint Benefits	$383,189.32	$724,295.30	$895,428.43
	m1	m2	m3

12 PV Vehicle Operation Cost Savings

[(m1 x 6 x 0.7416) + (m2 x 7 x 0.4511) + (m3 x 16 x 0.1958)]	$6,797,344.63	D

Worksheet 6 - Crash Cost Savings

1	**Project Type**	Isolated intersection/intersection as part of route improvement

2	**Crash Summary**

Total Crashes - 116
2 - Hospital, 13 - Medical, 76 - PDO Major, 25 - PDO Minor
Main Crash Type - Rear End

3	**Counter Measures**

Install Traffic Signal Controlled Seagull Intersection.
Protect turning traffic provide separate phases for different turning movements.

4	**Net PV of Crash Cost Savings (from CARS)**

	$1,309,690.90	*NPV*

5	**Annual Crash Cost Savings**

NPV / 4.329906	$302,475.60	*ACCS*

6	**Crash Growth Rate**

Crash growth rate		1.10%	*R*
Discount rate		8.00%	*DR*
Discount factor crash costs	*(1-((1+R)/(1+DR))^30)/(DR-R)] - [(1-((1+R)/(1+DR))^1)/(DR-R)]}*	11.56	*DFCC*

7	**PV Crash Cost Saving**

*ACCS * DFCC*	**$3,497,356.71**	**E**

Worksheet 7 - Non Tangible Benefits

1 Public Transport

Effect	Description	Score
Neutral	No expected change on overall public transport performance with no specific new/upgraded public transport infrastructure provided or removed.	0

Justification	There are no bus routes provided along the project route between Beechboro Road North to Dumpelliar Drive and there are no improvements suggested for public transport as part of this project.

2 Pedestrian Facilities

Effect	Description	Score
Positive	Demonstrated enhancement of existing pedestrian facilities to assist walking either along or across the road with measures meeting absolute minimum standards set out in appropriate MRWA and Austroads design guides with isolated facilities to meet existing demand. Low to moderate levels of pedestrian activity adjacent to or crossing the road length.	5

Justification	Central Median will provide a refuge for any pedestrians crossing the road

3 Cycling Facilities

Effect	Description	Score
Positive	Low to moderate levels of existing (or expected) cycling activity along a recognised designated existing cycling route or a route denoted as such within a Council's Local Bike Plan. Demonstrated enhancement of existing cycling facilities either along or across the road length under consideration with measures connecting to other facilities and meeting minimum standards set out in appropriate MRWA and Austroads design guides.	5

Justification	Provision of on-road 1.8m cycle lane along length of road.

4 Street Lighting

Score
9

Justification	300m of road is lit at present (assumed to be to AS1158 standards). 1000m of road near intersection is proposed to be lit to AS 1158 standards. Therefore it is assumed that 3 x 250 sections will be upgraded from Service level 0 to 2 (3 x 3 = 9 points), while 1 x 250m section of road is upgraded from Service level 1 to 2 (1 x 1 = 1 point). It is also assumed that the signalised intersection will be lit according to AS 1158 standards (1 point). Therefore maximum points are awarded.

5 Road Safety

Effect	Description	Score
Positive	*The proposed measures and design are intended to minimise the overall number and severity of crashes. A road safety audit has already been undertaken and any concerns have been addressed and mitigated against as part of the design.*	*6*

Justification	

6 Overall Score

19	F

Worksheet 8 - Overall Score

1 Present Value (PV) cost of Do-minimum

	$84,584.09	**A worksheet 2**

2 Present Value (PV) cost of Option

	$3,202,731.74	**B worksheet 3**

3 Unconstrained Benefit values

PV travel time cost savings	$100,688,102.18	**C worksheet 4**	*x update factor TTC*	1	$100,688,102.18	**W**
PV VOC and CO2 savings	$6,797,344.63	**D worksheet 5**	*x update factor VOC*	1	$6,797,344.63	**Y**
PV Crash cost savings	$3,497,356.71	**E worksheet 6**	*x update factor AC*	1	$3,497,356.71	**Z**

4 Ratio of Unconstrained Benefit to Cost

PV net unconstrained benefits / PV net costs	*(W + Y + Z) / (B - A)*	35.59
Score		35.59

5 FYRR

Discount Factor VOC	*{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}*	10.76345372	
Discount Factor TTC	*{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}*	10.76345372	
Discount Factor CC	*{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}*	10.75216952	
PV 1st Year benefits / PV net costs	*[(W+Y)/DF(voc&ttc)+Z/DFcc)] x 0.93 / (B - A)*	307.54	*%*

6 Non Tangible Benefit Score

	19	**F worksheet 7**

7 Total Score

31.44	**out of a possible score of 50**

Gnangara Road mid-block between Beechboro Road North and Gaskell Avenue

Worksheet 1 - Project Description

1 Applicant's Details

Organisation Name	City of Swan	**Legend**
MRRG Reference	2	*Calculated value*
Assessor(s) name and position	Kevin de Silva	*Free-text user input*
Reviewer(s) name and position	Tim Selby	*Dropdown selection*

2 Project Overview

Project Name	Gnangara Road MRRG Improvement Submission
Project Type	Mid-block/mid-block as part of route improvement
Mid-block section/intersection under consideration	Gnangara Road 4.80 SLK to 6.92 SLK
Road Type	District Distributor A

3 Problem Description

Describe issue/problems to be addressed	High volumes of traffic travelling along this section of road. Issues with road capacity.

4 Location Details

Brief description of location	Gnangara Road between Beechboro Road North and Gaskell Ave.

5 Project Strategic Alignment Yes

Justification	The project is listed under the EMRC's Regional Integrated Transport Strategy Action Plan 20120-2013.

6 Project Details

Describe the do-minimum	2 Lane Single Carriageway
Summarise options assessed	4 Lane Dual Carriageway

	Do Minimum	Option	
Length	2.12	2.12	*km*
Total number of traffic lanes	2.00	4.00	
Urban/rural	Rural Road	Rural Road	
Speed limit	90.00	90.00	*km/h*

7 Construction Details

Time zero	1/07/2012	*(dd/mm/yyyy)*

8 Time Frame Information

Date of economic evaluation	5/02/2014	*(dd/mm/yyyy)*

9 Traffic Growth

ROM daily traffic flow 2016	32600	*vehicles per day*
ROM daily traffic flow 2031	44500	*vehicles per day*
Annual geometric traffic growth	2.10%	

Worksheet 2 - Cost of the Do-minimum

1	**Road Type**	District Distributor A	
2	**PV of annual maintenance costs**		
		$4,549.52 *x 11.7023*	$53,239.85 **(a)**
3	**PV of periodic maintenance costs**		
	Proposed Rehab treatment measure	40mm SMA overlay	
	Rehab treatment cost		$21.50
	Site treatment area (from SLK to SLK)		15688.00 *m2*
	Rehab cost		$337,292.00

Periodic maintenance will be required in the following years:

Year	Type of Maintenance	Required?	Estimated Cost	SPPWF	PV
5	40mm SMA overlay	N/A	$337,292.00	0.680	N/A
10	40mm SMA overlay	N/A	$337,292.00	0.464	N/A
15	40mm SMA overlay	Yes	$337,292.00	0.320	$107,933.44
20	40mm SMA overlay	N/A	$337,292.00	0.210	N/A
25	40mm SMA overlay	N/A	$337,292.00	0.150	N/A
30	40mm SMA overlay	Yes	$337,292.00	0.100	$33,729.20

Sum of PV maintenance $141,662.64 **(b)**

4	**PV of annual associated operating cost**		
	Luminaire Type		ZE02C - 80MV
	Number of luminaires within study section		0 *units*
	Number of days luminaires are lit		365 *days*
	Total operating cost		$0.00
	PV of total operating cost	$0.00 *x 11.7023*	$0.00 **(c)**
5	**PV total Do-minimum maintenance costs**		
		(a) + (b) + (c)	$194,902.49 **A**

Worksheet 3 - Cost of the Option

1	**Road Type**	District Distributor A	

2 PV of estimated cost of proposed work (as per attached estimate sheet)

$6,755,592.00 *x 0.9259* $6,255,002.63 **(a)**

3 PV of routine maintenance costs following completion of the work

$9,836.80 *x 10.7398* $105,645.26 **(b)**

4 PV of maintenance cost in year 1

$4,549.52 **(c)**

5 PV of Option periodic maintenance cost

Proposed Rehab treatment measure	40mm SMA overlay
Rehab treatment cost	$21.50
Site treatment area (from SLK to SLK)	33920.00 *m2*
Rehab cost	$729,280.00

Periodic maintenance will be required in the following years:

Year	Type of Maintenance	Required?	Estimated Cost	SPPWF	PV
5	40mm SMA overlay	N/A	$729,280.00	0.680	N/A
10	40mm SMA overlay	N/A	$729,280.00	0.464	N/A
15	40mm SMA overlay	Yes	$729,280.00	0.320	$233,369.60
20	40mm SMA overlay	N/A	$729,280.00	0.210	N/A
25	40mm SMA overlay	N/A	$729,280.00	0.150	N/A
30	40mm SMA overlay	Yes	$729,280.00	0.100	$72,928.00

Sum of PV maintenance $306,297.60 **(d)**

6 PV of Annual associated operating cost

Luminaire Type	ZE20C - 70ML
Number of luminaires within study section	0 *units*
Number of days luminaires are lit	365 *days*
Total operating cost	$0.00

PV of annual operating costs (separate to maintenance costs)

Total $0.00 *x 10.7398* $0.00 **(e)**

7 PV total costs of the preferred option

(a) + (b) + (c) + (d) + (e) **$6,671,495.02 B**

Worksheet 4 - Travel Time Cost Savings

1	Road Type	District Distributor A
2	Project Type	Mid-block/mid-block as part of route improvement
3	Modelling Period Type	AM / Inter / PM peak periods

4 Midblock Assessment - Traffic Volumes

	DO MINIMUM					OPTION				
	Time Zero (veh/hr)	Year 2	Year 8	Year 15	Year 30	Time Zero (veh/hr)	Year 2	Year 8	Year 15	Year 30
AM Peak	1940	2022	2290	2648	2648	1940	2022	2290	2648	2648
Interpeak	1106	1153	1306	1510	1510	1106	1153	1306	1510	1510
PM Peak	1919	2000	2265	2619	2619	1919	2000	2265	2619	2619
AADT All periods	17520	18262	20683	23915	23915	17520	18262	20683	23915	23915

5 Do-minimum Modelling

	5A Project Timings from Annualisation Factors					5B Isolated Intersection				5C Road Midblock Improvement				5D Annual Travel Time Cost ($/year)				
			Time Periods		TTC	Modelling Results Inputs (veh.hr/hr)				Modelling Results Inputs (veh.hr/hr)								
	Time Period	Flow Factor	hours/day	days/year	$/HR	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
	Weekday AM Peak	1	2	245	$22.54	2.43	3.77	14.60	14.60	53.69	60.85	70.46	70.46	$593,030.12	$672,093.77	$778,254.93	$778,254.93	(a)
	Weekday Interpeak	1	8	245	$27.01	1.96	2.59	5.22	5.22	53.63	60.75	70.26	70.26	$2,839,058.68	$3,215,868.66	$3,719,364.50	$3,719,364.50	(b)
	Weekday PM Peak	1	2	245	$22.30	3.73	6.10	14.59	14.59	53.69	60.85	70.46	70.46	$586,715.69	$664,937.49	$769,968.27	$769,968.27	(c)
	Weekday Off Peak	0.25	12	245	$22.91	0.49	0.65	1.31	1.31	7.64	8.65	10.00	10.00	$514,509.61	$582,719.21	$673,810.80	$673,810.80	(d)
	Weekend Peak	0.45	8	120	$25.55	0.88	1.17	2.35	2.35	13.75	15.57	18.01	18.01	$337,297.04	$382,021.74	$441,754.16	$441,754.16	(e)
	Weekend Off Peak	0.15	16	120	$24.80	0.29	0.39	0.78	0.78	4.58	5.19	6.00	6.00	$218,222.54	$247,150.52	$285,781.90	$285,781.90	(f)
5E	All periods	N/A	24	365	$25.70	10	10	10	10	20.17	22.85	26.42	26.42	$4,541,633.70	$5,144,005.20	$5,948,600.28	$5,948,600.28	(g)
	(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)	(V)	(W)	(X)	(Y)	$5,088,833.67	$5,764,791.38	$6,668,934.56	$6,668,934.56	Total for All Day Periods
														$4,541,633.70	$5,144,005.20	$5,948,600.28	$5,948,600.28	Total for Day Long

6 Option Modelling

	6A Project Timings from Annualisation Factors					6B Isolated Intersection				6C Road Midblock Improvement				6D Annual Travel Time Cost ($/year)				
			Time Periods		TTC	Modelling Results Inputs (veh.hr/hr)				Modelling Results Inputs (veh.hr/hr)								
	Time Period	Flow Factor	hours/day	days/year	$/HR	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
	Weekday AM Peak	1	2	245	$22.54	2.49	2.94	3.94	3.94	53.62	60.74	70.24	70.24	$592,224.48	$670,802.94	$775,781.41	$775,781.41	(a)
	Weekday Interpeak	1	8	245	$27.01	2.19	2.58	3.43	3.43	53.60	60.71	70.21	70.21	$2,837,792.63	$3,214,097.81	$3,716,686.67	$3,716,686.67	(b)
	Weekday PM Peak	1	2	245	$22.30	3.23	3.87	5.46	5.46	53.62	60.74	70.24	70.24	$585,918.63	$663,660.41	$767,521.09	$767,521.09	(c)
	Weekday Off Peak	0.25	12	245	$22.91	0.55	0.65	0.86	0.86	7.64	8.65	10.00	10.00	$514,471.97	$582,670.12	$673,743.67	$673,743.67	(d)
	Weekend Peak	0.45	8	120	$25.55	0.99	1.16	1.54	1.54	13.75	15.57	18.01	18.01	$337,247.82	$381,956.55	$441,663.13	$441,663.13	(e)
	Weekend Off Peak	0.15	16	120	$24.80	0.33	0.39	0.51	0.51	4.58	5.19	6.00	6.00	$218,213.42	$247,138.71	$285,765.90	$285,765.90	(f)
6E	All periods	N/A	24	365	$25.70	10	10	10	10	20.17	22.84	26.41	26.41	$4,540,543.21	$5,142,534.42	$5,946,492.48	$5,946,492.48	(g)
	(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)	(V)	(W)	(X)	(Y)	$5,085,868.94	$5,760,326.53	$6,661,161.87	$6,661,161.87	Total for All Day Periods
														$4,540,543.21	$5,142,534.42	$5,946,492.48	$5,946,492.48	Total for Day Long

7 Annual Travel Time Cost for Modelled Years

		Annual Travel Time Cost ($/year) for modelled years					
		Start Year 2	End Year 7	Start Year 8	End Year 14	Start Year 15	End Year 30
	Travel Time Cost Do-minimum	$5,088,833.67	$5,764,791.38	$5,764,791.38	$6,668,934.56	$6,668,934.56	$6,668,934.56
	Travel Time Cost Option	$5,085,868.94	$5,760,326.53	$5,760,326.53	$6,661,161.87	$6,661,161.87	$6,661,161.87
	Midpoint	Year 4		Year 11.5		Year 22	
	Duration Years	6		7		16	
	Do-minimum TTC at midpoint	$5,426,812.53		$6,216,862.97		$6,668,934.56	
	Option TTC at midpoint	$5,423,097.74		$6,210,744.20		$6,661,161.87	
8	Midpoint Benefits	$3,714.79		$6,118.77		$7,772.70	
		m1		m2		m3	

9 PV Travel Time Cost Savings

[(m1 x 6 x 0.7416) + (m2 x 7 x 0.4511) + (m3 x 16 x 0.1958)] $60,200.89 C

Worksheet 5 - VOC and CO_2 Cost Savings

1	Road Type	District Distributor A
2	Project Type	Mid-block/mid-block as part of route improvement
3	Modelling Period Type	AM / Inter / PM peak periods
4	Do-minimum Traffic Flow	MID BLOCK ONLY

4A Project timings from Annualisation Factors				4B Traffic Flow Data (veh/hr)				
		Time periods						
Time Period	Flow Factor	Time periods (hrs/day)	Days/year	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	1	2	245	2022	2290	2648	2648	(a)
Weekday Interpeak	1	8	245	1153	1306	1510	1510	(b)
Weekday PM Peak	1	2	245	2000	2265	2619	2619	(c)
Weekday Off Peak	0.25	12	245	288	326	377	377	(d)
Weekend Peak	0.45	8	120	519	588	679	679	(e)
Weekend Off Peak	0.15	16	120	173	196	226	226	(f)
				AADT (veh/day)				
All periods	N/A	24	365	18262	20683	23915	23915	(g)
(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	

5	Option Traffic Flow	MID BLOCK ONLY

5A Project timings from Annualisation Factors				5B Traffic Flow Data (veh/hr)				
		Time periods						
Time Period	Flow Factor	Time periods (hrs/day)	Days/year	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	1	2	245	2022	2290	2648	2648	(a)
Weekday Interpeak	1	8	245	1153	1306	1510	1510	(b)
Weekday PM Peak	1	2	245	2000	2265	2619	2619	(c)
Weekday Off Peak	0.25	12	245	288	326	377	377	(d)
Weekend Peak	0.45	8	120	519	588	679	679	(e)
Weekend Off Peak	0.15	16	120	173	196	226	226	(f)
				AADT (veh/day)				
All periods	N/A	24	365	18262	20683	23915	23915	(g)
(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	

6 & 7	Vehicle Speeds and VOC costs - Do-minimum	

	# of Lanes	Interval	Hr	t0	Speed	Q	JA	tf (min/km)	rf	0.25*rf
Akcelik Link Parameters	2	10.00	60.00	0.75	80	1850	2.31	0.75	80.00	20.00

	Isolated intersection/intersection as part of route improvement				Mid-block/mid-block as part of route improvement								
	6A Mean Speed (km/hr)				6B Mean Speed (km/hr)				7A VOC Cost (cents/km)				
Year / Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	47	47	47	47	79.84	79.79	79.67	79.67	29.6	29.6	29.6	29.6	(a)
Weekday Interpeak	47	47	55	55	79.94	79.93	79.91	79.91	29.6	29.6	29.6	29.6	(b)
Weekday PM Peak	47	47	47	47	79.84	79.79	79.67	79.67	29.6	29.6	29.6	29.6	(c)
Weekday Off Peak	47	47	55	55	79.99	79.99	79.98	79.98	29.6	29.6	29.6	29.6	(d)
Weekend Peak	47	47	55	55	79.98	79.97	79.97	79.97	29.6	29.6	29.6	29.6	(e)
Weekend Off Peak	47	47	55	55	79.99	79.99	79.99	79.99	29.6	29.6	29.6	29.6	(f)
All periods	47	47	47	47	79.97	79.96	79.95	79.95	29.6	29.6	29.6	29.6	(g)

	Isolated intersection/intersection as part of route improvement				Mid-block/mid-block as part of route improvement								
	6C Total Travel Distance (veh.km/hr)				6D Total Travel Distance (veh.km/hr)				7B Annual VOC Cost ($/year)				
Year / Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	6	6	6	6	4287	4855	5614	5614	$621,790.91	$704,208.62	$814,268.80	$814,268.80	(a)
Weekday Interpeak	6	6	6	6	2444	2768	3201	3201	$1,417,939.69	$1,605,886.04	$1,856,868.64	$1,856,868.64	(b)
Weekday PM Peak	6	6	6	6	4241	4803	5553	5553	$615,060.19	$696,585.74	$805,454.55	$805,454.55	(c)
Weekday Off Peak	1.5	1.5	1.5	1.5	611	692	800	800	$531,727.38	$602,207.27	$696,325.74	$696,325.74	(d)
Weekend Peak	2.7	2.7	2.7	2.7	1100	1246	1440	1440	$312,525.48	$353,950.39	$409,269.01	$409,269.01	(e)
Weekend Off Peak	0.9	0.9	0.9	0.9	367	415	480	480	$208,350.32	$235,966.93	$272,846.00	$272,846.00	(f)
All periods	2	2	2	2	1613	1827	2113	2113	$4,182,861.90	$4,737,295.66	$5,477,683.68	$5,477,683.68	(g)
									$3,707,393.97	$4,198,804.98	$4,855,032.73	$4,855,032.73	Total for All Day periods
									$4,182,861.90	$4,737,295.66	$5,477,683.68	$5,477,683.68	Total for day long

8 & 9 Vehicle Speeds and VOC costs - Option

	# of Lanes	Interval	Hr	t0	Speed	Q	JA	tf (min/km)	rf	0.25*rf
Akcelik Link Parameters	4	10.00	60.00	0.75	80	1850	2.31	0.75	80.00	20.00

	Isolated intersection/intersection as part of route improvement				Mid-block/mid-block as part of route improvement								
	8A Mean Speed (km/hr)				8B Mean Speed (km/hr)				9A VOC Cost (cents/km)				
Year / **Time period**	*Year 2*	*Year 8*	*Year 15*	*Year 30*	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	45	45	45	45	79.95	79.94	79.93	79.93	29.6	29.6	29.6	29.6	(a)
Weekday Interpeak	45	45	45	45	79.98	79.97	79.97	79.97	29.6	29.6	29.6	29.6	(b)
Weekday PM Peak	45	45	45	45	79.95	79.94	79.93	79.93	29.6	29.6	29.6	29.6	(c)
Weekday Off Peak	45	45	45	45	79.99	79.99	79.99	79.99	29.6	29.6	29.6	29.6	(d)
Weekend Peak	45	45	45	45	79.99	79.99	79.99	79.99	29.6	29.6	29.6	29.6	(e)
Weekend Off Peak	45	45	45	45	80.00	80.00	80.00	80.00	29.6	29.6	29.6	29.6	(f)
All periods	35	35	35	35	79.98	79.98	79.98	79.98	29.6	29.6	29.6	29.6	(g)

	Isolated intersection/intersection as part of route improvement				Mid-block/mid-block as part of route improvement								
	8C Total Travel Distance (veh.km/hr)				8D Total Travel Distance (veh.km/hr)				9B Annual VOC Cost ($/year)				
Year / **Time period**	*Year 2*	*Year 8*	*Year 15*	*Year 30*	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	5	5	5	5	4287	4855	5614	5614	$621,790.91	$704,208.62	$814,268.80	$814,268.80	(a)
Weekday Interpeak	5	5	5	5	2444	2768	3201	3201	$1,417,939.69	$1,605,886.04	$1,856,868.64	$1,856,868.64	(b)
Weekday PM Peak	5	5	5	5	4241	4803	5553	5553	$615,060.19	$696,585.74	$805,454.55	$805,454.55	(c)
Weekday Off Peak	1.25	1.25	1.25	1.25	611	692	800	800	$531,727.38	$602,207.27	$696,325.74	$696,325.74	(d)
Weekend Peak	2.25	2.25	2.25	2.25	1100	1246	1440	1440	$312,525.48	$353,950.39	$409,269.01	$409,269.01	(e)
Weekend Off Peak	0.75	0.75	0.75	0.75	367	415	480	480	$208,350.32	$235,966.93	$272,846.00	$272,846.00	(f)
All periods	5	5	5	5	1613	1827	2113	2113	$4,182,861.90	$4,737,295.66	$5,477,683.68	$5,477,683.68	(g)
									$3,707,393.97	$4,198,804.98	$4,855,032.73	$4,855,032.73	Total for All Day periods
									$4,182,861.90	$4,737,295.66	$5,477,683.68	$5,477,683.68	Total for day long

10 Annual Vehicle Operating Cost for Modelled Years

	Annual Vehicle Operating Cost ($/year) for modelled years					
	Start Year 2	End Year 7	Start Year 8	End Year 14	Start Year 15	End Year 30
Annual VOC Cost - Do-minimum	$3,707,393.97	$4,198,804.98	$4,198,804.98	$4,855,032.73	$4,855,032.73	$4,855,032.73
Annual VOC Cost - Option	$3,707,393.97	$4,198,804.98	$4,198,804.98	$4,855,032.73	$4,855,032.73	$4,855,032.73

Midpoint	Year 4	11.5	22
Duration Years	6	7	16
Do-minimum VOC at midpoint	$3,953,099.48	$4,526,918.86	$4,855,032.73
Option VOC at midpoint	$3,953,099.48	$4,526,918.86	$4,855,032.73
11 *Midpoint Benefits*	$0.00	$0.00	$0.00
	m1	m2	m3

12 PV Vehicle Operation Cost Savings

[(m1 x 6 x 0.7416) + (m2 x 7 x 0.4511) + (m3 x 16 x 0.1958)] $0.00 D

Worksheet 6 - Crash Cost Savings

1	**Project Type**	Mid-block/mid-block as part of route improvement	

2	**Crash Summary**

Total Crashes - 33
3 - Hospital, 6 - Medical, 21 - PDO Major, 3 - PDO Minor
Main Crash Type - Rear End

3	**Counter Measures**

Install raised median - reduce head-on crashes

4	**Net PV of Crash Cost Savings (from CARS)**

	$0.00	*NPV*

5	**Annual Crash Cost Savings**

NPV / 4.329906	$0.00	*ACCS*

6	**Crash Growth Rate**

Crash growth rate		1.10%	*R*
Discount rate		8.00%	*DR*
Discount factor crash costs	*(1-((1+R)/(1+DR))^30)/(DR-R)] - [(1-((1+R)/(1+DR))^1)/(DR-R)]}*	11.56	*DFCC*

7	**PV Crash Cost Saving**

*ACCS * DFCC*	$0.00	**E**

Worksheet 7 - Non Tangible Benefits

1 Public Transport

Effect	Description	Score
Neutral	No expected change on overall public transport performance with no specific new/upgraded public transport infrastructure provided or removed.	0

Justification	There are no bus routes provided along the project route between Beechboro Road North to Dumpelliar Drive and there are no improvements suggested for public transport as part of this project.

2 Pedestrian Facilities

Effect	Description	Score
Positive	Demonstrated enhancement of existing pedestrian facilities to assist walking either along or across the road with measures meeting absolute minimum standards set out in appropriate MRWA and Austroads design guides with isolated facilities to meet existing demand. Low to moderate levels of pedestrian activity adjacent to or crossing the road length.	5

Justification	Central Median will provide a refuge for any pedestrians crossing the road

3 Cycling Facilities

Effect	Description	Score
Positive	Low to moderate levels of existing (or expected) cycling activity along a recognised designated existing cycling route or a route denoted as such within a Council's Local Bike Plan. Demonstrated enhancement of existing cycling facilities either along or across the road length under consideration with measures connecting to other facilities and meeting minimum standards set out in appropriate MRWA and Austroads design guides.	5

Justification	Provision of on-road 1.8m cycle lane along length of road.

4 Street Lighting

Score
0

Justification	There will be no improvements to the street lighting along this midblock section.

5 Road Safety

Effect	Description	Score
Neutral	A positive (+) or negative (-) NPV score has been entered into Worksheet 6 – Crash Costs, or the proposed measures have negligible impact on road safety overall.	0

Justification	The proposed measures have no impact on road safety overall.

6 Overall Score

10 F

Worksheet 8 - Overall Score

1 Present Value (PV) cost of Do-minimum

	$194,902.49	A worksheet 2

2 Present Value (PV) cost of Option

	$6,671,495.02	B worksheet 3

3 Unconstrained Benefit values

PV travel time cost savings	$60,200.89	C worksheet 4	*x update factor TTC*	1	$60,200.89	W
PV VOC and CO2 savings	$0.00	D worksheet 5	*x update factor VOC*	1	$0.00	Y
PV Crash cost savings	$0.00	E worksheet 6	*x update factor AC*	1	$0.00	Z

4 Ratio of Unconstrained Benefit to Cost

PV net unconstrained benefits / PV net costs	*(W + Y + Z) / (B - A)*	0.01
Score		0.01

5 FYRR

Discount Factor VOC	*{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}*	10.76345372	
Discount Factor TTC	*{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}*	10.76345372	
Discount Factor CC	*{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}*	10.75216952	
PV 1st Year benefits / PV net costs	*[(W+Y)/DF(voc&ttc)+Z/DFcc)] x 0.93 / (B - A)*	0.08	*%*

6 Non Tangible Benefit Score

10	F worksheet 7

7 Total Score

2.51	out of a possible score of 50

Gnangara Road /Gaskell Avenue Intersection

Worksheet 1 - Project Description

1 Applicant's Details

Organisation Name	City of Swan
MRRG Reference	3
Assessor(s) name and position	Kevin de Silva
Reviewer(s) name and position	Tim Selby

Legend
- *Calculated value*
- *Free-text user input*
- *Dropdown selection*

2 Project Overview

Project Name	Gnangara Road MRRG Improvement Submission
Project Type	Isolated intersection/intersection as part of route improvement
Mid-block section/intersection under consideration	Gnangara Road 6.92 SLK to 7.17 SLK
Road Type	District Distributor A

3 Problem Description

Describe issue/problems to be addressed	Intersection performance / capacity issues with vehicles turning in and out of the intersection.

4 Location Details

Brief description of location	Gaskell Avenue / Gnangara Road Intersection, Swan.

5 Project Strategic Alignment Yes

Justification	The project is listed under the EMRC's Regional Integrated Transport Strategy Action Plan 20120-2013.

6 Project Details

Describe the do-minimum	T - Intersection
Summarise options assessed	Seagull Intersection

	Do Minimum	Option	
Length	0.25	0.25	*km*
Total number of traffic lanes	2.00	4.00	
Urban/rural	Rural Road	Rural Road	
Speed limit	90.00	90.00	*km/h*

7 Construction Details

Time zero	1/07/2012	*(dd/mm/yyyy)*

8 Time Frame Information

Date of economic evaluation	5/02/2014	*(dd/mm/yyyy)*

9 Traffic Growth

ROM daily traffic flow 2016	32600	*vehicles per day*
ROM daily traffic flow 2031	44500	*vehicles per day*
Annual geometric traffic growth	2.10%	

Worksheet 2 - Cost of the Do-minimum

1	**Road Type**	District Distributor A	

2	**PV of annual maintenance costs**		
	$819.25	*x 11.7023*	$9,587.11 **(a)**

3 PV of periodic maintenance costs

Proposed Rehab treatment measure	40mm SMA overlay	
Rehab treatment cost	$21.50	
Site treatment area (from SLK to SLK)	2825.00	*m2*
Rehab cost	$60,737.50	

Periodic maintenance will be required in the following years:

Year	Type of Maintenance	Required?	Estimated Cost	SPPWF	PV
5	40mm SMA overlay	N/A	$60,737.50	0.680	N/A
10	40mm SMA overlay	N/A	$60,737.50	0.464	N/A
15	40mm SMA overlay	Yes	$60,737.50	0.320	$19,436.00
20	40mm SMA overlay	N/A	$60,737.50	0.210	N/A
25	40mm SMA overlay	N/A	$60,737.50	0.150	N/A
30	40mm SMA overlay	Yes	$60,737.50	0.100	$6,073.75

Sum of PV maintenance $25,509.75 **(b)**

4 PV of annual associated operating cost

Luminaire Type	ZE02C - 80MV	
Number of luminaires within study section	0	*units*
Number of days luminaires are lit	365	*days*
Total operating cost	$0.00	

PV of total operating cost

$0.00 *x 11.7023* $0.00 **(c)**

5 PV total Do-minimum maintenance costs

(a) + (b) + (c) $35,096.86 **A**

Worksheet 3 - Cost of the Option

1 Road Type — District Distributor A

2 PV of estimated cost of proposed work (as per attached estimate sheet)

$796,650.00 *x 0.9259* — $737,618.24 **(a)**

3 PV of routine maintenance costs following completion of the work

$1,522.50 *x 10.7398* — $16,351.35 **(b)**

4 PV of maintenance cost in year 1

$819.25 **(c)**

5 PV of Option periodic maintenance cost

Proposed Rehab treatment measure	40mm SMA overlay
Rehab treatment cost	$21.50
Site treatment area (from SLK to SLK)	5250.00 *m2*
Rehab cost	$112,875.00

Periodic maintenance will be required in the following years:

Year	Type of Maintenance	Required?	Estimated Cost	SPPWF	PV
5	40mm SMA overlay	N/A	$112,875.00	0.680	N/A
10	40mm SMA overlay	N/A	$112,875.00	0.464	N/A
15	40mm SMA overlay	Yes	$112,875.00	0.320	$36,120.00
20	40mm SMA overlay	N/A	$112,875.00	0.210	N/A
25	40mm SMA overlay	N/A	$112,875.00	0.150	N/A
30	40mm SMA overlay	Yes	$112,875.00	0.100	$11,287.50

Sum of PV maintenance $47,407.50 **(d)**

6 PV of Annual associated operating cost

Luminaire Type	ZE20C - 70ML
Number of luminaires within study section	0 *units*
Number of days luminaires are lit	365 *days*
Total operating cost	$0.00

PV of annual operating costs (separate to maintenance costs)

Total $0.00 *x 10.7398* — $0.00 **(e)**

7 PV total costs of the preferred option

(a) + (b) + (c) + (d) + (e) **$802,196.33** **B**

Worksheet 4 - Travel Time Cost Savings

1	Road Type	District Distributor A
2	Project Type	Isolated intersection/intersection as part of route improvement
3	Modelling Period Type	AM / Inter / PM peak periods

4 Midblock Assessment - Traffic Volumes

	DO MINIMUM					OPTION				
	Time Zero (veh/hr)	Year 2	Year 8	Year 15	Year 30	Time Zero (veh/hr)	Year 2	Year 8	Year 15	Year 30
AM Peak	1700	1772	2007	2321	2321	1700	1772	2007	2321	2321
Interpeak	1000	1042	1181	1365	1365	1000	1042	1181	1365	1365
PM Peak	1800	1876	2125	2457	2457	1800	1876	2125	2457	2457
AADT All periods	17520	18262	20683	23915	23915	17520	18262	20683	23915	23915

5 Do-minimum Modelling

	5A Project Timings from Annualisation Factors					5B Isolated Intersection				5C Road Midblock Improvement				5D Annual Travel Time Cost ($/year)				
			Time Periods		TTC	Modelling Results Inputs (veh.hr/hr)				Modelling Results Inputs (veh.hr/hr)								
	Time Period	Flow Factor	hours/day	days/year	$/HR	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
	Weekday AM Peak	1	2	245	$22.54	3.34	3.71	4.78	4.78	5.55	6.28	7.27	7.27	$36,888.96	$40,975.47	$52,793.19	$52,793.19	(a)
	Weekday Interpeak	1	8	245	$27.01	3.48	3.54	3.8	3.80	5.54	6.28	7.26	7.26	$184,229.81	$187,406.18	$201,170.48	$201,170.48	(b)
	Weekday PM Peak	1	2	245	$22.30	2.71	2.82	3.33	3.33	5.55	6.28	7.27	7.27	$29,612.17	$30,814.14	$36,386.91	$36,386.91	(c)
	Weekday Off Peak	0.25	12	245	$22.91	0.87	0.89	0.95	0.95	0.81	0.92	1.07	1.07	$58,599.20	$59,609.53	$63,987.63	$63,987.63	(d)
	Weekend Peak	0.45	8	120	$25.55	1.57	1.59	1.71	1.71	1.47	1.66	1.92	1.92	$38,410.85	$39,073.10	$41,942.88	$41,942.88	(e)
	Weekend Off Peak	0.15	16	120	$24.80	0.52	0.53	0.57	0.57	0.49	0.55	0.64	0.64	$24,855.55	$25,284.10	$27,141.12	$27,141.12	(f)
5E	All periods	N/A	24	365	$25.70	10	10	10	10	2.38	2.69	3.12	3.12	$2,251,320.00	$2,251,320.00	$2,251,320.00	$2,251,320.00	(g)
	(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)	(V)	(W)	(X)	(Y)	$372,596.54	$383,162.52	$423,422.21	$423,422.21	Total for All Day Periods
														$2,251,320.00	$2,251,320.00	$2,251,320.00	$2,251,320.00	Total for Day Long

6 Option Modelling

	6A Project Timings from Annualisation Factors					6B Isolated Intersection				6C Road Midblock Improvement				6D Annual Travel Time Cost ($/year)				
			Time Periods		TTC	Modelling Results Inputs (veh.hr/hr)				Modelling Results Inputs (veh.hr/hr)								
	Time Period	Flow Factor	hours/day	days/year	$/HR	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
	Weekday AM Peak	1	2	245	$22.54	3.29	3.59	4.33	4.33	5.54	6.28	7.26	7.26	$36,336.73	$39,650.11	$47,823.12	$47,823.12	(a)
	Weekday Interpeak	1	8	245	$27.01	3.46	3.5	3.71	3.71	5.54	6.27	7.25	7.25	$183,171.02	$185,288.60	$196,405.92	$196,405.92	(b)
	Weekday PM Peak	1	2	245	$22.30	2.7	2.76	2.99	2.99	5.54	6.28	7.26	7.26	$29,502.90	$30,158.52	$32,671.73	$32,671.73	(c)
	Weekday Off Peak	0.25	12	245	$22.91	0.87	0.88	0.93	0.93	0.81	0.92	1.07	1.07	$58,262.42	$58,935.98	$62,472.13	$62,472.13	(d)
	Weekend Peak	0.45	8	120	$25.55	1.56	1.58	1.67	1.67	1.47	1.66	1.92	1.92	$38,190.10	$38,631.60	$40,949.50	$40,949.50	(e)
	Weekend Off Peak	0.15	16	120	$24.80	0.52	0.53	0.56	0.56	0.49	0.55	0.64	0.64	$24,712.70	$24,998.40	$26,498.30	$26,498.30	(f)
6E	All periods	N/A	24	365	$25.70	10	10	10	10	2.38	2.69	3.11	3.11	$2,251,320.00	$2,251,320.00	$2,251,320.00	$2,251,320.00	(g)
	(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)	(V)	(W)	(X)	(Y)	$370,175.87	$377,663.21	$406,820.70	$406,820.70	Total for All Day Periods
														$2,251,320.00	$2,251,320.00	$2,251,320.00	$2,251,320.00	Total for Day Long

7 Annual Travel Time Cost for Modelled Years

		Annual Travel Time Cost ($/year) for modelled years					
		Start Year 2	End Year 7	Start Year 8	End Year 14	Start Year 15	End Year 30
	Travel Time Cost Do-minimum	$372,596.54	$383,162.52	$383,162.52	$423,422.21	$423,422.21	$423,422.21
	Travel Time Cost Option	$370,175.87	$377,663.21	$377,663.21	$406,820.70	$406,820.70	$406,820.70
	Midpoint	Year 4		Year 11.5		Year 22	
	Duration Years	6		7		16	
	Do-minimum TTC at midpoint	$377,879.53		$403,292.36		$423,422.21	
	Option TTC at midpoint	$373,919.54		$392,241.95		$406,820.70	
8	Midpoint Benefits	$3,959.99		$11,050.41		$16,601.51	
		m1		m2		m3	

9 PV Travel Time Cost Savings

[(m1 x 6 x 0.7416) + (m2 x 7 x 0.4511) + (m3 x 16 x 0.1958)] $104,523.46 C

Worksheet 5 - VOC and CO_2 Cost Savings

1	Road Type	District Distributor A
2	Project Type	Isolated intersection/intersection as part of route improvement
3	Modelling Period Type	AM / Inter / PM peak periods
4	Do-minimum Traffic Flow	MID BLOCK ONLY

4A Project timings from Annualisation Factors				4B Traffic Flow Data (veh/hr)				
		Time periods						
Time Period	Flow Factor	Time periods (hrs/day)	Days/year	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	1	2	245	1772	2007	2321	2321	(a)
Weekday Interpeak	1	8	245	1042	1181	1365	1365	(b)
Weekday PM Peak	1	2	245	1876	2125	2457	2457	(c)
Weekday Off Peak	0.25	12	245	261	295	341	341	(d)
Weekend Peak	0.45	8	120	469	531	614	614	(e)
Weekend Off Peak	0.15	16	120	156	177	205	205	(f)
				AADT (veh/day)				
All periods	N/A	24	365	18262	20683	23915	23915	(g)
(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	

5	Option Traffic Flow	MID BLOCK ONLY

5A Project timings from Annualisation Factors				5B Traffic Flow Data (veh/hr)				
		Time periods						
Time Period	Flow Factor	Time periods (hrs/day)	Days/year	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	1	2	245	1772	2007	2321	2321	(a)
Weekday Interpeak	1	8	245	1042	1181	1365	1365	(b)
Weekday PM Peak	1	2	245	1876	2125	2457	2457	(c)
Weekday Off Peak	0.25	12	245	261	295	341	341	(d)
Weekend Peak	0.45	8	120	469	531	614	614	(e)
Weekend Off Peak	0.15	16	120	156	177	205	205	(f)
				AADT (veh/day)				
All periods	N/A	24	365	18262	20683	23915	23915	(g)
(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	

6 & 7	Vehicle Speeds and VOC costs - Do-minimum

	# of Lanes	Interval	Hr	t0	Speed	Q	JA	tf (min/km)	rf	0.25*rf
Akcelik Link Parameters	2	10.00	60.00	0.75	80	1850	2.31	0.75	80.00	20.00

	Isolated intersection/intersection as part of route improvement				Mid-block/mid-block as part of route improvement								
Year	6A Mean Speed (km/hr)				6B Mean Speed (km/hr)				7A VOC Cost (cents/km)				
Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	73.4	74.1	73.3	73.3	79.87	79.83	79.76	79.76	29.14	29.14	29.14	29.14	(a)
Weekday Interpeak	64.6	67.1	68.9	68.9	79.95	79.94	79.92	79.92	28.51	28.51	28.77	28.77	(b)
Weekday PM Peak	75.3	76.5	76.8	76.8	79.87	79.83	79.76	79.76	29.14	29.14	29.14	29.14	(c)
Weekday Off Peak	64.6	67.1	68.9	68.9	79.99	79.99	79.99	79.99	28.51	28.51	28.77	28.77	(d)
Weekend Peak	64.6	67.1	68.9	68.9	79.98	79.98	79.97	79.97	28.51	28.51	28.77	28.77	(e)
Weekend Off Peak	64.6	67.1	68.9	68.9	79.99	79.99	79.99	79.99	28.51	28.51	28.77	28.77	(f)
All periods	47	47	47	47	79.97	79.96	79.95	79.95	29.2	29.2	29.2	29.2	(g)

	Isolated intersection/intersection as part of route improvement				Mid-block/mid-block as part of route improvement								
Year	6C Total Travel Distance (veh.km/hr)				6D Total Travel Distance (veh.km/hr)				7B Annual VOC Cost ($/year)				
Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	1497.4	1762.1	2130.5	2130.5	443	502	580	580	$213,807.76	$251,603.21	$304,205.57	$304,205.57	(a)
Weekday Interpeak	849.2	999.3	1208.3	1208.3	261	295	341	341	$474,529.56	$558,404.84	$681,350.70	$681,350.70	(b)
Weekday PM Peak	1469.7	1729.5	2091.2	2091.2	469	531	614	614	$209,852.58	$246,948.39	$298,594.08	$298,594.08	(c)
Weekday Off Peak	212.3	249.825	302.075	302.075	65	74	85	85	$177,948.59	$209,401.82	$255,506.51	$255,506.51	(d)
Weekend Peak	382.14	449.685	543.735	543.735	117	133	154	154	$104,590.19	$123,076.99	$150,175.26	$150,175.26	(e)
Weekend Off Peak	127.38	149.895	181.245	181.245	39	44	51	51	$69,726.79	$82,051.32	$100,116.84	$100,116.84	(f)
All periods	2	2	2	2	190	215	249	249	$5,115.84	$5,115.84	$5,115.84	$5,115.84	(g)
									$1,250,455.47	$1,471,486.57	$1,789,948.97	$1,789,948.97	Total for All Day periods
									$5,115.84	$5,115.84	$5,115.84	$5,115.84	Total for day long

8 & 9 Vehicle Speeds and VOC costs - Option

	# of Lanes	Interval	Hr	t0	Speed	Q	JA	tf (min/km)	rf	0.25*rf
Akcelik Link Parameters	4	10.00	60.00	0.75	80	1850	2.31	0.75	80.00	20.00

	Isolated intersection/intersection as part of route improvement				Mid-block/mid-block as part of route improvement								
	8A Mean Speed (km/hr)				8B Mean Speed (km/hr)				9A VOC Cost (cents/km)				
Year / Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	73.5	74.4	74.4	74.4	79.96	79.95	79.94	79.94	29.1	29.1	29.1	29.1	(a)
Weekday Interpeak	64.6	67.1	69.2	69.2	79.98	79.97	79.97	79.97	28.5	28.5	28.8	28.8	(b)
Weekday PM Peak	75.3	76.7	77.7	77.7	79.96	79.95	79.94	79.94	29.1	29.1	29.6	29.6	(c)
Weekday Off Peak	64.6	67.1	69.2	69.2	80.00	79.99	79.99	79.99	28.5	28.5	28.8	28.8	(d)
Weekend Peak	64.6	67.1	69.2	69.2	79.99	79.99	79.99	79.99	28.5	28.5	28.8	28.8	(e)
Weekend Off Peak	64.6	67.1	69.2	69.2	80.00	80.00	80.00	80.00	28.5	28.5	28.8	28.8	(f)
All periods	35	35	35	35	79.98	79.98	79.98	79.98	31.2	31.2	31.2	31.2	(g)

	Isolated intersection/intersection as part of route improvement				*Mid-block/mid-block as part of route improvement*								
	8C Total Travel Distance (veh.km/hr)				*8D Total Travel Distance (veh.km/hr)*				9B Annual VOC Cost ($/year)				
Year / Time period	Year 2	Year 8	Year 15	Year 30	*Year 2*	*Year 8*	*Year 15*	*Year 30*	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	1498.2	1763	2131.7	2131.7	443	502	580	580	$213,921.99	$251,731.72	$304,376.92	$304,376.92	(a)
Weekday Interpeak	849.9	1000.2	1209.3	1209.3	261	295	341	341	$474,920.72	$558,907.76	$681,914.60	$681,914.60	(b)
Weekday PM Peak	1469.9	1729.7	2091.5	2091.5	469	531	614	614	$209,881.14	$246,976.94	$303,351.16	$303,351.16	(c)
Weekday Off Peak	212.475	250.05	302.325	302.325	65	74	85	85	$178,095.27	$209,590.41	$255,717.97	$255,717.97	(d)
Weekend Peak	382.455	450.09	544.185	544.185	117	133	154	154	$104,676.40	$123,187.83	$150,299.54	$150,299.54	(e)
Weekend Off Peak	127.485	150.03	181.395	181.395	39	44	51	51	$69,784.27	$82,125.22	$100,199.70	$100,199.70	(f)
All periods	5	5	5	5	190	215	249	249	$13,665.60	$13,665.60	$13,665.60	$13,665.60	(g)
									$1,251,279.79	$1,472,519.89	$1,795,859.88	$1,795,859.88	Total for All Day periods
									$13,665.60	$13,665.60	$13,665.60	$13,665.60	Total for day long

10 Annual Vehicle Operating Cost for Modelled Years

	Annual Vehicle Operating Cost ($/year) for modelled years					
	Start Year 2	End Year 7	Start Year 8	End Year 14	Start Year 15	End Year 30
Annual VOC Cost - Do-minimum	$1,250,455.47	$1,471,486.57	$1,471,486.57	$1,789,948.97	$1,789,948.97	$1,789,948.97
Annual VOC Cost - Option	$1,251,279.79	$1,472,519.89	$1,472,519.89	$1,795,859.88	$1,795,859.88	$1,795,859.88

Midpoint	Year 4	11.5	22
Duration Years	6	7	16
Do-minimum VOC at midpoint	$1,360,971.02	$1,630,717.77	$1,789,948.97
Option VOC at midpoint	$1,361,899.84	$1,634,189.88	$1,795,859.88
11 *Midpoint Benefits*	-$928.82	-$3,472.12	-$5,910.92
	m1	m2	m3

12 PV Vehicle Operation Cost Savings

[(m1 x 6 x 0.7416) + (m2 x 7 x 0.4511) + (m3 x 16 x 0.1958)] -$33,614.49 D

Worksheet 6 - Crash Cost Savings

1	**Project Type**	**Isolated intersection/intersection as part of route improvement**	

2	**Crash Summary**

Total Crashes - 2
1-PDO Major, 1-PDO Minor
Main Crash Type Rear End and Side Swipe Crashes

3	**Counter Measures**

Install Seagull Intersection
Allow right turning traffic to position themselves within the median until they have an opportunity to complete their turning manouvre.

4	**Net PV of Crash Cost Savings (from CARS)**

$146,567.02 *NPV*

5	**Annual Crash Cost Savings**

NPV / 4.329906 **$33,849.93** *ACCS*

6	**Crash Growth Rate**

Crash growth rate		**1.10%**	*R*
Discount rate		**8.00%**	*DR*
Discount factor crash costs	*(1-((1+R)/(1+DR))^30)/(DR-R)] - [(1-((1+R)/(1+DR))^1)/(DR-R)]}*	**11.56**	*DFCC*

7	**PV Crash Cost Saving**

*ACCS * DFCC* **$391,387.88** **E**

Worksheet 7 - Non Tangible Benefits

1 Public Transport

Effect	Description	Score
Neutral	No expected change on overall public transport performance with no specific new/upgraded public transport infrastructure provided or removed.	0

Justification	There are no bus routes provided along the project route between Beechboro Road North to Dumpelliar Drive and there are no improvements suggested for public transport as part of this project.

2 Pedestrian Facilities

Effect	Description	Score
Positive	Demonstrated enhancement of existing pedestrian facilities to assist walking either along or across the road with measures meeting absolute minimum standards set out in appropriate MRWA and Austroads design guides with isolated facilities to meet existing demand. Low to moderate levels of pedestrian activity adjacent to or crossing the road length.	5

Justification	Central Median will provide a refuge for any pedestrians crossing the road

3 Cycling Facilities

Effect	Description	Score
Positive	Low to moderate levels of existing (or expected) cycling activity along a recognised designated existing cycling route or a route denoted as such within a Council's Local Bike Plan. Demonstrated enhancement of existing cycling facilities either along or across the road length under consideration with measures connecting to other facilities and meeting minimum standards set out in appropriate MRWA and Austroads design guides.	5

Justification	Provision of on-road 1.8m cycle lane along length of road.

4 Street Lighting

Score
0

Justification	At present there is no street lighting. The proposed intersection will also not have any street lighting. Therefore there is no change in service level.

5 Road Safety

Effect	Description	Score
Positive	*The proposed measures and design are intended to minimise the overall number and severity of crashes. A road safety audit has already been undertaken and any concerns have been addressed and mitigated against as part of the design.*	*6*

Justification	

6 Overall Score

10 F

Worksheet 8 - Overall Score

1 Present Value (PV) cost of Do-minimum

	$35,096.86	**A worksheet 2**

2 Present Value (PV) cost of Option

	$802,196.33	**B worksheet 3**

3 Unconstrained Benefit values

PV travel time cost savings	$104,523.46	**C worksheet 4**	*x update factor TTC*	1	$104,523.46	**W**
PV VOC and CO2 savings	-$33,614.49	**D worksheet 5**	*x update factor VOC*	1	-$33,614.49	**Y**
PV Crash cost savings	$391,387.88	**E worksheet 6**	*x update factor AC*	1	$391,387.88	**Z**

4 Ratio of Unconstrained Benefit to Cost

PV net unconstrained benefits / PV net costs	*(W + Y + Z) / (B - A)*	0.60
Score		0.60

5 FYRR

Discount Factor VOC	*{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}*	10.76345372	
Discount Factor TTC	*{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}*	10.76345372	
Discount Factor CC	*{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}*	10.75216952	
PV 1st Year benefits / PV net costs	*[(W+Y)/DF(voc&ttc)+Z/DFcc)] x 0.93 / (B - A)*	5.21	%

6 Non Tangible Benefit Score

	10	**F worksheet 7**

7 Total Score

	2.95	**out of a possible score of 50**

Gnangara Road mid-block between Gaskell Avenue and Drumpelliar Drive

Worksheet 1 - Project Description

1 Applicant's Details

Organisation Name	City of Swan	**Legend**
MRRG Reference	4	*Calculated value*
Assessor(s) name and position	Kevin de Silva	*Free-text user input*
Reviewer(s) name and position	Tim Selby	*Dropdown selection*

2 Project Overview

Project Name	Gnangara Road MRRG Improvement Submission
Project Type	Mid-block/mid-block as part of route improvement
Mid-block section/intersection under consideration	Gnangara Road 7.17 SLK to 7.84 SLK
Road Type	District Distributor A

3 Problem Description

Describe issue/problems to be addressed	High volumes of traffic travelling along this section of road. Issues with road capacity.

4 Location Details

Brief description of location	Gnangara Road between Beechboro Road North and Gaskell Ave.

5 Project Strategic Alignment Yes

Justification	The project is listed under the EMRC's Regional Integrated Transport Strategy Action Plan 20120-2013.

6 Project Details

Describe the do-minimum	2 Lane Single Carriageway
Summarise options assessed	4 Lane Dual Carriageway

	Do Minimum	Option	
Length	0.67	0.67	*km*
Total number of traffic lanes	2.00	4.00	
Urban/rural	Rural Road	Rural Road	
Speed limit	90.00	90.00	*km/h*

7 Construction Details

Time zero	1/07/2012	*(dd/mm/yyyy)*

8 Time Frame Information

Date of economic evaluation	5/02/2014	*(dd/mm/yyyy)*

9 Traffic Growth

ROM daily traffic flow 2016	32600	*vehicles per day*
ROM daily traffic flow 2031	44500	*vehicles per day*
Annual geometric traffic growth	2.10%	

Worksheet 2 - Cost of the Do-minimum

1 Road Type District Distributor A

2 PV of annual maintenance costs

$1,437.82 *x 11.7023* $16,825.80 **(a)**

3 PV of periodic maintenance costs

Proposed Rehab treatment measure	40mm SMA overlay	
Rehab treatment cost	$21.50	
Site treatment area (from SLK to SLK)	4958.00	*m2*
Rehab cost	$106,597.00	

Periodic maintenance will be required in the following years:

Year	Type of Maintenance	Required?	Estimated Cost	SPPWF	PV
5	40mm SMA overlay	N/A	$106,597.00	0.680	N/A
10	40mm SMA overlay	N/A	$106,597.00	0.464	N/A
15	40mm SMA overlay	Yes	$106,597.00	0.320	$34,111.04
20	40mm SMA overlay	N/A	$106,597.00	0.210	N/A
25	40mm SMA overlay	N/A	$106,597.00	0.150	N/A
30	40mm SMA overlay	Yes	$106,597.00	0.100	$10,659.70

Sum of PV maintenance $44,770.74 **(b)**

4 PV of annual associated operating cost

Luminaire Type	ZE02C - 80MV	
Number of luminaires within study section	0	*units*
Number of days luminaires are lit	365	*days*
Total operating cost	$0.00	

PV of total operating cost

$0.00 *x 11.7023* $0.00 **(c)**

5 PV total Do-minimum maintenance costs

(a) + (b) + (c) $61,596.54 **A**

Worksheet 3 - Cost of the Option

1	**Road Type**	District Distributor A	

2 PV of estimated cost of proposed work (as per attached estimate sheet)

$2,135,022.00 *x 0.9259* $1,976,816.87 **(a)**

3 PV of routine maintenance costs following completion of the work

$3,108.80 *x 10.7398* $33,387.89 **(b)**

4 PV of maintenance cost in year 1

$1,437.82 **(c)**

5 PV of Option periodic maintenance cost

Proposed Rehab treatment measure	40mm SMA overlay	
Rehab treatment cost	$21.50	
Site treatment area (from SLK to SLK)	10720.00	*m2*
Rehab cost	$230,480.00	

Periodic maintenance will be required in the following years:

Year	Type of Maintenance	Required?	Estimated Cost	SPPWF	PV
5	40mm SMA overlay	N/A	$230,480.00	0.680	N/A
10	40mm SMA overlay	N/A	$230,480.00	0.464	N/A
15	40mm SMA overlay	Yes	$230,480.00	0.320	$73,753.60
20	40mm SMA overlay	N/A	$230,480.00	0.210	N/A
25	40mm SMA overlay	N/A	$230,480.00	0.150	N/A
30	40mm SMA overlay	Yes	$230,480.00	0.100	$23,048.00

Sum of PV maintenance $96,801.60 **(d)**

6 PV of Annual associated operating cost

Luminaire Type	ZE20C - 70ML	
Number of luminaires within study section	0	*units*
Number of days luminaires are lit	365	*days*
Total operating cost	$0.00	

PV of annual operating costs (separate to maintenance costs)

Total $0.00 *x 10.7398* $0.00 **(e)**

7 PV total costs of the preferred option

(a) + (b) + (c) + (d) + (e) **$2,108,444.18 B**

Worksheet 4 - Travel Time Cost Savings

1	Road Type	District Distributor A
2	Project Type	Mid-block/mid-block as part of route improvement
3	Modelling Period Type	AM / Inter / PM peak periods

4 Midblock Assessment - Traffic Volumes

	DO MINIMUM					OPTION				
	Time Zero (veh/hr)	Year 2	Year 8	Year 15	Year 30	Time Zero (veh/hr)	Year 2	Year 8	Year 15	Year 30
AM Peak	1941	2023	2291	2650	2650	1941	2023	2291	2650	2650
Interpeak	1093	1139	1290	1492	1492	1093	1139	1290	1492	1492
PM Peak	1901	1982	2244	2595	2595	1901	1982	2244	2595	2595
AADT All periods	17520	18262	20683	23915	23915	17520	18262	20683	23915	23915

5 Do-minimum Modelling

	5A Project Timings from Annualisation Factors					5B Isolated Intersection				5C Road Midblock Improvement				5D Annual Travel Time Cost ($/year)				
			Time Periods		TTC	Modelling Results Inputs (veh.hr/hr)				Modelling Results Inputs (veh.hr/hr)								
	Time Period	Flow Factor	hours/day	days/year	$/HR	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
	Weekday AM Peak	1	2	245	$22.54	2.43	3.77	14.60	14.60	16.98	19.24	22.28	22.28	$187,512.94	$212,510.05	$246,069.48	$246,069.48	(a)
	Weekday Interpeak	1	8	245	$27.01	1.96	2.59	5.22	5.22	16.96	19.21	22.21	22.21	$897,700.70	$1,016,843.09	$1,176,038.89	$1,176,038.89	(b)
	Weekday PM Peak	1	2	245	$22.30	3.73	6.10	14.59	14.59	16.98	19.24	22.28	22.28	$185,516.35	$210,247.30	$243,449.40	$243,449.40	(c)
	Weekday Off Peak	0.25	12	245	$22.91	0.49	0.65	1.31	1.31	2.39	2.70	3.12	3.12	$160,692.90	$181,996.24	$210,446.09	$210,446.09	(d)
	Weekend Peak	0.45	8	120	$25.55	0.88	1.17	2.35	2.35	4.29	4.86	5.62	5.62	$105,345.24	$119,313.65	$137,969.25	$137,969.25	(e)
	Weekend Off Peak	0.15	16	120	$24.80	0.29	0.39	0.78	0.78	1.43	1.62	1.87	1.87	$68,155.85	$77,190.70	$89,256.14	$89,256.14	(f)
5E	All periods	N/A	24	365	$25.70	10	10	10	10	6.38	7.22	8.35	8.35	$1,435,327.63	$1,625,699.76	$1,879,982.17	$1,879,982.17	(g)
	(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)	(V)	(W)	(X)	(Y)	$1,604,923.98	$1,818,101.04	$2,103,229.25	$2,103,229.25	Total for All Day Periods
														$1,435,327.63	$1,625,699.76	$1,879,982.17	$1,879,982.17	Total for Day Long

6 Option Modelling

	6A Project Timings from Annualisation Factors					6B Isolated Intersection				6C Road Midblock Improvement				6D Annual Travel Time Cost ($/year)				
			Time Periods		TTC	Modelling Results Inputs (veh.hr/hr)				Modelling Results Inputs (veh.hr/hr)								
	Time Period	Flow Factor	hours/day	days/year	$/HR	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
	Weekday AM Peak	1	2	245	$22.54	2.49	2.94	3.94	3.94	16.95	19.20	22.21	22.21	$187,261.06	$212,107.32	$245,301.04	$245,301.04	(a)
	Weekday Interpeak	1	8	245	$27.01	2.19	2.58	3.43	3.43	16.95	19.20	22.20	22.20	$897,308.02	$1,016,294.63	$1,175,211.33	$1,175,211.33	(b)
	Weekday PM Peak	1	2	245	$22.30	3.23	3.87	5.46	5.46	16.95	19.20	22.21	22.21	$185,267.15	$209,848.86	$242,689.14	$242,689.14	(c)
	Weekday Off Peak	0.25	12	245	$22.91	0.55	0.65	0.86	0.86	2.39	2.70	3.12	3.12	$160,681.30	$181,981.11	$210,425.42	$210,425.42	(d)
	Weekend Peak	0.45	8	120	$25.55	0.99	1.16	1.54	1.54	4.29	4.86	5.62	5.62	$105,330.09	$119,293.60	$137,941.26	$137,941.26	(e)
	Weekend Off Peak	0.15	16	120	$24.80	0.33	0.39	0.51	0.51	1.43	1.62	1.87	1.87	$68,153.04	$77,187.06	$89,251.21	$89,251.21	(f)
6E	All periods	N/A	24	365	$25.70	10	10	10	10	6.37	7.22	8.35	8.35	$1,434,983.00	$1,625,234.93	$1,879,316.02	$1,879,316.02	(g)
	(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)	(V)	(W)	(X)	(Y)	$1,604,000.66	$1,816,712.59	$2,100,819.39	$2,100,819.39	Total for All Day Periods
														$1,434,983.00	$1,625,234.93	$1,879,316.02	$1,879,316.02	Total for Day Long

7 Annual Travel Time Cost for Modelled Years

		Annual Travel Time Cost ($/year) for modelled years					
		Start Year 2	End Year 7	Start Year 8	End Year 14	Start Year 15	End Year 30
	Travel Time Cost Do-minimum	$1,604,923.98	$1,818,101.04	$1,818,101.04	$2,103,229.25	$2,103,229.25	$2,103,229.25
	Travel Time Cost Option	$1,604,000.66	$1,816,712.59	$1,816,712.59	$2,100,819.39	$2,100,819.39	$2,100,819.39
	Midpoint	Year 4		Year 11.5		Year 22	
	Duration Years	6		7		16	
	Do-minimum TTC at midpoint	$1,711,512.51		$1,960,665.14		$2,103,229.25	
	Option TTC at midpoint	$1,710,356.62		$1,958,765.99		$2,100,819.39	
8	Midpoint Benefits	$1,155.89		$1,899.15		$2,409.86	
		m1		m2		m3	

9 PV Travel Time Cost Savings

[(m1 x 6 x 0.7416) + (m2 x 7 x 0.4511) + (m3 x 16 x 0.1958)] $18,689.80 C

Worksheet 5 - VOC and CO_2 Cost Savings

1	Road Type	District Distributor A
2	Project Type	Mid-block/mid-block as part of route improvement
3	Modelling Period Type	AM / Inter / PM peak periods
4	Do-minimum Traffic Flow	MID BLOCK ONLY

4A Project timings from Annualisation Factors				4B Traffic Flow Data (veh/hr)				
		Time periods						
Time Period	Flow Factor	Time periods (hrs/day)	Days/year	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	1	2	245	2023	2291	2650	2650	(a)
Weekday Interpeak	1	8	245	1139	1290	1492	1492	(b)
Weekday PM Peak	1	2	245	1982	2244	2595	2595	(c)
Weekday Off Peak	0.25	12	245	285	323	373	373	(d)
Weekend Peak	0.45	8	120	513	581	671	671	(e)
Weekend Off Peak	0.15	16	120	171	194	224	224	(f)
				AADT (veh/day)				
All periods	N/A	24	365	18262	20683	23915	23915	(g)
(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	

5	Option Traffic Flow	MID BLOCK ONLY

5A Project timings from Annualisation Factors				5B Traffic Flow Data (veh/hr)				
		Time periods						
Time Period	Flow Factor	Time periods (hrs/day)	Days/year	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	1	2	245	2023	2291	2650	2650	(a)
Weekday Interpeak	1	8	245	1139	1290	1492	1492	(b)
Weekday PM Peak	1	2	245	1982	2244	2595	2595	(c)
Weekday Off Peak	0.25	12	245	285	323	373	373	(d)
Weekend Peak	0.45	8	120	513	581	671	671	(e)
Weekend Off Peak	0.15	16	120	171	194	224	224	(f)
				AADT (veh/day)				
All periods	N/A	24	365	18262	20683	23915	23915	(g)
(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	

6 & 7	Vehicle Speeds and VOC costs - Do-minimum

	# of Lanes	Interval	Hr	t0	Speed	Q	JA	tf (min/km)	rf	0.25*rf
Akcelik Link Parameters	2	10.00	60.00	0.75	80	1850	2.31	0.75	80.00	20.00

	Isolated intersection/intersection as part of route improvement				Mid-block/mid-block as part of route improvement								
Year	6A Mean Speed (km/hr)				6B Mean Speed (km/hr)				7A VOC Cost (cents/km)				
Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	47	47	47	47	79.84	79.79	79.68	79.68	29.6	29.6	29.6	29.6	(a)
Weekday Interpeak	47	47	55	55	79.94	79.93	79.91	79.91	29.6	29.6	29.6	29.6	(b)
Weekday PM Peak	47	47	47	47	79.84	79.79	79.68	79.68	29.6	29.6	29.6	29.6	(c)
Weekday Off Peak	47	47	55	55	79.99	79.99	79.99	79.99	29.6	29.6	29.6	29.6	(d)
Weekend Peak	47	47	55	55	79.98	79.98	79.97	79.97	29.6	29.6	29.6	29.6	(e)
Weekend Off Peak	47	47	55	55	79.99	79.99	79.99	79.99	29.6	29.6	29.6	29.6	(f)
All periods	47	47	47	47	79.97	79.96	79.95	79.95	29.6	29.6	29.6	29.6	(g)

	Isolated intersection/intersection as part of route improvement				Mid-block/mid-block as part of route improvement								
Year	6C Total Travel Distance (veh.km/hr)				6D Total Travel Distance (veh.km/hr)				7B Annual VOC Cost ($/year)				
Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	6	6	6	6	1356	1535	1775	1775	$196,610.69	$222,671.22	$257,472.32	$257,472.32	(a)
Weekday Interpeak	6	6	6	6	763	865	1000	1000	$442,855.19	$501,555.16	$579,942.80	$579,942.80	(b)
Weekday PM Peak	6	6	6	6	1328	1504	1739	1739	$192,558.95	$218,082.42	$252,166.34	$252,166.34	(c)
Weekday Off Peak	1.5	1.5	1.5	1.5	191	216	250	250	$166,070.69	$188,083.18	$217,478.55	$217,478.55	(d)
Weekend Peak	2.7	2.7	2.7	2.7	343	389	450	450	$97,608.90	$110,546.85	$127,824.13	$127,824.13	(e)
Weekend Off Peak	0.9	0.9	0.9	0.9	114	130	150	150	$65,072.60	$73,697.90	$85,216.08	$85,216.08	(f)
All periods	2	2	2	2	510	577	668	668	$1,321,942.20	$1,497,164.20	$1,731,154.75	$1,731,154.75	(g)
									$1,160,777.01	$1,314,636.73	$1,520,100.22	$1,520,100.22	Total for All Day periods
									$1,321,942.20	$1,497,164.20	$1,731,154.75	$1,731,154.75	Total for day long

8 & 9 Vehicle Speeds and VOC costs - Option

	# of Lanes	Interval	Hr	t0	Speed	Q	JA	tf (min/km)	rf	0.25*rf
Akcelik Link Parameters	4	10.00	60.00	0.75	80	1850	2.31	0.75	80.00	20.00

	Isolated intersection/intersection as part of route improvement				Mid-block/mid-block as part of route improvement								
	8A Mean Speed (km/hr)				8B Mean Speed (km/hr)				9A VOC Cost (cents/km)				
Year / Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	45	45	45	45	79.95	79.94	79.93	79.93	29.6	29.6	29.6	29.6	(a)
Weekday Interpeak	45	45	45	45	79.98	79.97	79.97	79.97	29.6	29.6	29.6	29.6	(b)
Weekday PM Peak	45	45	45	45	79.95	79.94	79.93	79.93	29.6	29.6	29.6	29.6	(c)
Weekday Off Peak	45	45	45	45	79.99	79.99	79.99	79.99	29.6	29.6	29.6	29.6	(d)
Weekend Peak	45	45	45	45	79.99	79.99	79.99	79.99	29.6	29.6	29.6	29.6	(e)
Weekend Off Peak	45	45	45	45	80.00	80.00	80.00	80.00	29.6	29.6	29.6	29.6	(f)
All periods	35	35	35	35	79.98	79.98	79.98	79.98	29.6	29.6	29.6	29.6	(g)

	Isolated intersection/intersection as part of route improvement				Mid-block/mid-block as part of route improvement								
	8C Total Travel Distance (veh.km/hr)				8D Total Travel Distance (veh.km/hr)				9B Annual VOC Cost ($/year)				
Year / Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	5	5	5	5	1356	1535	1775	1775	$196,610.69	$222,671.22	$257,472.32	$257,472.32	(a)
Weekday Interpeak	5	5	5	5	763	865	1000	1000	$442,855.19	$501,555.16	$579,942.80	$579,942.80	(b)
Weekday PM Peak	5	5	5	5	1328	1504	1739	1739	$192,558.95	$218,082.42	$252,166.34	$252,166.34	(c)
Weekday Off Peak	1.25	1.25	1.25	1.25	191	216	250	250	$166,070.69	$188,083.18	$217,478.55	$217,478.55	(d)
Weekend Peak	2.25	2.25	2.25	2.25	343	389	450	450	$97,608.90	$110,546.85	$127,824.13	$127,824.13	(e)
Weekend Off Peak	0.75	0.75	0.75	0.75	114	130	150	150	$65,072.60	$73,697.90	$85,216.08	$85,216.08	(f)
All periods	5	5	5	5	510	577	668	668	$1,321,942.20	$1,497,164.20	$1,731,154.75	$1,731,154.75	(g)
									$1,160,777.01	$1,314,636.73	$1,520,100.22	$1,520,100.22	Total for All Day periods
									$1,321,942.20	$1,497,164.20	$1,731,154.75	$1,731,154.75	Total for day long

10 Annual Vehicle Operating Cost for Modelled Years

	Annual Vehicle Operating Cost ($/year) for modelled years					
	Start Year 2	End Year 7	Start Year 8	End Year 14	Start Year 15	End Year 30
Annual VOC Cost - Do-minimum	$1,160,777.01	$1,314,636.73	$1,314,636.73	$1,520,100.22	$1,520,100.22	$1,520,100.22
Annual VOC Cost - Option	$1,160,777.01	$1,314,636.73	$1,314,636.73	$1,520,100.22	$1,520,100.22	$1,520,100.22

Midpoint	Year 4	11.5	22
Duration Years	6	7	16
Do-minimum VOC at midpoint	$1,237,706.87	$1,417,368.47	$1,520,100.22
Option VOC at midpoint	$1,237,706.87	$1,417,368.47	$1,520,100.22
11 Midpoint Benefits	$0.00	$0.00	$0.00
	m1	m2	m3

12 PV Vehicle Operation Cost Savings

[(m1 x 6 x 0.7416) + (m2 x 7 x 0.4511) + (m3 x 16 x 0.1958)] $0.00 D

Worksheet 6 - Crash Cost Savings

1	**Project Type**	Mid-block/mid-block as part of route improvement	
2	**Crash Summary**		
	Total Crashes - 10 1 - Hospital, 3 - Medical, 2 - PDO Major, 4 - PDO Minor Main Crash Type - Rear End		
3	**Counter Measures**		
	Install raised median - reduce head-on crashes		
4	**Net PV of Crash Cost Savings (from CARS)**		
		$0.00	*NPV*
5	**Annual Crash Cost Savings**		
	NPV / 4.329906	$0.00	*ACCS*
6	**Crash Growth Rate**		
	Crash growth rate	1.10%	*R*
	Discount rate	8.00%	*DR*
	Discount factor crash costs *(1-((1+R)/(1+DR))^30)/(DR-R)] - [(1-((1+R)/(1+DR))^1)/(DR-R)]}*	11.56	*DFCC*
7	**PV Crash Cost Saving**		
	*ACCS * DFCC*	$0.00	**E**

Worksheet 7 - Non Tangible Benefits

1 Public Transport

Effect	Description	Score
Neutral	No expected change on overall public transport performance with no specific new/upgraded public transport infrastructure provided or removed.	0

Justification	There are no bus routes provided along the project route between Beechboro Road North to Dumpelliar Drive and there are no improvements suggested for public transport as part of this project.

2 Pedestrian Facilities

Effect	Description	Score
Positive	Demonstrated enhancement of existing pedestrian facilities to assist walking either along or across the road with measures meeting absolute minimum standards set out in appropriate MRWA and Austroads design guides with isolated facilities to meet existing demand. Low to moderate levels of pedestrian activity adjacent to or crossing the road length.	5

Justification	Central Median will provide a refuge for any pedestrians crossing the road

3 Cycling Facilities

Effect	Description	Score
Positive	Low to moderate levels of existing (or expected) cycling activity along a recognised designated existing cycling route or a route denoted as such within a Council's Local Bike Plan. Demonstrated enhancement of existing cycling facilities either along or across the road length under consideration with measures connecting to other facilities and meeting minimum standards set out in appropriate MRWA and Austroads design guides.	5

Justification	Provision of on-road 1.8m cycle lane along length of road.

4 Street Lighting

Score
0

Justification	There will be no improvements to the street lighting along this midblock section.

5 Road Safety

Effect	Description	Score
Neutral	A positive (+) or negative (-) NPV score has been entered into Worksheet 6 – Crash Costs, or the proposed measures have negligible impact on road safety overall.	0

Justification	The proposed measures have no impact on road safety overall.

6 Overall Score

10 F

Worksheet 8 - Overall Score

1 Present Value (PV) cost of Do-minimum

	$61,596.54	A worksheet 2

2 Present Value (PV) cost of Option

	$2,108,444.18	B worksheet 3

3 Unconstrained Benefit values

PV travel time cost savings	$18,689.80	C worksheet 4	x update factor TTC	1	$18,689.80	W
PV VOC and CO2 savings	$0.00	D worksheet 5	x update factor VOC	1	$0.00	Y
PV Crash cost savings	$0.00	E worksheet 6	x update factor AC	1	$0.00	Z

4 Ratio of Unconstrained Benefit to Cost

PV net unconstrained benefits / PV net costs	(W + Y + Z) / (B - A)	0.01
Score		0.01

5 FYRR

Discount Factor VOC	{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}	10.76345372	
Discount Factor TTC	{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}	10.76345372	
Discount Factor CC	{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}	10.75216952	
PV 1st Year benefits / PV net costs	[(W+Y)/DF(voc&ttc)+Z/DFcc)] x 0.93 / (B - A)	0.08	%

6 Non Tangible Benefit Score

10	F worksheet 7

7 Total Score

2.51	out of a possible score of 50

Combined Score

MRRG Reference	Total Score
1	31.44
2	2.51
3	2.95
4	2.51

Average Total Score	**9.85**

Final Score	**9.85**

The Final Score is the Average Total Score.

11.2 Worked Example 2 – Southern Link Road, Cannington (New Road)

Southern Link Road mid-block – New Link

Worksheet 1 - Project Description

1 Applicant's Details

Organisation Name	City of Canning
MRRG Reference	1
Assessor(s) name and position	Kevin de Silva
Reviewer(s) name and position	Tim Selby

Legend
- *Calculated value*
- *Free-text user input*
- *Dropdown selection*

2 Project Overview

Project Name	Southern Link Road
Project Type	Mid-block/mid-block as part of route improvement
Mid-block section/intersection under consideration	New Link - Southern Link Road: Liege St to Jameson St
Road Type	District Distributor A

3 Problem Description

Describe issue/problems to be addressed	No direct link from the Grose Ave/Liege St intersection to the Lake St/Jameson St/Gerald St intersection

4 Location Details

Brief description of location	Near Westfield Carousel, Cannington

5 Project Strategic Alignment Yes

Justification	Reference to the Strategic Community Plan

6 Project Details

Describe the do-minimum	Existing Staggered Route - Lake Street (westbound), Grose Ave (south bound), Grose Ave (eastbound).
Summarise options assessed	Proposed Direct Southern Link Road - between intersections Grose Ave/Liege St and Lake St/Jameson St/Gerald St.

	Do Minimum	Option	
Length	1.09	0.72	*km*
Total number of traffic lanes	2.00	2.00	
Urban/rural	Urban Road	Urban Road	
Speed limit	50.00	60.00	*km/h*

7 Construction Details

Time zero	1/07/2012	*(dd/mm/yyyy)*

8 Time Frame Information

Date of economic evaluation	5/02/2014	*(dd/mm/yyyy)*

9 Traffic Growth

ROM daily traffic flow 2016	4500	*vehicles per day*
ROM daily traffic flow 2031	5300	*vehicles per day*
Annual geometric traffic growth	1.10%	

Worksheet 2 - Cost of the Do-minimum

1	**Road Type**	District Distributor A	

2	**PV of annual maintenance costs**

$27,500.00 *x 11.7023* $321,813.25 **(a)**

3	**PV of periodic maintenance costs**

Proposed Rehab treatment measure	40mm SMA overlay	
Rehab treatment cost	$21.50	
Site treatment area (from SLK to SLK)	11000.00	*m2*
Rehab cost	$236,500.00	

Periodic maintenance will be required in the following years:

Year	Type of Maintenance	Required?	Estimated Cost	SPPWF	PV
5	40mm SMA overlay	N/A	$236,500.00	0.680	N/A
10	40mm SMA overlay	N/A	$236,500.00	0.464	N/A
15	40mm SMA overlay	Yes	$236,500.00	0.320	$75,680.00
20	40mm SMA overlay	N/A	$236,500.00	0.210	N/A
25	40mm SMA overlay	N/A	$236,500.00	0.150	N/A
30	40mm SMA overlay	Yes	$236,500.00	0.100	$23,650.00

Sum of PV maintenance $99,330.00 **(b)**

4	**PV of annual associated operating cost**

Luminaire Type	ZE07C - 250MV	
Number of luminaires within study section	24	*units*
Number of days luminaires are lit	365	*days*
Total operating cost	$6,112.72	

PV of total operating cost

$6,112.72 *x 11.7023* $71,532.87 **(c)**

5	**PV total Do-minimum maintenance costs**

(a) + (b) + (c) $492,676.12 **A**

Worksheet 3 - Cost of the Option

1	**Road Type**	District Distributor A	

2 PV of estimated cost of proposed work (as per attached estimate sheet)

$800,000.00 *x 0.9259* — **$740,720.00 (a)**

3 PV of routine maintenance costs following completion of the work

$20,000.00 *x 10.7398* — **$214,796.00 (b)**

4 PV of maintenance cost in year 1

$27,500.00 (c)

5 PV of Option periodic maintenance cost

Proposed Rehab treatment measure	40mm SMA overlay
Rehab treatment cost	$21.50
Site treatment area (from SLK to SLK)	8000.00 *m2*
Rehab cost	$172,000.00

Periodic maintenance will be required in the following years:

Year	Type of Maintenance	Required?	Estimated Cost	SPPWF	PV
5	40mm SMA overlay	N/A	$172,000.00	0.680	N/A
10	40mm SMA overlay	N/A	$172,000.00	0.464	N/A
15	40mm SMA overlay	Yes	$172,000.00	0.320	$55,040.00
20	40mm SMA overlay	N/A	$172,000.00	0.210	N/A
25	40mm SMA overlay	N/A	$172,000.00	0.150	N/A
30	40mm SMA overlay	Yes	$172,000.00	0.100	$17,200.00

Sum of PV maintenance **$72,240.00 (d)**

6 PV of Annual associated operating cost

Luminaire Type	ZE07C - 250MV
Number of luminaires within study section	52 *units*
Number of days luminaires are lit	365 *days*
Total operating cost	$13,244.23

PV of annual operating costs (separate to maintenance costs)

Total $13,244.23 *x 10.7398* — **$142,240.33 (e)**

7 PV total costs of the preferred option

(a) + (b) + (c) + (d) + (e) **$1,197,496.33 B**

Worksheet 4 - Travel Time Cost Savings

1	Road Type	District Distributor A
2	Project Type	Mid-block/mid-block as part of route improvement
3	Modelling Period Type	AM / Inter / PM peak periods

4 Midblock Assessment - Traffic Volumes

	DO MINIMUM					OPTION				
	Time Zero (veh/hr)	Year 2	Year 8	Year 15	Year 30	Time Zero (veh/hr)	Year 2	Year 8	Year 15	Year 30
AM Peak	291	297	318	343	343	291	297	318	343	343
Interpeak	134	137	146	158	158	134	137	146	158	158
PM Peak	269	275	294	317	317	269	275	294	317	317
AADT All periods	17520	17906	19118	20635	20635	17520	17906	19118	20635	20635

5 Do-minimum Modelling

	5A Project Timings from Annualisation Factors					5B Isolated Intersection				5C Road Midblock Improvement				5D Annual Travel Time Cost ($/year)				
			Time Periods		TTC	Modelling Results Inputs (veh.hr/hr)				Modelling Results Inputs (veh.hr/hr)								
	Time Period	Flow Factor	hours/day	days/year	$/HR	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
	Weekday AM Peak	1	2	245	$22.54	2.43	3.77	14.60	14.60	7.21	7.69	8.30	8.30	$79,588.51	$84,973.70	$91,718.85	$91,718.85	(a)
	Weekday Interpeak	1	8	245	$27.01	1.96	2.59	5.22	5.22	7.21	7.69	8.30	8.30	$381,431.70	$407,235.79	$439,555.44	$439,555.44	(b)
	Weekday PM Peak	1	2	245	$22.30	3.73	6.10	14.59	14.59	7.21	7.69	8.30	8.30	$78,741.08	$84,068.92	$90,742.25	$90,742.25	(c)
	Weekday Off Peak	0.25	12	245	$22.91	0.49	0.65	1.31	1.31	0.83	0.89	0.96	0.96	$55,862.38	$59,641.10	$64,373.88	$64,373.88	(d)
	Weekend Peak	0.45	8	120	$25.55	0.88	1.17	2.35	2.35	1.49	1.59	1.72	1.72	$36,617.81	$39,094.83	$42,197.26	$42,197.26	(e)
	Weekend Off Peak	0.15	16	120	$24.80	0.29	0.39	0.78	0.78	0.50	0.53	0.57	0.57	$23,694.41	$25,297.16	$27,304.57	$27,304.57	(f)
5E	All periods	N/A	24	365	$25.70	10	10	10	10	18.09	19.31	20.85	20.85	$4,072,030.25	$4,347,787.23	$4,693,242.32	$4,693,242.32	(g)
	(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)	(V)	(W)	(X)	(Y)	$655,935.88	$700,311.50	$755,892.24	$755,892.24	Total for All Day Periods
														$4,072,030.25	$4,347,787.23	$4,693,242.32	$4,693,242.32	Total for Day Long

6 Option Modelling

	6A Project Timings from Annualisation Factors					6B Isolated Intersection				6C Road Midblock Improvement				6D Annual Travel Time Cost ($/year)				
			Time Periods		TTC	Modelling Results Inputs (veh.hr/hr)				Modelling Results Inputs (veh.hr/hr)								
	Time Period	Flow Factor	hours/day	days/year	$/HR	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
	Weekday AM Peak	1	2	245	$22.54	2.49	2.94	3.94	3.94	4.76	5.08	5.49	5.49	$52,572.23	$56,129.42	$60,584.93	$60,584.93	(a)
	Weekday Interpeak	1	8	245	$27.01	2.19	2.58	3.43	3.43	4.76	5.08	5.48	5.48	$251,954.88	$268,999.79	$290,348.54	$290,348.54	(b)
	Weekday PM Peak	1	2	245	$22.30	3.23	3.87	5.46	5.46	4.76	5.08	5.49	5.49	$52,012.45	$55,531.77	$59,939.84	$59,939.84	(c)
	Weekday Off Peak	0.25	12	245	$22.91	0.55	0.65	0.86	0.86	0.55	0.58	0.63	0.63	$36,899.92	$39,395.96	$42,522.20	$42,522.20	(d)
	Weekend Peak	0.45	8	120	$25.55	0.99	1.16	1.54	1.54	0.99	1.05	1.14	1.14	$24,187.91	$25,824.11	$27,873.42	$27,873.42	(e)
	Weekend Off Peak	0.15	16	120	$24.80	0.33	0.39	0.51	0.51	0.33	0.35	0.38	0.38	$15,651.35	$16,710.05	$18,036.05	$18,036.05	(f)
6E	All periods	N/A	24	365	$25.70	10	10	10	10	11.95	12.76	13.77	13.77	$2,689,781.45	$2,871,932.85	$3,100,123.37	$3,100,123.37	(g)
	(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)	(V)	(W)	(X)	(Y)	$433,278.75	$462,591.09	$499,304.97	$499,304.97	Total for All Day Periods
														$2,689,781.45	$2,871,932.85	$3,100,123.37	$3,100,123.37	Total for Day Long

7 Annual Travel Time Cost for Modelled Years

		Annual Travel Time Cost ($/year) for modelled years					
		Start Year 2	End Year 7	Start Year 8	End Year 14	Start Year 15	End Year 30
	Travel Time Cost Do-minimum	$655,935.88	$700,311.50	$700,311.50	$755,892.24	$755,892.24	$755,892.24
	Travel Time Cost Option	$433,278.75	$462,591.09	$462,591.09	$499,304.97	$499,304.97	$499,304.97
	Midpoint	Year 4		Year 11.5		Year 22	
	Duration Years	6		7		16	
	Do-minimum TTC at midpoint	$678,123.69		$728,101.87		$755,892.24	
	Option TTC at midpoint	$447,934.92		$480,948.03		$499,304.97	
8	Midpoint Benefits	$230,188.78		$247,153.85		$256,587.28	
		m1		m2		m3	

9 PV Travel Time Cost Savings

[(m1 x 6 x 0.7416) + (m2 x 7 x 0.4511) + (m3 x 16 x 0.1958)] $2,608,522.30 C

Worksheet 5 - VOC and CO_2 Cost Savings

1	Road Type	District Distributor A
2	Project Type	Mid-block/mid-block as part of route improvement
3	Modelling Period Type	AM / Inter / PM peak periods
4	Do-minimum Traffic Flow	MID BLOCK ONLY

4A Project timings from Annualisation Factors				4B Traffic Flow Data (veh/hr)				
		Time periods						
Time Period	Flow Factor	Time periods (hrs/day)	Days/year	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	1	2	245	297	318	343	343	(a)
Weekday Interpeak	1	8	245	137	146	158	158	(b)
Weekday PM Peak	1	2	245	275	294	317	317	(c)
Weekday Off Peak	0.25	12	245	34	37	39	39	(d)
Weekend Peak	0.45	8	120	62	66	71	71	(e)
Weekend Off Peak	0.15	16	120	21	22	24	24	(f)
				AADT (veh/day)				
All periods	N/A	24	365	17906	19118	20635	20635	(g)
(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	

5	Option Traffic Flow	MID BLOCK ONLY

5A Project timings from Annualisation Factors				5B Traffic Flow Data (veh/hr)				
		Time periods						
Time Period	Flow Factor	Time periods (hrs/day)	Days/year	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	1	2	245	297	318	343	343	(a)
Weekday Interpeak	1	8	245	137	146	158	158	(b)
Weekday PM Peak	1	2	245	275	294	317	317	(c)
Weekday Off Peak	0.25	12	245	34	37	39	39	(d)
Weekend Peak	0.45	8	120	62	66	71	71	(e)
Weekend Off Peak	0.15	16	120	21	22	24	24	(f)
				AADT (veh/day)				
All periods	N/A	24	365	17906	19118	20635	20635	(g)
(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	

6 & 7	Vehicle Speeds and VOC costs - Do-minimum

	# of Lanes	Interval	Hr	t0	Speed	Q	JA	tf (min/km)	rf	0.25*rf
Akcelik Link Parameters	2	10.00	60.00	1.33	45	1700	6.72	1.33	45.00	11.25

	Isolated intersection/intersection as part of route improvement				Mid-block/mid-block as part of route improvement								
	6A Mean Speed (km/hr)				6B Mean Speed (km/hr)				7A VOC Cost (cents/km)				
Year / Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	47	47	47	47	44.99	44.99	44.99	44.99	29.2	29.2	29.2	29.2	(a)
Weekday Interpeak	47	47	55	55	44.99	44.99	44.99	44.99	29.2	29.2	29.2	29.2	(b)
Weekday PM Peak	47	47	47	47	44.99	44.99	44.99	44.99	29.2	29.2	29.2	29.2	(c)
Weekday Off Peak	47	47	55	55	45.00	45.00	45.00	45.00	29.2	29.2	29.2	29.2	(d)
Weekend Peak	47	47	55	55	45.00	45.00	45.00	45.00	29.2	29.2	29.2	29.2	(e)
Weekend Off Peak	47	47	55	55	45.00	45.00	45.00	45.00	29.2	29.2	29.2	29.2	(f)
All periods	47	47	47	47	44.96	44.96	44.95	44.95	29.2	29.2	29.2	29.2	(g)

	Isolated intersection/intersection as part of route improvement				Mid-block/mid-block as part of route improvement								
	6C Total Travel Distance (veh.km/hr)				6D Total Travel Distance (veh.km/hr)				7B Annual VOC Cost ($/year)				
Year / Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	6	6	6	6	324	346	374	374	$46,384.57	$49,522.08	$53,451.73	$53,451.73	(a)
Weekday Interpeak	6	6	6	6	149	159	172	172	$85,436.87	$91,215.93	$98,454.05	$98,454.05	(b)
Weekday PM Peak	6	6	6	6	300	320	345	345	$42,877.83	$45,778.14	$49,410.71	$49,410.71	(c)
Weekday Off Peak	1.5	1.5	1.5	1.5	37	40	43	43	$32,038.83	$34,205.97	$36,920.27	$36,920.27	(d)
Weekend Peak	2.7	2.7	2.7	2.7	67	72	77	77	$18,830.98	$20,104.73	$21,700.08	$21,700.08	(e)
Weekend Off Peak	0.9	0.9	0.9	0.9	22	24	26	26	$12,553.99	$13,403.16	$14,466.72	$14,466.72	(f)
All periods	2	2	2	2	813	868	937	937	$2,080,230.36	$2,220,939.72	$2,397,174.62	$2,397,174.62	(g)
									$238,123.07	$254,230.01	$274,403.55	$274,403.55	Total for All Day periods
									$2,080,230.36	$2,220,939.72	$2,397,174.62	$2,397,174.62	Total for day long

8 & 9 Vehicle Speeds and VOC costs - Option

	# of Lanes	Interval	Hr	t0	Speed	Q	JA	tf (min/km)	rf	0.25*rf
Akcelik Link Parameters	2	10.00	60.00	1.33	45	1700	6.72	1.33	45.00	11.25

Year	*Isolated intersection/intersection as part of route improvement*				Mid-block/mid-block as part of route improvement								
	8A Mean Speed (km/hr)				8B Mean Speed (km/hr)				9A VOC Cost (cents/km)				
Time period	*Year 2*	*Year 8*	*Year 15*	*Year 30*	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	45	45	45	45	44.99	44.99	44.99	44.99	29.2	29.2	29.2	29.2	(a)
Weekday Interpeak	45	45	45	45	44.99	44.99	44.99	44.99	29.2	29.2	29.2	29.2	(b)
Weekday PM Peak	45	45	45	45	44.99	44.99	44.99	44.99	29.2	29.2	29.2	29.2	(c)
Weekday Off Peak	45	45	45	45	45.00	45.00	45.00	45.00	29.2	29.2	29.2	29.2	(d)
Weekend Peak	45	45	45	45	45.00	45.00	45.00	45.00	29.2	29.2	29.2	29.2	(e)
Weekend Off Peak	45	45	45	45	45.00	45.00	45.00	45.00	29.2	29.2	29.2	29.2	(f)
All periods	35	35	35	35	44.96	44.96	44.95	44.95	29.2	29.2	29.2	29.2	(g)

Year	*Isolated intersection/intersection as part of route improvement*				Mid-block/mid-block as part of route improvement								
	8C Total Travel Distance (veh.km/hr)				8D Total Travel Distance (veh.km/hr)				9B Annual VOC Cost ($/year)				
Time period	*Year 2*	*Year 8*	*Year 15*	*Year 30*	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	5	5	5	5	214	229	247	247	$30,639.35	$32,711.83	$35,307.57	$35,307.57	(a)
Weekday Interpeak	5	5	5	5	99	105	114	114	$56,435.36	$60,252.72	$65,033.87	$65,033.87	(b)
Weekday PM Peak	5	5	5	5	198	211	228	228	$28,322.97	$30,238.77	$32,638.26	$32,638.26	(c)
Weekday Off Peak	1.25	1.25	1.25	1.25	25	26	28	28	$21,163.26	$22,594.77	$24,387.70	$24,387.70	(d)
Weekend Peak	2.25	2.25	2.25	2.25	44	47	51	51	$12,438.81	$13,280.19	$14,334.00	$14,334.00	(e)
Weekend Off Peak	0.75	0.75	0.75	0.75	15	16	17	17	$8,292.54	$8,853.46	$9,556.00	$9,556.00	(f)
All periods	5	5	5	5	537	574	619	619	$1,374,097.12	$1,467,042.75	$1,583,454.80	$1,583,454.80	(g)
									$157,292.30	$167,931.75	$181,257.39	$181,257.39	Total for All Day periods
									$1,374,097.12	$1,467,042.75	$1,583,454.80	$1,583,454.80	Total for day long

10 Annual Vehicle Operating Cost for Modelled Years

	Annual Vehicle Operating Cost ($/year) for modelled years					
	Start Year 2	End Year 7	Start Year 8	End Year 14	Start Year 15	End Year 30
Annual VOC Cost - Do-minimum	$238,123.07	$254,230.01	$254,230.01	$274,403.55	$274,403.55	$274,403.55
Annual VOC Cost - Option	$157,292.30	$167,931.75	$167,931.75	$181,257.39	$181,257.39	$181,257.39

Midpoint	Year 4	11.5	22
Duration Years	6	7	16
Do-minimum VOC at midpoint	$246,176.54	$264,316.78	$274,403.55
Option VOC at midpoint	$162,612.03	$174,594.57	$181,257.39
11 *Midpoint Benefits*	$83,564.51	$89,722.21	$93,146.16
	m1	m2	m3

12 PV Vehicle Operation Cost Savings

[(m1 x 6 x 0.7416) + (m2 x 7 x 0.4511) + (m3 x 16 x 0.1958)] $946,952.77 D

Worksheet 6 - Crash Cost Savings

1	**Project Type**	Mid-block/mid-block as part of route improvement	

2 Crash Summary

Total Crashes - 39
3 - Medical, 17 - PDO Major, 19 - PDO Minor
Main Crash Type - Leaving Driveway

3 Counter Measures

No crash savings benefits should be derived for new roads due to the complexity associated with such modelling.

4 Net PV of Crash Cost Savings (from CARS)

	$0.00	*NPV*

5 Annual Crash Cost Savings

NPV / 4.329906	$0.00	*ACCS*

6 Crash Growth Rate

Crash growth rate		-1.90%	*R*
Discount rate		8.00%	*DR*
Discount factor crash costs	*(1-((1+R)/(1+DR))^30)/(DR-R)] - [(1-((1+R)/(1+DR))^1)/(DR-R)]}*	8.61	*DFCC*

7 PV Crash Cost Saving

*ACCS * DFCC*	$0.00	**E**

Worksheet 7 - Non Tangible Benefits

1 Public Transport

Effect	Description	Score
Neutral	No expected change on overall public transport performance with no specific new/upgraded public transport infrastructure provided or removed.	0

Justification	There are no public transport faclities provided in Southern Link Road. There are no public transport faclities on the existing staggered route.

2 Pedestrian Facilities

Effect	Description	Score
Positive	Demonstrated enhancement of existing pedestrian facilities to assist walking either along or across the road with measures meeting absolute minimum standards set out in appropriate MRWA and Austroads design guides with isolated facilities to meet existing demand. Low to moderate levels of pedestrian activity adjacent to or crossing the road length.	5

Justification	Pedestrian access in the area is improved as Southern Link Road will have a footpath along the northern kerbline with connectivity provided to existing footpaths on Grose Avenue and Lake Street

3 Cycling Facilities

Effect	Description	Score
Positive	Low to moderate levels of existing (or expected) cycling activity along a recognised designated existing cycling route or a route denoted as such within a Council's Local Bike Plan. Demonstrated enhancement of existing cycling facilities either along or across the road length under consideration with measures connecting to other facilities and meeting minimum standards set out in appropriate MRWA and Austroads design guides.	5

Justification	1.5m wide bike plans are proposed on both sides of the Southern Link Road.

4 Street Lighting

Score
0

Justification	The existing alignment has street lighting, however does not meet AS 1158. The proposed Southern Link Road will have street lighting that meet AS 1158. However, the existing traffic volumes are less than 8000 vpd. As such, no points can be allocated.

5 Road Safety

Effect	Description	Score
Positive	The proposed measures and design are intended to minimise the overall number and severity of crashes. A road safety audit has already been undertaken and any concerns have been addressed and mitigated against as part of the design.	6

Justification	Raised Median has been provided along entire stretch of Southern Link Road as opposed to only certain sections of the existing staggered route having a raised median.

6 Overall Score

16 F

Worksheet 8 - Overall Score

1 Present Value (PV) cost of Do-minimum

	$492,676.12	A worksheet 2

2 Present Value (PV) cost of Option

	$1,197,496.33	B worksheet 3

3 Unconstrained Benefit values

PV travel time cost savings	$2,608,522.30	C worksheet 4	*x update factor TTC*	1	$2,608,522.30	W
PV VOC and CO2 savings	$946,952.77	D worksheet 5	*x update factor VOC*	1	$946,952.77	Y
PV Crash cost savings	$0.00	E worksheet 6	*x update factor AC*	1	$0.00	Z

4 Ratio of Unconstrained Benefit to Cost

PV net unconstrained benefits / PV net costs	*(W + Y + Z) / (B - A)*	5.04
Score		5.04

5 FYRR

Discount Factor VOC	*{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}*	10.7521769	
Discount Factor TTC	*{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}*	10.7521769	
Discount Factor CC	*{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}*	10.7183243	
PV 1st Year benefits / PV net costs	*[(W+Y)/DF(voc&ttc)+Z/DFcc)] x 0.93 / (B - A)*	43.63	%

6 Non Tangible Benefit Score

	16	F worksheet 7

7 Total Score

7.78	out of a possible score of 50

Southern Link Road / Lake Street / Gerald Street / Jameson Street Intersection

Worksheet 1 - Project Description

1 Applicant's Details

Organisation Name	City of Canning
MRRG Reference	2
Assessor(s) name and position	Kevin de Silva
Reviewer(s) name and position	Tim Selby

Legend
- *Calculated value*
- *Free-text user input*
- *Dropdown selection*

2 Project Overview

Project Name	Southern Link Road
Project Type	Isolated intersection/intersection as part of route improvement
Mid-block section/intersection under consideration	Lake St / Gerald St / Jameson St / Southern Link Road roundabout
Road Type	District Distributor A

3 Problem Description

Describe issue/problems to be addressed	No direct link from the Grose Ave/Liege St intersection to the Lake St/Jameson St/Gerald St intersection

4 Location Details

Brief description of location	Near Westfield Carousel, Cannington

5 Project Strategic Alignment Yes

Justification	Reference to the Strategic Community Plan

6 Project Details

Describe the do-minimum	Roundabout Intersection with three approaches - Lake St, Gerald St, Jameson St.
Summarise options assessed	Roundabout Intersection with four approaches - Lake St, Gerald St, Jameson St and Southern Link Road.

	Do Minimum	Option	
Length	0.05	0.05	*km*
Total number of traffic lanes	2.00	2.00	
Urban/rural	Urban Road	Urban Road	
Speed limit	50.00	60.00	*km/h*

7 Construction Details

Time zero	1/07/2012	*(dd/mm/yyyy)*

8 Time Frame Information

Date of economic evaluation	5/02/2014	*(dd/mm/yyyy)*

9 Traffic Growth

ROM daily traffic flow 2016	4500	*vehicles per day*
ROM daily traffic flow 2031	5300	*vehicles per day*
Annual geometric traffic growth	1.10%	

Worksheet 2 - Cost of the Do-minimum

1	**Road Type**	District Distributor A	

2	**PV of annual maintenance costs**

$500.00 x 11.7023 $5,851.15 **(a)**

3	**PV of periodic maintenance costs**

Proposed Rehab treatment measure	40mm SMA overlay
Rehab treatment cost	$21.50
Site treatment area (from SLK to SLK)	200.00 m2
Rehab cost	$4,300.00

Periodic maintenance will be required in the following years:

Year	Type of Maintenance	Required?	Estimated Cost	SPPWF	PV
5	40mm SMA overlay	N/A	$4,300.00	0.680	N/A
10	40mm SMA overlay	N/A	$4,300.00	0.464	N/A
15	40mm SMA overlay	Yes	$4,300.00	0.320	$1,376.00
20	40mm SMA overlay	N/A	$4,300.00	0.210	N/A
25	40mm SMA overlay	N/A	$4,300.00	0.150	N/A
30	40mm SMA overlay	Yes	$4,300.00	0.100	$430.00

Sum of PV maintenance $1,806.00 **(b)**

4	**PV of annual associated operating cost**

Luminaire Type	ZE07C - 250MV
Number of luminaires within study section	4 units
Number of days luminaires are lit	365 days
Total operating cost	$1,018.79

PV of total operating cost

$1,018.79 x 11.7023 $11,922.15 **(c)**

5	**PV total Do-minimum maintenance costs**

(a) + (b) + (c) $19,579.30 **A**

Worksheet 3 - Cost of the Option

1	**Road Type**	District Distributor A	
2	**PV of estimated cost of proposed work (as per attached estimate sheet)**		
		$1,000,000.00 *x 0.9259*	$925,900.00 **(a)**
3	**PV of routine maintenance costs following completion of the work**		
		$500.00 *x 10.7398*	$5,369.90 **(b)**
4	**PV of maintenance cost in year 1**		
			$500.00 **(c)**
5	**PV of Option periodic maintenance cost**		
	Proposed Rehab treatment measure	40mm SMA overlay	
	Rehab treatment cost		$21.50
	Site treatment area (from SLK to SLK)		200.00 *m2*
	Rehab cost		$4,300.00

Periodic maintenance will be required in the following years:

Year	Type of Maintenance	Required?	Estimated Cost	SPPWF	PV
5	40mm SMA overlay	N/A	$4,300.00	0.680	N/A
10	40mm SMA overlay	N/A	$4,300.00	0.464	N/A
15	40mm SMA overlay	Yes	$4,300.00	0.320	$1,376.00
20	40mm SMA overlay	N/A	$4,300.00	0.210	N/A
25	40mm SMA overlay	N/A	$4,300.00	0.150	N/A
30	40mm SMA overlay	Yes	$4,300.00	0.100	$430.00

Sum of PV maintenance $1,806.00 **(d)**

6	**PV of Annual associated operating cost**		
	Luminaire Type		ZE07C - 250MV
	Number of luminaires within study section		5 *units*
	Number of days luminaires are lit		365 *days*
	Total operating cost		$1,273.48
	PV of annual operating costs (separate to maintenance costs) Total	$1,273.48 *x 10.7398*	$13,676.95 **(e)**
7	**PV total costs of the preferred option**		
		(a) + (b) + (c) + (d) + (e)	**$947,252.85** **B**

Worksheet 4 - Travel Time Cost Savings

1	Road Type	District Distributor A
2	Project Type	Isolated intersection/intersection as part of route improvement
3	Modelling Period Type	AM / Inter / PM peak periods

4 Midblock Assessment - Traffic Volumes

	DO MINIMUM Time Zero (veh/hr)	Year 2	Year 8	Year 15	Year 30	OPTION Time Zero (veh/hr)	Year 2	Year 8	Year 15	Year 30
AM Peak	291	297	318	343	343	291	297	318	343	343
Interpeak	134	137	146	158	158	134	137	146	158	158
PM Peak	269	275	294	317	317	269	275	294	317	317
AADT All periods	17520	17906	19118	20635	20635	17520	17906	19118	20635	20635

5 Do-minimum Modelling

	5A Project Timings from Annualisation Factors					5B Isolated Intersection				5C Road Midblock Improvement				5D Annual Travel Time Cost ($/year)				
			Time Periods		TTC	Modelling Results Inputs (veh.hr/hr)				Modelling Results Inputs (veh.hr/hr)								
	Time Period	Flow Factor	hours/day	days/year	$/HR	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
	Weekday AM Peak	1	2	245	$22.54	2.18	2.35	2.62	2.62	0.33	0.35	0.38	0.38	$24,077.23	$25,954.81	$28,936.85	$28,936.85	(a)
	Weekday Interpeak	1	8	245	$27.01	2.03	2.19	2.43	2.43	0.33	0.35	0.38	0.38	$107,467.39	$115,937.72	$128,643.23	$128,643.23	(b)
	Weekday PM Peak	1	2	245	$22.30	2.41	2.60	3.02	3.02	0.33	0.35	0.38	0.38	$26,334.07	$28,410.20	$32,999.54	$32,999.54	(c)
	Weekday Off Peak	0.25	12	245	$22.91	0.51	0.55	0.61	0.61	0.04	0.04	0.04	0.04	$34,182.87	$36,877.08	$40,918.41	$40,918.41	(d)
	Weekend Peak	0.45	8	120	$25.55	0.91	0.99	1.09	1.09	0.07	0.07	0.08	0.08	$22,406.33	$24,172.34	$26,821.37	$26,821.37	(e)
	Weekend Off Peak	0.15	16	120	$24.80	0.30	0.33	0.36	0.36	0.02	0.02	0.03	0.03	$14,499.07	$15,641.86	$17,356.03	$17,356.03	(f)
5E	All periods	N/A	24	365	$25.70	10	10	10	10	0.83	0.89	0.96	0.96	$2,251,320.00	$2,251,320.00	$2,251,320.00	$2,251,320.00	(g)
	(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)	(V)	(W)	(X)	(Y)	$228,966.95	$246,994.02	$275,675.43	$275,675.43	Total for All Day Periods
														$2,251,320.00	$2,251,320.00	$2,251,320.00	$2,251,320.00	Total for Day Long

6 Option Modelling

	6A Project Timings from Annualisation Factors					6B Isolated Intersection				6C Road Midblock Improvement				6D Annual Travel Time Cost ($/year)				
			Time Periods		TTC	Modelling Results Inputs (veh.hr/hr)				Modelling Results Inputs (veh.hr/hr)								
	Time Period	Flow Factor	hours/day	days/year	$/HR	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
	Weekday AM Peak	1	2	245	$22.54	1.80	1.94	2.19	2.19	0.33	0.35	0.38	0.38	$19,880.28	$21,426.52	$24,187.67	$24,187.67	(a)
	Weekday Interpeak	1	8	245	$27.01	1.93	2.08	2.32	2.32	0.33	0.35	0.38	0.38	$102,173.43	$110,114.37	$122,819.87	$122,819.87	(b)
	Weekday PM Peak	1	2	245	$22.30	2.59	2.83	3.30	3.30	0.33	0.35	0.38	0.38	$28,300.93	$30,923.41	$36,059.10	$36,059.10	(c)
	Weekday Off Peak	0.25	12	245	$22.91	0.48	0.52	0.58	0.58	0.04	0.04	0.04	0.04	$32,498.98	$35,024.81	$39,066.13	$39,066.13	(d)
	Weekend Peak	0.45	8	120	$25.55	0.87	0.94	1.04	1.04	0.07	0.07	0.08	0.08	$21,302.57	$22,958.21	$25,607.23	$25,607.23	(e)
	Weekend Off Peak	0.15	16	120	$24.80	0.29	0.31	0.35	0.35	0.02	0.02	0.03	0.03	$13,784.83	$14,856.19	$16,570.37	$16,570.37	(f)
6E	All periods	N/A	24	365	$25.70	10	10	10	10	0.83	0.89	0.96	0.96	$2,251,320.00	$2,251,320.00	$2,251,320.00	$2,251,320.00	(g)
	(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)	(V)	(W)	(X)	(Y)	$217,941.02	$235,303.51	$264,310.38	$264,310.38	Total for All Day Periods
														$2,251,320.00	$2,251,320.00	$2,251,320.00	$2,251,320.00	Total for Day Long

7 Annual Travel Time Cost for Modelled Years

		Annual Travel Time Cost ($/year) for modelled years					
		Start Year 2	End Year 7	Start Year 8	End Year 14	Start Year 15	End Year 30
	Travel Time Cost Do-minimum	$228,966.95	$246,994.02	$246,994.02	$275,675.43	$275,675.43	$275,675.43
	Travel Time Cost Option	$217,941.02	$235,303.51	$235,303.51	$264,310.38	$264,310.38	$264,310.38
	Midpoint	Year 4		Year 11.5		Year 22	
	Duration Years	6		7		16	
	Do-minimum TTC at midpoint	$237,980.48		$261,334.72		$275,675.43	
	Option TTC at midpoint	$226,622.26		$249,806.94		$264,310.38	
8	Midpoint Benefits	$11,358.22		$11,527.78		$11,365.05	
		m1		m2		m3	

9 PV Travel Time Cost Savings

[(m1 x 6 x 0.7416) + (m2 x 7 x 0.4511) + (m3 x 16 x 0.1958)] $122,545.21 C

Worksheet 5 - VOC and CO_2 Cost Savings

1	Road Type	District Distributor A
2	Project Type	Isolated intersection/intersection as part of route improvement
3	Modelling Period Type	AM / Inter / PM peak periods
4	Do-minimum Traffic Flow	MID BLOCK ONLY

4A Project timings from Annualisation Factors				4B Traffic Flow Data (veh/hr)				
		Time periods						
Time Period	Flow Factor	Time periods (hrs/day)	Days/year	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	1	2	245	297	318	343	343	(a)
Weekday Interpeak	1	8	245	137	146	158	158	(b)
Weekday PM Peak	1	2	245	275	294	317	317	(c)
Weekday Off Peak	0.25	12	245	34	37	39	39	(d)
Weekend Peak	0.45	8	120	62	66	71	71	(e)
Weekend Off Peak	0.15	16	120	21	22	24	24	(f)
				AADT (veh/day)				
All periods	N/A	24	365	17906	19118	20635	20635	(g)
(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	

5	Option Traffic Flow	MID BLOCK ONLY

5A Project timings from Annualisation Factors				5B Traffic Flow Data (veh/hr)				
		Time periods						
Time Period	Flow Factor	Time periods (hrs/day)	Days/year	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	1	2	245	297	318	343	343	(a)
Weekday Interpeak	1	8	245	137	146	158	158	(b)
Weekday PM Peak	1	2	245	275	294	317	317	(c)
Weekday Off Peak	0.25	12	245	34	37	39	39	(d)
Weekend Peak	0.45	8	120	62	66	71	71	(e)
Weekend Off Peak	0.15	16	120	21	22	24	24	(f)
				AADT (veh/day)				
All periods	N/A	24	365	17906	19118	20635	20635	(g)
(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	

6 & 7	Vehicle Speeds and VOC costs - Do-minimum

	# of Lanes	Interval	Hr	t0	Speed	Q	JA	tf (min/km)	rf	0.25*rf
Akcelik Link Parameters	2	10.00	60.00	1.33	45	1700	6.72	1.33	45.00	11.25

	Isolated intersection/intersection as part of route improvement				Mid-block/mid-block as part of route improvement								
	6A Mean Speed (km/hr)				6B Mean Speed (km/hr)				7A VOC Cost (cents/km)				
Year / Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	38	37.9	37.8	37.8	44.99	44.99	44.99	44.99	30.01	30.01	30.01	30.01	(a)
Weekday Interpeak	38	37.9	37.8	37.8	44.99	44.99	44.99	44.99	30.01	30.01	30.01	30.01	(b)
Weekday PM Peak	37.7	37.6	37.4	37.4	44.99	44.99	44.99	44.99	30.01	30.01	31.2	31.2	(c)
Weekday Off Peak	38	37.9	37.8	37.8	45.00	45.00	45.00	45.00	30.01	30.01	30.01	30.01	(d)
Weekend Peak	38	37.9	37.8	37.8	45.00	45.00	45.00	45.00	30.01	30.01	30.01	30.01	(e)
Weekend Off Peak	38	37.9	37.8	37.8	45.00	45.00	45.00	45.00	30.01	30.01	30.01	30.01	(f)
All periods	47	47	47	47	44.96	44.96	44.95	44.95	29.2	29.2	29.2	29.2	(g)

	Isolated intersection/intersection as part of route improvement				Mid-block/mid-block as part of route improvement								
	6C Total Travel Distance (veh.km/hr)				6D Total Travel Distance (veh.km/hr)				7B Annual VOC Cost ($/year)				
Year / Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	370.9	396	426.5	426.5	15	16	17	17	$54,540.47	$58,231.40	$62,716.40	$62,716.40	(a)
Weekday Interpeak	355.1	379.2	413.5	413.5	7	7	8	8	$208,868.40	$223,043.92	$243,219.05	$243,219.05	(b)
Weekday PM Peak	418.7	447.1	482.6	482.6	14	15	16	16	$61,569.42	$65,745.61	$73,779.89	$73,779.89	(c)
Weekday Off Peak	88.775	94.8	103.375	103.375	2	2	2	2	$78,325.65	$83,641.47	$91,207.14	$91,207.14	(d)
Weekend Peak	159.795	170.64	186.075	186.075	3	3	4	4	$46,036.30	$49,160.70	$53,607.46	$53,607.46	(e)
Weekend Off Peak	53.265	56.88	62.025	62.025	1	1	1	1	$30,690.87	$32,773.80	$35,738.31	$35,738.31	(f)
All periods	2	2	2	2	37	40	43	43	$5,115.84	$5,115.84	$5,115.84	$5,115.84	(g)
									$480,031.11	$512,596.91	$560,268.25	$560,268.25	Total for All Day periods
									$5,115.84	$5,115.84	$5,115.84	$5,115.84	Total for day long

8 & 9 Vehicle Speeds and VOC costs - Option

	# of Lanes	Interval	Hr	t0	Speed	Q	JA	tf (min/km)	rf	0.25*rf
Akcelik Link Parameters	2	10.00	60.00	1.33	45	1700	6.72	1.33	45.00	11.25

	Isolated intersection/intersection as part of route improvement				Mid-block/mid-block as part of route improvement								
	8A Mean Speed (km/hr)				8B Mean Speed (km/hr)				9A VOC Cost (cents/km)				
Year / Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	39.4	39.3	39.1	39.1	44.99	44.99	44.99	44.99	30.0	30.0	30.0	30.0	(a)
Weekday Interpeak	38.6	38.4	38.2	38.2	44.99	44.99	44.99	44.99	30.0	30.0	30.0	30.0	(b)
Weekday PM Peak	38.1	37.9	37.6	37.6	44.99	44.99	44.99	44.99	30.0	30.0	30.0	30.0	(c)
Weekday Off Peak	38.6	38.4	38.2	38.2	45.00	45.00	45.00	45.00	30.0	30.0	30.0	30.0	(d)
Weekend Peak	38.6	38.4	38.2	38.2	45.00	45.00	45.00	45.00	30.0	30.0	30.0	30.0	(e)
Weekend Off Peak	38.6	38.4	38.2	38.2	45.00	45.00	45.00	45.00	30.0	30.0	30.0	30.0	(f)
All periods	35	35	35	35	44.96	44.96	44.95	44.95	31.2	31.2	31.2	31.2	(g)

	Isolated intersection/intersection as part of route improvement				*Mid-block/mid-block as part of route improvement*								
	8C Total Travel Distance (veh.km/hr)				*8D Total Travel Distance (veh.km/hr)*				9B Annual VOC Cost ($/year)				
Year / Time period	Year 2	Year 8	Year 15	Year 30	*Year 2*	*Year 8*	*Year 15*	*Year 30*	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	369.5	394.6	424.9	424.9	15	16	17	17	$54,334.61	$58,025.54	$62,481.12	$62,481.12	(a)
Weekday Interpeak	360.9	385.4	429.4	429.4	7	7	8	8	$212,279.94	$226,690.74	$252,571.36	$252,571.36	(b)
Weekday PM Peak	454.7	485.5	533.6	533.6	14	15	16	16	$66,863.18	$71,392.29	$78,465.35	$78,465.35	(c)
Weekday Off Peak	90.225	96.35	107.35	107.35	2	2	2	2	$79,604.98	$85,009.03	$94,714.26	$94,714.26	(d)
Weekend Peak	162.405	173.43	193.23	193.23	3	3	4	4	$46,788.23	$49,964.49	$55,668.79	$55,668.79	(e)
Weekend Off Peak	54.135	57.81	64.41	64.41	1	1	1	1	$31,192.15	$33,309.66	$37,112.53	$37,112.53	(f)
All periods	5	5	5	5	37	40	43	43	$13,665.60	$13,665.60	$13,665.60	$13,665.60	(g)
									$491,063.08	$524,391.74	$581,013.41	$581,013.41	Total for All Day periods
									$13,665.60	$13,665.60	$13,665.60	$13,665.60	Total for day long

10 Annual Vehicle Operating Cost for Modelled Years

	Annual Vehicle Operating Cost ($/year) for modelled years					
	Start Year 2	End Year 7	Start Year 8	End Year 14	Start Year 15	End Year 30
Annual VOC Cost - Do-minimum	$480,031.11	$512,596.91	$512,596.91	$560,268.25	$560,268.25	$560,268.25
Annual VOC Cost - Option	$491,063.08	$524,391.74	$524,391.74	$581,013.41	$581,013.41	$581,013.41

11

Midpoint	Year 4	11.5	22
Duration Years	6	7	16
Do-minimum VOC at midpoint	$496,314.01	$536,432.58	$560,268.25
Option VOC at midpoint	$507,727.41	$552,702.57	$581,013.41
Midpoint Benefits	-$11,413.40	-$16,270.00	-$20,745.16
	m1	m2	m3

12 PV Vehicle Operation Cost Savings

[(m1 x 6 x 0.7416) + (m2 x 7 x 0.4511) + (m3 x 16 x 0.1958)] -$167,151.28 D

Worksheet 6 - Crash Cost Savings

1	**Project Type**	Isolated intersection/intersection as part of route improvement	

2 Crash Summary

Total Crashes - 2 PDO Minor Right Thru Crashes

3 Counter Measures

None

4 Net PV of Crash Cost Savings (from CARS)

	$0.00	*NPV*

5 Annual Crash Cost Savings

NPV / 4.329906	$0.00	*ACCS*

6 Crash Growth Rate

Crash growth rate		-1.90%	*R*
Discount rate		8.00%	*DR*
Discount factor crash costs	*(1-((1+R)/(1+DR))^30)/(DR-R)] - [(1-((1+R)/(1+DR))^1)/(DR-R)]}*	8.61	*DFCC*

7 PV Crash Cost Saving

*ACCS * DFCC*	$0.00	**E**

Worksheet 7 - Non Tangible Benefits

1 Public Transport

Effect	Description	Score
Neutral	No expected change on overall public transport performance with no specific new/upgraded public transport infrastructure provided or removed.	0

Justification	There are no public transport routes along this corridor. As such, modification of this intersection does not affect the public transport performance.

2 Pedestrian Facilities

Effect	Description	Score
Neutral	No expected change on overall pedestrian levels of service with no specific walking infrastructure improvements provided or existing facilities removed.	0

Justification	There is no change in overall pedestrian levels of service as the intersection modified to include an additional leg without a refuge area in the raised median in the new leg.

3 Cycling Facilities

Effect	Description	Score
Neutral	No expected change on overall cycling levels of service with no specific cycling infrastructure improvements provided or existing facilities removed.	0

Justification	There is no change in overall cyclists levels of service as the intersection modified to include an additional leg without a refuge area in the raised median in the new leg.

4 Street Lighting

Score
0

Justification	The existing intersection has street lighting to meet AS 1158 standards. The modified intersection will also have street lighting to meet AS 1158. As such, no points can be allocated in this area.

5 Road Safety

Effect	Description	Score
Neutral	A positive (+) or negative (-) NPV score has been entered into Worksheet 6 – Crash Costs, or the proposed measures have negligible impact on road safety overall.	0

Justification	The proposed measures have negligible impact on road safety overall.

6 Overall Score

0 F

Worksheet 8 - Overall Score

1 Present Value (PV) cost of Do-minimum

	$19,579.30	**A worksheet 2**

2 Present Value (PV) cost of Option

	$947,252.85	**B worksheet 3**

3 Unconstrained Benefit values

PV travel time cost savings	$122,545.21	**C worksheet 4**	*x update factor TTC*	1	$122,545.21	**W**
PV VOC and CO2 savings	-$167,151.28	**D worksheet 5**	*x update factor VOC*	1	-$167,151.28	**Y**
PV Crash cost savings	$0.00	**E worksheet 6**	*x update factor AC*	1	$0.00	**Z**

4 Ratio of Unconstrained Benefit to Cost

PV net unconstrained benefits / PV net costs	*(W + Y + Z) / (B - A)*	-0.05
Score		-0.05

5 FYRR

Discount Factor VOC	*{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}*	10.7521769	
Discount Factor TTC	*{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}*	10.7521769	
Discount Factor CC	*{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}*	10.7183243	
PV 1st Year benefits / PV net costs	*[(W+Y)/DF(voc&ttc)+Z/DFcc)] x 0.93 / (B - A)*	-0.42	%

6 Non Tangible Benefit Score

	0	**F worksheet 7**

7 Total Score

	-0.04	**out of a possible score of 50**

Lake Street / Grose Avenue Intersection

Worksheet 1 - Project Description

1	**Applicant's Details**	
	Organisation Name	City of Canning
	MRRG Reference	3
	Assessor(s) name and position	Kevin de Silva
	Reviewer(s) name and position	Tim Selby
2	**Project Overview**	
	Project Name	Southern Link Road
	Project Type	Isolated intersection/intersection as part of route improvement
	Mid-block section/intersection under consideration	Lake St / Grose Ave roundabout
	Road Type	District Distributor A
3	**Problem Description**	
	Describe issue/problems to be addressed	No direct link from the Grose Ave/Liege St intersection to the Lake St/Jameson St/Gerald St intersection
4	**Location Details**	
	Brief description of location	Near Westfield Carousel, Cannington
5	**Project Strategic Alignment**	Yes
	Justification	Reference to the Strategic Community Plan
6	**Project Details**	
	Describe the do-minimum	Roundabout Intersection of Grose Ave and Lake Street - existing traffic volumes
	Summarise options assessed	Roundabout Intersection of Grose Ave and Lake Street - reduced traffic volumes due to use of Southern Link Road

Legend

- Calculated value
- Free-text user input
- Dropdown selection

	Do Minimum	Option	
Length	0.05	0.05	km
Total number of traffic lanes	2.00	2.00	
Urban/rural	Urban Road	Urban Road	
Speed limit	50.00	50.00	km/h

7	**Construction Details**		
	Time zero	1/07/2012	(dd/mm/yyyy)
8	**Time Frame Information**		
	Date of economic evaluation	5/02/2014	(dd/mm/yyyy)
9	**Traffic Growth**		
	ROM daily traffic flow 2016	4500	vehicles per day
	ROM daily traffic flow 2031	5300	vehicles per day
	Annual geometric traffic growth	1.10%	

Worksheet 2 - Cost of the Do-minimum

1	**Road Type**	District Distributor A	

2 PV of annual maintenance costs

$500.00 *x 11.7023* $5,851.15 **(a)**

3 PV of periodic maintenance costs

Proposed Rehab treatment measure	40mm SMA overlay	
Rehab treatment cost	$21.50	
Site treatment area (from SLK to SLK)	200.00	*m2*
Rehab cost	$4,300.00	

Periodic maintenance will be required in the following years:

Year	Type of Maintenance	Required?	Estimated Cost	SPPWF	PV
5	40mm SMA overlay	N/A	$4,300.00	0.680	N/A
10	40mm SMA overlay	N/A	$4,300.00	0.464	N/A
15	40mm SMA overlay	Yes	$4,300.00	0.320	$1,376.00
20	40mm SMA overlay	N/A	$4,300.00	0.210	N/A
25	40mm SMA overlay	N/A	$4,300.00	0.150	N/A
30	40mm SMA overlay	Yes	$4,300.00	0.100	$430.00

Sum of PV maintenance $1,806.00 **(b)**

4 PV of annual associated operating cost

Luminaire Type	ZE07C - 250MV	
Number of luminaires within study section	4	*units*
Number of days luminaires are lit	365	*days*
Total operating cost	$1,018.79	

PV of total operating cost

$1,018.79 *x 11.7023* $11,922.15 **(c)**

5 PV total Do-minimum maintenance costs

(a) + (b) + (c) $19,579.30 **A**

Worksheet 3 - Cost of the Option

1	**Road Type**	District Distributor A		
2	**PV of estimated cost of proposed work (as per attached estimate sheet)**			
		$1,000,000.00 *x 0.9259*	$925,900.00	**(a)**
3	**PV of routine maintenance costs following completion of the work**			
		$500.00 *x 10.7398*	$5,369.90	**(b)**
4	**PV of maintenance cost in year 1**			
			$500.00	**(c)**
5	**PV of Option periodic maintenance cost**			
	Proposed Rehab treatment measure	40mm SMA overlay		
	Rehab treatment cost		$21.50	
	Site treatment area (from SLK to SLK)		200.00	*m2*
	Rehab cost		$4,300.00	

Periodic maintenance will be required in the following years:

Year	Type of Maintenance	Required?	Estimated Cost	SPPWF	PV
5	40mm SMA overlay	N/A	$4,300.00	0.680	N/A
10	40mm SMA overlay	N/A	$4,300.00	0.464	N/A
15	40mm SMA overlay	Yes	$4,300.00	0.320	$1,376.00
20	40mm SMA overlay	N/A	$4,300.00	0.210	N/A
25	40mm SMA overlay	N/A	$4,300.00	0.150	N/A
30	40mm SMA overlay	Yes	$4,300.00	0.100	$430.00

		Sum of PV maintenance	$1,806.00	**(d)**
6	**PV of Annual associated operating cost**			
	Luminaire Type		ZE07C - 250MV	
	Number of luminaires within study section		4	*units*
	Number of days luminaires are lit		365	*days*
	Total operating cost		$1,018.79	
	PV of annual operating costs (separate to maintenance costs)			
	Total	$1,018.79 *x 10.7398*	$10,941.56	**(e)**
7	**PV total costs of the preferred option**			
		(a) + (b) + (c) + (d) + (e)	**$944,517.46**	**B**

Worksheet 4 - Travel Time Cost Savings

1	Road Type	District Distributor A
2	Project Type	Isolated intersection/intersection as part of route improvement
3	Modelling Period Type	AM / Inter / PM peak periods

4 Midblock Assessment - Traffic Volumes

	DO MINIMUM					OPTION				
	Time Zero (veh/hr)	Year 2	Year 8	Year 15	Year 30	Time Zero (veh/hr)	Year 2	Year 8	Year 15	Year 30
AM Peak	291	297	318	343	343	291	297	318	343	343
Interpeak	134	137	146	158	158	134	137	146	158	158
PM Peak	269	275	294	317	317	269	275	294	317	317
AADT All periods	17520	17906	19118	20635	20635	17520	17906	19118	20635	20635

5 Do-minimum Modelling

	5A Project Timings from Annualisation Factors					5B Isolated Intersection				5C Road Midblock Improvement				5D Annual Travel Time Cost ($/year)				
			Time Periods		TTC	Modelling Results Inputs (veh.hr/hr)				Modelling Results Inputs (veh.hr/hr)								
	Time Period	Flow Factor	hours/day	days/year	$/HR	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
	Weekday AM Peak	1	2	245	$22.54	1.73	1.87	2.10	2.10	0.33	0.35	0.38	0.38	$19,107.16	$20,653.40	$23,193.66	$23,193.66	(a)
	Weekday Interpeak	1	8	245	$27.01	1.99	2.16	2.44	2.44	0.33	0.35	0.38	0.38	$105,349.80	$114,349.54	$129,172.62	$129,172.62	(b)
	Weekday PM Peak	1	2	245	$22.30	2.78	3.04	3.54	3.54	0.33	0.35	0.38	0.38	$30,377.06	$33,218.08	$38,681.58	$38,681.58	(c)
	Weekday Off Peak	0.25	12	245	$22.91	0.50	0.54	0.61	0.61	0.04	0.04	0.04	0.04	$33,509.31	$36,371.92	$41,086.79	$41,086.79	(d)
	Weekend Peak	0.45	8	120	$25.55	0.90	0.97	1.10	1.10	0.07	0.07	0.08	0.08	$21,964.82	$23,841.22	$26,931.74	$26,931.74	(e)
	Weekend Off Peak	0.15	16	120	$24.80	0.30	0.32	0.37	0.37	0.02	0.02	0.03	0.03	$14,213.38	$15,427.58	$17,427.46	$17,427.46	(f)
5E	All periods	N/A	24	365	$25.70	10	10	10	10	0.83	0.89	0.96	0.96	$2,251,320.00	$2,251,320.00	$2,251,320.00	$2,251,320.00	(g)
	(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)	(V)	(W)	(X)	(Y)	$224,521.53	$243,861.73	$276,493.86	$276,493.86	Total for All Day Periods
														$2,251,320.00	$2,251,320.00	$2,251,320.00	$2,251,320.00	Total for Day Long

6 Option Modelling

	6A Project Timings from Annualisation Factors					6B Isolated Intersection				6C Road Midblock Improvement				6D Annual Travel Time Cost ($/year)				
			Time Periods		TTC	Modelling Results Inputs (veh.hr/hr)				Modelling Results Inputs (veh.hr/hr)								
	Time Period	Flow Factor	hours/day	days/year	$/HR	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
	Weekday AM Peak	1	2	245	$22.54	1.17	1.26	1.42	1.42	0.33	0.35	0.38	0.38	$12,922.18	$13,916.20	$15,683.33	$15,683.33	(a)
	Weekday Interpeak	1	8	245	$27.01	1.65	1.79	2.01	2.01	0.33	0.35	0.38	0.38	$87,350.34	$94,761.88	$106,408.60	$106,408.60	(b)
	Weekday PM Peak	1	2	245	$22.30	1.82	1.97	2.24	2.24	0.33	0.35	0.38	0.38	$19,887.14	$21,526.19	$24,476.48	$24,476.48	(c)
	Weekday Off Peak	0.25	12	245	$22.91	0.41	0.45	0.50	0.50	0.04	0.04	0.04	0.04	$27,784.10	$30,141.54	$33,846.09	$33,846.09	(d)
	Weekend Peak	0.45	8	120	$25.55	0.74	0.81	0.90	0.90	0.07	0.07	0.08	0.08	$18,212.04	$19,757.30	$22,185.58	$22,185.58	(e)
	Weekend Off Peak	0.15	16	120	$24.80	0.25	0.27	0.30	0.30	0.02	0.02	0.03	0.03	$11,784.96	$12,784.90	$14,356.22	$14,356.22	(f)
6E	All periods	N/A	24	365	$25.70	10	10	10	10	0.83	0.89	0.96	0.96	$2,251,320.00	$2,251,320.00	$2,251,320.00	$2,251,320.00	(g)
	(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)	(V)	(W)	(X)	(Y)	$177,940.76	$192,888.01	$216,956.30	$216,956.30	Total for All Day Periods
														$2,251,320.00	$2,251,320.00	$2,251,320.00	$2,251,320.00	Total for Day Long

7 Annual Travel Time Cost for Modelled Years

		Annual Travel Time Cost ($/year) for modelled years					
		Start Year 2	End Year 7	Start Year 8	End Year 14	Start Year 15	End Year 30
	Travel Time Cost Do-minimum	$224,521.53	$243,861.73	$243,861.73	$276,493.86	$276,493.86	$276,493.86
	Travel Time Cost Option	$177,940.76	$192,888.01	$192,888.01	$216,956.30	$216,956.30	$216,956.30
	Midpoint	Year 4		Year 11.5		Year 22	
	Duration Years	6		7		16	
	Do-minimum TTC at midpoint	$234,191.63		$260,177.80		$276,493.86	
	Option TTC at midpoint	$185,414.39		$204,922.15		$216,956.30	
8	Midpoint Benefits	$48,777.25		$55,255.64		$59,537.56	
		m1		m2		m3	

9 PV Travel Time Cost Savings

[(m1 x 6 x 0.7416) + (m2 x 7 x 0.4511) + (m3 x 16 x 0.1958)] $578,039.25 C

Worksheet 5 - VOC and CO_2 Cost Savings

1	Road Type	District Distributor A
2	Project Type	Isolated intersection/intersection as part of route improvement
3	Modelling Period Type	AM / Inter / PM peak periods
4	Do-minimum Traffic Flow	MID BLOCK ONLY

4A Project timings from Annualisation Factors				4B Traffic Flow Data (veh/hr)				
		Time periods						
Time Period	Flow Factor	Time periods (hrs/day)	Days/year	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	1	2	245	297	318	343	343	(a)
Weekday Interpeak	1	8	245	137	146	158	158	(b)
Weekday PM Peak	1	2	245	275	294	317	317	(c)
Weekday Off Peak	0.25	12	245	34	37	39	39	(d)
Weekend Peak	0.45	8	120	62	66	71	71	(e)
Weekend Off Peak	0.15	16	120	21	22	24	24	(f)
				AADT (veh/day)				
All periods	N/A	24	365	17906	19118	20635	20635	(g)
(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	

5	Option Traffic Flow	MID BLOCK ONLY

5A Project timings from Annualisation Factors				5B Traffic Flow Data (veh/hr)				
		Time periods						
Time Period	Flow Factor	Time periods (hrs/day)	Days/year	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	1	2	245	297	318	343	343	(a)
Weekday Interpeak	1	8	245	137	146	158	158	(b)
Weekday PM Peak	1	2	245	275	294	317	317	(c)
Weekday Off Peak	0.25	12	245	34	37	39	39	(d)
Weekend Peak	0.45	8	120	62	66	71	71	(e)
Weekend Off Peak	0.15	16	120	21	22	24	24	(f)
				AADT (veh/day)				
All periods	N/A	24	365	17906	19118	20635	20635	(g)
(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	

6 & 7	Vehicle Speeds and VOC costs - Do-minimum	

	# of Lanes	Interval	Hr	t0	Speed	Q	JA	tf (min/km)	rf	0.25*rf
Akcelik Link Parameters	2	10.00	60.00	1.33	45	1700	6.72	1.33	45.00	11.25

	Isolated intersection/intersection as part of route improvement				Mid-block/mid-block as part of route improvement								
	6A Mean Speed (km/hr)				6B Mean Speed (km/hr)				7A VOC Cost (cents/km)				
Year / Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	37.2	37	36.8	36.8	44.99	44.99	44.99	44.99	31.2	31.2	31.2	31.2	(a)
Weekday Interpeak	36.3	36.2	36	36	44.99	44.99	44.99	44.99	31.2	31.2	31.2	31.2	(b)
Weekday PM Peak	35.3	35.1	34.7	34.7	44.99	44.99	44.99	44.99	31.2	31.2	31.2	31.2	(c)
Weekday Off Peak	36.3	36.2	36	36	45.00	45.00	45.00	45.00	31.2	31.2	31.2	31.2	(d)
Weekend Peak	36.3	36.2	36	36	45.00	45.00	45.00	45.00	31.2	31.2	31.2	31.2	(e)
Weekend Off Peak	36.3	36.2	36	36	45.00	45.00	45.00	45.00	31.2	31.2	31.2	31.2	(f)
All periods	47	47	47	47	44.96	44.96	44.95	44.95	29.2	29.2	29.2	29.2	(g)

	Isolated intersection/intersection as part of route improvement				Mid-block/mid-block as part of route improvement								
	6C Total Travel Distance (veh.km/hr)				6D Total Travel Distance (veh.km/hr)				7B Annual VOC Cost ($/year)				
Year / Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	273.6	292.2	323.2	323.2	15	16	17	17	$41,827.97	$44,671.54	$49,410.82	$49,410.82	(a)
Weekday Interpeak	283.2	302.4	334.8	334.8	7	7	8	8	$173,182.46	$184,923.65	$204,736.90	$204,736.90	(b)
Weekday PM Peak	355.2	379.3	422.5	422.5	14	15	16	16	$54,302.98	$57,987.38	$64,591.80	$64,591.80	(c)
Weekday Off Peak	70.8	75.6	83.7	83.7	2	2	2	2	$64,943.42	$69,346.37	$76,776.34	$76,776.34	(d)
Weekend Peak	127.44	136.08	150.66	150.66	3	3	4	4	$38,170.83	$40,758.68	$45,125.68	$45,125.68	(e)
Weekend Off Peak	42.48	45.36	50.22	50.22	1	1	1	1	$25,447.22	$27,172.45	$30,083.79	$30,083.79	(f)
All periods	2	2	2	2	37	40	43	43	$5,115.84	$5,115.84	$5,115.84	$5,115.84	(g)
									$397,874.88	$424,860.07	$470,725.32	$470,725.32	Total for All Day periods
									$5,115.84	$5,115.84	$5,115.84	$5,115.84	Total for day long

8 & 9 Vehicle Speeds and VOC costs - Option

	# of Lanes	Interval	Hr	t0	Speed	Q	JA	tf (min/km)	rf	0.25*rf
Akcelik Link Parameters	2	10.00	60.00	1.33	45	1700	6.72	1.33	45.00	11.25

Year	Isolated intersection/intersection as part of route improvement 8A Mean Speed (km/hr)				Mid-block/mid-block as part of route improvement 8B Mean Speed (km/hr)				9A VOC Cost (cents/km)				
Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	37.1	37.1	37	37	44.99	44.99	44.99	44.99	31.2	31.2	31.2	31.2	(a)
Weekday Interpeak	36.5	36.4	36.3	36.3	44.99	44.99	44.99	44.99	31.2	31.2	31.2	31.2	(b)
Weekday PM Peak	36.3	36.2	36	36	44.99	44.99	44.99	44.99	31.2	31.2	31.2	31.2	(c)
Weekday Off Peak	36.5	36.4	36.3	36.3	45.00	45.00	45.00	45.00	31.2	31.2	31.2	31.2	(d)
Weekend Peak	36.5	36.4	36.3	36.3	45.00	45.00	45.00	45.00	31.2	31.2	31.2	31.2	(e)
Weekend Off Peak	36.5	36.4	36.3	36.3	45.00	45.00	45.00	45.00	31.2	31.2	31.2	31.2	(f)
All periods	35	35	35	35	44.96	44.96	44.95	44.95	31.2	31.2	31.2	31.2	(g)

Year	Isolated intersection/intersection as part of route improvement 8C Total Travel Distance (veh.km/hr)				*Mid-block/mid-block as part of route improvement 8D Total Travel Distance (veh.km/hr)*				9B Annual VOC Cost ($/year)				
Time period	Year 2	Year 8	Year 15	Year 30	*Year 2*	*Year 8*	*Year 15*	*Year 30*	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	183.1	195.5	218.2	218.2	15	16	17	17	$27,992.33	$29,888.04	$33,358.42	$33,358.42	(a)
Weekday Interpeak	240	256.3	278.3	278.3	7	7	8	8	$146,764.80	$156,732.58	$170,186.02	$170,186.02	(b)
Weekday PM Peak	261.7	279.5	304.7	304.7	14	15	16	16	$40,008.70	$42,729.96	$46,582.54	$46,582.54	(c)
Weekday Off Peak	60	64.075	69.575	69.575	2	2	2	2	$55,036.80	$58,774.72	$63,819.76	$63,819.76	(d)
Weekend Peak	108	115.335	125.235	125.235	3	3	4	4	$32,348.16	$34,545.14	$37,510.39	$37,510.39	(e)
Weekend Off Peak	36	38.445	41.745	41.745	1	1	1	1	$21,565.44	$23,030.09	$25,006.92	$25,006.92	(f)
All periods	5	5	5	5	37	40	43	43	$13,665.60	$13,665.60	$13,665.60	$13,665.60	(g)
									$323,716.22	$345,700.52	$376,464.04	$376,464.04	Total for All Day periods
									$13,665.60	$13,665.60	$13,665.60	$13,665.60	Total for day long

10 Annual Vehicle Operating Cost for Modelled Years

	Annual Vehicle Operating Cost ($/year) for modelled years					
	Start Year 2	End Year 7	Start Year 8	End Year 14	Start Year 15	End Year 30
Annual VOC Cost - Do-minimum	$397,874.88	$424,860.07	$424,860.07	$470,725.32	$470,725.32	$470,725.32
Annual VOC Cost - Option	$323,716.22	$345,700.52	$345,700.52	$376,464.04	$376,464.04	$376,464.04

Midpoint	Year 4	11.5	22
Duration Years	6	7	16
Do-minimum VOC at midpoint	$411,367.48	$447,792.70	$470,725.32
Option VOC at midpoint	$334,708.37	$361,082.28	$376,464.04
11 *Midpoint Benefits*	$76,659.10	$86,710.42	$94,261.28
	m1	m2	m3

12 PV Vehicle Operation Cost Savings

[(m1 x 6 x 0.7416) + (m2 x 7 x 0.4511) + (m3 x 16 x 0.1958)] $910,209.57 **D**

Worksheet 6 - Crash Cost Savings

1	**Project Type**	Isolated intersection/intersection as part of route improvement

2	**Crash Summary**

Total Crashes - 12
1 - Medical, 5 - PDO Major, 6 - PDO Minor
Common Crash Type - Thru-Thru Crashes

3	**Counter Measures**

None

4	**Net PV of Crash Cost Savings (from CARS)**

	$0.00	*NPV*

5	**Annual Crash Cost Savings**

NPV / 4.329906	$0.00	*ACCS*

6	**Crash Growth Rate**

Crash growth rate		-1.90%	*R*
Discount rate		8.00%	*DR*
Discount factor crash costs	*(1-((1+R)/(1+DR))^30)/(DR-R)] - [(1-((1+R)/(1+DR))^1)/(DR-R)]}*	8.61	*DFCC*

7	**PV Crash Cost Saving**

*ACCS * DFCC*	$0.00	**E**

Worksheet 7 - Non Tangible Benefits

1 Public Transport

Effect	Description	Score
Neutral	No expected change on overall public transport performance with no specific new/upgraded public transport infrastructure provided or removed.	0

Justification	There are no public transport routes along this corridor. As such, modification of this intersection does not affect the public transport performance.

2 Pedestrian Facilities

Effect	Description	Score
Neutral	No expected change on overall pedestrian levels of service with no specific walking infrastructure improvements provided or existing facilities removed.	0

Justification	There is no change in overall pedestrian levels of service as the intersection modified to include an additional leg without a refuge area in the raised median in the new leg.

3 Cycling Facilities

Effect	Description	Score
Neutral	No expected change on overall cycling levels of service with no specific cycling infrastructure improvements provided or existing facilities removed.	0

Justification	There is no change in overall cyclists levels of service as the intersection modified to include an additional leg without a refuge area in the raised median in the new leg.

4 Street Lighting

Score
0

Justification	The existing intersection has street lighting to meet AS 1158 standards. The modified intersection will also have street lighting to meet AS 1158. As such, no points can be allocated in this area.

5 Road Safety

Effect	Description	Score
Neutral	A positive (+) or negative (-) NPV score has been entered into Worksheet 6 – Crash Costs, or the proposed measures have negligible impact on road safety overall.	0

Justification	The proposed measures have negligible impact on road safety overall.

6 Overall Score

0 F

Worksheet 8 - Overall Score

1 Present Value (PV) cost of Do-minimum

	$19,579.30	**A worksheet 2**

2 Present Value (PV) cost of Option

	$944,517.46	**B worksheet 3**

3 Unconstrained Benefit values

PV travel time cost savings	$578,039.25	**C worksheet 4**	*x update factor TTC*	1	$578,039.25	**W**
PV VOC and CO2 savings	$910,209.57	**D worksheet 5**	*x update factor VOC*	1	$910,209.57	**Y**
PV Crash cost savings	$0.00	**E worksheet 6**	*x update factor AC*	1	$0.00	**Z**

4 Ratio of Unconstrained Benefit to Cost

PV net unconstrained benefits / PV net costs	*(W + Y + Z) / (B - A)*	1.61
Score		1.61

5 FYRR

Discount Factor VOC	*{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}*	10.7521769
Discount Factor TTC	*{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}*	10.7521769
Discount Factor CC	*{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}*	10.7183243
PV 1st Year benefits / PV net costs	*[(W+Y)/DF(voc&ttc)+Z/DFcc)] x 0.93 / (B - A)*	13.92 %

6 Non Tangible Benefit Score

	0	**F worksheet 7**

7 Total Score

1.21	**out of a possible score of 50**

Grose Avenue / Carousel Road Intersection

Worksheet 1 - Project Description

1 Applicant's Details

Organisation Name	City of Canning		**Legend**
MRRG Reference	4		*Calculated value*
Assessor(s) name and position	Kevin de Silva		*Free-text user input*
Reviewer(s) name and position	Tim Selby		*Dropdown selection*

2 Project Overview

Project Name	Southern Link Road
Project Type	Isolated intersection/intersection as part of route improvement
Mid-block section/intersection under consideration	Carousel Road / Grose Ave roundabout
Road Type	District Distributor A

3 Problem Description

Describe issue/problems to be addressed	No direct link from the Grose Ave/Liege St intersection to the Lake St/Jameson St/Gerald St intersection

4 Location Details

Brief description of location	Near Westfield Carousel, Cannington

5 Project Strategic Alignment Yes

Justification	Reference to the Strategic Community Plan

6 Project Details

Describe the do-minimum	Roundabout Intersection of Grose Ave and Lake Street - existing traffic
Summarise options assessed	Roundabout Intersection of Grose Ave and Lake Street - reduced traffic due to use of Southern Link Road

	Do Minimum	Option	
Length	0.05	0.05	*km*
Total number of traffic lanes	2.00	2.00	
Urban/rural	Urban Road	Urban Road	
Speed limit	50.00	50.00	*km/h*

7 Construction Details

Time zero	1/07/2012	*(dd/mm/yyyy)*

8 Time Frame Information

Date of economic evaluation	5/02/2014	*(dd/mm/yyyy)*

9 Traffic Growth

ROM daily traffic flow 2016	4500	*vehicles per day*
ROM daily traffic flow 2031	5300	*vehicles per day*
Annual geometric traffic growth	1.10%	

Worksheet 2 - Cost of the Do-minimum

1	**Road Type**	District Distributor A	

2	**PV of annual maintenance costs**

$500.00 *x 11.7023* $5,851.15 **(a)**

3	**PV of periodic maintenance costs**

Proposed Rehab treatment measure	40mm SMA overlay	
Rehab treatment cost	$21.50	
Site treatment area (from SLK to SLK)	200.00	*m2*
Rehab cost	$4,300.00	

Periodic maintenance will be required in the following years:

Year	Type of Maintenance	Required?	Estimated Cost	SPPWF	PV
5	40mm SMA overlay	N/A	$4,300.00	0.680	N/A
10	40mm SMA overlay	N/A	$4,300.00	0.464	N/A
15	40mm SMA overlay	Yes	$4,300.00	0.320	$1,376.00
20	40mm SMA overlay	N/A	$4,300.00	0.210	N/A
25	40mm SMA overlay	N/A	$4,300.00	0.150	N/A
30	40mm SMA overlay	Yes	$4,300.00	0.100	$430.00

Sum of PV maintenance $1,806.00 **(b)**

4	**PV of annual associated operating cost**

Luminaire Type	ZE07C - 250MV	
Number of luminaires within study section	6	*units*
Number of days luminaires are lit	365	*days*
Total operating cost	$1,528.18	

PV of total operating cost

$1,528.18 *x 11.7023* $17,883.22 **(c)**

5	**PV total Do-minimum maintenance costs**

(a) + (b) + (c) $25,540.37 **A**

Worksheet 3 - Cost of the Option

1 Road Type District Distributor A

2 PV of estimated cost of proposed work (as per attached estimate sheet)

$1,000,000.00 *x 0.9259* $925,900.00 **(a)**

3 PV of routine maintenance costs following completion of the work

$500.00 *x 10.7398* $5,369.90 **(b)**

4 PV of maintenance cost in year 1

$500.00 **(c)**

5 PV of Option periodic maintenance cost

Proposed Rehab treatment measure	40mm SMA overlay
Rehab treatment cost	$21.50
Site treatment area (from SLK to SLK)	200.00 *m2*
Rehab cost	$4,300.00

Periodic maintenance will be required in the following years:

Year	Type of Maintenance	Required?	Estimated Cost	SPPWF	PV
5	40mm SMA overlay	N/A	$4,300.00	0.680	N/A
10	40mm SMA overlay	N/A	$4,300.00	0.464	N/A
15	40mm SMA overlay	Yes	$4,300.00	0.320	$1,376.00
20	40mm SMA overlay	N/A	$4,300.00	0.210	N/A
25	40mm SMA overlay	N/A	$4,300.00	0.150	N/A
30	40mm SMA overlay	Yes	$4,300.00	0.100	$430.00

Sum of PV maintenance $1,806.00 **(d)**

6 PV of Annual associated operating cost

Luminaire Type	ZE07C - 250MV
Number of luminaires within study section	6 *units*
Number of days luminaires are lit	365 *days*
Total operating cost	$1,528.18

PV of annual operating costs (separate to maintenance costs)

Total $1,528.18 *x 10.7398* $16,412.35 **(e)**

7 PV total costs of the preferred option

(a) + (b) + (c) + (d) + (e) **$949,988.25 B**

Worksheet 4 - Travel Time Cost Savings

1	Road Type	District Distributor A
2	Project Type	Isolated intersection/intersection as part of route improvement
3	Modelling Period Type	AM / Inter / PM peak periods

4 Midblock Assessment - Traffic Volumes

	DO MINIMUM					OPTION				
	Time Zero (veh/hr)	Year 2	Year 8	Year 15	Year 30	Time Zero (veh/hr)	Year 2	Year 8	Year 15	Year 30
AM Peak	291	297	318	343	343	291	297	318	343	343
Interpeak	134	137	146	158	158	134	137	146	158	158
PM Peak	269	275	294	317	317	269	275	294	317	317
AADT All periods	17520	17906	19118	20635	20635	17520	17906	19118	20635	20635

5 Do-minimum Modelling

	5A Project Timings from Annualisation Factors					5B Isolated Intersection			
			Time Periods		TTC	Modelling Results Inputs (veh.hr/hr)			
	Time Period	Flow Factor	hours/day	days/year	$/HR	Year 2	Year 8	Year 15	Year 30
	Weekday AM Peak	1	2	245	$22.54	0.92	0.99	1.12	1.12
	Weekday Interpeak	1	8	245	$27.01	1.27	1.37	1.54	1.54
	Weekday PM Peak	1	2	245	$22.30	2.01	2.18	2.54	2.54
	Weekday Off Peak	0.25	12	245	$22.91	0.32	0.34	0.39	0.39
	Weekend Peak	0.45	8	120	$25.55	0.57	0.62	0.69	0.69
	Weekend Off Peak	0.15	16	120	$24.80	0.19	0.21	0.23	0.23
5E	All periods	N/A	24	365	$25.70	10	10	10	10
	(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)

	5C Road Midblock Improvement				5D Annual Travel Time Cost ($/year)				
	Modelling Results Inputs (veh.hr/hr)								
Time Period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	0.33	0.35	0.38	0.38	$10,161.03	$10,934.15	$12,369.95	$12,369.95	(a)
Weekday Interpeak	0.33	0.35	0.38	0.38	$67,233.29	$72,527.25	$81,526.98	$81,526.98	(b)
Weekday PM Peak	0.33	0.35	0.38	0.38	$21,963.27	$23,820.86	$27,754.58	$27,754.58	(c)
Weekday Off Peak	0.04	0.04	0.04	0.04	$21,385.34	$23,069.22	$25,931.83	$25,931.83	(d)
Weekend Peak	0.07	0.07	0.08	0.08	$14,017.75	$15,121.51	$16,997.90	$16,997.90	(e)
Weekend Off Peak	0.02	0.02	0.03	0.03	$9,070.85	$9,785.09	$10,999.30	$10,999.30	(f)
All periods	0.83	0.89	0.96	0.96	$2,251,320.00	$2,251,320.00	$2,251,320.00	$2,251,320.00	(g)
(Q)	(V)	(W)	(X)	(Y)	$143,831.53	$155,258.09	$175,580.55	$175,580.55	Total for All Day Periods
					$2,251,320.00	$2,251,320.00	$2,251,320.00	$2,251,320.00	Total for Day Long

6 Option Modelling

	6A Project Timings from Annualisation Factors					6B Isolated Intersection			
			Time Periods		TTC	Modelling Results Inputs (veh.hr/hr)			
	Time Period	Flow Factor	hours/day	days/year	$/HR	Year 2	Year 8	Year 15	Year 30
	Weekday AM Peak	1	2	245	$22.54	0.74	0.80	0.90	0.90
	Weekday Interpeak	1	8	245	$27.01	1.14	1.22	1.38	1.38
	Weekday PM Peak	1	2	245	$22.30	1.53	1.65	1.89	1.89
	Weekday Off Peak	0.25	12	245	$22.91	0.29	0.31	0.35	0.35
	Weekend Peak	0.45	8	120	$25.55	0.51	0.55	0.62	0.62
	Weekend Off Peak	0.15	16	120	$24.80	0.17	0.18	0.21	0.21
6E	All periods	N/A	24	365	$25.70	10	10	10	10
	(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)

	6C Road Midblock Improvement				6D Annual Travel Time Cost ($/year)				
	Modelling Results Inputs (veh.hr/hr)								
Time Period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	0.33	0.35	0.38	0.38	$8,173.00	$8,835.68	$9,940.14	$9,940.14	(a)
Weekday Interpeak	0.33	0.35	0.38	0.38	$60,351.14	$64,586.31	$73,056.65	$73,056.65	(b)
Weekday PM Peak	0.33	0.35	0.38	0.38	$16,718.31	$18,029.55	$20,652.03	$20,652.03	(c)
Weekday Off Peak	0.04	0.04	0.04	0.04	$19,196.29	$20,543.40	$23,237.61	$23,237.61	(d)
Weekend Peak	0.07	0.07	0.08	0.08	$12,582.86	$13,465.87	$15,231.89	$15,231.89	(e)
Weekend Off Peak	0.02	0.02	0.03	0.03	$8,142.34	$8,713.73	$9,856.51	$9,856.51	(f)
All periods	0.83	0.89	0.96	0.96	$2,251,320.00	$2,251,320.00	$2,251,320.00	$2,251,320.00	(g)
(Q)	(V)	(W)	(X)	(Y)	$125,163.95	$134,174.54	$151,974.83	$151,974.83	Total for All Day Periods
					$2,251,320.00	$2,251,320.00	$2,251,320.00	$2,251,320.00	Total for Day Long

7 Annual Travel Time Cost for Modelled Years

		Annual Travel Time Cost ($/year) for modelled years					
		Start Year 2	End Year 7	Start Year 8	End Year 14	Start Year 15	End Year 30
	Travel Time Cost Do-minimum	$143,831.53	$155,258.09	$155,258.09	$175,580.55	$175,580.55	$175,580.55
	Travel Time Cost Option	$125,163.95	$134,174.54	$134,174.54	$151,974.83	$151,974.83	$151,974.83
	Midpoint	Year 4		Year 11.5		Year 22	
	Duration Years	6		7		16	
	Do-minimum TTC at midpoint	$149,544.81		$165,419.32		$175,580.55	
	Option TTC at midpoint	$129,669.24		$143,074.69		$151,974.83	
8	Midpoint Benefits	$19,875.57		$22,344.63		$23,605.71	
		m1		m2		m3	

9 PV Travel Time Cost Savings

[(m1 x 6 x 0.7416) + (m2 x 7 x 0.4511) + (m3 x 16 x 0.1958)] $232,947.96 C

Worksheet 5 - VOC and CO_2 Cost Savings

1	Road Type	District Distributor A
2	Project Type	Isolated intersection/intersection as part of route improvement
3	Modelling Period Type	AM / Inter / PM peak periods
4	Do-minimum Traffic Flow	MID BLOCK ONLY

4A Project timings from Annualisation Factors				4B Traffic Flow Data (veh/hr)				
		Time periods						
Time Period	Flow Factor	Time periods (hrs/day)	Days/year	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	1	2	245	297	318	343	343	(a)
Weekday Interpeak	1	8	245	137	146	158	158	(b)
Weekday PM Peak	1	2	245	275	294	317	317	(c)
Weekday Off Peak	0.25	12	245	34	37	39	39	(d)
Weekend Peak	0.45	8	120	62	66	71	71	(e)
Weekend Off Peak	0.15	16	120	21	22	24	24	(f)
				AADT (veh/day)				
All periods	N/A	24	365	17906	19118	20635	20635	(g)
(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	

5	Option Traffic Flow	MID BLOCK ONLY

5A Project timings from Annualisation Factors				5B Traffic Flow Data (veh/hr)				
		Time periods						
Time Period	Flow Factor	Time periods (hrs/day)	Days/year	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	1	2	245	297	318	343	343	(a)
Weekday Interpeak	1	8	245	137	146	158	158	(b)
Weekday PM Peak	1	2	245	275	294	317	317	(c)
Weekday Off Peak	0.25	12	245	34	37	39	39	(d)
Weekend Peak	0.45	8	120	62	66	71	71	(e)
Weekend Off Peak	0.15	16	120	21	22	24	24	(f)
				AADT (veh/day)				
All periods	N/A	24	365	17906	19118	20635	20635	(g)
(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	

6 & 7	Vehicle Speeds and VOC costs - Do-minimum

	# of Lanes	Interval	Hr	t0	Speed	Q	JA	tf (min/km)	rf	0.25*rf
Akcelik Link Parameters	2	10.00	60.00	1.33	45	1700	6.72	1.33	45.00	11.25

	Isolated intersection/intersection as part of route improvement				Mid-block/mid-block as part of route improvement								
	6A Mean Speed (km/hr)				6B Mean Speed (km/hr)				7A VOC Cost (cents/km)				
Year / Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	39.5	39.5	39.4	39.4	44.99	44.99	44.99	44.99	30.01	30.01	30.01	30.01	(a)
Weekday Interpeak	39.2	39.1	38.9	38.9	44.99	44.99	44.99	44.99	30.01	30.01	30.01	30.01	(b)
Weekday PM Peak	38.5	38.4	38	38	44.99	44.99	44.99	44.99	30.01	30.01	30.01	30.01	(c)
Weekday Off Peak	39.2	39.1	38.9	38.9	45.00	45.00	45.00	45.00	30.01	30.01	30.01	30.01	(d)
Weekend Peak	39.2	39.1	38.9	38.9	45.00	45.00	45.00	45.00	30.01	30.01	30.01	30.01	(e)
Weekend Off Peak	39.2	39.1	38.9	38.9	45.00	45.00	45.00	45.00	30.01	30.01	30.01	30.01	(f)
All periods	47	47	47	47	44.96	44.96	44.95	44.95	29.2	29.2	29.2	29.2	(g)

	Isolated intersection/intersection as part of route improvement				Mid-block/mid-block as part of route improvement								
	6C Total Travel Distance (veh.km/hr)				6D Total Travel Distance (veh.km/hr)				7B Annual VOC Cost ($/year)				
Year / Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	192.5	205.6	230.4	230.4	15	16	17	17	$28,306.93	$30,233.27	$33,880.09	$33,880.09	(a)
Weekday Interpeak	255.6	272.9	305.2	305.2	7	7	8	8	$150,342.90	$160,518.69	$179,517.42	$179,517.42	(b)
Weekday PM Peak	375.5	401	451.3	451.3	14	15	16	16	$55,216.90	$58,966.65	$66,363.21	$66,363.21	(c)
Weekday Off Peak	63.9	68.225	76.3	76.3	2	2	2	2	$56,378.59	$60,194.51	$67,319.03	$67,319.03	(d)
Weekend Peak	115.02	122.805	137.34	137.34	3	3	4	4	$33,136.80	$35,379.63	$39,567.10	$39,567.10	(e)
Weekend Off Peak	38.34	40.935	45.78	45.78	1	1	1	1	$22,091.20	$23,586.42	$26,378.07	$26,378.07	(f)
All periods	2	2	2	2	37	40	43	43	$5,115.84	$5,115.84	$5,115.84	$5,115.84	(g)
									$345,473.32	$368,879.17	$413,024.93	$413,024.93	Total for All Day periods
									$5,115.84	$5,115.84	$5,115.84	$5,115.84	Total for day long

8 & 9 Vehicle Speeds and VOC costs - Option

	# of Lanes	Interval	Hr	t0	Speed	Q	JA	tf (min/km)	rf	0.25*rf
Akcelik Link Parameters	2	10.00	60.00	1.33	45	1700	6.72	1.33	45.00	11.25

	Isolated intersection/intersection as part of route improvement				Mid-block/mid-block as part of route improvement								
	8A Mean Speed (km/hr)				8B Mean Speed (km/hr)				9A VOC Cost (cents/km)				
Year / Time period	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	39.2	39.2	39.1	39.1	44.99	44.99	44.99	44.99	30.0	30.0	30.0	30.0	(a)
Weekday Interpeak	39.1	39	38.9	38.9	44.99	44.99	44.99	44.99	30.0	30.0	30.0	30.0	(b)
Weekday PM Peak	38.5	38.4	38.3	38.3	44.99	44.99	44.99	44.99	30.0	30.0	30.0	30.0	(c)
Weekday Off Peak	39.1	39	38.9	38.9	45.00	45.00	45.00	45.00	30.0	30.0	30.0	30.0	(d)
Weekend Peak	39.1	39	38.9	38.9	45.00	45.00	45.00	45.00	30.0	30.0	30.0	30.0	(e)
Weekend Off Peak	39.1	39	38.9	38.9	45.00	45.00	45.00	45.00	30.0	30.0	30.0	30.0	(f)
All periods	35	35	35	35	44.96	44.96	44.95	44.95	31.2	31.2	31.2	31.2	(g)

	Isolated intersection/intersection as part of route improvement				*Mid-block/mid-block as part of route improvement*								
	8C Total Travel Distance (veh.km/hr)				*8D Total Travel Distance (veh.km/hr)*				9B Annual VOC Cost ($/year)				
Year / Time period	Year 2	Year 8	Year 15	Year 30	*Year 2*	*Year 8*	*Year 15*	*Year 30*	Year 2	Year 8	Year 15	Year 30	
Weekday AM Peak	145.8	155.7	175.5	175.5	15	16	17	17	$21,439.74	$22,895.53	$25,807.10	$25,807.10	(a)
Weekday Interpeak	224.6	239.9	271.5	271.5	7	7	8	8	$132,108.82	$141,108.22	$159,695.21	$159,695.21	(b)
Weekday PM Peak	283.2	302.5	342.9	342.9	14	15	16	16	$41,644.28	$44,482.32	$50,423.10	$50,423.10	(c)
Weekday Off Peak	56.15	59.975	67.875	67.875	2	2	2	2	$49,540.81	$52,915.58	$59,885.71	$59,885.71	(d)
Weekend Peak	101.07	107.955	122.175	122.175	3	3	4	4	$29,117.86	$31,101.40	$35,198.13	$35,198.13	(e)
Weekend Off Peak	33.69	35.985	40.725	40.725	1	1	1	1	$19,411.91	$20,734.27	$23,465.42	$23,465.42	(f)
All periods	5	5	5	5	37	40	43	43	$13,665.60	$13,665.60	$13,665.60	$13,665.60	(g)
									$293,263.42	$313,237.33	$354,474.67	$354,474.67	Total for All Day periods
									$13,665.60	$13,665.60	$13,665.60	$13,665.60	Total for day long

10 Annual Vehicle Operating Cost for Modelled Years

	Annual Vehicle Operating Cost ($/year) for modelled years					
	Start Year 2	End Year 7	Start Year 8	End Year 14	Start Year 15	End Year 30
Annual VOC Cost - Do-minimum	$345,473.32	$368,879.17	$368,879.17	$413,024.93	$413,024.93	$413,024.93
Annual VOC Cost - Option	$293,263.42	$313,237.33	$313,237.33	$354,474.67	$354,474.67	$354,474.67

11

Midpoint	Year 4	11.5	22
Duration Years	6	7	16
Do-minimum VOC at midpoint	$357,176.24	$390,952.05	$413,024.93
Option VOC at midpoint	$303,250.37	$333,856.00	$354,474.67
Midpoint Benefits	$53,925.87	$57,096.05	$58,550.26
	m1	m2	m3

12 PV Vehicle Operation Cost Savings

[(m1 x 6 x 0.7416) + (m2 x 7 x 0.4511) + (m3 x 16 x 0.1958)] $603,667.00 D

Worksheet 6 - Crash Cost Savings

1 Project Type

Isolated intersection/intersection as part of route improvement

2 Crash Summary

Total Crashes - 2 PDO Major (Same Lane Rear End, Same Lane Left Rear), 1 PDO Minor (Thru - Right)

3 Counter Measures

None

4 Net PV of Crash Cost Savings (from CARS)

	$0.00	*NPV*

5 Annual Crash Cost Savings

NPV / 4.329906	$0.00	*ACCS*

6 Crash Growth Rate

Crash growth rate		-1.90%	*R*
Discount rate		8.00%	*DR*
Discount factor crash costs	*(1-((1+R)/(1+DR))^30)/(DR-R)] - [(1-((1+R)/(1+DR))^1)/(DR-R)]}*	8.61	*DFCC*

7 PV Crash Cost Saving

*ACCS * DFCC*	$0.00	**E**

Worksheet 7 - Non Tangible Benefits

1 Public Transport

Effect	Description	Score
Neutral	No expected change on overall public transport performance with no specific new/upgraded public transport infrastructure provided or removed.	0
Justification	There are no public transport routes along this corridor. As such, modification of this intersection does not affect the public transport performance.	

2 Pedestrian Facilities

Effect	Description	Score
Neutral	No expected change on overall pedestrian levels of service with no specific walking infrastructure improvements provided or existing facilities removed.	0
Justification	There is no change in overall pedestrian levels of service as the intersection modified to include an additional leg without a refuge area in the raised median in the new leg.	

3 Cycling Facilities

Effect	Description	Score
Neutral	No expected change on overall cycling levels of service with no specific cycling infrastructure improvements provided or existing facilities removed.	0
Justification	There is no change in overall cyclists levels of service as the intersection modified to include an additional leg without a refuge area in the raised median in the new leg.	

4 Street Lighting

	Score
	0
Justification	The existing intersection has street lighting to meet AS 1158 standards. The modified intersection will also have street lighting to meet AS 1158. As such, no points can be allocated in this area.

5 Road Safety

Effect	Description	Score
Neutral	A positive (+) or negative (-) NPV score has been entered into Worksheet 6 – Crash Costs, or the proposed measures have negligible impact on road safety overall.	0
Justification	The proposed measures have negligible impact on road safety overall.	

6 Overall Score

0 F

Worksheet 8 - Overall Score

1 Present Value (PV) cost of Do-minimum

	$25,540.37	A worksheet 2

2 Present Value (PV) cost of Option

	$949,988.25	B worksheet 3

3 Unconstrained Benefit values

PV travel time cost savings	$232,947.96	C worksheet 4	*x update factor TTC*	1	$232,947.96	W
PV VOC and CO2 savings	$603,667.00	D worksheet 5	*x update factor VOC*	1	$603,667.00	Y
PV Crash cost savings	$0.00	E worksheet 6	*x update factor AC*	1	$0.00	Z

4 Ratio of Unconstrained Benefit to Cost

PV net unconstrained benefits / PV net costs	*(W + Y + Z) / (B - A)*	0.90
Score		0.90

5 FYRR

Discount Factor VOC	*{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}*	10.7521769	
Discount Factor TTC	*{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}*	10.7521769	
Discount Factor CC	*{(USPWF30 – USPWF1) + (R x (AGPWF30 – AGPWF1))}*	10.7183243	
PV 1st Year benefits / PV net costs	*[(W+Y)/DF(voc&ttc)+Z/DFcc)] x 0.93 / (B - A)*	7.83	%

6 Non Tangible Benefit Score

0	F worksheet 7

7 Total Score

0.68	out of a possible score of 50

Combined Score

MRRG Reference	Total Score
1	7.78
2	-0.04
3	1.21
4	0.68

Average Total Score	2.41

Final Score	7.78

The Final Score is the higher of the Average Total Score and Individual Assessment Scores.

Appendix A New Links

Whilst the procedures can best be utilised for upgrading existing midblock lengths and intersections (and hence route lengths through a combination of these nodes and links), the potential also exists to use the procedures for the construction of a new road (asset creation), such as a bypass which reduces the route length and/or travel time/vehicle operating costs for traffic between two fixed points.

The benefits associated with a new road with respect to improved travel times and/or vehicle operating costs/CO2 can be attributed to:

1. Those vehicles transferring to the new route which may be shorter and/or have less traffic on it than the existing route (potentially resulting in increased speeds); and
2. Those vehicles using the existing route having less traffic on it (potentially resulting in increased speeds/fewer delays at intersections) due to reassigned traffic using the new route.

Given the above, benefits can be calculated using either/or both of the following elements:

1. Transferring vehicle benefits – considered as a mid-block calculation:
   - Treat both the existing road/route (Do Minimum) and the new road (Option) as section lengths in their entirety (i.e. between where the existing and new roads/routes intersect at either end) regardless of whether there are intersections along either road/route length when entering the Project Length data in Worksheet 1.
   - Use the same traffic volumes (equating to the re-assigned traffic flow) for both the Do Minimum and the Option for the mid-block information requirements in Worksheet 4 and 5 for the Travel Time and VOC benefits (as we're comparing like for like i.e. transferred traffic at this stage of the assessment).

   It is acknowledged that the actual current total traffic on the existing route will include those vehicles that will transfer to a new route in due course as well as other vehicles heading elsewhere. As such, simply using the re-assigned traffic volumes for the Do Minimum may result in the associated calculated average mid-block speeds being artificially high. However for comparative purposes, this is considered acceptable.

2. Existing route benefits – derived from reduced delays etc. at intersections only along the existing route (mid-block benefits are not recognised in this instance given that the majority of benefits will be derived at intersections and the potentially overly time consuming nature of working out each mid-block length):
   - At intersections, use the existing traffic turning movements for the Do Minimum and the revised turning movements (without the transferred/reassigned traffic) for the Option to determine benefits at each intersection along the existing route.
   - For the Option cost in this instance, use the total cost of the new road at each intersection being assessed, as without the full Option being built, no benefits will be derived at the intersections on the existing route.

   It is recognised that due to the need to use the full Option cost for each intersection assessment along the existing route, a low ratio of unconstrained benefit to cost may be achieved. When such benefits at intersections along the existing route are averaged out in conjunction with the mid-block benefits along the new road, the overall score may reduce. In such instances, it is acceptable to simply provide/declare the mid-block benefits associated with the new road only (with any spin-off benefits for the intersections along the existing route being undisclosed).

To allow for a robust analysis, no crash saving benefits should be derived for new roads due to the complexity associated with such modelling.

Appendix B Do Minimum Cost Calculations

1. Select the road type for the project.

2. Calculate the PV of annual maintenance cost **(a)** for the Do Minimum by multiplying the Do Minimum maintenance cost by the discount factor 11.7023. If typical annual maintenance costs for the intersection or mid-block are not known, enter zero.

3. Calculate the Do Minimum periodic maintenance cost using the following steps:

   (i) The proposed rehab treatment measure for the issue will be filled in automatically depending upon the road type selected e.g. District Distributor A/B – 40mm SMA Overlay $21.50
   (ii) Enter the site treatment area in square metres (from SLK to SLK).
   (iii) Calculate the Rehabilitation Cost ($) = (i) x (ii).

   Calculate the PV of the periodic maintenance cost over the 30 year life of the road. This will be calculated using the following steps:

   (iv) The years for periodic maintenance will be filled in automatically based on the road type selected – e.g. District Distributor A/B: every 15 years over the 30 year period.
   (v) Enter the estimated period maintenance cost for each year selected as indicated in Step 3.
   (vi) The appropriate Single Payment Present Worth Factor (SPPWF) from Table B1 below will be selected automatically to determine the PV at time zero (estimated cost x SPPWF).
   (vii) Sum the PV of the periodic costs to determine the PV of total periodic maintenance costs **(b)** – this will be done automatically.

Table B1 - Single Payment Present Worth Factor SPPWF (for 8% discount rate)

Year	SPPWF	Year	SPPWF
1	0.93	**16**	0.29
2	0.86	**17**	0.27
3	0.79	**18**	0.25
4	0.74	**19**	0.23
5	0.68	**20**	0.21
6	0.63	**21**	0.20
7	0.58	**22**	0.18
8	0.54	**23**	0.17
9	0.50	**24**	0.16
10	0.464	**25**	0.15
11	0.43	**26**	0.14
12	0.40	**27**	0.13
13	0.37	**28**	0.12
14	0.34	**29**	0.11
15	0.32	**30**	0.10

4. Insert the annual associated operating cost of the project length based on street lighting costs. This will be calculated using the following steps:

(i) Select the appropriate Western Power tariff code and wattage that is appropriate for the luminaires (street lights) - within drop down menu. This provides a cost in terms of $/lamp/day. The values that will be within the drop down menu are shown in Table B2 below.

Table B2 – Luminaire Values

Western Power Tariff Code	Wattage	$/lamp/day
ZE02C	80MV	0.395718
ZE03C	125MV	0.505919
ZE07C	250MV	0.697799
ZE13C	150HPS	0.523202
ZE15C	250HPS	0.792204
ZE19C	70HPS	0.408487
ZE20C	70ML	0.713818
ZE21C	150ML	0.999235
ZE22C	250ML	1.261879
ZE87SC	42CFL	0.335294

(ii) Enter the number of luminaires (street lights) that are currently existing within your study section.
(iii) Enter the number of days the luminaries (street lights) are lit for.
(iv) The total annual operating cost = ($/lamp/day) x (no of luminaires (street lights)) x (no days the luminaires (street lights) are lit for).
(v) Calculate the PV of the annual associated operating cost of the road midblock, or isolated intersection by multiplying it by 10.7398 **(c).**

5. Calculate the sum of **(a)** + **(b)** + **(c)** to obtain the PV total cost of the Do Minimum.

Appendix C Option Cost Calculations

1. Select the road type for the project – automatically copied from Worksheet 1.

2. Enter the capital costs of the proposed option. Multiply the project cost by the discount factor 0.9259 and enter at **(a)**.

3. Calculate the PV of annual maintenance cost for the option by multiplying the Do Minimum maintenance cost by the discount factor 10.7398 and enter at **(b)**.

4 The cost of the maintenance for year 1 at **(c)** is assumed to be the same as the existing maintenance strategy in year that the proposed option works are carried out.

5 Calculate the option maintenance costs using the following steps:
(i) The proposed rehabilitation treatment measure and cost will be filled in automatically based on the selected road type e.g. District Distributor A/B – 40mm SMA Overlay $21.50.
(ii) Enter the site treatment area for the option – typically this will be same as in **Worksheet 2** (from SLK to SLK).
(iii) Calculate the Rehabilitation Cost ($) = (i) x (ii).

The periodic maintenance costs for the option will be calculated using the following steps:
(iv) The years for periodic maintenance will be filled in automatically based on the selected road type - e.g. District Distributor A/B: every 15 years over the 30 year period.
(v) Enter the estimated period maintenance cost for each year selected.
(vi) The appropriate Single Payment Present Worth Factor (SPPWF) from Table C1 will be selected automatically to determine the PV at time zero (estimated cost x SPPWF).
(vii) Sum the PV of the periodic costs to determine the PV of total periodic maintenance costs **(d)**.

Table C1 - Single Payment Present Worth Factor SPPWF (for 8% discount rate)

Year	SPPWF	Year	SPPWF
1	0.93	**16**	0.29
2	0.86	**17**	0.27
3	0.79	**18**	0.25
4	0.74	**19**	0.23
5	0.68	**20**	0.21
6	0.63	**21**	0.20
7	0.58	**22**	0.18
8	0.54	**23**	0.17
9	0.50	**24**	0.16
10	0.464	**25**	0.15
11	0.43	**26**	0.14
12	0.40	**27**	0.13
13	0.37	**28**	0.12
14	0.34	**29**	0.11
15	0.32	**30**	0.10

6 Insert the annual associated operating cost of the project length under consideration for street lighting. This will be calculated using the following steps:

(i) Select Western Power tariff code and wattage that is appropriate for the luminaires (street lights) that are needed for the option within your study section from the list (within drop down menu), this will give you the cost $/lamp/day. The values that will be within the drop down menu are shown in Table C2.

Table C2 – Luminaire Values

Western Power Tariff Code	Wattage	$/lamp/day
ZE02C	80MV	0.395718
ZE03C	125MV	0.505919
ZE07C	250MV	0.697799
ZE13C	150HPS	0.523202
ZE15C	250HPS	0.792204
ZE19C	70HPS	0.408487
ZE20C	70ML	0.713818
ZE21C	150ML	0.999235
ZE22C	250ML	1.261879
ZE87SC	42CFL	0.335294

(ii) Insert the number of luminaires (street lights) that are needed for the option within your study section

(iii) Enter the number of days the luminaries (street lights) will be lit for.

(iv) The total annual operating cost = ($/lamp/day) x (no of luminaires (street lights)) x (no days the luminaires (street lights) are lit for).

(v) Calculate the PV of the annual associated operating cost of the road midblock, or isolated intersection by multiplying the value obtained in Step (iv) by 10.7398 at **(e)**.

7 Calculate the sum of **(a)+(b)+(c)+(d)+(e)** to obtains the PV cost of the preferred option at **B**. Transfer the PV cost of the preferred option to **B** in **Worksheet 1** - this value will be entered automatically.

Appendix D Tangible Benefit Cost Saving Calculations

D1 Travel Time Costs

1 Select the road type for the project.

2 Select the project type.

3 Enter the modelling period type – either morning (AM)/Inter-peak/evening (PM) peak periods; or a day long period.

4 For midblock sections only, enter the total two-way traffic flow along the length affected for the Do Minimum and Option at Time Zero for each of the AM, Inter-peak and PM peak periods (vehicles per hour); or the AADT for day long modelled periods.

5/6 Follow the Steps (A to E) shown below for both the Do Minimum and Option.

Step 5A/6A
Enter the following Annualisation factors (these are calculated automatically as part of the process):

- Time periods (column **(Q)** row **(a)** to **(g)**) – identified/highlighted automatically;
- Flow factors (column **(R)** row **(d)** to **(g)**) for off peak periods not modelled;
- Hours per day(column **(S)** row **(a)** to **(g)**); and
- Days per year (column **(T)** row **(a)** to **(g)**).

Note: For intersections and congested midblock sections, a range of time periods will be required, Column **(Q)** rows **(a)** to **(f)**. In some cases it will be possible to model mid-blocks with a day long time period; for these situation use only Column **(Q)** row **(g)**.

Enter the TTC in units $/hr into (column **(U)** row **(a)** to **(g)**) for the time periods modelled and road type using Table D1. Table D1 provides Travel Time Costs for District Distributor A and B road types for all time relevant periods.

Table D1 - Travel Time Costs for District Distributors A and B for all time periods (Base Date July 2022)

Time period	Base value of time ($/hr)
Morning commuter peak	22.54
Daytime inter-peak	27.01
Afternoon commuter peak	22.30
Evening/night time	22.91
Weekday all periods	25.55
Weekend/holiday	24.80
All periods	25.70

Step 5B/6B - Intersections
Three future years: 2, 8, 15 are to be modelled for the specified time period with Year 30 being the same as Year 15. Once the existing intersection has been modelled, the three future years can be modelled relatively simply in SIDRA by applying the traffic growth factor and the desired future year assessment.

For intersection projects, enter the SIDRA modelling control delay (total) from the "Intersection Summary" output, into columns **(V)** to **(Y)** rows **(a)** to **(c)** for each time period and model year for both the Do Minimum and Option.

Step 5C/6C – Mid-Block
For road midblock projects with multiple modelled time periods (per day), for example morning, inter peak and evening peak periods, enter the veh.hr/hr values into columns **(V)** to **(Y)** rows **(a)** to **(c)** (similar to isolated intersections) for each time period and model year for both the Do Minimum and option. These values are calculated using:

- Mean vehicle speed (km/hr);
- Traffic volume (veh/hr); and
- Section length (km).

Mean speeds are determined as set out in Appendix D2 for intersections using outputs from the SIDRA intersection modelling.

Use these model outputs with the equations below to determine the veh.hr/hr values for entering into the Do Minimum and Option tables.

For Do Minimums with multiple time periods in day use:

$$\frac{(veh/hr\ (do\ \mathrm{min}\ \ hourly\ traffic\ flow) * Length\ (in\ km\ for\ do\ \mathrm{min})}{Mean\ Speed\ (for\ domin\ in\ \frac{km}{hr})} = \text{veh.hr/hr}$$

For options with multiple time periods in day use:

$$\frac{(veh/hr\ (\text{Option}\ \ hourly\ traffic\ flow) * Length\ (in\ km\ for\ \text{Option})}{Mean\ Speed\ (for\ Option\ in\ \frac{km}{hr})} = \text{veh.hr/hr}$$

If the modelling has only been done for day long time periods, skip Step 5C and go to Step 5D:

Step 5D/6D
For road midblock projects that have been modelled with day long time periods, enter modelling outputs veh.hr/hr in columns **(V)** to **(Y)** row **(g)** for each modelled year and option (Do Minimum and option). These values are calculated using:

- Mean vehicle speed,(km/hr);
- Traffic volume AADT (veh/day); and
- Section length (km).

Mean speeds are determined as set out in Appendix D2 for mid-block sections using a speed-flow model.

Use these outputs with the equations below to determine veh.hr/hr for entering into the Do Minimum and Option tables as described previously.

For Do Minimums with a day long time period use:

$$\frac{(\frac{AADT}{24}(do \min\ avererage\ hourly\ traffic\ flow)*Length\ (in\ km\ for\ do \min)}{Mean\ Speed\ (for\ domin\ in\ \frac{km}{hr})} = \text{veh.hr/hr}$$

For options with a day long time period use:

$$\frac{(\frac{AADT}{24}(Option\ avererage\ hourly\ traffic\ flow)*Length\ (in\ km\ for\ do \min)}{Mean\ Speed\ (for\ domin\ in\ \frac{km}{hr})} = \text{veh.hr/hr}$$

Enter Do Minimum and option modelling results in units of veh.hr/hr in the appropriate model year columns **(V)** to **(Y)**, row **(g)**.

Step 5E/6E
For projects with multiple modelled time periods, calculate the Do Minimum and Option annual travel time costs for each time period and modelled year by multiplying the hour and day Annualisation Factors together with the TTC ($/hr) and modelling inputs (veh.hr/hr) – calculated automatically. Add the various time periods together to obtain the total annual TTC for the day long period.

For projects with a day long modelled time period, calculate the Do Minimum and Option annual travel time costs for each modelled year by multiplying the day and year Annualisation Factors together with the TTC ($/hr) and modelling inputs (veh.hr/hr) – calculated automatically.

7 Determine and enter the Do Minimum and Option TTC midpoint values by averaging the TCC at the start and end of each of the four modelled periods – carried out automatically.

Example: in the first six year period (years start 2 – end 7), the end of year 4 is the mid–point. The value to input for midpoint is:

$$(TTC_{\text{Start of Year 2}} + TTC_{\text{End of Year 7}})/2$$

8 Calculate the 'mid–point benefits' by subtracting Option TTC midpoint from the Do Minimum TTC midpoint to obtain **m^1**, **m^2** and **m^3**– carried out automatically.

9 Using the formula provided in the spread sheet, calculate the PV of the travel time cost savings for the project option – calculated automatically at **C**.

D2 Vehicle Operating Costs

1 Select the road type for the project.

2 Select the project type.

3 Enter the modelling period type – either morning (AM)/Inter-peak/evening (PM) peak periods; or a day long period.

4/5 Follow the Steps (A and B) below for the Do Minimum and Option.

Step 4A/5A
Enter the following project Annualisation factors**:**
- Time periods (column **(Q)** row **(a)** to **(g)**);
- Flow factors (column **(R)** row **(d)** to **(g)**) for off peak periods not modelled;
- Hour per day(column **(S)** row **(a)** to **(g)**); and
- Days per year (column **(T)** row **(a)** to **(g)**).

Note: For intersection and congested midblock projects, a range of time periods will be required as shown in column **(Q)** rows **(a)** to **(f)**. In some cases road mid-blocks will have been modelled for a day long time period - for these situation use only column **(Q)** row **(g)**.

Step 4B/5B
For midblock projects only, enter the traffic flow data for the four future assessed years for each time period.

6/7 Enter the modelling results (see below) for each time period and year modelled along with the corresponding VOC cost for the Do Minimum.

Step 6A/6B/7A – Mean Speed and VOC
For intersections, enter the SIDRA modelling "Travel Speed" (mean speed) from the "Intersection Summary" outputs for each year and peak periods modelled in rows **(a)** to **(c)**. (Note: the off peak, weekend peak and weekend off peak time periods use the same mean speeds as the inter-peak.) The minimum permitted speed to be entered for intersections is 10km/h as below this speed, an inconsistent relationship with operating and travel time costs exists.

For midblock projects, the forecast operating speeds for each time period and each future year is calculated using a speed-flow model developed by Akcelik (Speed Flow Models for Uninterrupted Facilities, 2003 Version 3) as indicated overleaf. This speed flow model has been cross-referenced with the Highway Capacity Manual (2000) with regards to average and typical free flow travel speeds for different street classes. These models are based on traffic flow by direction and the number of traffic lanes. To simplify the process and allow for a variety of traffic data inputs to be used, it has been necessary to combine the 2-way weekday peak hour volumes and subsequently obtain an average per direction for the peak periods. Outside these weekday peak periods, the supplied/calculated traffic volumes are used within the speed-flow model. For the day long modelled time period, it has been necessary to derive an average hourly flow over the entire period.

$$t = t_0\left\{1 + 0.25r_f\left[(x-1) + \sqrt{(x-1)^2 + \frac{8J_A x}{Qt_0 r_f}}\right]\right\}$$

where : t = average travel time (minutes/km);
t_0 = minimum (zero-flow) travel time (minutes/km);
J_A = Curve Parameter;
$x = q/Q$ = degree of saturation,
T_f = Analysis Flow Period, taken as 60 minutes (min);
q = demand (arrival) Flow rate (veh/hr);
Q = Link Capacity (veh/hr);
r_f = ratio of flow period T_f, to minimum travel time t_0 ($r_f = T_f/t_0$)

The minimum permitted speed to be entered for mid-block sections is 10km/h as below this speed, an inconsistent relationship with operating and travel time costs exists.

Determine the VOC for each year and model period. To obtain the value, look up the mean speed in Table D2. Table D2 provides VOC for District Distributors A and B, based on average operating speed.

Table D2 - Vehicle Operating Costs (including CO_2 emissions) in cents/km by mean vehicle speed for District Distributors A and B (Base date: July 2022)

Mean vehicle speed (km/hr)	VOC cents/km
5	54.57
10	48.69
15	42.82
20	38.44
25	35.22
30	32.89
35	31.20
40	30.01
45	29.20
50	28.70
55	28.45
60	28.40
65	28.51
70	28.77
75	29.14
80	29.60
85	30.16
90	30.78
95	31.47
100	32.20
105	32.99
110	33.82
115	34.68

Step 6C/6D/7B – Travel Distance and Annual VOC

For intersections, enter the SIDRA modelling “Travel Distance (Total)” from the “Intersection Summary” output for each year and peak period modelled in rows **(a)** to **(c).** Note: for the time periods; off peak; weekend peak and weekend off peak, modelling results are predicted using inter-peak model results multiplied by the flow factor.

For midblock projects where the modelling has been broken down into peak periods, enter the Total Travel Distance (veh.km/hr) in rows **(a)** to **(c)** – see below. If the midblock modelling has been done for a day period, then enter the Total Travel Distance in row **(g)**.

Calculate the Total Travel Distance by using the following model parameters:

- Project length (km); and
- Traffic volume (veh/hr or AADT (veh/day)).

This calculation, using the equations shown below, is undertaken automatically as part of the spread sheet process.

For mid-block projects, where a number of time periods are used in the modelling, use the following equation to determine the Total Distance Travelled for each peak period and year modelled:

Veh/hr (do min hourly traffic flow) x Length (in km for do-min) = veh.km/hr

For road midblock projects where one day long period was modelled use the following equation to determine the Total Distance Travelled:

$$\frac{AADT}{24} \textit{(do min average hourly traffic flow) x Length (in km for do min) = veh.km/hr}$$

Calculate the Do Minimum annual VOC for each modelled year and time period by multiplying the hour and day Annualisation Factors together with the VOC (cents/km) and Total Travel Distance (veh.km/hr) – calculated automatically. Add the various time periods together to obtain the total annual TTC for the day long period.

For projects with a day long modelled time period, calculate the Do Minimum annual VOC for each modelled year by multiplying the day and year Annualisation Factors together with the VOC (cents/km) and Total Travel Distance (veh.km/hr) – calculated automatically.

8/9 Calculate the preferred Option annual VOC costs for each modelled year using the same process as identified in Steps 6 and 7 above for the Do Minimum.

10 Determine and enter the Do Minimum and Option VOC midpoint values by averaging the Annual VOC at the start and end of each of the four modelled periods.

Example: in the first six year period (years start 2 – end 7), the end of year 4 is the mid–point. The value to input for midpoint is:

$$(VOC_{\text{Start of Year 2}} + VOC_{\text{End of Year 7}})/2$$

11 Calculate the 'mid–point benefits' by subtracting Option VOC midpoint from the Do Minimum VOC midpoint to obtain m1, m2 and m3.

12 Using the formula provided in the spread sheet, calculate the PV of the total VOC (including CO_2) savings for the project over the 30 year analysis period at **D**.

D3 Crash Costs

1 Select the road type for the project.

2 Enter a summary of crash types and numbers.

3 Enter the countermeasure(s) selected in the CARS to address any road safety problems as part of the option design.

4 Enter the NPV of Crash Cost savings as an output from CARS unless less than five fatal or injury crashes have been recorded or the proposed treatment isn't intended to address the crash problem, in which case zero (0) should be entered.

5 Convert this NPV Crash Cost saving into Annual Crash Cost Saving by the following equation:

Annual Crash Cost savings (ACCS)
= NPV (from WA CRASH Tool) / 4.329906

Note: the factor 4.329906 is taken from the USPWF calculations.

6 Crash growth rate (R) is assumed to be a function of traffic growth and the speed environment. The following adjustments shown in Table D3 below should be applied to the traffic growth rate to give the "R" crash growth rate. This is done automatically in the spreadsheet.

Table D3 Growth rate adjustment factors

Modification to traffic growth rate (R)	Posted speed limit	
	40, 50 and 60 km/hr	70 km/hr and above
	-3%	-1%

The negative growth numbers indicate that if there was a zero or a low traffic growth, crash numbers would be reducing annually. For example in a speed environment of 50 km/hr with a growth rate of 4%, the "R" growth value would be (4%-3%) or 1%. The logic being that as time goes on, crash rates will reduce with better and safer road infrastructure, safer vehicles fleets with improved breaking and crash systems, and more awareness with safety education of motorist.

Convert the Annual Crash Cost savings into the PV Crash Cost saving for the 30 year analysis period with growth adjustment using the following method (calculated automatically):

PV Crash Cost savings

=ACCS x {[(1-((1+R)/(1+DR))^e)/(DR-R)] - [(1-((1+R)/(1+DR))^s)/(DR-R)]}

=ACCS x DFCC

Where:

- ACCS – Annual Crash Cost savings from step 5;
- DR – discount rate as a decimal i.e. 0.08;

- R – Geometric growth rate as a decimal, this is a modified growth rate as discussed above for crashes;
- s is start year of benefits which is end of year 1;
- e is end of year benefits which is end of year 30; and
- DFCC is discount factor Crash Costs.

The equation with these inputs becomes:

=ACCS x {[(1-((1+R)/(1+0.08))^30)/(0.08-R)] - [(1-((1+R)/(1+0.08))^1)/(0.08-R)]}

=PV Crash Cost saving (for a 30 year analysis period)

7 Enter this PV crash cost saving into **E**