Youngs Crossing Upgrade

Review of the Multi-Criteria-Assessment of the Options Analysis/Concept Design report

Table of Contents

Transport Planning Assessment Tools to support decision making 2

Options Assessment available tools and pros and cons of each 2

The MCA 3

Decision making in Council 3

The role of the MCA in this project 5

How the MCA was performed 6

Available information 6

Criteria selection methodology 6

Assessment panel 7

Scoring methodology 8

Weighting scoring 8

Criteria scoring 8

MCA results 9

Weighting results 9

Options scoring results 10

Sensitivity testing 10

New information that was not available at the MCA workshop 11

Results of Community Consultation 11

Federal funding clarification 11

How the MCA results might have been impacted from the new information 12

Review Summary and Lessons learned 14

Lessons learned for future projects 14

Bibliography 15

Transport Planning Assessment Tools to support decision making

(Transport) "*Planning is the deliberate social or organisational activity of developing an optimal strategy of future action to achieve a desired set of goals, for solving novel problems in complex contexts, and attended by the power and intention to commit resources and to act as necessary to implement the chosen strategy.*" Ernest R. Alexander, Professor Urban Planning - University of Wisconsin-Milwaukee- Approaches to Planning, 1986

Transport Planning is a multi-disciplinary, collaborative and participatory approach that is future oriented with a purpose to support decision making. It is the first step to transport infrastructure delivery. In summary, Transport Planning involves data collection and analysis, forecasting relevant indicators, designing of alternatives and assessing of the impacts each alternative will have.

The Australian Transport Assessment and Planning (ATAP) Guidelines (the Guidelines) provide a comprehensive framework for planning, assessing and developing transport systems and related initiatives.

Options generation and assessment is the third step in this framework, once a) a clear and integrated set of goals and objectives and set realistic targets and performance indicators has been established; and b) the problems that are preventing the goals and objectives from being achieved are identified, assessed and prioritised.

This third step of the framework, involves setting a clear set of goals and objectives, generating a broad range of options, assessing the impact of each option on the identified problems and weighing it up against alternatives. The final outcome of this step is to arrive at a preferred option (or package of options) that is supported by a rich set of information about its impacts and merits.

Previous work on the same identified problem, flood immunity and traffic capacity of Youngs Crossing, allowed Council to narrow down Options Generation and focus only on the two most feasible alignments that when combined with different levels of road flood immunity resulted in the Options shortlist.

Options Assessment available tools and pros and cons of each

Several tools are recommended for use in the options assessment process.

The ATAP Guidelines offer the following tools:

Options assessment stage	Recommended tools
Strategic Merit Test	Multi-criteria assessment (MCA) e.g. Objective Impact Table (OIT))
Rapid appraisal	Rapid Cost-Benefit Analysis (CBA) Rapid Appraisal Summary Table (AST)
Detailed appraisal	Detailed CBA Detailed AST

In brief, their main features are:

- An MCA is an approach that scores an option or initiative under several different criteria (which may or may not be weighted and aggregated into a single score)
- A CBA is an economic analysis tool for calculating the net benefits (benefits less costs) of an option or initiative expressed in money units

- An AST is a format for summarising the results of an appraisal process, including non-monetised benefits and costs.

MCAs in general are less resources intensive than CBAs. CBAs are more frequently used when monetised benefits are the main indicator used for decision making. Large organisations are the only ones that use CBAs and, in most cases, only for large projects. Both tools have received academic critique. The problem of monetary valuation or the incommensurability is a frequent theme of most criticism particularly in a field of environmental assessment. Another issue raised with CBAs is that they are based on complex assumptions, and hence likely to be inaccurate.

The MCA

MCA is often seen as a form of 'non-monetary' valuation. It emerged from the broad operations research literature and is concerned with the general mathematical problems of optimising multi-attribute functions. MCA is seen as simpler to apply than CBA and, in some ways, may be less data intensive; but this simplicity comes at a cost.

It is important to note that because the criteria all involve different scales, **the resulting index can only be used as an ordinal ranking, not a cardinal one.** In other words, both the raw and weighted scores are often not comparable in terms of scale and magnitude of scope and service levels.

MCA starts from a fundamentally different premise from CBA – it is not concerned with valuation and aggregation of individual preferences. Therefore, a number of studies have expressed substantive concerns about the use of MCA. A primary issue with MCA is that it compares and sums metrics in different, incompatible dimensions. The resulting score has no units and no meaning beyond the specific piece of analysis. Even the meaning within the analysis is questionable due to the subjectivity and lack of transparency around conversion, scores and weights.

Other concerns and limitations of MCA:

- While one motivation for choosing MCA is to avoid assigning dollar values to non-market social outcomes, the method implicitly assigns dollar values.
- MCA does not explicitly assume a particular accounting stance or perspective of a stakeholder or the community in the analysis. The determination of weights and/or scores for specific goals is generally determined by subject matter experts, focus groups (which are subject to self-selection bias), or specific interest groups. The analyst's interpretation of views of stakeholders also has the potential to influence the selection of weights and scores.
- The goals (or impacts) that are included in analysis of a project come from a very large set of possible goals. It is unlikely that any two analysts or decision makers would select the same goals to assess. The selection of criteria is likely to be subject to bias based on the interests of the analyst or decision maker.

Despite the above concerns about the MCA, Infrastructure Australia in its Assessment Framework for initiatives and projects to be included in the Infrastructure Priority List (March 2018) recognises that:

> While CBA is the preferred method for evaluating options, we recognise that MCA is often the most appropriate tool for short-listing options during the Options Assessment stage.

Decision making in Council

Council has experience in conducting MCAs for projects that are in the Options Assessment Stage. Especially for road projects and regardless of their cost scale, the process of identifying alternative

options and then using a number of criteria to select the preferred option to progress to design and construction is very common. Often this is done internally for smaller projects and external consultants are engaged for larger scale projects. On the other hand, Council has very limited experience in conducting CBAs, and this is even more true in conducting CBAs for the purpose of selecting a preferred option from a short list. As an example, the 2010 West Petrie Bypass, Options Analysis report by Arup, calculated a rather simplistic Benefit/Cost ratio for each of the options examined that used transport modelling to estimate and forecast time savings for each year.

Council officers support Council decision making by providing a recommendation at the end of the Options Analysis phase by considering all available tools, information and analysis:

- Strategic planning documents and Council policies
- History of transport planning for the project
- Issues and constraints identified in the concept design phase including environmental concerns
- The results of MCA
- Transport and traffic modelling analysis
- Other project related issues (e.g. constructability and asset maintenance)

Following this recommendation, Council makes the final decision taking also into account political representations and Council wide investment priorities. Again, using the West Petrie Bypass as an example, in 2013 Council resolved that Option G was the preferred option, although the 2010 Arup Options Analysis report recommended Option B -Andrew Petrie Drive as the preferred option.

The role of the MCA in this project

The transport planning analysis for this project, having Council's Design Brief as the base, developed a list of options for initial consideration. The brief limited the alignments to be investigated to just two, the existing Youngs Crossing Rd and the Andrew Petrie Drive corridor.

Options were developed from combining the two alignments with three different road flood immunity levels:

- 20% AEP flood immunity (part of the original scope but not investigated due to comparable cost to 10% AEP immunity, replaced by 1% AEP immunity)
- 10% AEP flood immunity;
- 5% AEP flood immunity; and
- 1% AEP flood immunity.

This resulted in 6 final options:

Option	Alignment	Flood Immunity
1A	Young's Crossing Corridor	10% AEP
1B	Young's Crossing Corridor	5% AEP
1C	Young's Crossing Corridor	1% AEP
2A	Andrew Petrie Drive Connection Corridor	10% AEP
2B	Andrew Petrie Drive Connection Corridor	5% AEP
2C	Andrew Petrie Drive Connection Corridor	1% AEP

The MCA was selected as the most suitable tool to assess the short-listed options and provide a recommendation for the preferred option to progress to the concept design phase.

After the final results, that showed the Andrew Petrie Drive alignment at Q100 (Option 2C) as the most preferred option with the Youngs Crossing Rd alignment also at Q100 (Option 1C) as the second most preferred option, the project team decided to progress both options to Concept Design and Cost Estimate.

How the MCA was performed

A weighted MCA was undertaken, using matched pairs system in an MCA workshop held on the 26th of May 2020. The matched pairs method was used to determine each participant's preference and calculate the participant's weightings.

Available information

The workshop participants had some prior project knowledge due to their individual roles in Council. A presentation at the start of the workshop, provided the participants a more comprehensive overview of all the different project aspects that were previously investigated as part of the Consultant's (Cardno) work. Information available included:

- Project background including project brief requirements
- Dam operations and flood immunity levels
- Topography and bank levels
- Concept sketches of the two alignments and basic road features (length of link and bridge)
- Flood modelling preliminary results and afflux levels for the 6 options
- Initial traffic analysis results
- Preliminary constructability findings
- High level cost estimates for all options

Criteria selection methodology

Cardno proposed a set of criteria and weightings for the MCA:

Criterion	Weighting	Elements
Network Performance	15%	Improves vehicle travel time
		Improves intersection performance (LOS)
		Improves pedestrian connectivity
		Improves cycling connectivity
		Improves flood immunity
Safety	25%	Reduced crash rate & crash severity
		Improved sight distance
		Improved safety for cyclists and pedestrians
Constructability	10%	Constructability
		PUP relocations
		Disruption to traffic during construction
		Construction period
Social & Environmental Impacts	20%	Impact on property owners (i.e. minimise property resumptions)

		Environmental impacts
		Community acceptance
		Visual Amenity
		Cultural Heritage impacts
Flood Immunity	10%	Level of Flood Immunity
Cost	20%	Capital cost
		Maintenance costs

The criteria, following a review from the project team, were slightly revised as follows:

Criterion	Sub-criteria
Traffic performance	Improves vehicle travel time
	Improves travel time reliability
Safety	Reduced crash rate & crash severity
Constructability 1	Staging & Construction period
Constructability 2	Risk of other road owners
Community Impacts	Impact on property owners
	Environmental impacts
Flood Immunity	Level of Flood Immunity
Cost	Capital cost

It was also decided that the weights will be selected by the working group using the pairs method.

Assessment panel

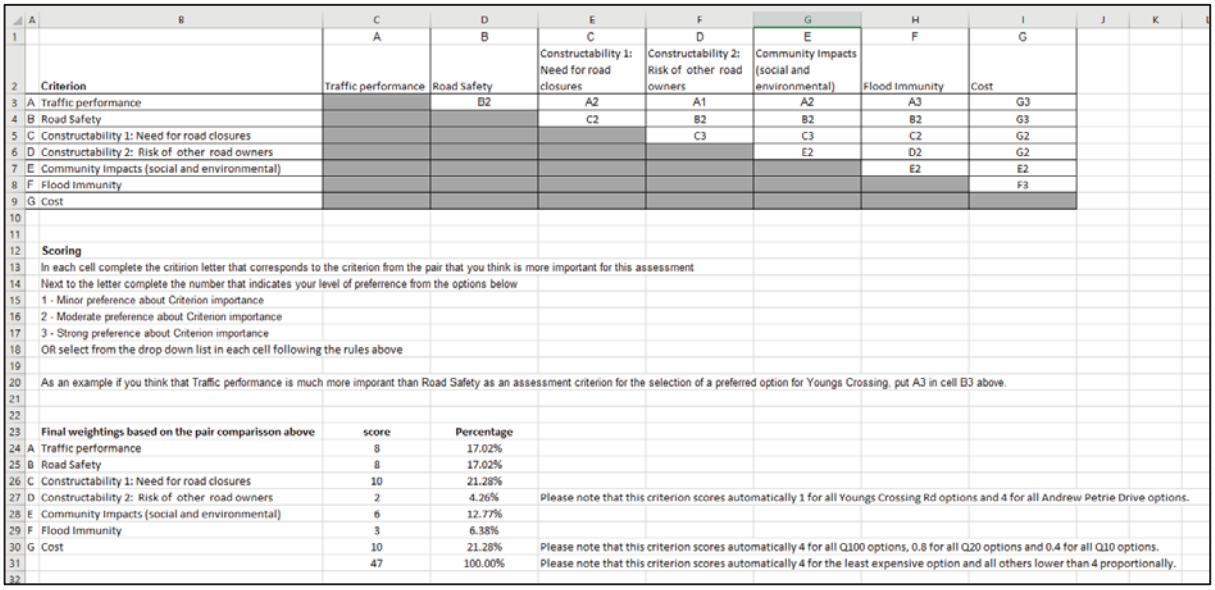
The MCA team from MBRC consisted of:

- Alex Wisniowiecka, Cultural Heritage Planning Officer
- Daniel Young, Team Leader Civil Design
- Jon Dare-Williams, Major Infrastructure Planning Manager (submit results only for weights)
- Ken Murray, Team Leader Landscape Architecture
- Lee Purchase, Manager Program Management
- Robert Auld, Policy and Planning Environmental Officer
- Leanne Salter, Senior Engineer Stormwater Infrastructure
- Simon Bennett, Coordinator Integrated Transport Planning

Scoring methodology

Weighting scoring

Each participant was given an Objective link to an individual spreadsheet that had to be completed during the workshop. For the weighting scoring, the table and instructions were:



	A	B	C	D	E	F	G	H	I	J	K
1			A	B	C	D	E	F	G		
2		Criterion	Traffic performance	Road Safety	Constructability 1: Need for road closures	Constructability 2: Risk of other road owners	Community Impacts (social and environmental)	Flood Immunity	Cost		
3	A	Traffic performance		B2	A2	A1	A2	A3	G3		
4	B	Road Safety			C2	B2	B2	B2	G3		
5	C	Constructability 1: Need for road closures				C3	C3	C2	G2		
6	D	Constructability 2: Risk of other road owners					E2	D2	G2		
7	E	Community Impacts (social and environmental)						E2	E2		
8	F	Flood Immunity							F3		
9	G	Cost									
10											
11											
12		**Scoring**									
13		In each cell complete the critirion letter that corresponds to the criterion from the pair that you think is more important for this assessment									
14		Next to the letter complete the number that indicates your level of preferrence from the options below									
15		1 - Minor preference about Criterion importance									
16		2 - Moderate preference about Criterion importance									
17		3 - Strong preference about Criterion importance									
18		OR select from the drop down list in each cell following the rules above									
19											
20		As an example if you think that Traffic performance is much more imporant than Road Safety as an assessment criterion for the selection of a preferred option for Youngs Crossing, put A3 in cell B3 above.									
21											
22											
23		**Final weightings based on the pair comparisson above**	**score**	**Percentage**							
24	A	Traffic performance	8	17.02%							
25	B	Road Safety	8	17.02%							
26	C	Constructability 1: Need for road closures	10	21.28%							
27	D	Constructability 2: Risk of other road owners	2	4.26%	Please note that this criterion scores automatically 1 for all Youngs Crossing Rd options and 4 for all Andrew Petrie Drive options.						
28	E	Community Impacts (social and environmental)	6	12.77%							
29	F	Flood Immunity	3	6.38%							
30	G	Cost	10	21.28%	Please note that this criterion scores automatically 4 for all Q100 options, 0.8 for all Q20 options and 0.4 for all Q10 options.						
31			47	100.00%	Please note that this criterion scores automatically 4 for the least expensive option and all others lower than 4 proportionally.						
32											

Criteria scoring

Three of the criteria were scored automatically based on quantitative methods while the other three were scored by the workgroup members:

Traffic performance	Very big improvement - 4	Big Improvement - 3	Moderate Improvement - 2	Minor improvement - 1
Safety	Very big improvement - 4	Big Improvement - 3	Moderate Improvement - 2	Minor improvement - 1
Constructability 1 - Staging & Construction period	Very Convenient Staging and Shorter Construction period - 4	Convenient Staging and Short Construction period - 3	Inconvenient Staging and Long Construction period - 2	Very Inconvenient Staging and Longer Construction period - 1
Constructability 2 - Risk of other road owners	Scored automatically: Yes -1; No -4			
Community Impacts	Very big impacts - 1	Big Impacts - 2	Moderate Impacts - 3	Minor impacts - 4
Flood Immunity	Scored automatically: 100 ARI: 4 score; all others proportionally			

Cost	Scored automatically: Least expensive option gets a 4 and the others proportionally

The participants had to complete the scoring table in their individual spreadsheets.

Weighting	Number	Criterion	Sub-criteria	Option 1A Youngs Crossing Road Q10		Option 1B Youngs Crossing Road Q20		Option 1C Youngs Crossing Road Q100		Option 2A Andrew Petrie Drive Q10		Option 2B Andrew Petrie Drive Q20		Option 2C Andrew Petrie Drive Q100	
				Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
17%	A	Traffic performance	Improves vehicle travel time	1	17.0	2	34.0	3	51.1	1	17.0	2	34.0	3	51.1
			Improves travel time reliability												
					17.0		34.0		51.1		17.0		34.0		51.1
17%	B	Safety	Reduced crash rate & crash severity	1	17.0	2	34.0	3	51.1	1	17.0	2	34.0	3	51.1
					17.0		34.0		51.1		17.0		34.0		51.1
21%	C	Constructability 1	Staging & Construction period	2	42.6	2	42.6	2	42.6	3	63.8	3	63.8	3	63.8
					42.6		42.6		42.6		63.8		63.8		63.8
4%	D	Constructability 2	Risk of other road owners	1	4.3	1	4.3	1	4.3	4	17.0	4	17.0	4	17.0
					4.3		4.3		4.3		17.0		17.0		17.0
13%	E	Community Impacts	Impact on property owners	3	38.3	3	38.3	3	38.3	3	38.3	2	25.5	1	12.8
			Environmental impacts												
					38.3		38.3		38.3		38.3		25.5		12.8
6%	5	Flood Immunity	Level of Flood Immunity	0.4	2.6	0.8	5.1	4	25.5	0.4	2.6	0.8	5.1	4	25.5
					2.6		5.1		25.5		2.6		5.1		25.5
21%	6	Cost	Capital cost	4.00	85.1	3.95837	84.2	3.77267	80.3	3.90893	83.2	3.85383	82.0	3.66006	77.9
					85.1		84.2		80.3		83.2		82.0		77.9
100%			TOTALS		200		233		263		219		239		257
			Ranking		6		4		1		5		3		2

Please note that the results above both in terms of scoring and ranking represent your individual scoring only.
The final score and ranking of the options will be the result of the average of individual scoring of all working group members.

MCA results

Weighting results

Weighting	All respondents Average
Traffic Performance	16.03%
Road Safety	25.14%
Constructability 1: Need for road closures	7.89%
Constructability 2: Risk of other road owners	5.29%
Community Impacts (social and environmental)	23.99%
Flood Immunity	14.99%
Cost	6.67%

- Three out of seven working group members, scored Cost as the very last priority of all, resulting in their score being 0%.
- Selected as top priority: Flood Immunity (3), Road Safety (2), Community Impacts (2), Constructability 1 (1).

Options scoring results

Rank	Average Ranking	Weight Average Total
Option1A Q10	6	1396
Option 1B Q20	5	1469
Option 1C Q100	2	1856
Option 2A Q10	4	1574
Option 2B Q20	3	1623
Option 2C Q100	1	2032

- The highest score an option could get was 2800
- First preferences: Option 2C (4), Option 1C (3) - Split Panel
- Two members of the group scored the Andrew Petrie Dr alignment in the first three spots.

Sensitivity testing

A sensitivity testing exercise was conducted as part of the MCA to see how the options rank with the same scoring but for different weightings based on certain scenarios.

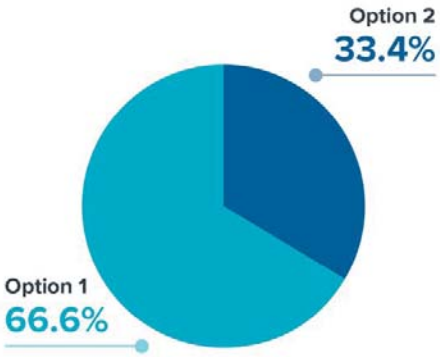
Criterion	Money is not a problem	All criteria equal	All about traffic	Flood immunity is not a problem
Traffic Performance	17.15%	14.29%	33.33%	18.53%
Road Safety	26.25%	14.29%	33.33%	27.64%
Constructability 1: Need for road closures	9.00%	14.29%	0.00%	10.38%
Constructability 2: Risk of other road owners	6.40%	14.29%	0.00%	7.79%
Community Impacts (social and environmental)	25.10%	14.29%	0.00%	26.49%
Flood Immunity	16.10%	14.29%	33.33%	0.00%
Cost	0.00%	14.29%	0.00%	9.17%
Total	100.00%	100.00%	100.00%	100.00%

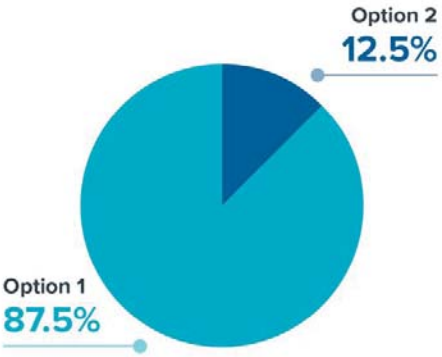
- All four scenarios ended up with the same preferred option as the original - Option 2C
- Two of the scenarios had the exact same order with the original for all 5 options
- All four scenarios had the same order of first two preferred options with the original

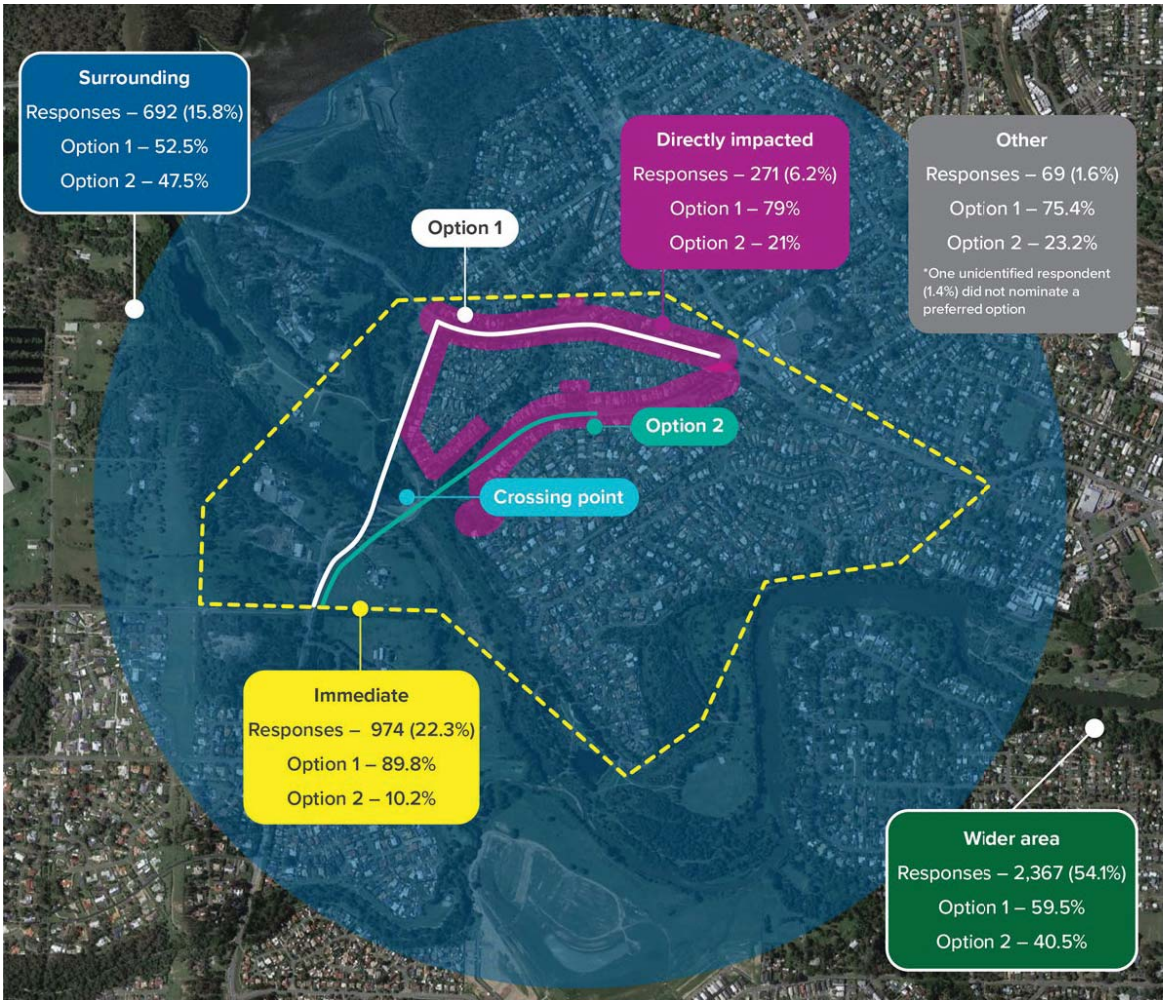
New information that was not available at the MCA workshop

Results of Community Consultation

The results of the community consultation that the project team with the help of external communication consultants undertook between 2/9 and 6/10 showed strong community preference in favour of Option 1.







Federal funding clarification

The federal government via officer level advice and the local MP public statements clarified that they will not support and fund Option 2 and that the $7.75m in election commitment are only for Option 1.

How the MCA results might have been impacted from the new information

If this new information was available at the time of the MCA workshop, it would have impacted the results of two of the criteria: Community Impacts and Cost.

For the **Community Impacts** the most likely scenario is that it would split this Criterion in the two sub-criteria that originally were scored as one: Impact on Property Owners and Environmental Impacts. These two would then have had a separate weighting. We can not speculate how the working group would have prioritised the two against the other.

In a theoretic scenario where the community consultation results are a better indicator for both these sub-criteria than the working group scoring, a simple scoring outcome for the two top Options would be to score them according to the total preference percentages.

	Consultation Results	MCA scoring (out of a total of 4)
Option 2C	33.4%	2.664
Option 1C	66.6%	1.336

Rank	Weight Average Total	Ranking
Option1A Q10	1467	5
Option 1B Q20	1541	3
Option 1C Q100	1976	1
Option 2A Q10	1430	6
Option 2B Q20	1503	4
Option 2C Q100	1936	2

In such exercise the preferred option changes from the original.

For the **Cost** criterion, the original MCA opted to score the total project cost to connect Protheroe Rd to Beeville Rd that included the cost of stage 2 for the Option1 alignment (+$3,736,000).

Option		Total Project Cost	MCA Original Score (out of 4)	Sub sum of total MCA Score
1A	Youngs Crossing Rd Q10	$37,816,765.37	4	186.785
1B	Youngs Crossing Rd Q20	$38,214,507.37	3.958	184.8238
1C	Youngs Crossing Rd Q100	$40,095,456.37	3.772	176.1383
2A	Andrew Petrie Drive Q10	$38,697,784.46	3.909	182.5357
2B	Andrew Petrie Drive Q20	$39,251,126.46	3.854	179.9674
2C	Andrew Petrie Drive Q100	$41,329,066.46	3.660	170.9083

Cost had only 6.67% weighting on the original MCA and the differences in total cost between the options did not result in large differences in the MCA scores for this criterion. The difference between Option 2C and Option 1C was just 5.2.

Now that the funding of this project is clearer, an alternative way to score the cost criterion would be to score the Cost to Council and not the total cost of the corridor upgrade. This doesn't take into account though, that in the end, the community will end up paying for the Stage 2 of Option 1, simply as tax payers and not rate payers.

In such scenario, the scoring of the cost component will be:

Option		Total Project Cost	MCA Original Score (out of 4)	Sub sum of total MCA Score	New MCA Score	New Sub sum of total MCA Score
1C	Youngs Crossing Rd Q100	$41,750,000	3.772	176.1383	4	186.785
2C	Andrew Petrie Drive Q100	$56,100,000	3.660	170.9083	3.72	173.710

The above costs were as estimated after the two finalist options were progressed further from Concept sketch level to Concept level. The above new MCA scoring is based on a comparison of just the two options, with this time Option 1 not only being without the previous +$3.7M cost to upgrade Dayboro Rd but also being the absolute cheapest option. If there was a much cheaper Q10 option in the comparison mix, then the difference in total score between the two options would have been in the small levels as the original MCA, since the total weighting used for this criterion is only 6.67%.

Review Summary and Lessons learned

The most interesting points from the MCA review are:

- The MCA was performed in a professional way that meets the Australian guidelines standards
- Some of the MCA elements could have been different but this is within the nature of this tool and its degree of subjectivity
- The results of the MCA are considered representative of the technical understanding that Council officers had about this project at that point in time, the problems trying to address, the environmental and other constraints as well as their view of community impacts.
- The MCA is only one of the tools used by the project team to provide evidence-based information for Council to make an informed decision on this project.
- In relation to the two criteria that additional information become available after the MCA workshop, it can only be assumed as a theoretical exercise that their scoring might have been impacted by this and as a result the recommended option of the MCA might have been different.
- The results of the community consultation are not necessarily more relevant and better indicator of the real community impacts, than the collective opinion of the technical officers that most of them also live locally in the area.
- The results of a CBA for the two shortlisted options would have also been open to criticism and debate as the method is based on a series of complicated assumptions especially in calculating benefits of each Option.

Lessons learned for future projects

- Early public consultation on projects can allow MCA to consider the community feedback
- A broader working group can provide a larger diversity of views and more representative results
- There is no real benefit in trying to improve further the MCA process as the MCA by its nature has specific weaknesses and its role in the decision making should not be overestimated and overrepresented anyway.
- The MCA can continue to be used in transport planning projects, noting its ease of use but at the same time being conscious of its weaknesses and limitations in supporting decision making.

Bibliography

Australian Transport Assessment and Planning (ATAP) Guidelines, Commonwealth Department of Infrastructure and Regional Development

Infrastructure Australia Assessment Framework 2018, Infrastructure Australia