A SMARTER TOOL FOR SELECTING SAFE AND EFFECTIVE PEDESTRIAN CROSSINGS

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ABSTRACT

Selecting the best kind of pedestrian crossing for a given road can be a tricky task. The wrong facility in a given location may encourage pedestrians to cross unsafely, reduce vehicle compliance or cause undue delay to pedestrians and drivers. In Australia there are no consistent guidelines to assist professionals in determining the most appropriate facility. While the New Zealand Transport Agency has developed a spreadsheet-based tool, it primarily uses economic performance, including the cost of crashes, to determine the best type of crossing and does not consider other softer measures for determining 'appropriateness'.

This research developed a smart web-based tool applicable in both New Zealand and Australia to assist practitioners in selecting the most appropriate crossing. The web tool can assess raised platforms, kerb extensions, median refuges, zebra crossings, signals, grade separation and appropriate combinations of these physical aids and priority measures. Unlike existing tools it can assess crossings proposed for intersection or midblock locations, and accounts for the level of service experienced by pedestrians, safety implications and economic factors such as delay to vehicles. The user friendly design, web-based implementation and wide range of facilities that can be assessed by the tool present significant improvements over existing crossing selection tools.

INTRODUCTION

Practitioners in Australia and New Zealand currently have no consistent guidelines for determining the most appropriate pedestrian crossing facility at midblock or intersection locations. Benefits associated with crossing facilities are not well understood in terms of walkability, safety and economic viability. The purpose of this research was to develop a standardised web-based tool to assist practitioners in selecting the most appropriate and pedestrian-friendly crossing facility. The tool will be made available to all practitioners throughout Australia and New Zealand in early 2015.

This technical note describes the development and outputs of the research, which was conducted by Abley Transportation Consultants for Austroads, the organisation of Australasian Road Controlling Authorities (of which the New Zealand Transport Agency is a member organisation).

BACKGROUND

In developing an Australasian tool that included pedestrian perceptions of walkability and a range of crossing types it was necessary to research:

- the equivalence of pedestrian perceptions relating to crossing facilities between New Zealand and Australia
- comparison of economic analysis guidelines and legislation between Australia and New Zealand
- existing pedestrian facility selection guidelines and tools
- pedestrian walkability studies that relate to new and upgraded crossing facilities.

There is no specific evidence to indicate that pedestrian perceptions of crossing facilities are homogeneous between Australia and New Zealand. However, with approximately 480,000 New Zealanders estimated to be living in Australia (Statistics New Zealand 2012) and 60,000 Australians living in New Zealand (Dominion Post 2008) there is some likelihood that this is the case. New Zealand and Australian Road Controlling Authorities and practitioners frequently share the same set of guidelines in traffic engineering, road safety, road design and pavement design applications. On this basis it would not be unprecedented to develop a pedestrian selection tool and supporting guidelines which can be used in both countries.

The types of pedestrian crossing facilities permitted by the legal frameworks in Australia and New Zealand are similar, though in Australia there is jurisdictional discretion to limit or extend the range of permitted facilities. In both countries, the selection of crossing facility type is left to the local authorities, with historical numerical warrants having been generally removed over the last few decades. There are sub-national legal frameworks published by most Australian jurisdictions however there is no clear guidance to differentiate between jurisdictional and National legal frameworks with regard to pedestrian crossing facilities.

The NZ Transport Agency provides a simplified economic evaluation procedure for evaluating walking facilities in a spreadsheet (NZ Transport Agency, 2013). This considers travel time and accident benefits which are offset against costs to calculate a benefit cost ratio. Most Australian jurisdictions currently apply national evaluation procedures for pedestrian facilities (Austroads, 2005-2012) with the sole exception being New South Wales (Transport for NSW, 2013). Neither of these Australian procedures prescribe a specific evaluation procedure solely for walking facilities, however benefits and costs associated with walking facilities can be readily incorporated into the cost benefit analysis framework.

The literature review identified the NZ Transport Agency Pedestrian Facility Selection Guidelines (Tate & Waibl 2007) with its associated spreadsheet, and the Queensland Pedestrian Crossing

Facility Guidelines and Prioritisation System (QTMR 2011), as the most comprehensive starting points for development of an Australasian pedestrian facility selection tool. The NZ Transport Agency spreadsheet tool, which was developed in conjunction with the Pedestrian Planning and Design Guide (NZ Transport Agency 2009), includes economic analysis by calculating a benefit/cost ratio based on assumed facility costs and the net present value of delay and safety costs/savings. The NZ Transport Agency calculation of pedestrian level of service is based solely on delay. The Australasian pedestrian facility selection tools do not include comprehensive walkability/pedestrian level of service calculations but evaluation methodologies do exist.

Although a number of studies were identified for assessing pedestrian walkability or level of service (e.g. Abley and Turner (2011), Muraleetharan et al (2005), Petritsch et al (2006) and Asadi-Shekari et al. (2011)), many of these focused on the assessment of existing facilities, and were not appropriate for assessing the potential walkability improvements that would form part of the tool. Following assessment of the relevant literature, this was the most significant knowledge gap to be addressed by the research.

WALKABILITY RESEARCH & FOCUS GROUPS

An analysis was conducted of the Community Street Review (CSR) data collected by Abley and Turner (2011). The goal of this assessment was to develop a walkability-based level of service model applicable to new crossings that was sensitive to three walkability elements: delay, safety and comfort. However, the CSR dataset predominantly contained variables more relevant to assessing existing facilities, such as pavement condition or presence of litter. The analysis did allow relations between significant walkability elements (delay and safety) and overall walkability to be quantified, but not the relations between physical, operational and environmental variables and walkability elements. Through this analysis comfort was not identified as a significant variable.

Consequently, two focus groups were conducted, one each in Christchurch and Wellington, to address the remaining gaps, specifically accounting for pedestrian perceptions of safety, and validating the overall walkability equation as a function of safety and delay separately for midblock and intersection applications.

Information combined from the CSR data and focus group survey results was used to develop three pedestrian level of service indicators, relating to perception of delay, perception of safety and overall walkability.

TOOL DEVELOPMENT

The selection tool built upon the existing NZ Transport Agency crossing selection tool, developed by Tate & Waibl (2007) and documented in Tate (2007), and the literature review, gap analysis, CSR analysis and walkability focus group findings. The spreadsheet tool, in turn, makes significant use of the Pedestrian crossing point guideline 'Warrants' report by Abley (2002).

Compared to existing tools this new tool:

- Analyses pedestrian crossing facilities at both intersection and midblock locations
- Accounts for economic factors in both Australia and New Zealand
- Uses a walkability-based pedestrian level of service calculation
- Calculates delay at signals, determined by signal control methodology
- Calculates and outputs sight distances relevant to pedestrian and vehicle visibility

The web tool can assess raised platforms, kerb extensions, median refuges, zebra crossings, signals, grade separation, and appropriate combinations. Full details of the tool assessment

methodology are contained in the forthcoming Austroads report, but are overviewed in **Figure 1**.

The user enters a range of values for the site, including physical/environmental, operational and safety information. The tool then determines which of the possible facilities is feasible for the site. From this list the user enters further details regarding the facilities to be tested. The tool then calculates a series of indicators regarding the tested facilities, and presents detailed outputs of the economic analysis and pedestrian level of service modelling.

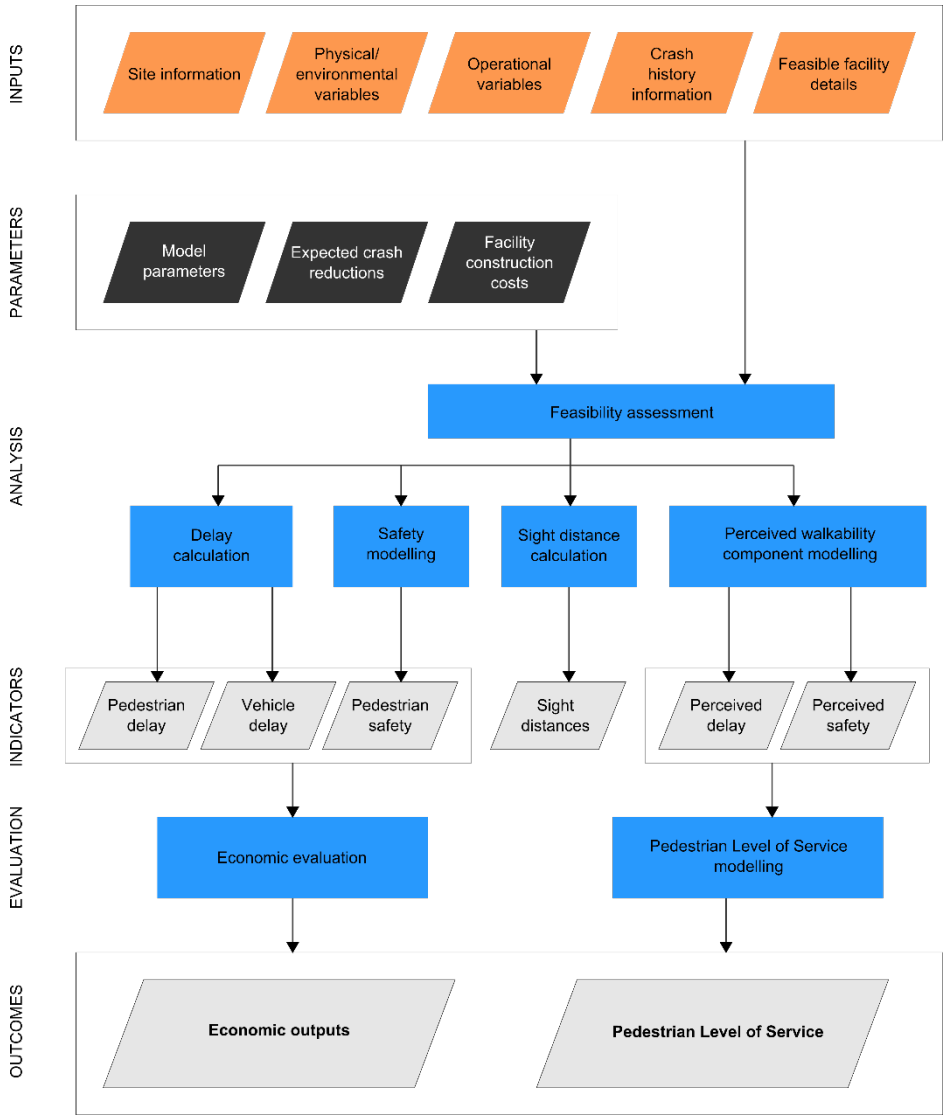


Figure 1. Pedestrian crossing facility web tool overview

The web tool was programmed in JavaScript with a user interface implemented in HTML. This means the tool is supported on all modern web browsers, responsive to use, can accept a large number of simultaneous users and does not require any particular server-side software. A comprehensive user guide (describes all inputs in detail, and presents a quick-start guide and troubleshooting) was developed alongside the tool and is available for download from the tool webpage. The tool is presented with a series of example inputs and the corresponding outputs (including some facilities that are not feasible for the site) in **Figure 2** and **Figure 3**. Figure 2 shows the tool inputs for an intersection crossing. Figure 3 shows the tool outputs for the crossing described in Figure 2 (note that the inputs for the facilities to be tested are not shown, and that some facilities are not shown in the output). As the example crossing is at an intersection, facilities such as zebras and grade separation, which are not feasible at intersections, do not have outputs

calculated or shown. Crossings of low cost which do not delay vehicles have the highest benefit cost ratio (BCR) at this location. Pedestrian level of service values are poor at facilities with long pedestrian delays, but better at refuges and signals, where pedestrian delays are reduced.

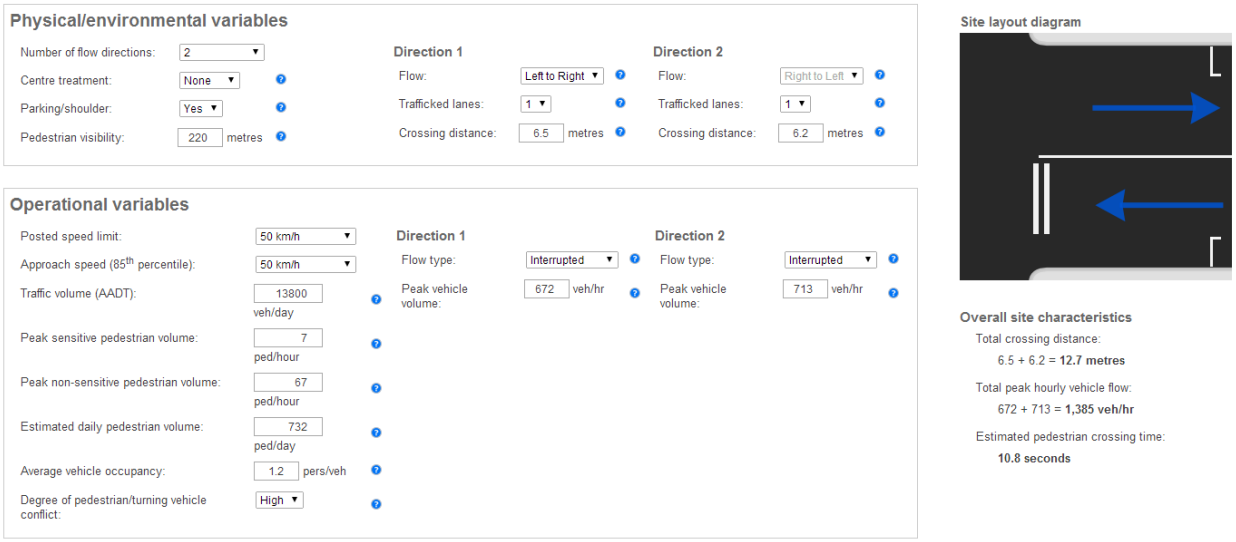
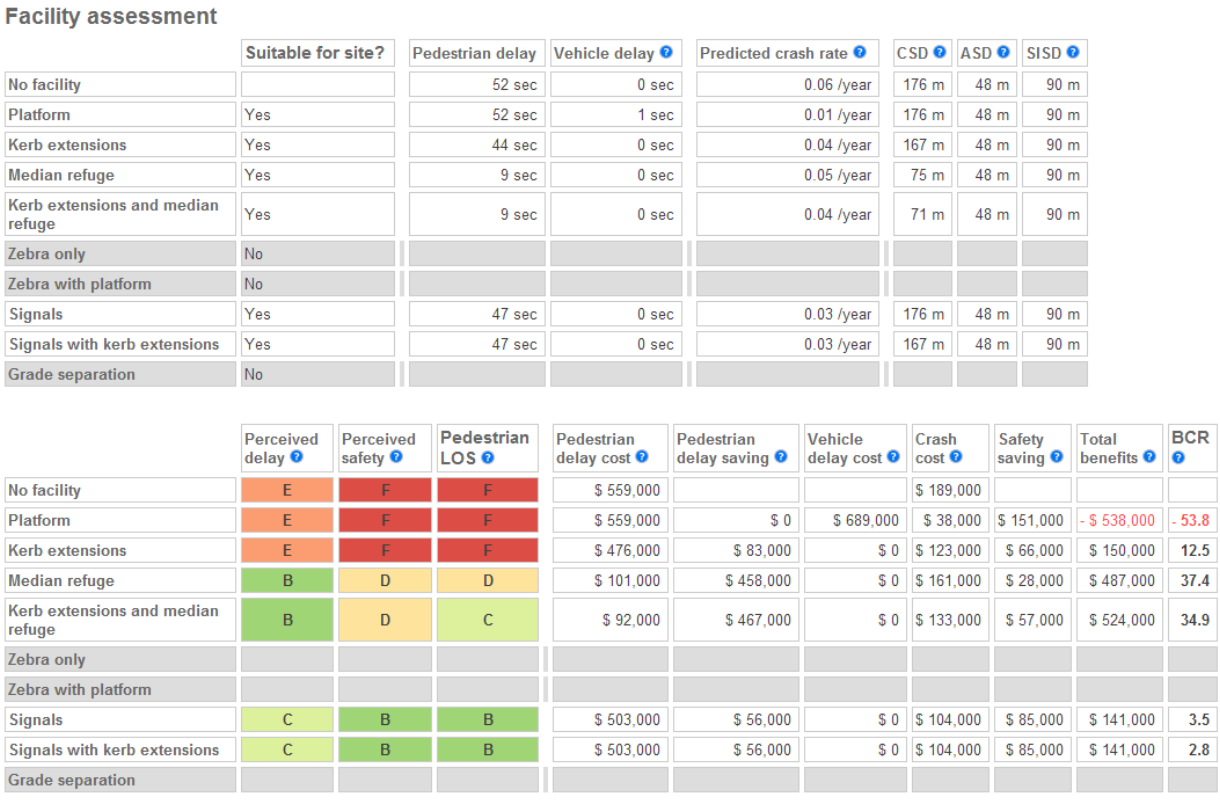


Figure 2. Pedestrian crossing web tool example inputs



	Suitable for site?	Pedestrian delay	Vehicle delay	Predicted crash rate	CSD	ASD	SISD
No facility		52 sec	0 sec	0.06 /year	176 m	48 m	90 m
Platform	Yes	52 sec	1 sec	0.01 /year	176 m	48 m	90 m
Kerb extensions	Yes	44 sec	0 sec	0.04 /year	167 m	48 m	90 m
Median refuge	Yes	9 sec	0 sec	0.05 /year	75 m	48 m	90 m
Kerb extensions and median refuge	Yes	9 sec	0 sec	0.04 /year	71 m	48 m	90 m
Zebra only	No						
Zebra with platform	No						
Signals	Yes	47 sec	0 sec	0.03 /year	176 m	48 m	90 m
Signals with kerb extensions	Yes	47 sec	0 sec	0.03 /year	167 m	48 m	90 m
Grade separation	No						

	Perceived delay	Perceived safety	Pedestrian LOS	Pedestrian delay cost	Pedestrian delay saving	Vehicle delay cost	Crash cost	Safety saving	Total benefits	BCR
No facility	E	F	F	$ 559,000			$ 189,000			
Platform	E	F	F	$ 559,000	$ 0	$ 689,000	$ 38,000	$ 151,000	- $ 538,000	- 53.8
Kerb extensions	E	F	F	$ 476,000	$ 83,000	$ 0	$ 123,000	$ 66,000	$ 150,000	12.5
Median refuge	B	D	D	$ 101,000	$ 458,000	$ 0	$ 161,000	$ 28,000	$ 487,000	37.4
Kerb extensions and median refuge	B	D	C	$ 92,000	$ 467,000	$ 0	$ 133,000	$ 57,000	$ 524,000	34.9
Zebra only										
Zebra with platform										
Signals	C	B	B	$ 503,000	$ 56,000	$ 0	$ 104,000	$ 85,000	$ 141,000	3.5
Signals with kerb extensions	C	B	B	$ 503,000	$ 56,000	$ 0	$ 104,000	$ 85,000	$ 141,000	2.8
Grade separation										

Figure 3. Pedestrian crossing web tool indicators and outputs for an example site

CONCLUSIONS

The web-based tool developed by this research presents a standardised platform for practitioners. It enables numerous factors to be quickly and easily assessed for a wide range of pedestrian

crossing facilities at a site. The user friendly design, web-based implementation and range of physical aids and priority measures that can be assessed by the tool present significant improvements over existing crossing selection tools.

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