WALKABILITY
SCOPING PAPER

February 2005

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1 INTRODUCTION

Background

1.1 Land Transport New Zealand commissioned Steve Abley to prepare a scoping paper on the development of walking tools in advance of a meeting of interested parties in Christchurch on 14 March 2005. This paper has been prepared to provide background, clarify the terminology, raise the issues that need to be resolved and suggest the objectives walkability tools should achieve for the improvement of walking.

1.2 The development of walkability tools is one element towards meeting New Zealand's overall transport vision that "***by 2010 New Zealand will have an affordable, integrated, safe, responsive, and sustainable transport system."***

1.3 Steve Abley has undertaken a brief literature review and collated and considered the following specific information:

- Christchurch City Council 'Assessment of Pedestrian Level of Service Methodologies' report prepared by Paul Cottam.
- Steve Abley presentation to the inaugural 2004 Living Street Conference.
- Land Transport New Zealand 'Pedestrian Network Planning and Facilities Design Guide' Draft for Consultation October 2004.

Paper Structure

1.4 This paper is divided into sections to aid understanding of the issues:

- Walkability
  – Including the general design process and the various techniques used to improve designs.
- Performance Design
  – Discussion of the different reviewing, auditing and ratingsystems.
- Discussion
  – Summary of earlier material, advantages and disadvantages, and development of New Zealand walkability systems.
- Issues needing resolution

1.5 A number of quotations are taken from other references. Typically these are noted in the text and all quotations are *"italicised"*. Important or especially relevant sections of quotations are **bold**.

2 WALKABILITY

Introduction

2.1 Walking is typically the forgotten mode of transport and consequently few analytical techniques are available to help practitioners identify low standard walking environments.

2.2 Providing accessibility to the transport network for all members of a community is vitally important. For most members of the community severed from easy accessibility i.e. the very young, old, or mobility impaired, walking provides the first, last and often the only mode of transport. Other functions that walking aids includes community involvement, health, recreation, meeting and greeting are all affected by low quality walking environments.

2.3 Therefore, being able to identify low quality walking environments using different practioner tools and then taking the steps to prioritize and action improvement in those environments will aid New Zealand towards meeting its overall transport vision. The problem is, what constitutes a low quality walking environment and if it can be identified, how does it compare against other walking environments? Additionally, how can funding be directed towards these low quality walking environments in an efficient, auditable, transparent and repeatable process?

What is Walkability

2.4 All technical disciplines have their own terminology and jargon. The technical words associated with walking have to cross professional disciplines e.g. engineering, planning, and health. These words also have to be understood by the community, and in fact have many have probably been developed in the community and picked up by practioners. It is for this reason that words such as 'walkability' infer a certain meaning but without their correct definition confusion between these different disciplines can become apparent.

2.5 The Land Transport New Zealand draft 'Pedestrian Network Planning and Facilities Design Guide' (PNPFDG) defines *'walking'* and it is the inclusion of *'…on foot or on small wheels, or assisted by additional aids."* which means its definition in terms of a practioner guide is very community inclusive. This differs from the Oxford University Press Dictionary which only includes for *"…to move or go somewhere by putting one foot in front of the other on the ground, but without running"*.

2.6 *'Walkability'* and *'Walkable'* are words often touted but their definition is less clear. Neither of these words is defined in the Oxford Dictionary although 'walk', 'ability' and 'able' are all described. *'Walkability'* and *'Walkable'* are not defined in the PNPFDG Glossary although *'Walkability*' is referred to in *'Chapter 4 Community Walkability'* and generally defined as *"…the extent to which walking is readily available as a safe, connected, accessible and pleasant mode of transport"*. This definition has been copied from the Mayor of London and Transport for London (TfL) *'Making London a Walkable City: The Walking Plan for London'* although other practioner definitions are also available.

2.7 A paper presented to the 2004 USA Transport Research Board AGM by Livi and Clifton [1] summarised recent work undertaken in describing *'walkability*'. This paper reviewed other researchers' attempts to define these terms that concluded *"None of them directly explain and define the term"*. The paper continues and describes other research approaches including *"…localities of interest regarding how "friendly" they are to pedestrians"*. It is the inclusion of "friendliness" that probably correlates with the TfL description and later they mention other research work involved with walkability including *"…some aspects are objective, and*

therefore easily measurable, but others are subjective". Livi and Clifton also mention other friendliness terms including; *functional*, *safety*, *aesthetic* and *destination* as well as *safety*, *security*, *comfort* and *convenience*, *continuity*, *system coherence*, and *attractiveness* (again).

2.8 Other references include Seilo, [2] in his thesis project to the Department of Planning, Public Policy and Management and the Graduate School of the University of Oregon, describing *"Walkability - is a measure of the urban form and the quality and availability of pedestrian infrastructure contained within a defined area. Pedestrian infrastructure includes amenities developed to promote pedestrian efficiency and safety such [as] sidewalks, trails, [and] pedestrian bridges."* The USA National Centre for Chronic Disease Prevention and Health Promotion (CDC) [3] defines *"Walkability is the idea of quantifying the safety and desirability of the walking routes"*. The USA's Walkable Communities Inc premise is "…*Walkable communities put urban environments back on a scale for sustainability of resources (both natural and economic) and lead to more social interaction, physical fitness and diminished crime and other social problems".*

2.9 Walkability appears to include an element of measurability as defined by the PNPFDG "*the extent to which*", Livi and Clifton *"objective…and subjective",* Seilo *"measure" and* CDC *"quantifying".* The USA's Walkable Communities Inc premise does not mention measuring although they do undertake Walkability Audits (defined later as Walkability Reviews).

2.10 The Oxford University Press Dictionary defines 'ability' as *"the fact that somebody/something is able to do something"*. Consequently, 'walkability' must then include some measure of the success that something is "walking friendly" although the measuring bases may be simple or complex, subjective or qualitative.

2.11 It is also appropriate that the 'something' is defined. It appears that the majority of examples refer to the built environment although other examples have been found that refer to people i.e. the walking ability of an individual or walking community. It seems that the built environment and the extent that the environment succeeds in being "walking friendly" is most appropriate for the purpose of this paper when considering New Zealand's vision for the "*transport system"*.

2.12 Therefore this paper proposes that the definition of **walkability and walkable is: the extent to which the built environment is walking friendly**. This enables the opportunity for a subjective or qualitative assessment against specific criteria. These criteria may be characteristics such as the "5'C's" i.e. connected, convivial, conspicuous, comfortable and convenient, or other criteria specific to a particular user.

Identifying Problems

2.13 Typically problems in the road environment are identified though a network of proactive mechanisms such as consultation, measuring safety or efficiency and road controlling authority officer identification. Reactive techniques include measuring safety or efficiency and resident complaint.

2.14 Reactive techniques are neither efficient nor able to be planned with certainty when allocating future year funding. Sometimes they are also subject to the idea of *'who shouts the loudest'*. The problem is the loudest problem may not necessarily be the most deserving or most efficient use of funds.

2.15 Large capital projects are typically excluded from the *'who shouts the loudest'* process because they involve large sums of money and hence there are well set out processes for managing suitable solutions. This has typically been through

using strong economic measures of benefits verses cost. Smaller projects have more discretion and walking projects, because they are typically much lower cost or included in larger projects subject to different rules and procedures, have been difficult to quantify.

2.16 After a problem is identified it is typically one of two types, is it a maintenance issue whereby it is ideally repaired immediately, or it requires further investigation. It is this investigation phase, both reactive as discussed earlier, but also proactive that is the principal subject of this paper.

2.17 The application of proactive measures to improve the existing built environment are increasing in favour and result in performance design where the existing environment is tested against performance measures such as, walkability. These performance design techniques include reviewing, auditing and rating.

Reviewing, Auditing and Rating

2.18 This paper identifies three broad techniques to assess the performance of the built environment; these are reviewing, auditing and rating. This paper focuses these techniques towards assessing walkability although they can also be used to assess other facilities and criteria.

Reviewing: Applies to existing situations and may include audit and rating as well as other assessment tools. Develops options for and assesses how well proposed options improve walkability qualitatively.

Auditing: Can be applied to existing and proposed designs. Identifies deficiencies against recognised standards and can propose solutions. Ideal for identifying maintenance issues and simple remedies both qualitatively and quantitatively.

Rating: Tool for scoring walkability for an environment or facility. Can be used on existing or proposed designs, enables a practioner to compare different walking environments quantitatively.

2.19 The similarities, differences, subjective or qualitative elements of each of these techniques are described in **Table 2.1**. These techniques are not tools; the different tools for undertaking a review, audit or rating are discussed later.

Table 2.1 Reviewing, Auditing and Rating Comparison

Performance Design Technique	Procedure	Situation	Identifies Problems	Analyse Deficiency	Proposes Solutions	Undertaken by	Relative Cost	May Require	Example Methodology	Discussion
Reviewing	Qualitative	Existing	Yes	Yes	Yes	Professional	High	Everything below plus: safety records, traffic surveys, more observation	Good practice	Can include other tools such as auditing and/or rating
Auditing	Qualitative and Quantitative	Existing and Proosed	Yes	No	Sometimes	Technician / Advocate / Community	Medium	Everything below plus: camera, and consultation.	• LTNZ Safety Audit • Living Streets DIY Community Street Audits	Can include elements of rating
Rating	Quantitative	Existing and Proposed	Yes	No	No	Technician	Low	Mapping, site visit, incidentals such as pen paper, calculator, level, measuring tape etc	• RAMM • Cycle for Science • PERS	Attempts to infer a level of performance from a qualitative process that is transferred to a quantitative assessment

3 PERFORMANCE DESIGN

Reviewing

3.1 Reviewing is a technique whereby a whole environment or environment specific element is assessed against performance criteria specific to the problem being considered. Reviewing is typically a very fluid technique that may include the use of various tools both analytical and subjective, qualitative or quantitative. The difference between a review and an audit is that a review develops options for consideration towards implementation, an audit does not.

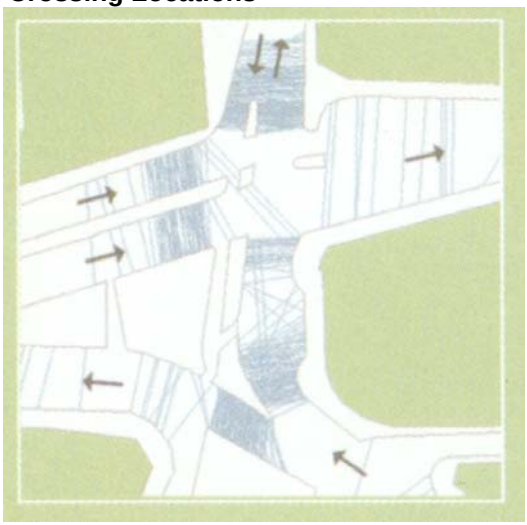
3.2 Reviewing may also include elements of auditing or rating and, because the tools used when undertaking a review are specific to the problem being considered, reviewing is usually undertaken by a professional such as an urban planner, traffic engineer, transport planner etc. Reviews can include such focused reviews as 'Transport Assessments', 'Management Plans', 'Traffic Impact Assessments' and 'Transport Appraisals'.

Reviewing Example

3.3 The following review example was undertaken by Intelligent Space Partnership (ISP) for Shoreditch Town Hall Trust, London, UK. The review included a study of pedestrian movement and safety in the Shoreditch Triangle in response to TfL public consultation on traffic reform.

3.4 The methodology selected by ISP was a blend of analytical techniques using survey and observations and included an analysis of pedestrian crossings. The location where pedestrians exited and entered the footpath was plotted over the existing street so a map of pedestrian movements could be interrogated. This is shown in **Figure 3.1** and shows that the actual location and direction where pedestrian crossing took place were often dispersed and angular. The direction of traffic flow is identified by 'arrows'.

Figure 3.1 Existing Pedestrian Crossing Locations



3.5 The computer modelling of 'desire lines' are shown in **Figure 3.2**. The result of this technique provided evidence to review the location of proposed and existing crossing facilities as shown in **Figure 3.3**. The location of the proposed crossing locations are shown in "grey" and the additional crossing location identified through the review process is shown in "red".

Figure 3.2 Modelled Desire Lines

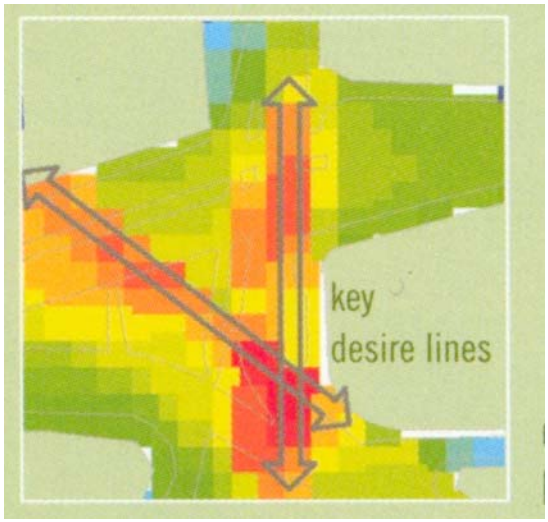
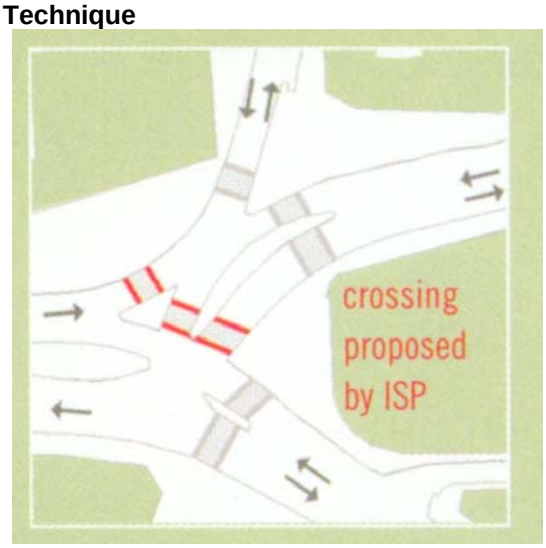
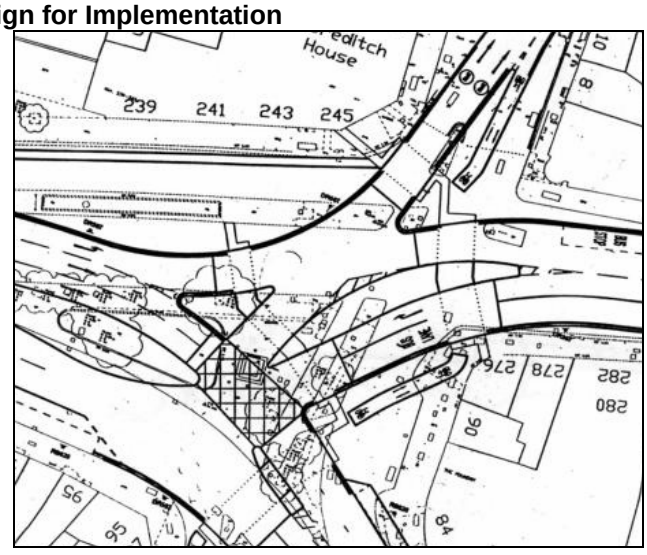


Figure 3.3 Results of Review Technique



3.6 ISP's proposed additional crossing location was accepted by the road controlling authority and resulted in an amended and anticipated improved design. The result is shown in **Figure 3.4** that shows the proposed design in "black" overlaid the existing street environment in "grey".

Figure 3.4 Accepted Design for Implementation

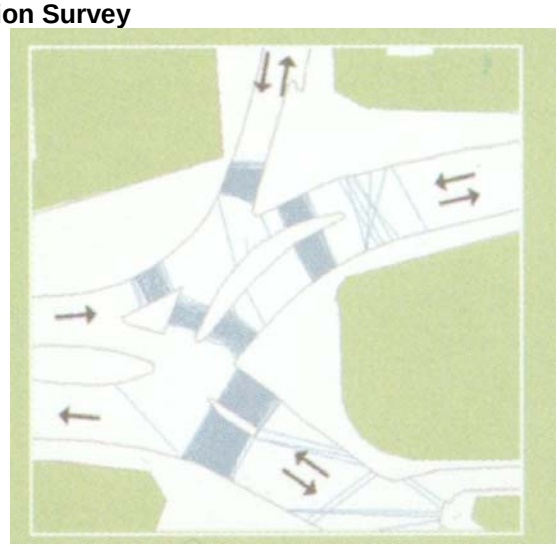


3.7 In June 2003, ISP undertook a follow-up study of the Shoreditch Triangle Traffic Reform scheme. The aim of the project was to evaluate the impact that the TfL scheme had on the pedestrian environment and in particular, to see how well the recommendations that ISP had made about the design were working in practice. The key recommendations that ISP made in 2001 prior to the scheme implementation were:

- an increase in the number of traffic signal crossing facilities
- revised placement of traffic signal locations along pedestrian 'desire lines'
- pavement widening in some areas
- support for TfL's creation of new public spaces

The result of the post implementation survey is shown in **Figure 3.5** and shows how 'desire lines' are clustered around the implemented crossing locations. This is a significant improvement to that shown in Figure 3.1

Figure 3.5 Post Implementation Survey



3.8 The review technique enabled ISP to use comparable data on flows, crossings and land use before and after the intervention to objectively evaluate the effects of the scheme. The main findings of the study are:

- Road crossing in Shoreditch is much safer
- Pedestrian use of assigned crossing areas has increased by 56%
- Informal crossing away from assigned crossing areas has decreased by 61%

3.9 The evidence based approach to crossing designs that ISP advocated has led directly to a quantifiable improvement in the quality of provision for pedestrian movement. As a result, overall accident risk has been substantially reduced.

- Roads are much easier to cross (severance has been reduced).
- Overall crossings have increased by 9%, despite a large increase in the number of vacant buildings (vacant footprint area doubled) and a 4% reduction in flows. This strongly indicates a large reduction in severance for local communities.

3.10 The quality of public spaces has been greatly improved. There have been substantive improvements to the physical environment in terms of widened pavements, new public spaces, improved quality of streetscape and traffic calming measures; these changes have contributed towards greater leisure use of the Triangle streetscape.

3.11 One issue that still could be improved is the phasing of traffic signals for pedestrians. There has been a general increase in the rate of 'red man' phase crossings at assigned crossing areas since 2001 and very high risk crossings have been identified by the new study. This increase is probably caused by a combination of complex traffic light phasing, provision of traffic islands, and slower traffic speeds.

3.12 Overall the review process was successful and resulted in a better design proven through the result of the post implementation survey.

Auditing

3.13 Auditing can also be applied to a whole environment or environment specific element. The difference between reviewing and auditing is the structure of the applied methodology. Auditing has a significantly stronger methodology than reviewing and consequently there are a number of published audit techniques.

3.14 Auditing can include elements of rating although the process is significantly more qualitative than quantitative. Auditing can be applied to existing or proposed designs, identifies deficiencies and may suggest remedies. Audits are ideal for identifying maintenance issues and simple remedies.

Auditing Examples

3.15 Two examples of audit techniques used in New Zealand are:

1. DIY Community Street Audits. Developed by Living Streets, UK, in 2002 and used for *"evaluating the quality of public spaces – streets, housing estates, parks and squares – from the viewpoint of the people who use it, rather than those that manage it".* The cover is shown in **Figure 3.6**.

2. Safety Audits. Numerous safety audit techniques are available although the technique used in New Zealand is the 1993 Transit New Zealand Guidance. Safety Audits, as the name suggests focus almost entirely on safety aspects of projects.

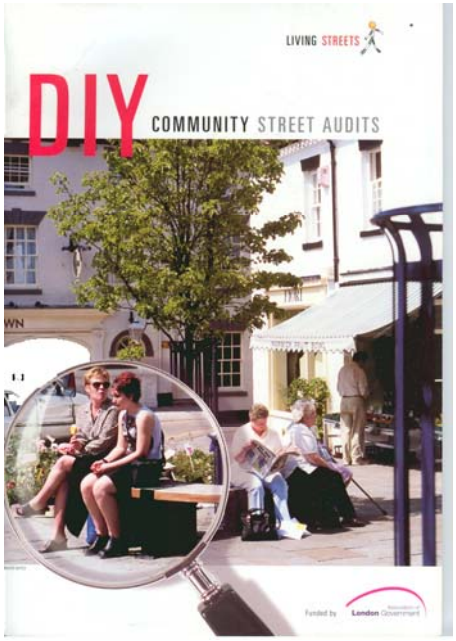
3.16 Community Street Audits are: *"Designed for use by local people committed to seeing real improvements for people on foot, the DIY pack can be used in partnership with local authorities, schools, community groups or tenants and residents associations. It's an easy-to-use, non-technical publication designed to help you identify opportunities for making your streets and spaces safer and more enjoyable for everyone."*

"This publication should be used by:

- *Residents, who want to put a comprehensive case together for improvements to their local street.*
- *Community activists who want to learn the essentials of auditing streets and open spaces.*
- *Council officers, who want to help their communities take part in decisions affecting their local areas."*

The promotional material for DIY Community Street Audits says:"*can help you find a way forward to more walkable neighbourhoods",* although Living Streets does not specifically define the term walkable. The Living Street's web site states *"Walkability Projects will identify [physical] barriers to walking*".

Figure 3.6 DIY Community Street Audits



3.17 Safety Audit is an overview process which seeks to match the overall level of uniformity against recognised design and maintenance standards, and thus seeks to achieve a consistent standard over a network for roads of a like status. Safety audits although not typically focused just on walking, do include for the safety of pedestrians. Safety Audits usually involve a checklist but also include the judgement of the audit team regarding the safety performance of the particular environment or facility. Safety Audit does not normally include an assessment based on the "5 C's".

3.18 Both DIY Community Street Audits and Safety Audits are typically presented in a 'problem' and 'solution' / 'recommendation' format. Sometimes the recommendations are graded similar to a rating system so priority can be focused on the elements that the auditor considers most concerning.

3.19 It is interesting to note that the USA's Walkable Communities Inc undertake 'Walkable Audits' although they go on to explain that *"A Walkable Audit is a review of walking conditions along specified streets conducted with several or many community members".* It is important to note that although Walkable Communities Inc market 'Walking Audits' they consider they are actually undertaking a review. For the purpose of this paper the technique they are using is an Audit process and although without a structured methodology, appears very similar to the Living Street's DIY Community Street Audits technique.

Rating

3.20 A rating system ensures the inspection and analysis of an environment is structured, in such a way that the results can also be used for developing options and assessing them and that they address the matters that are dragging down the overall rating. Rating or scoring the performance of an environment is fairly common although the application to walking environments is relatively new.

3.21 The most common rating system is the Road Maintenance and Management System (RAMM) used to assess the pavement environment of roads including an inventory of road features. All road controlling authorities in New Zealand use RAMM and consequently will be familiar with rating systems.

3.22 Systems for rating other environments such as cycling facilities are also available, such as the Institution of Highways and Transportation, London "Guidelines for Cycle Audit and Review" and the recently trialed “Cycle for Science” undertaken in Christchurch in December 2004.

3.23 Rating the performance of a walking environment was first proposed by Dr. John J. Fruin in his 1971 book ‘Pedestrian Planning and Design’ published by the Metropolitan Association of Urban Designers and Environmental Planners, New York. Fruin investigated walkability against pedestrian walking density and flow rates for particular walking purposes and then related this to a particular Level Of Service (LOS).

3.24 LOS is a qualitative measure describing operational conditions of pedestrian flow. It is based on service measures such as the freedom to choose a desired speed, to bypass others as well as the ability to cross a pedestrian traffic stream, to walk in the reverse direction of a major pedestrian flow, to manoeuvre generally without conflicts and changes in walking speed and the delay experienced by pedestrians at signalized and unsignalised intersections.

3.25 Six levels of service are defined, designated ‘A’ to ‘F’, where ‘A’ represents the best operating conditions and ‘F’ the worst. Safety is not included in the measures that establish service levels. LOS definitions for different purposes, as defined by the Highway Capacity Manual (HCM) published by the Transportation Research Board (USA) are included in **Appendix A**.

3.26 The HCM notes that additional environmental factors that contribute to the walking experience and therefore to perceived LOS are the comfort, convenience, safety, security, and economy of the walkway system. Comfort factors include weather protection, climate control, arcades, transit shelters, and other pedestrian amenities. Convenience factors include walking distances, pathway directness, grades, sidewalk ramps, directional signing, directory maps, and other features making pedestrian travel easy and uncomplicated.

3.27 Although Fruin and the HCM mention these other environmental factors they do not attempt to quantify their significance or propose a method for valuing their individual performance. It is the absence of tools for quantifying significance and proposing a method for valuation that has lead to a number of walkability rating systems being developed.

Rating Examples

3.28 Paul Cottam in his report “Assessment of Pedestrian Level of Service Methodologies” for the Christchurch City Council, and included in **Appendix B**, identifies the following rating tools:

- DETR – Encouraging Walking: Advice to local authorities, UK
- Dixon – Bicycle and Pedestrian LOS
- Gallin – Quantifying Pedestrian Friendliness – Guidelines for Assessing Pedestrian Level of Service, Australia.
- Jaskiewicz – Pedestrian LOS based on Trip Quality, USA

- Landis et al – Modelling The Roadside Walking Environment: A Pedestrian Level Of Service, USA
- Muraleetharan et al – Evaluation of Pedestrian LOS, Japan
- PEDSAFE – University of Queensland – Lillis and Paurmoradian, Australia
- PERS: Pedestrian Environment Review System – TRL, UK.

3.29 Other rating systems include:

- Boulter and Rutherford - Walking Audit Methodology, New Zealand.
- CDC Walkability Audit Tool, USA
- Christchurch City Council Walk a Child to School Day (WCSD) Walkability Rating, New Zealand
- How walkable is your community? – Pedestrian and Bicycle Information Centre, USA
- James Emery - Walking Suitability Assessment Form - UNC School of Public Health, Health Behaviour and Health Education, USA
- Measuring Walkability: Tools and Assessment – City of Kansas, USA

3.30 As can be seen there is a proliferation of walking rating systems of which three are known to have been used in New Zealand, i.e PERS in 2004, Boulter and Rutherford in 2004 and the CCC WCSD Walkability Rating in 2000.

3.31 A comprehensive study of all the different walkability rating systems has never been undertaken although the Cottam report provides a significant insight into the application of two overseas rating systems in New Zealand. Cottam principally reviewed the Gallin (AUST) and PERS system while making comment about the other systems listed. Output from the Cottam surveys are included in **Appendix C**.

3.32 Cottam compares the strength and weakness of the PERS and Gallin systems and this is reproduced in **Table 3.1**.

Table 3.1 Cottam Comparison between PERS and Gallin Rating Systems

PERS -Pedestrian Environment Review System	Gallin – Quantifying Pedestrian Friendliness
Strengths	
Systematic, detailed assessment, using a number of factors, and providing good descriptive information for making ratings assessments for both footpath links and crossings	Straightforward for staff to understand and use, easy to tabulate results and derive LOS grades
Easy to interpret graphical outputs show scores and gradings for each factor as well as overall link or crossing being assessed	Combines link and crossing factors into one assessment tool, gives an emphasis to vehicle conflict
Good range of environmental and amenity factors, and includes qualitative factors	Covers most issues affecting walkability assessment of the pedestrian environment
Good assessment tool for existing urban and suburban areas, including footpaths and intersections	Good tool for making assessments where there is no footpath
Weaknesses	
Lacks scoring descriptions where there is no actual footpath on the link being assessed, making	May not be enough factors being assessed, and some factors could be split up as contain too many

PERS -Pedestrian Environment Review System	Gallin – Quantifying Pedestrian Friendliness
it a little awkward to score some factors, especially to rural areas. However, areas with a poor intuitive feel nevertheless scored low	items of note
Requires some understanding beforehand and initial trialing out to use	Delineation of grades may not be accurate, eg. assessments can result in mostly one grade being produced
Not quite enough emphasis on pedestrian safety from traffic	Weightings under-emphasise safety and over-emphasise user flow factors such as pedestrian volume and user mix
Route assessment very similar to link assessment, difficult to apply to situations which were mostly of a link nature. However, could be for area wide investigations, eg. travel to school.	Does not provide gradings for each factor to provide specific courses of action

3.33 Cottam's conclusions between the PERS and Gallin methods include…

"For reviewing or auditing existing footpaths, the PERS method is considered to be the most thorough. Its level of detail, weighted factors, computer calculated assessments and quality outputs make it a superior product to utilise. Having said that its main weakness, stemming from a UK environment, is that for New Zealand conditions there is a lack of emphasis on road safety, with only one factor directly considering this. For audits [ratings] in the urban environment, it is felt that this can be mitigated to a reasonable extent by harshly interpreting factors relevant to road safety such as user conflict and path width."

3.34 Cottam makes a series of recommendations that are paraphrased below:

- A rating system specific to New Zealand and particularly for assessing new footpaths be developed.
- Other environmental factors be included in the proposed New Zealand rating system specific to the New Zealand walking environment i.e. semi rural walking environments.
- The environmental factors are based around the "5 C's" concept i.e. connected, convivial, conspicuous, comfortable and convenient.
- The significance of the environmental factors is considered specific to New Zealand conditions.
- The scores for each environmental factor be simplified e.g. a score from 0 to 4 representing a 5 point system.
- The scoring system for each environmental factor should be very closely related to a description for that particular score.

3.35 Cottam suggests different environmental factors and a significance of the environmental factor to the overall assessment.

3.36 The other two rating systems used in New Zealand include the CCC WCSD Walkability Rating and Boulter and Rutherford methodology. There is very little published material on either of these methodologies other than:

1. http://www.ccc.govt.nz/SafeRoutes/events.asp - *"WCSD Walkability Ratings Schools were asked to distribute a 'walkability' survey to parents who were walking to school on WCSD. The idea of the walkability survey was to check on the 'level of service' provided to pedestrians, and to see where we need to further our school road safety efforts. Parents were also asked to rank, on a five point scale, their walking journeys according to*

factors of convenience, continuity, pleasantness, crossing facilities and overall road safety." The system appears to only have been used once in 2000 although it appears to have been successfully trialed by 42 schools.

2. Discussions between Steve Abley and Roger Boulter who explains that the *"[Boulter and Rutherford] methodology builds on overseas best practice and uses both numerate and qualitative rating techniques, concluding with numerate scores. The methodology also provides qualitative recommendations in terms of adaptations of the walking environment".* The system has been used by Waitakere City Council.

4 DISCUSSION

Introduction

4.1 The improvement of the walking environment is gaining more priority as New Zealand begins to understand the significance walking can contribute towards meeting New Zealand's overall transport vision. The vision is that by 2010 New Zealand will have an affordable, integrated, safe, responsive, and sustainable transport system. The problem is New Zealand practitioners have few, if any real immediate and accessible tools for the assessment of walking environments and walkability.

4.2 Performance design techniques have been used by the transport profession to assess vehicle projects for a long time. Typically a 'do-nothing' scheme is considered against various performance criteria. The problem is similar techniques to assess walking environments have not been available to New Zealand practitioners and hence, other than providing for walking with the use of footpaths and crossing locations, the ongoing performance of these environments is infrequently considered. Consequently some walking environments are disjointed, provide poor quality, reduce accessibility and increase severance for some members of the community.

4.3 Typical performance design techniques such as reviewing, auditing and rating can be applied to walking environments and New Zealand practioners are starting to import overseas tools to provide them with different techniques to consider and prioritise walking schemes. Unfortunately this is being undertaken with little knowledge of other New Zealand experience and with little consideration for how those techniques are applied in a New Zealand situation. This is apparent when considering auditing techniques but most serious with rating systems that have a very strict methodology.

4.4 The importance to research and develop New Zealand based walkability tools at the infancy of growing demand should not be underestimated. A delay in undertaking research in this area means inappropriate data collection, mistaken analysis and faulty conclusions that could result in wrong decisions. Conversely prompt research in this area will promote uniformity, correct analysis and will result in right decisions. Additionally, it will provide a base of knowledge for practitioners to build upon and collaborate with other practitioners using 'approved' New Zealand techniques.

4.5 Also, there appears to be an abundance of overseas material for which New Zealand can gleam important insights and may not need to wholly 'reinvent the wheel'. There are though some important decisions that need to be made for how New Zealand goes about developing these tools.

Potential Outputs and Objectives

4.6 Steve Ably has been asked to identify the potential outputs and the prime objectives the development of New Zealand walkability tools could provide. Ultimately the walkability tools that are developed should be:

1. Widely used and adopted as New Zealand good practice, deviation from the published New Zealand guides or manual would be discouraged.

2. Strike a balance between being comprehensive and easy to use.

3. Give results that provide better outcomes for users and better value for money over the life of the walking environment.

4. Relevant and applicable to all New Zealand walking environments.

5. Appropriate for the particular assessment being undertaken.

4.7 The following list is subjective and will be subject to further discussion but may include the potential outputs for each of the assessment technques:

Reviewing:

4.8 Production of a general good practice manual that would provide practioners with guidance for how to undertake a review. The guide would include a list of technical tools that could be used when assessing walking environments including acknowledgement of rating and auditing tools. The guide could also include good practice projects where reviews have been undertaken and provided practioners with improved walking environment designs that have been later implemented.

Objective 1: Will include the latest techniques including New Zealand's reviewing and rating tools as well as newer techniques such as Space Syntax analysis [5].

Objective 2: Development of good practice guide will be developed with stakeholders and professional interests such as urban designers, landscape architects, engineers, and architects.

Auditing:

4.9 Production of a good practice guide for undertaking walking audits including application of existing walkability audit tools. The inclusion of a checklist for when audits should be undertaken and topic areas for all the variables that affect walkability e.g. security, amenity etc. Possible cross reference to specific construction and good practice design standards. Could include good practice projects where audits have been undertaken and identified commons elements to provide practitioners with better design techniques.

Objective 1: Development or acceptance of an approved New Zealand walkability audit system.

Objective 2: The development of a store of existing New Zealand audits so practitioners have a basis of audit best practice and reporting excellence.

Objective 3: The requirement to undertake a walkability audit of a facility during the different stages of design in a similar manner as Safety Audits. This may be applied to various road users including 'bikeability'.

Objective 4: Review of audits that have been undertaken to identify common deficiency issues for referral back to practioners when undertaking designs.

Rating:

4.10 Production of a good practice guide for undertaking New Zealand walkability ratings. This could be supplemented with a computer based program for the collection of this data and graphical and spatial reporting as like the PERS software and shown in **Appendix D**. Could include UK good practice projects such as where bike audits and reviews have been combined. The rating system may also include development of a prioritisation system to aid decision making.

Objective 1: Development or acceptance of an approved New Zealand walkability rating system that is reflective and calibrated to New Zealand user perceptions.

Objective 2: Confirmation that the New Zealand walkability rating system is repeatable, transferable and applicable to New Zealand.

Objective 3: That the New Zealand walkability rating system be linked to the Land Transport New Zealand RAMM and Crash Analysis System to provide the most information possible.

Objective 4: Will permit comparisons between different environment and communities.

4.11 For New Zealand to meet all or some of the above objectives there are a number of issues that need to be resolved to progress forward.

5 ISSUES NEEDING RESOLUTION

Our Questions

5.1 The following questions are intended to be thought provoking. They will not conclude the issues that need to be considered but will form the basis for the discussion to be undertaken by interested parties at the meeting in Christchurch on 14 March 2005.

1. The term 'walkability' is not used anywhere in the PERS software although the term is well used in overseas literature. Is defining 'walkability' important and if so is the definition proposed in this paper appropriate?

2. Does New Zealand need 'approved' reviewing auditing or rating techniques?

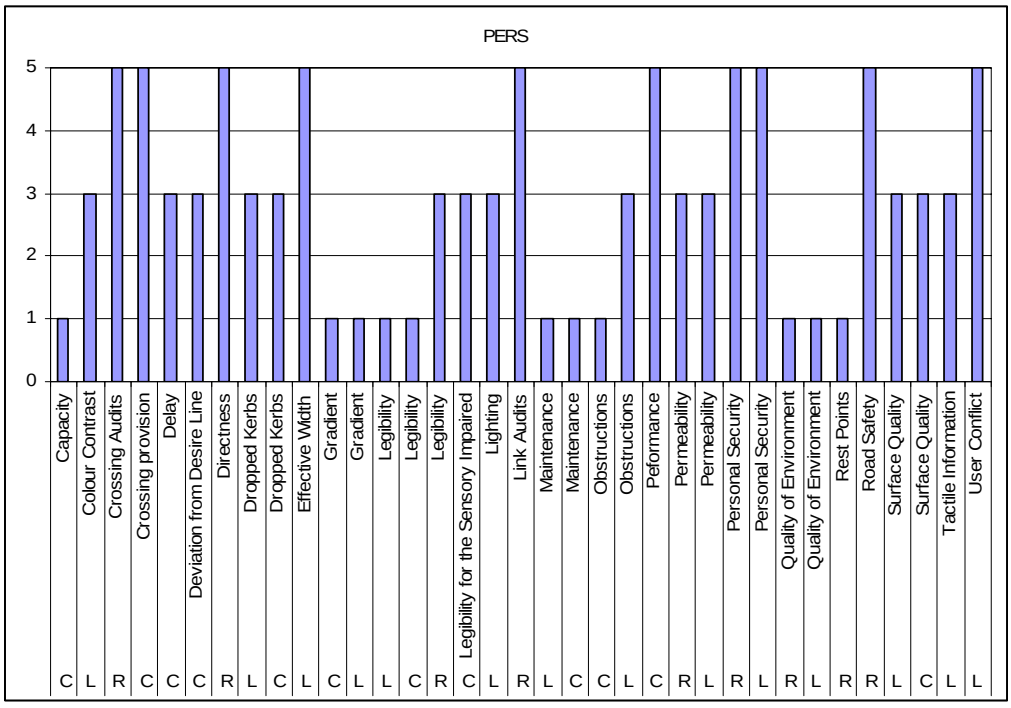
3. New Zealand has barely ever used auditing and rating tools, does it really need them now?

4. Can New Zealand import an overseas walkability rating system without adjustment to New Zealand conditions?

5. The PERS rating system has recently had a significant amount of publicity in New Zealand. PERS is the only system that requires purchase (£485 incl VAT and delivery or about NZ$1500); the other systems are free or very cheap. Should we accept the PERS system just because it can be purchased and consequently should be to a higher standard?

6. The PERS system places the following significance on different walking environmental variables as shown in **Figure 6.1** depending if they are part of a route (R), Link (L) or Crossing (C). If New Zealand adopted PERS do we need to differentiate between these variables and calibrate, and if so, do we accept the PERS or Cottam significance or something else?

Figure 6.1 PERS Walking Environment Variables and Significance



7. How should walkability be shown and described i.e. LOS, red – amber - green, star rating, etc?

8. There are overseas techniques such as the Landis et al Pedestrian LOS tool that try and predict walkability before projects are constructed, should New Zealand investigate these tools?

9. How should the absence of footpaths be assessed in audits and rating methodologies, or maybe this doesn't matter?

10. If a rating means that an environmental variable fails a particular test, should the rating assessment be stopped or identified as failed until those variables are repaired when say, a LOS, red – amber - green, or star rating could be concluded?

11. Should New Zealand set targets for different walkability ratings for different walking environments such as where a high proportion of vulnerable users may be apparent?

12. Pedestrians come in a vast variety of forms, big, small, wheeled, visually impaired etc. Should New Zealand set a 'target user' for reviewing, auditing and rating tools and if so who is this user?

13. Economics is excluded from the performance design techniques mentioned in this paper although the Ministry for the Environment considers that walking could be valued using the Litman [4] technique. Should New Zealand include an environmental variable such as 'the cost of walking'?

14. Is the "5 C's" concept a good idea for the basis of the environmental variables used in walkability rating systems?

15. There are other measures of walkability other than scoring systems such as PERS e.g. the Local Government Commission in Sacramento California, USA uses a simple yet effective measure of walkability as 'permeability'. They measure the average block size (square feet or acres) in an area or the number of street intersections per square mile. Might this suffice as a rating system and the measurement of walkability?

16. If a rating system is developed should a prioritisation system be developed in parallel so practitioners have an application for the overall rating values?

17. Should the rating system be flexible enough to be adjusted depending on the complexity of the surrounding walking environment and vary with the specific situation?

Your Questions

18. _____?

19. _____?

20. _____?

21. _____?

22. _____?

References

1 Livi AD and Clifton K J, “Issues and Methods in Capturing Pedestrian Behaviours, Attitudes and Perceptions: Experiences with a Community Based Walkability Survey”, *Transportation Research Board,* Annual Meeting 2004.

2 Seilo Paul, “Walkability And Urban Form: A Gis-Based Analysis Of Nodal Development Areas In The Eugene-Springfield Metropolitan Area”, *Thesis - Department of Planning, Public Policy and Management and the Graduate School of the University of Oregon*, June 2004.

3 http://www.cdc.gov/nccdphp/dnpa/walkability/

4 Litman T A, “Economic Value of Walkability”, Victoria Transport Policy Institute 2003 - http://www.vtpi.org/

5 Hillier Bill, J Hanson, J Peponis, J Hudson and R Burdett (1983) 'Space syntax' from the Architect’s Journal, Vol 178 (48), pp 67-75 - http://www.spacesyntax.org

Appendicies

Appendix A	HCM/Fruin Walking Level of Service
Appendix B	Christchurch City Council 'Assessment of Pedestrian Level of Service Methodologies' Report Prepared by Paul Cottam
Appendix C	'Cottam' Survey Assessment and PERS Output
Appendix D	PERS LOS Mapping Demo

WALKABILITY
SCOPING PAPER
Appendix A

HCM / Fruin
Walking Level of Service

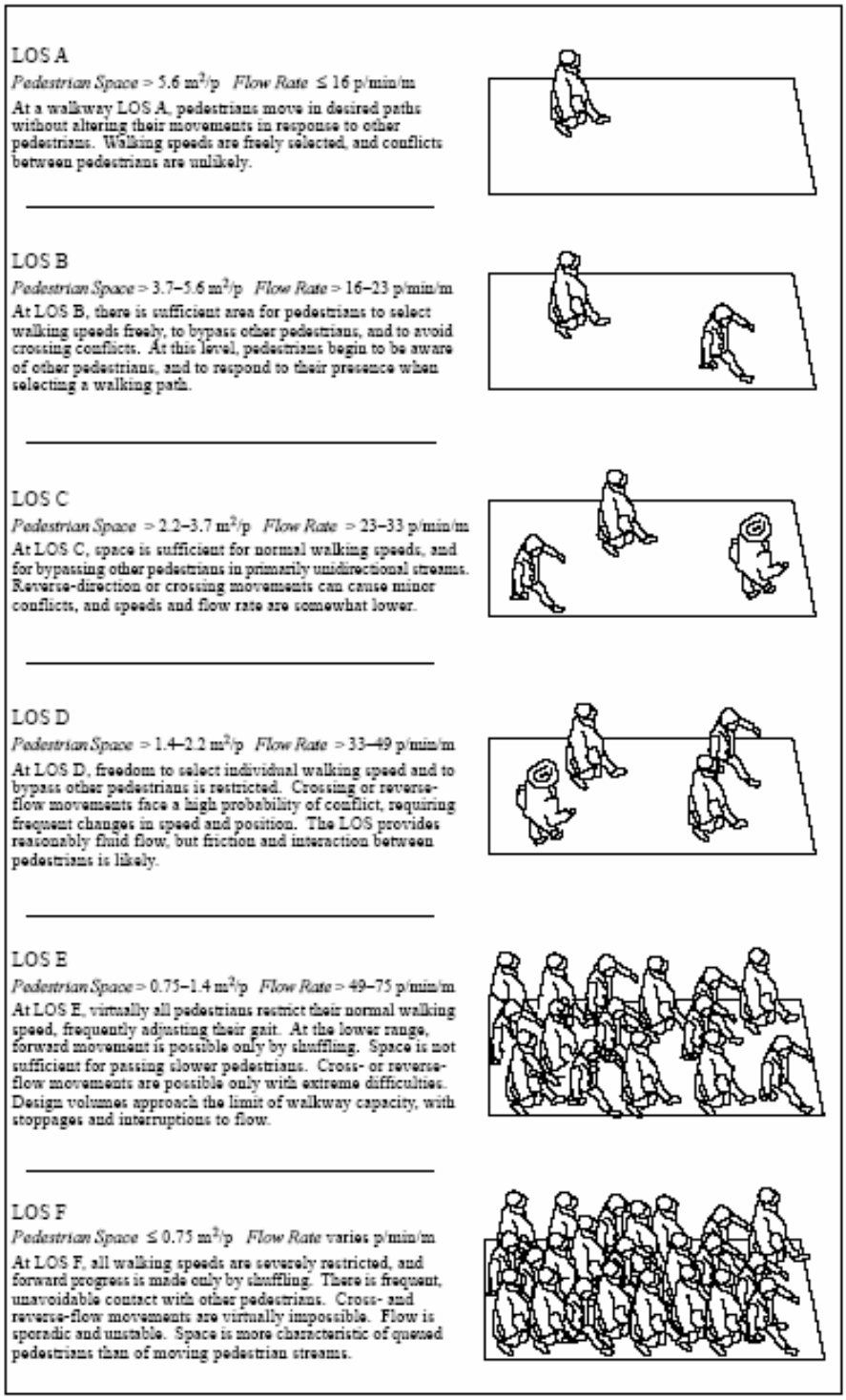
Steve Abley
Chartered Traffic and Transportation Engineer
BE(Hons) NZCE MIPENZ CPEng MICE CEng(UK) MNZIM IntPE(NZ)

HIGHWAY CAPACITY MANUAL (HCM)

Transportation Research Board
National Research Council, Washington DC, USA

Graphic illustrations and descriptions of walkway Level Of Service (LOS) are shown below. These LOS criteria are based on average flow and do not consider platoons.

EXHIBIT 11-8. PEDESTRIAN WALKWAY LOS



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LOS descriptions for queuing areas (with standing pedestrians) are based on average pedestrian space, personal comfort, and degrees of internal mobility and are shown below.

EXHIBIT 11-9. QUEUING AREA LOS

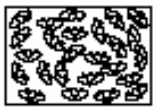
LOS A
Average Pedestrian Space > 1.2 m^2/p
Standing and free circulation through the queuing area is possible without disturbing others within the queue.

LOS B
Average Pedestrian Space > 0.9–1.2 m^2/ p
Standing and partially restricted circulation to avoid disturbing others in the queue is possible.

LOS C
Average Pedestrian Space > 0.6–0.9 m^2/p
Standing and restricted circulation through the queuing area by disturbing others in the queue is possible; this density is within the range of personal comfort.

LOS D
Average Pedestrian Space > 0.3–0.6 m^2/p
Standing without touching is possible; circulation is severely restricted within the queue and forward movement is only possible as a group; long-term waiting at this density is uncomfortable.

LOS E
Average Pedestrian Space > 0.2–0.3 m^2/p
Standing in physical contact with others is unavoidable; circulation in the queue is not possible; queuing can only be sustained for a short period without serious discomfort.



LOS F
Average Pedestrian Space ≤ 0.2 m^2/p
Virtually all persons within the queue are standing in direct physical contact with others; this density is extremely uncomfortable; no movement is possible in the queue; there is potential for panic in large crowds at this density.

WALKABILITY
SCOPING PAPER
Appendix B

Christchurch City Council
'Assessment of
Pedestrian Level of
Service Methodologies'
Report Prepared by
Paul Cottam

Assessment of Pedestrian Level of Service Methodologies

Paul Cottam
Transport Researcher
City Transport Unit
Christchurch City Council

November 2004

Summary

The Council is seeking a method by which to prioritise requests for new footpaths over and above its existing footpath sealing and renewal programmes. Two methods for assessing pedestrian level of service were used on a range of twelve geographically spread sites in Christchurch.

These methods were the recently developed PERS model from the United Kingdom (Pedestrian Environment Review System), and an Australian model (referred to here as AUST) presented at the Australia: Walking in the 21st Century conference in 2001. Six further methods of assessing walking conditions for pedestrians were examined as part of a brief literature review.

Conclusions drawn from the two methods tested are that they produced reasonably consistent results at moderate and higher rating pedestrian environments for the sites assessed. They diverged more on what were assessed as low LOS ratings. Although AUST was easier to apply, more consistency was found with the PERS software, with its worst rating sites tending to be on arterial roads with 50km/h speed limits.

Several weaknesses were identified in the PERS and AUST methods as applied to a New Zealand context, eg. a lack of emphasis in PERS on pedestrian safety from traffic. Other methods reviewed between them contained a range of LOS factors that were seen as overcoming deficiencies in the PERS and AUST methods for assessing new footpath locations.

For measuring pedestrian LOS for existing footpaths, as well as at intersections and crossings, it is recommended that PERS be used as a valid methodology. A model based on the PERS factors but using an AUST assessment methodology is proposed for assessing demand for new footpaths.

This report in three sections. Section One examines and compares the PERS and AUST methods as used in the field. Section Two reviews other pedestrian LOS methods. Recommendations for assessing proposed and existing footpaths are contained in Section Three.

Contents

Section One: The PERS and AUST Methodologies

1. PERS: Pedestrian Environment Review System

PERS seeks to systematically evaluate the quality of the pedestrian environment through an objective framework. Developed in the United Kingdom, it is designed to act as an audit to assess current levels of service. It could also be used to audit design proposals.

Under PERS, the pedestrian environment is conceptually seen as comprising four broad areas of significance: Capacity, Legibility, Safety, and Quality. These are translated into a broad hierarchy of overall **routes**, specific **links** and **crossing** points. Each hierarchical category consists of a range of factors to be assessed, as listed below. Definitions are given for each factor in PERS.

Assessments involve taking descriptive notes and giving numerical ratings to factors on seven-point scales in each hierarchical category (see Figure One below). Scale descriptions and prompt questions for each factor are provided to guide assessments. The numerical scorings are then weighted via a software package to produce an overall assessment, given as one of three grades (green, amber or red).

The data entered into the accompanying software package is used to produce graphical assessment results for each factor, as well as an overall grading. The scorings of factors are also given as grades to provide directions for action for particular factors. In addition, the descriptive notes can be entered and reproduced.

Routes
Directness
Road Safety
Permeability
Rest Points
Legibility
Quality of Environment

Links
Effective width
Dropped Kerbs
Gradient
Obstructions
Permeability
Legibility
Lighting
Tactile Information
Colour Contrast
Personal Security
Surface Quality
User Conflict
Quality of the Environment
Maintenance

Crossings
Crossing Provision
Deviation from Desire Line
Performance
Capacity
Delay
Legibility
Dropped Kerbs
Gradient
Obstructions
Surface Quality
Maintenance

2. Australian Pedestrian Level of Service (Gallin)

This is a model (subsequently referred to as AUST) developed for assessing pedestrian LOS based on three categories of physical (or design) characteristics, location factors, and user factors, giving a total of eleven LOS factors to consider as noted below:

Physical factors
Path width
Surface quality
Obstructions
Crossing opportunities
Support facilities

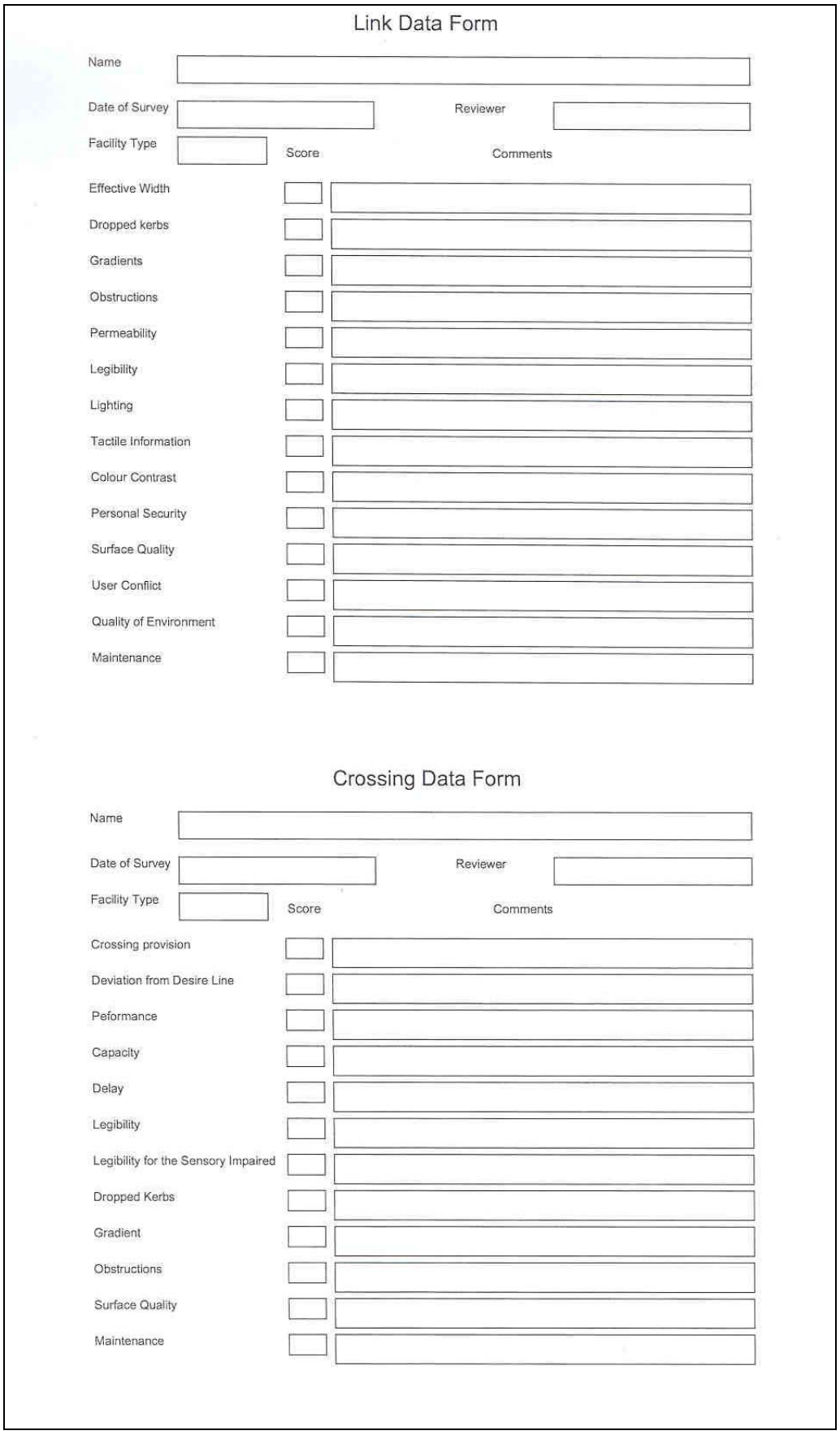
Location factors
Connectivity
Path environment
Potential for vehicle conflict

User factors
Pedestrian volume
Mix of path users
Personal security

Factors within the categories are weighted by their perceived relative importance from a professional viewpoint. Numerical assessments are given on a five point scale of zero to four. Notes are also taken for each factor. After the scores are weighted, the resulting calculations are banded within a LOS scale (see Table One below). Brief descriptions are provided for scoring factors on the numerical scale.

This method draws upon Austroads information, with much overseas literature not seen as relevant to the Western Australia environment. The importance of desktop as well as on-site investigations is noted.

Figure One: PERS Crossing and Link Data Forms



Link Data Form

Name

Date of Survey

Reviewer

Facility Type

Score

Comments

Effective Width

Dropped kerbs

Gradients

Obstructions

Permeability

Legibility

Lighting

Tactile Information

Colour Contrast

Personal Security

Surface Quality

User Conflict

Quality of Environment

Maintenance

Crossing Data Form

Name

Date of Survey

Reviewer

Facility Type

Score

Comments

Crossing provision

Deviation from Desire Line

Peformance

Capacity

Delay

Legibility

Legibility for the Sensory Impaired

Dropped Kerbs

Gradient

Obstructions

Surface Quality

Maintenance

Table One: Pedestrian Level Of Service Evaluation (Gallin)

Category	Factor	Measurement/Value (Comment)	Points Score (P)	Weight (W)	Weighted Score (PxW)
Physical Characteristics	Path Width			4	
	Surface Quality			5	
	Obstructions			3	
	Crossing Opportunities			4	
	Support Facilities			2	
Location Factors	Connectivity			4	
	Path Environment			2	
	Potential for Veh. Conflict			3	
User Factors	Pedestrian Volume			3	
	Mix of Path Users			4	
	Personal Security			4	
				TOTAL	

LOS Grade A = Score of 132 or higher
B = 101 to 131
C = 69 to 100
D = 37 to 68
E = 36 or lower

3. PERS and Australian Model Comparisons

Assessment and Results

The PERS and Australian models were tested at twelve locations across Christchurch in 2004 that were initially felt to be priorities for new footpaths. There were two sites in each of the then community board areas. As shown in Table Two, six were on arterial roads, two on collector roads, and four on local roads. Nine were in 50km/h speed limit environments. Nine links were of 400m to 700m in length.

Table Two: Description of Footpath Links

Link Location	Link Length (m)	Speed Limit (km/h)	Road Type
Avonhead Rd (west from Roydvale Ave)	400	50	Collector
Bexley Rd (Breezes Rd to Birch St)	1120	70	Arterial
Cavendish Rd (east side of rural section)	600	70	Collector
Dyers Rd (Ti Rakau Rd to Ferry Rd)	630	50	Arterial
Frosts Rd (Travis Rd to Beach Rd)	700	50	Minor Arterial
Halswell Rd (Dunbars Rd to Templeton Rd)	1300	80	Minor Arterial
Jenkins Ave (east side	400	50	Local
Main Rd opposite Peacocks Gallop Res.	500	50	Minor Arterial
Palatine Tce (south of Malcolm Ave footbridge)	100	50	Local
Port Hills Rd (east from Mary Duncan Park)	100	50	Arterial
Steadman Rd (east side)	550	50	Local
Watsons Rd	700	50	Local

Assessments were carried out during fine weather, with the two methods being used on the same day at each location. For comparability, the PERS results, which in their original form are given as a percentage of the maximum score from –100 to 100 (and so could be negative or positive), were scaled to percentage scores on a range of 0 to 100. The Australian numerical results, originally scored from zero to a maximum possible score of 152, were also scaled to a percentage score of 0 to 100. Locations were then ranked by the scaled scores in order of the best LOS that was found. These comparisons are listed in Table Three, and are also shown graphically in Figure Two.

Only the PERS method could assess intersections separately, with AUST including intersections within its methodology. The PERS intersection results, scaled as before, are given in Table Four as well as Figure Three. How well the LOS matched up between each link and where it had an intersection (lowest performing if more than one) is shown in Figure Four.

Table Three: PERS & Australian Footpath Link Assessment Comparisons

Location	PERS					AUST			
	Grade	Raw Score	Percent of Max.	Scaled Score	Rank	Grade	Raw Score	Scaled Score	Rank
Jenkins Ave	Green	43	27	64	1	C	77	51	3
Palatine Tce	Amber	34	21	61	2	C	91	60	1
Avonhead Rd	Amber	20	12	56	3	C	78	51	2
Steadman Rd	Amber	-6	-5	48	4	D	60	39	6
Port Hills Rd opp DP	Amber	-30	-25	38	5	D	64	42	4
Cavendish Rd	Red	-29	-24	38	6	D	48	32	10
Bexley Rd	Red	-49	-41	30	7	D	49	32	9
Watsons Rd	Red	-48	-40	30	8	D	40	26	11
Halswell Rd	Red	-51	-42	29	9	D	51	34	8
Main Rd opp PG	Red	-52	-43	29	10	E	34	22	12
Dyers Rd	Red	-67	-56	22	11	D	53	35	7
Frosts Rd	Red	-72	-60	20	12	D	61	40	5

Table Four: PERS Intersection Assessments

Intersection/ Crossing	Grade	Raw Score	Percent of Max.	Scaled Score	Rank
Jenkins Ave at Solomon St	Green	86	72	93	1
Cavendish Rd at RP Drive	Green	91	76	88	2
Avonhead Rd at Roydvale Ave	Green	56	47	74	3
Palatine Rd at address No.68	Green	37	31	69	4
Frosts Rd at Travis Rd	Amber	29	24	65	5
Palatine Rd at footbridge	Amber	7	6	54	6
Dyers Rd at Ferry Rd	Amber	-15	-17	43	7
Cavendish Rd at Barnes St	Amber	-29	-32	34	8
Halswell Rd at Dunbars Rd	Red	-37	-41	32	9
Halswell Rd at Templeton Rd	Red	-44	-49	28	10
Frosts Rd at Beach Rd	Red	-46	-51	27	11
Watsons Rd at Harewood Rd	Red	-53	-59	24	12
Dyers Rd at Palinurus Rd	Red	-57	-63	22	13
Bexley Rd at Birch St	Red	-56	-82	9	14

Figure Two: PERS & AUST PLOS COMPARISON

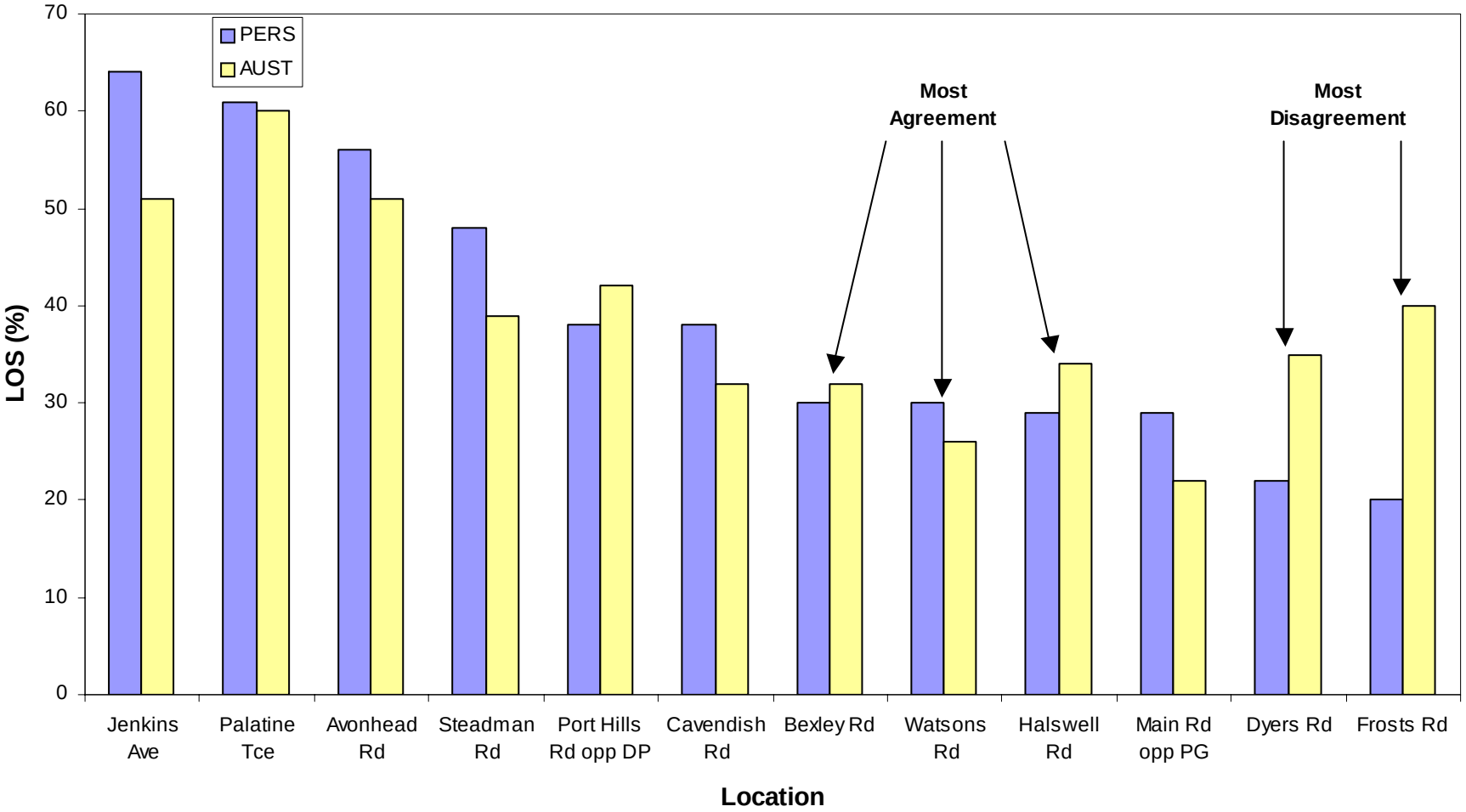


Figure Three: PERS INTERSECTION ASSESSMENT

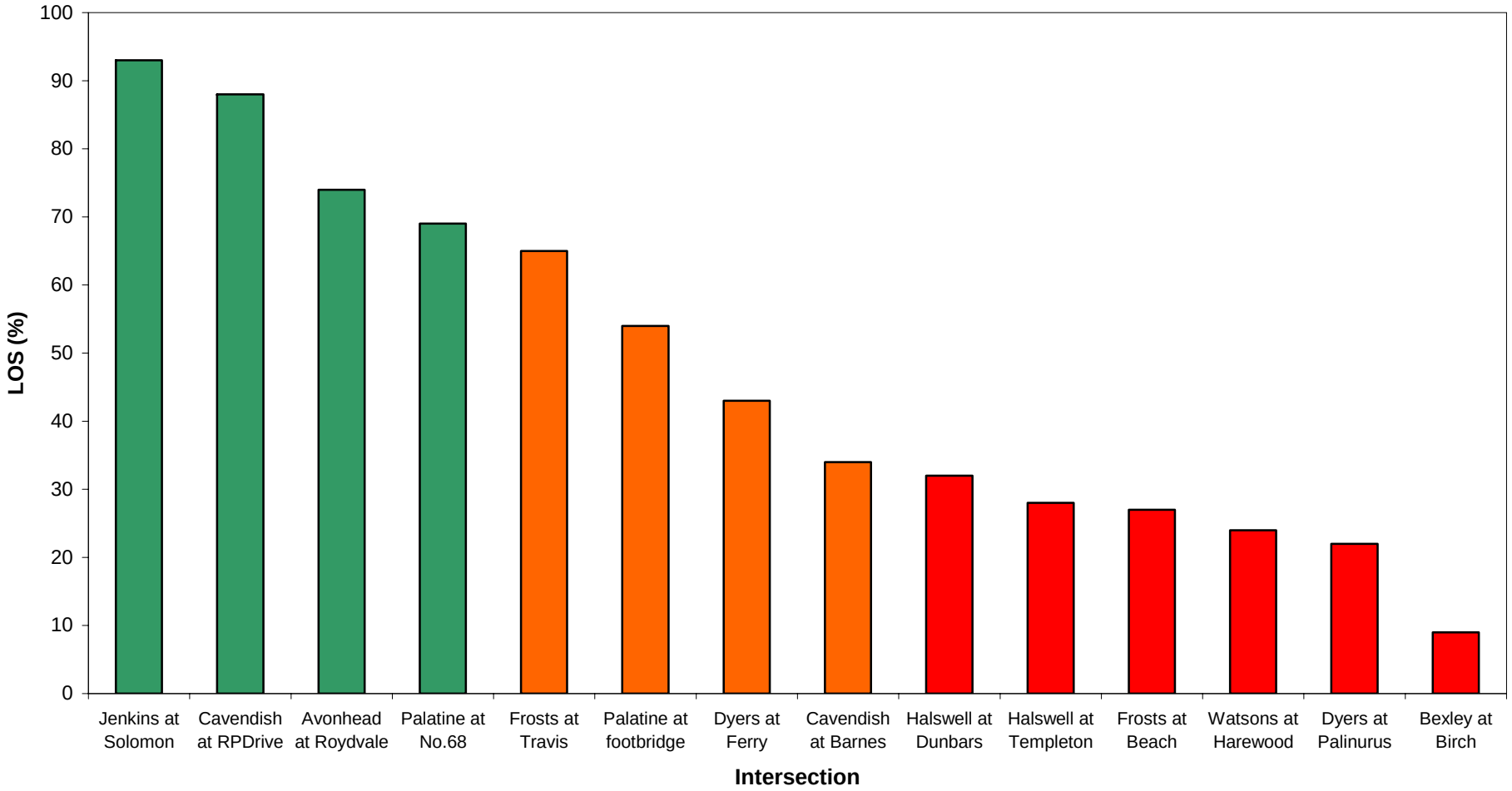
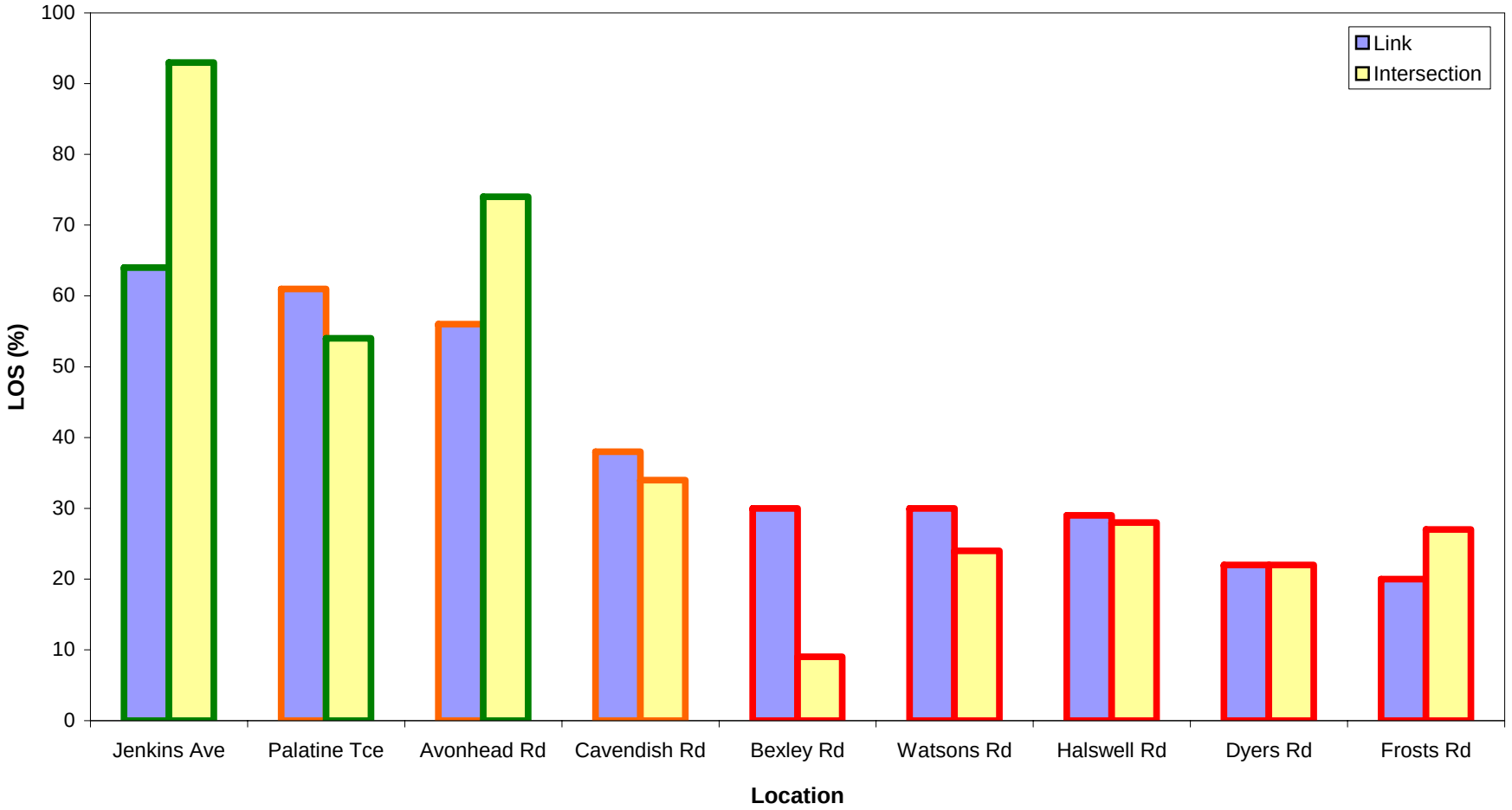


Figure Four: PERS Link & Intersection Comparison



Discussion

(i) Ease of Use

PERS provides a systematic and detailed assessment. A large number of footpath environment factors are considered, including qualitative aspects. The accompanying software package stores information and produces good graphical results. It does take time initially to study the range of factors being considered, how to evaluate them and to become familiar with the software package. Assessments and data entry can also be time consuming, partly because scoring judgements are left up to the assessor, rather than scoring factors by having a series of statements linked to numerical scores. Nevertheless, PERS should be seen as a good assessment tool for existing footpath situations, especially in urban and suburban situations.

However, PERS lacks scoring descriptions where there is no actual footpath on the link being assessed. This makes it a little awkward to score some factors, and lends itself to bias, eg. low scorings sometimes being given even though the question may be less than relevant or meaningful, especially in rural or semi-rural settings. Scoring difficulties in these situations are also partly due to no zero scoring option being provided, even though this is stated as an assessment benefit. These problems particularly apply to rural areas, although areas with a poor intuitive feel nevertheless scored low. More emphasis on pedestrian safety from traffic is also needed in PERS.

The AUST method is straightforward and quicker to understand and use. Most of the key issues affecting walkability seem to be covered, including the absence of a footpath. For ease of use, link and crossing factors are combined in the methodology.

Despite its intuitive appeal, AUST's easy to use approach tends to result in too many influences on walkability being subsumed into one factor, i.e. some factors could be split up. The weightings used also seem to under-emphasise safety and over-emphasise user flow factors such as pedestrian volume, e.g. low pedestrian volumes scoring well and contributing to a higher assessment despite an obviously unfavourable traffic volume and speed environment.

(ii) Assessment Comparisons

In comparing the LOS assessments for PERS and AUST that were made, the two methods produced generally consistent results in terms of agreement on what were the middle LOS band of footpath links (Figure Two). They diverged more on what were assessed as low LOS ratings.

The poorest link ratings in PERS were not the poorest rating footpaths in AUST. Although all the red grades on PERS were coded D (mostly) or E (once) on AUST, there was variation on the AUST LOS assessments. This was particularly so for Dyers Road and Frosts Road, which received the lowest PERS scores with LOS of 22% and 20%, yet had a mid-table ranking for AUST with LOS of 35% and 40% (Table Three).

In terms of roading types, the worst PERS ratings showed some consistency in terms of being arterials, and in 50km/h areas. It should be noted that these were rural or

semi-rural locations, and it was strongly suspected that they have high 85th percentile speeds. In contrast, a mixture of road types was noted for the worst rating AUST assessments. The best performing links for both methods were on local or collector roads in 50km/h areas with residential development on at least one side of the road.

For the grades assigned by each method, there was broad agreement between them. However, as noted above, the gradings for AUST were felt to be too broad, especially in terms of not producing the lowest grading where the situation clearly seemed to warrant it (eg. Dyers Road and Frosts Road). This resulted in a lack of differentiation in gradings between a diverse range of footpath environments.

For the PERS intersection assessments, there was a direct match in terms of red gradings being assigned within links to both the links and their worst performed intersection (Figure Four). No links had red grades without red intersection grades, and vice-versa.

The overall perceived strengths and weaknesses of PERS and AUST are briefly summarised below in Table Five.

Table Five: PERS & AUST Strengths and Weaknesses

	PERS	AUST
Strengths	Systematic, detailed assessment, using a number of factors, and providing good descriptive information for making ratings assessments for both footpath links and crossings	Straightforward for staff to understand and use, easy to tabulate results and derive LOS grades
	Easy to interpret graphical outputs show scores and gradings for each factor as well as overall link or crossing being assessed	Combines link and crossing factors into one assessment tool, gives an emphasis to vehicle conflict
	Good range of environmental and amenity factors, and includes qualitative factors	Covers most issues affecting walkability assessment of the pedestrian environment
	Good assessment tool for existing urban and suburban areas, including footpaths and intersections	Good tool for making assessments where there is no footpath
Weaknesses	Lacks scoring descriptions where there is no actual footpath on the link being assessed, making it a little awkward to score some factors, especially to rural areas. However, areas with a poor intuitive feel nevertheless scored low	May not be enough factors being assessed, and some factors could be split up as contain too many items of note
	Requires some understanding beforehand and initial trialing out to use	Delineation of grades may not be accurate, eg. assessments can result in mostly one grade being produced
	Not quite enough emphasis on pedestrian safety from traffic	Weightings under-emphasise safety and over-emphasise user flow factors such as pedestrian volume and user mix
	Route assessment very similar to link assessment, difficult to apply to situations which were mostly of a link nature. However, could be for area wide investigations, eg. travel to school.	Does not provide gradings for each factor to provide specific courses of action

Section Two: Other Methodologies

1. DETR – Encouraging Walking: Advice to local authorities

A UK publication that provides a five category checklist based on the five C's, with open-ended questions in each category, which is itself posed as a question. The checklist aims to give a basis to establishing a localised action plan for pedestrian LOS improvement. Categories and questions are:

1. Is the local walking environment **connected**?
   - How well is walking integrated with public transport?
   - Are routes to key destinations continuous, i.e. without barriers such as major roads that are difficult to cross?
   - Are walking networks designed to give good access to key destinations?
   - Is the distance to public transport stops as short as possible for people within the area served?
   - Are pedestrian crossings sited on 'desire lines' where people want to cross to get to public transport interchanges?
   - Have important routes been given sufficiently high priority, eg. short waiting times at signalled crossings on routes to bus and rail interchanges?

2. Is the local walking environment **comfortable**?
   - Do local facilities meet design standards, such as footway widths, good quality walking surfaces, planning for disabled people?
   - Is pavement parking a problem?
   - Is there a problem with cycling on the footpath?
   - Are routes safe?
   - Is the general condition of the walking surface clear of obstructions, broken paving, etc?
   - Is it easy for people to report footway faults?
   - Is traffic speed or volume a problem?

3. Is the local walking environment **convenient**?
   - Are the walking routes continuous, eg. is the road raised to footway level at junctions?
   - Can streets be crossed easily and safely?
   - Do existing facilities cause delays to pedestrians?
   - Are there pedestrian signals or phases at traffic signalled junctions?

4. Is the local walking environment **convivial**?
   - Is the urban design to a high standard?
   - Are the pedestrian routes interesting?
   - Are the footways substantially free from litter and dog mess?
   - Is crime or fear of crime a cause for concern?

5. Is the local walking environment **conspicuous**?
   - Are walking routes clearly signposted? Is it obvious how to get to shops, leisure facilities or bus stops?
   - Are local walking routes published? Are there local maps and are they included with travel and tourist information?

- Are there local walking schemes such as ‘Safe Routes to School’?
- Are street names clearly visible, and are there sufficient repeater name plates?

Possible Strengths

- A recognised set of pedestrian LOS parameters
- User-friendly discussion format that could be used by or with most people
- Considers a mix of quantitative and qualitative factors
- Could provide rich, descriptive information
- Could highlight issues for further exploration

Possible Weaknesses

- Category questions would need to be adapted or narrowed down to assess particular footpath links, i.e. it is a route-based assessment tool
- Few questions consider the absence of a footpath
- No graded scales to quantify and/or compare footpath assessments, i.e. no technical quantification of issues
- Some questions lack precision or are too general

2. Pedestrian LOS based on Trip Quality (Jaskiewicz)

An American assessment based upon aesthetics, safety, and ease of movement. Nine factors, scored on a one (very poor) to five (excellent) scale, to give ratings for each factor, and an overall score (maximum = 45). Scores can also be aggregated and averaged to obtain an overall LOS grade (see below).

Descriptions provided for each factor, with the methodology largely requiring an on the spot subjective assessment. The results obtained aim to provide a specific list of improvements that need to be made at a location. The overall objective is to identify qualitative factors to go alongside traditional quantitative ones in assessing pedestrian environments.

Qualitative Factors

- Enclosure
- Complexity
- Building Articulation
- Complexity of spaces
- Varied roof/overhang lines
- Buffer zone
- Shade trees
- Public/private transparency
- Physical condition (considers Sidewalk condition, Lane width, Broken sight lines, Sharp turns, On-street parking, Pedestrian crossing treatment, Lighting)

LOS Grade

A = 4.0 to 5.0 = very pleasant	D = 2.2 to 2.7 = uncomfortable
B = 3.4 to 3.9 = comfortable	E = 1.6 to 2.1 = unpleasant
C = 2.8 to 3.3 = acceptable	F = 1.0 to 1.5 = very unpleasant

Possible Strengths

- Emphasises pedestrian safety and comfort as well as traditional volume and capacity factors
- Mitigates against traditional considerations of pedestrian flow being too dominant in LOS assessments
- Aims to highlight aspects of LOS that need improving
- Straightforward to understand and use

Possible Weaknesses

- In isolation could underemphasize quantitative factors
- Physical condition factor seems too detailed, needs to be broken down in proportion with other factors
- Lacks an overall grading system to compare footpath links with each other, i.e. gives numerical totals only
- Seems best suited to an urban context

3. PEDSAFE – University of Queensland (Lillis and Pourmoradian)

An Australian model that aims to develop an auditing method for professional and community use. The PEDSAFE audit is targeted at pedestrian 'corridors', i.e. an area based approach. It identifies eleven categories of key pedestrian planning issues, with categories containing anywhere between one and nine factors that are framed into questions as the basis of an audit. PEDSAFE seeks to evaluate areas of pedestrian safety, levels of amenity, and quality of pedestrian facilities. The outcome sought is in terms of a targeted action plan, for both new and existing areas.

Lillis and Pourmoradian describe the common advantages and disadvantages to watch for in usual pedestrian auditing methodologies. They note important methodological characteristics of what a good pedestrian audit should contain. The PEDSAFE model is a mixture of 38 open and closed questions (see planning issues and factors in Table Six below). Pictorial and graphical examples are provided to help code answers. The categories are:

- Surrounding areas/Context of corridor
- Mobility & Connectivity
- Roadways
- Form of corridor
- Street crossings
- Footpaths & kerb ramps
- Street furniture
- Signage
- Car parking
- Special needs groups
- General amenity

Possible Strengths

- Good tool for area wide or larger location assessments, e.g. school environment
- Good emphasis given to amenity factors
- Good emphasis on safety from traffic
- Range of question types to elicit detailed picture of area being studied, e.g. open and closed questions, objective and subjective questions, pictorial and graphical response options and examples.
- Gives 'undecided' option for many questions to avoid respondent bias

Possible Weaknesses

- A wide scope means it is too broad to use at the footpath link or crossing level
- Some questions appear to be of little use or provide little meaning (e.g. broadly describing 'activity levels' relative to other streets)
- No scoring index provided, although this is apparently available

Table Six: List of Pedestrian Planning Issues (Lillis & Pourmoradian)

Surrounding Areas/Context of Corridor	***Footpaths and Kerb Ramps***
• Pedestrian Generating Activities	• Presence of Footpaths
• Directness and Safety of Local Walking Routes	• Footpath Width
Mobility and Connectivity	• Footpath Alignment
• Pedestrian Traffic Volumes and Levels of Service	• Surface Type/Quality
• Vehicular Traffic Volumes	• Provision of Kerb Ramps
• Public Transport Service Frequency	• Pedestrian Guidance and Control
• Public Transport Facilities	• Pedestrian/Cyclist conflict
Roadways	• Obstructions
• Surface Quality	• Presence of dog dirt, weeds, dead leaves or snow
• Alignment	***Street Furniture***
• Traffic Calming Devices	• Presence of Amenities and Public Art
• Speed Limit and Vehicular Speeding	***Signage***
Form of Corridor	***Car Parking***
• Gradient	• Off-street car parking
• Level of Enclosure	• On-street car parking
• Weather Protection	• Dangerous ingress/egress points to parking
• Vertical Clearance	• Vehicles parked on footpath
• Pedestrian Security	***Special Needs Groups***
• Lighting	• Presence of Facilities
• Non-discriminatory access to Buildings	***General Amenity***
Street Crossings	• Vehicular Noise
• Crossings near unsignalled intersections	• Overall Amenity
• Motorist visibility of crossing pedestrians	
• Motorist Stopping Distance	
• Jaywalking / Use of Crossings	

4. Evaluation of Pedestrian LOS (Muraleetharan et. al.)

A Japanese model that aims to develop a method to evaluate pedestrian LOS. It notes that although most methodologies identify factors affecting pedestrian LOS, many factors are not included in the actual computations of LOS. This method uses conjoint analysis to identify the relative importance of factors to pedestrians. A sample of pedestrians were used to complete surveys asking them to rate, via linear scales, pedestrian situations across a range of factors and levels of service provision within them (see Figure Five below).

Analysis of the sample data resulted in assigning specific weighted utility values for LOS factors for footpaths ('sidewalks') and intersections ('crosswalks'). These factors are described as 'attributes', with three weighted levels of provision determined for each attribute (i.e. high, medium and low LOS within an attribute). LOS grades (A to F) are then given to particular pedestrian footpath and/or intersection environments according to the summed utility values across the attributes as assessed when applying the model. The attributes are:

Footpath

- Width and separation
- Obstructions
- Flow rate
- Percent of cyclists

Intersection

- Area size
- Crossing facilities
- Turning vehicles
- Delay

LOS Grade

A = Range of utilities 7.55 to 9.26		D = 2.37 to 4.08
B = 5.82 to 7.54		E = 0.64 to 2.36
C = 4.09 to 5.81		F = -1.10 to 0.63

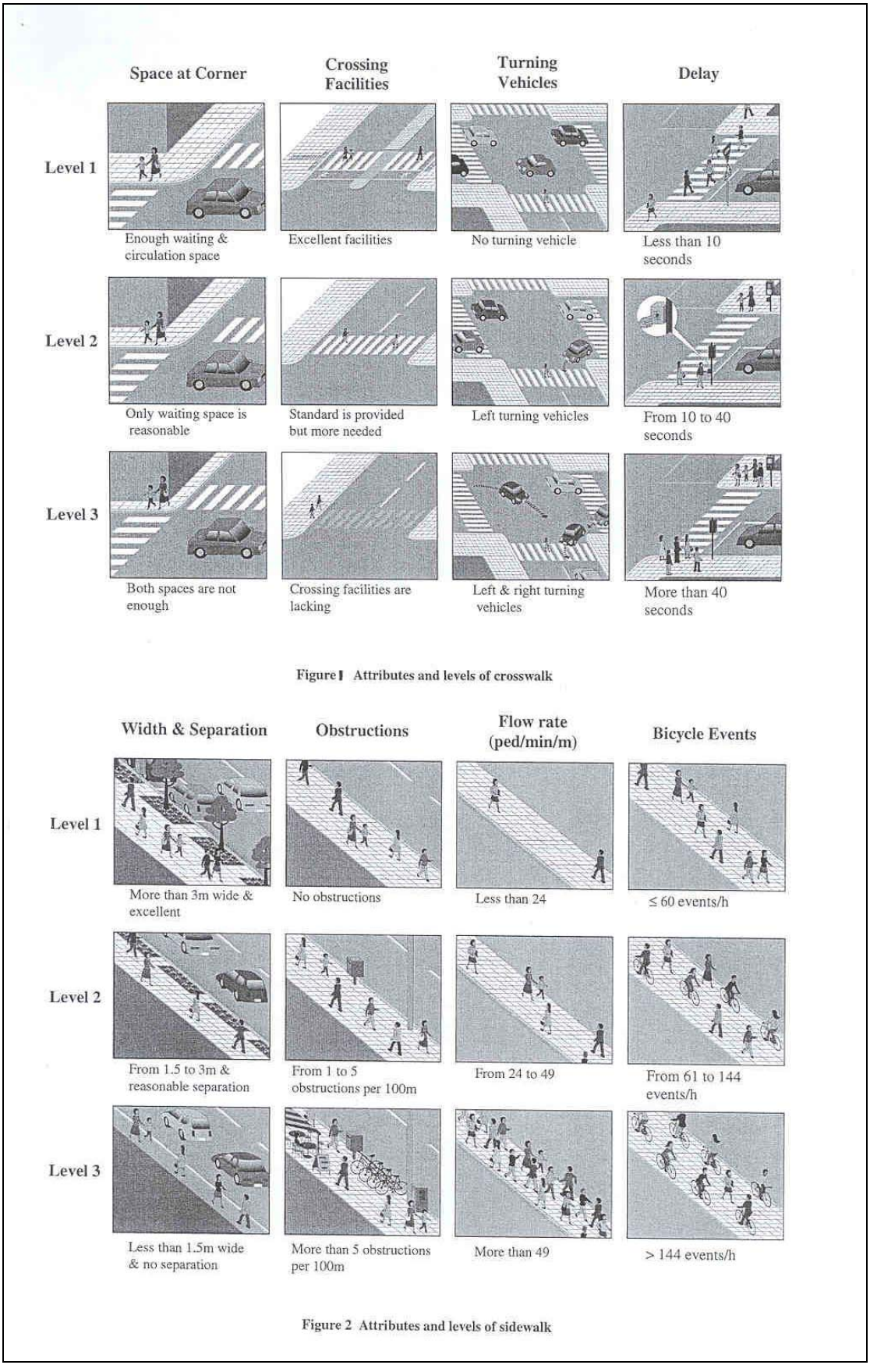
Possible Strengths

- Straightforward, quantifiable methodology that can be applied by staff
- Use of pedestrian perceptions in determining relative importance of factors
- Could be used just for assessments of footpath links or intersections
- Could be a basis for developing models specific to each country

Possible Weaknesses

- May not contain enough factors for a range of pedestrian environments, especially where no existing footpaths
- Probably only suitable for inner city pedestrian environments, and may only really apply to Japanese cities.
- Method relies on pre-determined factors that may not capture contextual meaning or subjective influences on walkability
- Method developed using only a university student sample

Figure Five: Attributes and Levels of Crossings and Sidewalks (Muraleetharan et. al.)



5. Bicycle & Pedestrian Level of Service (Dixon)

An American congestion management plan that includes LOS measures for bicycle and pedestrian facilities. The methodology hypothesizes that there are a critical mass of variables that must be present to attract motorized trips. The methodology is stated as applicable for evaluations on arterial and collector roads in urban and suburban areas.

Dixon notes that most methodologies do not adequately account for the range of pedestrian improvements that could be carried out. She states that LOS analyses should use data that are easily gathered, account for varying users, and produce recommendations for a wide range of improvements in addition to traditional facility improvements.

Under this model, roadway corridors are evaluated using a total point system ranging from 1 to 21 across seven categories, with a range of factors (23 in all) in each category, as shown in Table Seven. These factors are well described, and are drawn from established design criteria. This results in LOS ratings from A to F, with descriptions of what their gradings mean provided. The categories of LOS factors are:

- Pedestrian facility provided
- Conflicts
- Amenities
- Motor vehicle LOS
- Maintenance
- TDM/Multi-modal

Possible Strengths

- Straightforward, quantifiable methodology that can be applied by staff
- Considers absence of footpaths
- Good descriptions for assessing factors

Possible Weaknesses

- Despite stated aim, only contains quantitative factors, i.e. no qualitative environmental assessments relating to walkability
- Seems to be best suited to footpath assessments, applicability to intersections uncertain
- Need to apply or adapt an associated American motor vehicle LOS measure

Table Seven: Pedestrian Level of Service Performance Measure Point System (Dixon)

Category	Criterion	Points
Pedestrian facility Provided (Max Value = 10)	Not continuous or non-existent	0
	Continuous on one side	4
	Continuous on both sides	6
	Min. 1.53m wide and barrier free	2
	Sidewalk width >1.53m	1
	Off-street/parallel alternative facility	1
Conflicts (Max Value = 4)	Driveways and sidestreets	1
	Ped signal delay 40 sec or less	0.5
	Reduced turn conflict implemented	0.5
	Crossing width 18.3m or less	0.5
	Posted speed	0.5
	Medians present	1
Amenities (Max Value = 2)	Buffer not less than 1m	1
	Benches or pedestrian scale lighting	0.5
	Shade trees	0.5
Motor vehicle LOS	LOS = E, F, OR 6 or more travel lanes	0
	LOS = D and <6 travel lanes	1
	LOS = A, B, C, and <6 travel lanes	2
Maintenance (Max Value = 2)	Major or frequent problems	-1
	Minor or infrequent problems	0
	No problems	2
TDM/Multi-modal (Max Value = 1)	No support	0
	Support exists	1
Calculations	Segment Score (1)	21
	Segment Weight (2)	1
	Adjusted Segment Score (3)	21
	Corridor Score (4)	21 = LOS A

(1) Segment score = sum of points in the six categories
(2) Segment weight = segment length/corridor length
(3) Adjusted segment score = Segment score x Segment weight
(4) Corridor score = sum of the Adjusted segment scores in the corridor

LOS Grade A = Score of 18 to 21
B = 15 to 17
C = 12 to 14
D = 8 to 11
E = 4 to 7
F = 3 and below

6. Pedestrian LOS Model (Landis et. al.)

An American model aiming to develop a quantifiable, calibrated measure of pedestrian LOS. It aims to be used both in design and retro-fit schemes. The model was developed through regression analysis of participant field observations to identify statistically significant variables describing pedestrian perceptions of safety and comfort.

The authors acknowledge three general performance measures describing the roadside environment: sidewalk capacity, quality of the walking environment, and pedestrian perception of safety (or comfort) regarding motor vehicles. From their analysis of field observations, they note the following factors as primarily affecting pedestrian sense of safety:

- Lateral separation between pedestrians and vehicles, including
    - Presence of sidewalk
    - Width of sidewalk
    - Buffers between sidewalk and traffic lanes
    - Presence of barriers within buffer area
    - Presence of on-street parking
    - Width of outside travel lane
    - Presence and width of shoulder or bike lane
- Traffic volume
- Effect of vehicle speed
- Vehicle mix
- Driveway access frequency and volume

From these factors a mathematical model in the form of an equation was developed, and an associated LOS grading was listed according to model scores (see Figure Six below).

Possible Strengths

- Objective, quantifiable, technical methodology that can be applied by staff
- Dedicated assessment of pedestrian safety perception
- Provides direct assessments of footpath links

Possible Weaknesses

- Does not describe or evaluate intersection conditions
- Surrounding aesthetics not taken into consideration in development of model
- Relies on technical measurements that may not capture contextual meaning or subjective influences on walkability
- May be difficult or impractical to measure all the elements in the model
- May only be applicable to the American environment

Figure Six: Landis et. al. Model

$$\text{Ped LOS} = -1.2021 \ln (W_{ol} + W_l + f_p x \%OSP + f_b x W_b + f_{sw} x W_s) + 0.253 \ln (Vol_{15}/L) + 0.0005\ SPD^2 + 5.3876$$

Where:

W_{ol} = Width of outside lane (feet)
W_l = Width of shoulder or cycle lane (feet)
f_p = On-street parking effect coefficient (=0.20)
%OSP = Percent of segment with on-street parking
f_b = Buffer area barrier coefficient (=5.37 for trees spaced 20 feet on centre)
W_b = Buffer width (distance between edge of pavement and sidewalk, in feet)
f_{sw} = Sidewalk presence coefficient (= $6 – 0.3W_s$)
W_s = Width of sidewalk (feet)
Vol_{15} = Average traffic during a fifteen minute period
L = Total number of through lanes for road or street
SPD = Average running speed of motor vehicle traffic (mph)

LOS Grade A = Score of =< 1.5
B = > 1.5 and =< 2.5
C = > 2.5 and =< 3.5
D = > 3.5 and =< 4.5
E = > 4.5 and =< 5.5
F = > 5.5

Section Three: Recommendations

1. Existing Footpaths

For reviewing or auditing existing footpaths, the PERS method is considered to be the most thorough. Its level of detail, weighted factors, computer calculated assessments and quality outputs make it a superior product to utilise. Having said that its main weakness, stemming from a UK environment, is that for New Zealand conditions there is a lack of emphasis on road safety, with only one factor directly considering this. For audits in the urban environment, it is felt that this can be mitigated to a reasonable extent by harshly interpreting factors relevant to road safety such as user conflict and path width.

2. Proposed Footpaths

Based on usage of the PERS and AUST methodologies, their advantages and disadvantages, and a brief review of other methods a model for the New Zealand context, particularly for assessing new footpath situations, is suggested.

Using PERS as a basis, some original PERS factors are removed, while factors from the other methods considered are added. The aim throughout was to obtain a balance of factors for a New Zealand situation, with particular regard to new footpaths by and large being on the fringes of suburban development, i.e. in semi-rural environments.

The proposed pedestrian LOS for the Council seeks to be consistent with the aims of the Pedestrian Strategy, i.e. that the pedestrian environment is friendly, safe and accessible. There is also an attempt to reflect the '5 C's' philosophy in the proposed LOS.

As shown in Table Eight, weightings for the new factors are given, with an attempt to be consistent with original PERS weightings for the retained factors. These weightings, like the original PERS ones, give a higher priority to safety factors.

Like several of the methods examined, a five point scoring scale for each factor is proposed, ranging from zero to four. Similar to the AUST method, factor scores are then multiplied by the weighting factor to get an assessment score. These scores are then totalled. A LOS grade can then be determined, although the method would have to be trialled out to arrive at appropriate scoring bands.

Ideally, scoring descriptions need to be developed, with a view to making scoring assessments on the basis of the best descriptive fit, which is considered to reduce subjectivity. From there, field testing would result in working out appropriate LOS gradings. In the meantime, a simple very poor (= 0) to very good (= 4) intuitive scale could be used.

Table Eight: Proposed Pedestrian Level Of Service Evaluation

Category	Factor	Weighting
Physical Characteristics	Path Width (PERS, Gallin, Dixon, Muraleetharan)	3
	Surface Quality (PERS, Gallin)	3
	Obstructions (PERS, Gallin, Muraleetharan)	2
	Lighting (PERS)	2
	Gradient (PERS)	1
	Maintenance (PERS, Dixon, Jaskiewicz)	1
Safety Factors	Vehicle Conflict (Gallin, Dixon)	3
	Driveway conflict (Dixon, Landis)	3
	Personal Security (PERS, Gallin)	3
	Traffic Speed (Pedsafe, Dixon, Landis)	3
	Traffic Volume (Pedsafe, Dixon, Landis)	2
	User Mix Conflict (Gallin, Pedsafe, Muraleetharan)	2
	Crossing Opportunities (Gallin, Pedsafe, Dixon)	2
Environmental Factors	Integration/Connectedness (Gallin, Pedsafe)	1
	Quality of Environment (PERS, Gallin)	1
	Overall Amenity (Pedsafe, Dixon, Jaskiewicz)	1

References

Department of Environment Transport and the Regions (2000). Encouraging walking: Advice to local authorities. London.

Dixon, L.B. (1996). Bicycle and pedestrian level of service measures and standards for congestion management systems. *Transportation Research Record* 1538, Transportation Research Board, 1996.

Gallin, N. (2001). Quantifying Pedestrian Friendliness: Guidelines for assessing pedestrian level of service. *Proceedings of the Australia: Walking the 21st Century Conference*, Perth, February 2001.

Jaskiewicz, F. (1999). Pedestrian level of service based on trip quality. *Proceedings from Urban street symposium*, Dallas, June 1999.

Landis, B., Vattikuti, V. R., Ottenburg, R. M., McLeod, D. S., & Guttenplan, M. (2000). Modeling the roadside walking environment: A pedestrian level of service. Florida Department of Transport, Tallahassee.

Lillis, J., & Pourmoradian, S. (2001). Pedsafe: Development of a new pedestrian auditing method. University of Queensland, Brisbane

Muraleetharan, T., Takeo, A., Toru, H., Seiichi, K., & Ken'etsu, U. (2004). Evaluation of pedestrian level of service on sidewalks and crosswalks using conjoint analysis. *Transport Research Board 83rd Annual Meeting*, Washington D.C., January 2004.

Transport Research Laboratory (2003). Pedestrian Environment Review System. Crowthorne.

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Appendix C

'Cottam' Survey
Assessment
and PERS Output

Pedestrian Route Assessment

Route: Frosts Rd
Route index:
Name: Paul Cottam
Auditor:
Date: 30.4.04

Detailed parameter	Score	Comments
Directness	3	Potentially direct to QE2
Permeability	-1	Spd/vol. Issues w/out f/path
Road Safety	-2	Poor provision
Personal security	-1	No real provision/catering
Legibility	-2	Little info' or link-up info'
Rest points	-2	None - @ Wetland walk?
Quality of the environment	2	Potentially a pleasant route
Ped. Link Audits		
Ped. Crossing Audits		

OTHER NOTES
-3

Pedestrian Environment Review System
Review Handbook Version 1. June 2003

Pedestrian Link Assessment

Route: Frosts Rd
Link index:
Name: Paul Cottam
Auditor:
Date: 30.4.04

Detailed parameter	Score	Comments
Effective width	-3	Little room
Dropped kerbs	-2	Only @ Travis
Gradients	-2	Rough surface
Obstructions	-1	Trees obstruction
Permeability	-1	High speed difficulty
Legibility	-2	Little info' or indication
Lighting	-1	Trees obstruction
Tactile Information	-1	None @ Travis
Colour contrast	-2	No identificatn of ped space
Personal security	-1	Unfriendly feel w/out provision
Surface quality	-2	No surface as such
User Conflict	-3	No segregation from vehicles
Quality of environment	2	Potentially a quality route
Maintenance	-2	Not maintained for walking

TOTAL SCORES
-21

OTHER NOTES

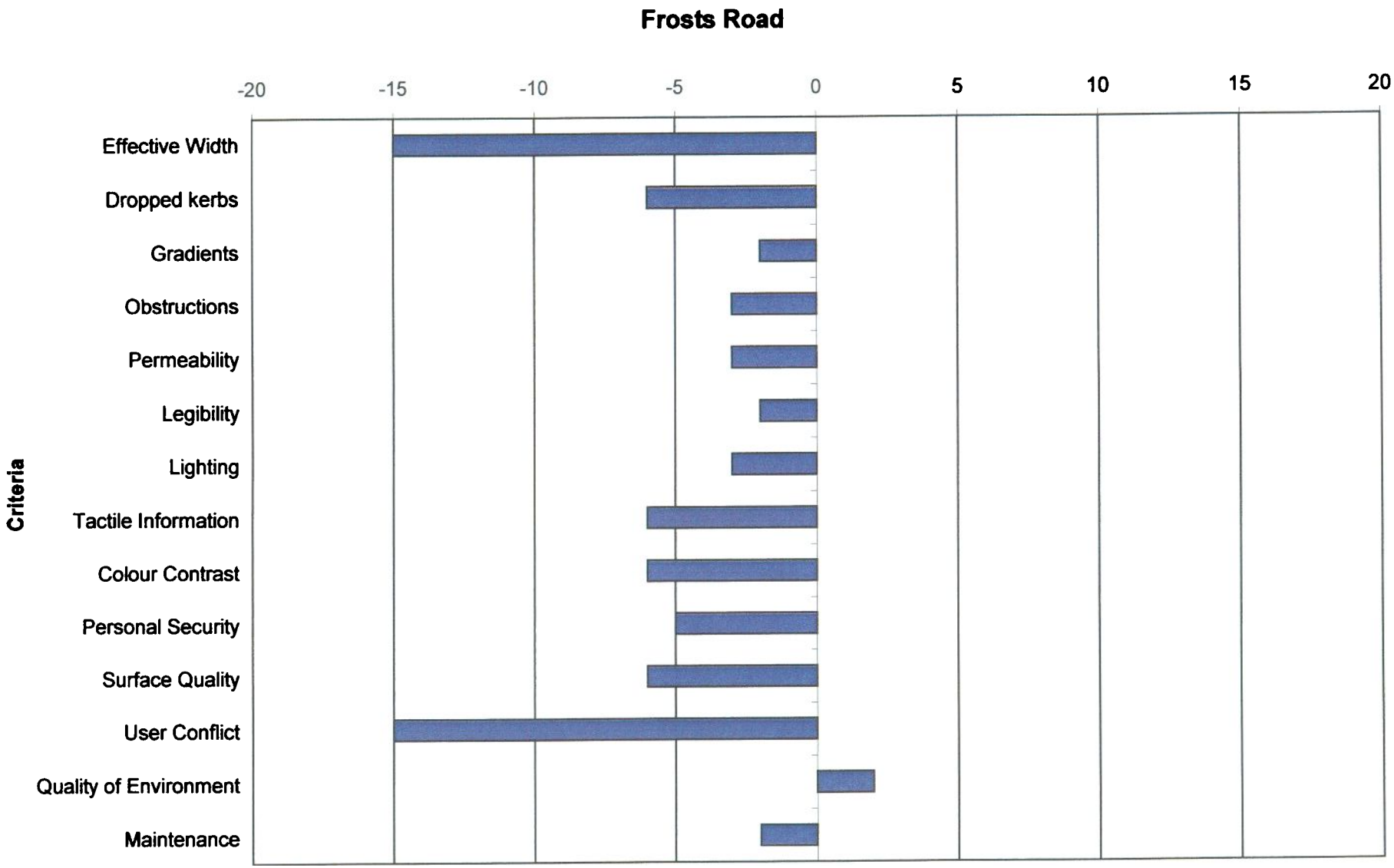
Frosts

Facility Type: Primary

Date of Survey: 30 / 04 / 04

Reviewer: Surveyor

	Score	Comments	Total Score	% of max Score	RAG
	-3	Little room	-15	-100	
	-2	Only at Travis end	-6	-67	
Gradients	-2	Rough surface		-67	
Obstructions	-1	Tree obstructions		-33	
Permeability	-1	High speed difficulty		-33	
Legibility	-2	Little information or indication		-67	
Lighting	-1	Tree obstruction		-33	
Tactile Information	-2	None at Travis end		-67	
Colour Contrast	-2	No identification of pedestrian space		-67	
Personal Security	-1	Unfriendly feel without pedestrian provision	-5	-33	
Surface Quality	-2	No surface as such	-6	-67	
User Conflict	-3	No segregation from vehicles	-15	-100	
Quality of Environment	2	Potentially a quality route	2	50	
Maintenance	-2	Not maintained for walking	-2	-67	
		Total Score for Link	-72	-60	


Frosts Road
-20
-15
-10
-5
0
5
10
15
20
Criteria
Effective Width
Dropped kerbs
Gradients
Obstructions
Permeability
Legibility
Lighting
Tactile Information
Colour Contrast
Personal Security
Surface Quality
User Conflict
Quality of Environment
Maintenance

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Appendix D

PERS LOS Mapping Demo

s: **Total scores**
Total scores
ngs: **Total scores**