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Rail Station Access – an assessment of options

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Abstract

Rail is a critical component of public transport systems in major cities, but the effectiveness of rail is fundamentally determined by the quality of passenger access to stations. Planning for access to rail stations is generally not well-developed as a discipline in Australia or the USA, and many of the variables that affect quality of station access are not widely known.

Typical transport analysis focuses on the automobile, often to the detriment of other transport modes. Meanwhile, rigorous analysis methods for non-auto modes are currently in their infancy among the professions interested in transport.

Research into the factors contributing to station access mode choice suggests that station-area characteristics figure prominently in mode choice decisions.

The paper summarises findings from a review of literature exploring station-area access planning, and the emerging field of non-auto transport evaluation methods. We find that encouraging walking, cycling, and riding public transport to rail stations can increase ridership without the need to provide additional car parking facilities, which clearly tend to be expensive, land-intensive, and which generate localised congestion. Instead, station-area land can be used more productively, through residential, office, and retail transit-oriented development (TOD) which provides economic value to the community and ridership for the rail agency.

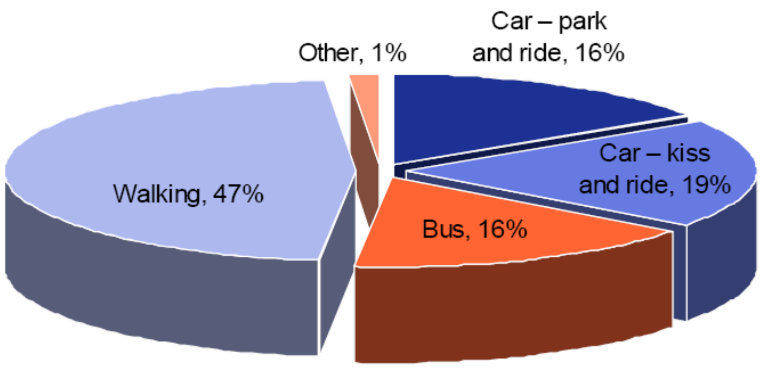
1. Introduction – new approaches to station access planning

Station access presents itself as a key component of an "overall journey" involving public transport or rail legs. The experience of this overall journey is fundamentally determined by what occurs at both the beginning of the trip (in reaching the station) and at the end of the trip (from station to end destination).

"The time and inconvenience related to trips to and from these stops substantially reduces the attractiveness of public transport vis-a`-vis the private car." (Martens 2007, p 326)

Some rail agencies are planning for multi-modal access, but few have an organised or comprehensive approach to their station area planning. In fact, many agencies do little to actively measure and analyse access mode data. This is perhaps surprising given the key role that access plays in attracting passengers and generating ridership for rail at a particular location. Collecting access data, as Sydney has done (see Figure 1), provides a baseline understanding of passengers patterns at each station and can help agencies prioritise access improvements (NSW Department of Planning 2006).

Figure 1: NSW Department of Planning, 2006. Rail station access mode shares, Sydney NSW.



There appears still to be a lack of detailed understanding regarding how to best accommodate each access mode, how to enhance access by preferred modes, or how to manage conflicts between them. But the flow-through of broader policy and planning discussion on delivering better transit outcomes appears set to reflect itself in greater attention to station access planning in coming years.

"Policy has been influenced by the notion of a seamless public transport journey where the underlying requirement is to make public transport more attractive and user friendly in terms of improved services, reliability, travel information, safety and improvements to associated infrastructure such as waiting rooms and public areas." (Hine & Scott 2000, p217)

1.2 Method and Motivation

This paper represents a review of recent and informative sources and literature on rail station access planning - including research, agency guidelines and policies, and station-specific access plans. It is undertaken as the earliest step in a scoping exercise to develop a longer-term research program in station access planning for rail agencies in Australia. By investigating current and recognised sources in station access planning, the authors hope to establish initial issues and challenges, review the aspects of station access that might benefit from quantitative and/or qualitative assessment, and chart a new direction for developing "level of service" tools for assessing the quality of station access by various modes. These tools will hopefully become available for utilisation in efforts to improve station access, for growing ridership by access enhancement, and perhaps for conscious efforts to shift access mode share from less-preferred to more-preferred modes. In this vein, the researchers are also ultimately hoping to establish the relative attractiveness or effectiveness of various access modes on a range of fronts, including; cost, effectiveness at ridership generation, environmental-friendliness, urban design outcomes and land utilisation, and other issues.

1.3 The access modes

"*A railway journey is almost always part of a journey 'chain' that includes a journey to, and later from, the railway station by different modes of transport. The integration of these components is essential to achieve a continuous travel, door-to-door when using the rail, and in order to make the railway a viable and attractive alternative to the car*." (Givoni & Rietveld 2007, p357)

The paper is structured around a view of considerations and issues for each of the four main access modes. Rail passengers access public transport stations primarily through: walking, bicycling, riding feeder transit (and transferring to/from rail), and driving (or being dropped-off by car). Planning for rail station access needs to fully consider each mode, as they each have unique requirements and characteristics. There are recent examples of a change in agency mindset, and a station planning report from the WMATA agency in Washington DC offered some indication of this emerging new direction in its recommendations for access infrastructure alterations:

"*The access improvements proposed in the study include additional station entrances and mezzanines, improved intermodal traffic conditions in the area surrounding the station, improved traffic operations on adjacent streets, and improved connections between Metrobus and Metrorail*." (WMATA 2002, p1)

The discussion that follows also seeks to encompass the idea that emphasising particular access modes offers a different set of opportunities to the rail transit provider. We feel that generally speaking, a re-emphasis in favour of sustainable access modes is likely to occur.

Picture 1: C Hale, October 2008. Bike parking, Den Haag Centraal Station, Netherlands. The potential for bikes to grow as an access mode to stations in Australia is significant – but bikes bring their own unique challenges…

2. Auto Access

Public transport passengers use cars to access rail stations either by driving and parking at the station (park-and-ride) or being dropped off by another driver (kiss-and-ride). Auto access is the dominant mode at some rail stations (at suburban locations in particular) that primarily serve commuter trips, and which have been *planned* to cater primarily to car-based access. The problems with auto-based access approaches start with the fact that cars are generally the most costly mode for transit agencies to accommodate (Weant & Levinson 1998; TCRP 2009).

"Station car park investment should be minimised in inner city areas with good public transport and cycling access." (Green & Hall 2009, p7)

The success of park-and-ride is fundamentally determined by parking availability and the relative accessibility of other modes. Where parking is not formally provided, and where demand exists, vehicles will tend to use on-street parking to the extent it is inexpensive or free, and available (Dickins 1991, pp23-36). However, the provision of off-street parking can encourage people to use public transport who would otherwise only drive (TCRP 2004, ch3). Stations generally have only limited parking availability – so real world examples have shown that parking pricing and transportation demand management (TDM) should be able to shift public transport passengers' access mode choices away from cars without affecting overall public transport ridership. However, if pricing is too high, agencies conceivably risk losing passengers. Parking management alone has not been shown to increase ridership in the short-term, but may have long-term benefits in introducing potential passengers who currently drive to consider changing habits (TCRP 2004, ch3; Duecker 1998; Rephlo et al 2008). Kiss-and-ride is a reality (either formally or informally) at almost all rail stations, but has not received the same level of attention as park-and-ride. Kiss-and-ride (K&R) facilities are less costly than park-and-ride or possibly feeder transit infrastructure and services, but agencies seldom invest much toward structured K&R planning exercises (Schank 2002, pp7-14).

Dedicating the land needed for parking is very costly for agencies, both in terms of capital expenses and opportunity costs (Vuchic 2005). Transit agencies must pay for the land required, and build improvements for surface or structured car parking lots, and can only recover that cost through fares and, in some cases, parking charges. On a per rider basis, park-and-ride would appear to be by far the most expensive access mode from the agency's point of view (Weant & Levinson 1998; TCRP 2009) – and this question will be investigated in greater detail in the ensuing research process. Moreover, the land on which rail station parking stands often has more value as another land-use - such as for residential development, retail, offices, or a mix of uses. At some stations, agency-owned land could be utilised or developed as a revenue-generating opportunity for the rail agency. Depending on configuration and scale, station-area development should be able to generate the same level of ridership, or more, compared to replaced car parking (Fehr & Peers 2006). This approach is now gaining traction in US rail agencies such as BART and WMATA. If a realistic appraisal of costs and benefits for P&R were performed, we might expect a re-emphasis over time away from P&R, toward real estate development options on agency land, supported by better access planning and infrastructure for non-car modes.

"*Policies toward providing, financing, and charging for P+R are strongly influenced by the heavy subsidy of automobile in urbanized areas …Extremely low direct user charges, cheap gasoline, and frequent subsidies to parking even in central cities force transit agencies to subsidize P+R in suburbs."* (Vuchic 2005, p283)

2.1 Potential Evaluation Methods

Auto-based performance evaluation of roadways is very well-developed and represents a primary focus of the traffic engineering profession in the 20th century (NCHRP 2008). Park-and-ride stations will generally have a known "trip generation" rate and the related impact on surrounding roadways can be evaluated. Similarly, research into the distance commuters will travel to park-and-ride stations allows planners to identify an approximate catchment for car access passengers (TCRP 2003). Recently, however, some agencies have begun to evaluate the relationships and trade-offs between car parking and transit-oriented development (TOD). San Francisco's rail public transport provider, Bay Area Rapid Transit (BART), is a leader in rail station access planning and has developed tools to help measure these trade-offs. Using a spreadsheet-based methodology, BART plans station-area priorities based on parking demand and development demand to quantitatively assess the impacts of each in terms of costs (parking supply, access improvements) and revenue (passenger fares, development rent). Decision-makers are then able to the ridership and development opportunity around BART stations (Willson & Menotti 2007).

Potential metrics and areas of analysis for next-generation assessment of parking level-of service might need to include:

- Access mode share by P&R at-station
- Assessment of trade-offs between P&R provision and other options in cost/benefit and ridership-generation terms
- A more strategic approach to identifying where P&R facilities should best be located in a system-wide P&R strategy
- Assessment of parking demand management options
- Assessment of the utilisation of P&R facilities. For example, investigation into where parkers are driving from including distance travelled, what their needs are, and prospects for catering to these journeys through other access options

Picture 2: C Hale, June 2007. P&R facility – Pleasant Hill BART station, Alameda County, CA. BART has now converted this land-hungry facility into structured parking– releasing land for revenue-positive TOD

3. Feeder Bus

Public transport feeder service has the potential to extend the catchment of rail transport far beyond walking distance, especially for those without vehicles or for whom the cost of parking is prohibitive – but also for those who simply live at a distance to rail. Feeder bus service also places less demand on the road network surrounding the station and is considered more environmentally friendly than car access (TCRP 2009).

"*Public transport interchange has assumed a new significance in the new transport agenda and the movement towards seamless travel by public transport. …Central to the requirement of a seamless public transport journey is the need to reduce the costs associated with interchange, both perceived and actual. These costs can influence the demand for public transport in terms of the effects that the interchange has on time spent waiting, time spent transferring between vehicles and the attendant risks and inconvenience that are involved with this activity*." (Hine & Scott 2000, p217)

Many agencies, however, find it difficult to provide feeder service that is both time-competitive for passengers and cost-effective for the public transport agency. Nonetheless, the potential to provide such service represents a valuable opportunity for rail transit as it would facilitate increased ridership without the need for significant station-area P&R infrastructure. Strategies for more effective feeder bus services identified in the literature include increased route efficiency and intelligent transportation systems (ITS) to provide customer information and scheduling (TCRP 2007; TCRP 2006). But more widely, a truly integrated multi-modal transit system based on effective transfer opportunities is considered fundamental to overall transit quality (Mees 2010). Pursuit of this aim brings many of the transfer-related benefits that we consider more specifically in the "feeder" context. Any way we look at it, transfers are a fundamental component of effective transit. Mees (2010) also discusses the idea that Australian transit networks generally see far lower rates of transfer when compared to otherwise comparable networks such as in Canadian cities. To offer feeder buses as a genuine alternative to P&R access, it seems that Australian urban networks need to return transfers and connectivity to the forefront of network planning, interchange design, and operational considerations.

"*Public transport access should be improved through a closer partnership with local authorities and bus operators, to encourage the re-location of bus stations closer to railway stations and to provide seamless bus/rail ticketing*." (Green & Hall 2009, p7)

A US survey of feeder transit usage found that service frequency was the most significant predictor of feeder bus usage, but important considerations also included; competing auto travel time, parking cost and availability, the presence of employer subsidies, and auto ownership levels (Cervero 2006).

Schedule and fare coordination between the feeder and rail service is of prime importance for feeder transit. Reducing the time needed to transfer, and improving the quality of transfer facilities are critical to increasing feeder bus access mode share (Hine & Scott 2000).

3.1 Potential Evaluation Methods

Evaluating feeder bus service levels can generally be conducted according to the same methods as with assessing mainstream public transport services (TCRP 2003), but with specific attention paid to the workability of feeder transit elements identified above at the *station area* scale. Fare and schedule coordination are also critical to encouraging riders to utilise feeder transit – and should be assessed.

Opportunities exist to develop tools which compare the costs of providing feeder transit versus parking, as the literature review yielded none. Although providing feeder bus service can be expensive, it may not be as costly as dedicated car parking facilities in some cases – and this must be investigated in greater detail. We might also assume that much of the resources for better rail-bus integration can come from 'smarter' use of existing bus services.

Potential metrics and areas of analysis for next-generation assessment of feeder bus level-of service might need to include:

- Access mode share by feeder transit at-station
- Distance travelled by bus arrivals
- Frequency of service for both modes at point of transfer
- Configuration and design of facilities to facilitate efficient, weather-protected and convenient intermodal transfer
- Quality of real-time information and other system-navigation aids for passengers
- Service for clear travel desire lines to-and-from stations and their surrounding suburbs
- Accumulation of basic metrics on existing transfer and feeder-usage rates. Aspects or metrics such as "trips involving transfers as a proportion of all transit trips" at both a localised and system-wide scale are highly useful
- Customer service and feedback on transfer convenience and feeder usage

Picture 3: C Hale, October 2008. Bus-rail transfer, Singapore.
Few stations offer this quality of inter-modal integration.

4. Bicycle

Bicycle access at rail stations is often given low priority or even completely overlooked, though some agencies are beginning to see benefits in increased bicycle access (and egress) mode share. Cycling presents opportunities to increase the range of potential public transport destinations, increasing the public transport catchment distance perhaps to 10 times greater than by walking. Reduced demand on station-area road infrastructure is possible through shifts to cycling access. Growing cycling access essentially translates into increased public transport ridership at low access-service cost for agencies (QT 2006).

"*The number of policy initiatives to promote the use of bike-and-ride, the combined use of the bicycle and public transport for one trip, has seen a substantial increase over the past decade in many industrialized countries as part of the search for more sustainable transport solutions …The increasing interest stems from the fact that bike-and-ride can help solve a key weakness of public transport: the accessibility of public transport stops*." (Martens 2007, p326)

Although most agencies achieve bicycle access mode shares around 2-5%, international research shows that bicycle access mode shares up to 40 percent are attainable (Parsons Brinkerhoff 2009; Martens 2004; Herman et al 1993). Indeed, 47% of respondents in a survey of New Jersey rail commuters stated they *would* consider cycling from home to the train station, if facilities were improved (Herman et al 1993). Some of the factors contributing to passengers' decisions to cycle to the rail station are traditionally considered to be outside the direct influence of the rail authority, including things such as topography, weather, and culture. More interesting though is the question of station-area bicycle infrastructure – which has also traditionally been considered "someone else's problem". Improving facilities such as bike lanes around rail stations is typically a local government's responsibility and would require the rail agency to co-operate with other stakeholders to construct useful bike lanes or other on-street or off-street bicycle improvements (Federal Highway Administration 1992).

"*The use of the bicycle in access trips (at the home-end of a trip) and/or egress trips (at the activity-end of a trip) can substantial reduce the door-to-door travel time of public transport trips. As a feedering mode, the bicycle is substantially faster than walking and more flexible than public transport due to its 'continuous' character eliminating waiting and scheduling costs, suggesting that the use of the bicycle in access and/or egress trips can help closing the 'travel time gap' between car and public transport*." (Martens 2007, p327)

Despite perceived challenges, the research (and common sense) overwhelmingly indicates that cycle-focused infrastructure improvements at the station correspond with an increase in bicycle access mode split (TCRP 2005; Martens 2007). The most significant infrastructure related to bicycle access is safe and attractive parking facilities. A study in the Netherlands found that the installation of secure bicycle parking led to increased user satisfaction, growth in the number of parked bicycles, and increased bicycle use for access trips (Martens 2007). Elements of successful parking facilities include shelter from weather, secure locking facilities or lockers, and highly visible and convenient locations. It is also important that the supply of parking is sufficient to meet demand, and that it is cost effective for passengers (Federal Highway Administration 1992; TCRP 2005; BART 2002; Hagelin 2002).

Much of the thinking around providing bike parking at stations, however, only applies to one "side" of the total public transport journey. Passengers can also conceivably utilise bicycling at the *egress* portion of their public transport trip, increasing the number of destinations the rail network can reach (QT 2006; TCRP 2005). Permitting passengers to carry bicycles on board the rail car is a preferred option and provides maximum flexibility, especially when bicycle hooks and storage space are explicitly provided (Federal Highway Administration

1992; TCRP 2005; BART 2002). In some cases, though, capacity limitations on the train inhibit an agency's ability to accommodate bicycles during peak periods. Bike hire programs, or perhaps dedicated parking at the destination station could help to boost egress bike-use.

"*Cycle access should be targeted to double at individual stations over the next five years – with a national target of 5% of passengers cycling to stations. This should be achieved through the specification of secure storage and extension of the cycle hub concept in future franchises, and through joint initiatives with local authorities to create segregated cycle routes. These initiatives should be reviewed after two years of experience*." (Recommendation from the UK "Better Rail Stations" report - Green & Hall 2009, p7)

4.1 Potential Evaluation Methods

Few robust methods are currently available for evaluating bicycle facilities. Many government agencies have developed bicycle safety audit checklists (RTA 2005; Austroads 1999), but these focus on safety issues rather than comfort and attractiveness. Moreover, these are not typically incorporated into standard transport planning and engineering evaluation. Where bicycle issues have not been raised or are not present, they are often ignored. Audits are conducted as a response to a problem and are not effective in creating attractive bicycle facilities. Recent research in the U.S. has developed a Multimodal Level of Service (MMLOS) analysis for urban streets which evaluates a roadway's performance for each transport mode: auto, public transport, bicycle, and pedestrian (NCHRP 2008). The methods are based partially on traditional *Highway Capacity Manual* (TRB 2000) analysis techniques, particularly for auto and public transport modes. But the MMLOS is also based on the quality of a facility for cyclists and pedestrians, as well as public transport and auto. Characteristics of a bicycle route can be evaluated using this methodology to determine the level of service for cyclists on a scale (perhaps from A to F) – possibly with respect to attributes such as lane protection and safety. Equally, developing a tool that translates bike mode share (or targeted shares) into parking requirements appears to offer value.

In summary, potential metrics and areas of analysis for next-generation assessment of bike access level-of service might need to include:

- Access mode share by bikes
- Daily access numbers by bikes – hence parking needs
- Parking space supply, and whether locked/secured
- Distance typically travelled by bike arrivals
- Length dedicated & protected bike lanes in surrounding area
- Provision and allowances for on-transit bike haulage
- Availability of hire bike schemes at stations (especially for egress)

Picture 4: C Hale, Nov 2008. Hire bikes – Paris. Could rent-a-bike schemes eventually fill a gap at the "destination end" of journeys involving mass transit?

5. Walking

Pedestrian access to public transport is generally assumed, but is seldom planned proactively – even though this would appear to be a basic station design principle. Conventional wisdom is that residents and employees within 800 metres of the station will walk, and those further from the station will not (TCRP 2009). However, the research and analysis uncovered in the literature review indicate that people are willing to walk an *average* of 800 metres, and many will walk considerably farther to high quality rail transport (Martens 2007; Dantas 2005) – especially where pedestrian infrastructure and conditions are favourable.

"*Over the past decade, there has been an increasing recognition that urban streets contribute in many ways to the economic, environmental and social functioning of cities, and do much more than simply provide the infrastructure for vehicle-based transport systems - they are important public places too. Streets represent around 80% of public space in cities, and most buildings and urban activities front onto streets. So that most urban activity and much urban identity is closely associated with the urban street network*." (Jones & Boujenko 2009, p1)

The factors influencing a rail passenger's decision to walk to the station include a variety of issues beyond simple walking *distance*. Issues such as urban design, pedestrian facilities, crime and safety perceptions, and demographics contribute to the decision to walk, though these are traditionally considered outside of the agency's control (TRCP 2005; Martens 2007; Dantas 2005). Improving access for pedestrians, therefore, usually requires direct partnership with the local government jurisdictions that make these decisions.

The most substantial opportunity for rail agencies to increase pedestrian access mode share is to support or encourage development in the vicinity of the station. TOD facilitates increased residential, employment, and retail density which can all translate into rail transport trips. It also provides the opportunity to reduce parking and/or feeder bus services. However, TOD depends primarily on the market forces required to support development.

Improved pedestrian access mode shares – delivered through better access infrastructure - appears to offer significant ridership growth opportunities at many stations without onerous cost implications.

Picture 5: C Hale, July 2007. Streetscape - Brooklyn, NY. Pedestrian infrastructure requires careful design and investment if walking is to be attractive.

5.1 Potential Evaluation Methods

As with bicycle access, relatively few methods are currently available to evaluate pedestrian facilities. Road safety audits typically include an assessment of pedestrian safety, but seldom consider the overall quality of a pedestrian facility. MMLOS methods have been derived alongside the bicycle techniques, and could potentially reshape the way transport planners and engineers think about pedestrian transport.

The BART tool identified previously (Willson & Menotti 2007) can be used to evaluate the tradeoffs between TOD and parking. Coupled with the MMLOS analysis methods, rail agencies have the opportunity comprehensively consider all access planning modes and their relative benefits in terms of costs, revenue, and ridership. The 'link and place' methodology (Jones & Boujenko 2009) has also opened up some new pedestrian service-level evaluation tools and approaches, perhaps partially translatable into the station access context.

Potential metrics and areas of analysis for next-generation assessment of pedestrian access level-of service might need to include:

- Access mode share by walk-up
- Analytical tools identifying primary access lines and walking volumes
- Qualitative evaluation of access path conditions (safety, topography, width, crossing conditions, legibility, attractiveness)
- Distance travelled by walk-up arrivals
- Major origins/generators of walk-up traffic
- Investment levels over time for localised pedestrian infrastructure
- Catchment analysis using GPS-based tools that specify street-level access beyond the limitations of broad-brush "400 metre" or "800 metre" radial assumptions
- Surveys and customer feedback on the experience of station access on-foot

Picture 5: C Hale, June 2008. New pedestrian/bike path in urban renewal area of Munich. Creating attractive conditions for walking and cycling can result in significant increases in mode share to these 'active transport' options.

6. Recommendations for better station access planning and new tools

"The access to stations is becoming an obstacle to further rail growth…" (Green & Hall 2009, p5)

From the early base provided by this paper, opportunities seem to be emerging to develop new tools for assessing access infrastructure and conditions, and hopefully for improving them through proactive planning and design with the aim of boosting transit ridership by growing access by the cost-effective and environmentally-friendly modes. Drawing on the selection of potential analytical options listed here, the researchers intend to invite industry feedback to develop a list of higher-priority metrics and analytical fields.

"Given the complementarity between railway services and access modes to railway stations, it is important to know to what extent the overall quality of railway trips depends on the quality of the access modes." (Givoni & Rietveld 2007, p362)

Beyond that, application of the potential analytical fields and metrics identified through stakeholder research (and here in this paper) to real station cases seems to be a next-step in refining options and approaches. It may also be helpful to pursue case studies nationally or internationally to deepen the understanding of how rail agencies and other parties (local government for example) are approaching this issue. Ultimately, for access planning tools to be effective, there needs to be a focus on cost-effectiveness and on trade-offs in the resources required by the various access modes. So an economic perspective is part of the broader picture that helps us understand the relative desirability of various modes. From early research presented here, the impression has emerged that walking and cycling are most likely the cost-effective access modes of choice. While high quality bike parking and bike trails to stations are not cheap, they are also not in the same league as catering to car access through structured parking. Feeder services loom as relatively resource intensive, and probably need advanced planning and analytical techniques, as well as design intervention and operational change to deliver real improvement in most cases. But because this concept of advanced and inter-connected multi-modalism is at the heart of contemporary transit network planning, we assume that improved feeder access to rail can move forward within the resources and frameworks allocated more broadly to our transit systems and networks.

Car-based access presents itself as being problematic. It is costly, and carries implications for land use and development opportunity at stations. There also appears to be widespread assumptions that P&R will be provided free or very cheaply – even while the *majority* of rail travellers continue primarily to bear their own access costs by walking (or riding) to stations. In this sense, there appears to be an imbalance of resources and attention in favour of car access and parking that will probably correct itself in years to come – especially where a more objective viewpoint is adopted among agencies and stakeholders. At the same time, priced parking offers revenue-generation opportunity in a resource-constrained environment for public transit.

Growing rail ridership into the future means growing access. The authors believe that growing this access and ridership by sustainable and cost-effective means will emerge as the preferred path forward.

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