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The windscreen world of land use transport integration

Experiences from Perth, a dispersed city

'Land use transport integration' has been part of planning ideology for decades. Today it is seen as a means of achieving sustainable travel outcomes. Despite the clear intentions of early planning policy, its selective implementation resulted in a low-density, dispersed city. Now the ability to reduce motorised travel and car kilometres is a major challenge given the spread of land use and scatter of activity across a very large metropolitan area. The 'love affair with the car' has seen a struggle for focus on access for pedestrians, cyclists and public transport. But the more recent experience in the context of this dispersed city is promising, urban development is achieving some of the physical characteristics of land use transport integration with greatest progress made in recent years. At the neighbourhood scale there are small 'islands' of development change with a strong focus on achieving accessibility, proximity and creation of shared streets. At the metro/regional scale the focus is on extending the rail network, but city planning is still driven by 'car-centric' principles – the windscreen view of the world. Designing a transport system to compete with the car, rather than tailoring the demand for mobility by designing a different spatial land use pattern perpetuates hypermobility and automobility.

'Land use transport integration' (LUTI) has become something of a buzz phrase in the planning and transport fields, but an analysis of land use and transport policies shows that it has been part of planning ideology for decades. What changes is the approach to LUTI as the adverse consequences of past approaches are reconsidered. Today, LUTI is seen as a means of achieving sustainable travel outcomes, a message reinforced in the Australian context by the National Charter on Integrated Land Use and Transport Planning (DOTARS, 2003). A sustainable transport system is one which is more efficient, uses less energy and achieves better environmental quality (Reitveld and Stough, 2005), its goals include achieving a mode share with as few kilometres travelled by private car as possible (Bertolini and le Clercq, 2003).

This paper assesses the experience of land use transport integration in a dispersed city and evaluates its achievements. The evolution of LUTI ideas are tracked through four phases of planning for the Perth Metropolitan Region (PMR) in Western Australia: pre-planning; planning the compact city; dispersing the city; and integrating the city. The achievements are considered at two scales – metro/sub-regional and the

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Figure 1 Perth metropolitan area: town and city centres and railway network

neighbourhood. The PMR (population 1.4 million) provides a particularly interesting example of the type of approaches that have been applied in a dispersed low-density metropolis. Perth has a tradition of low-density residential development, currently about six dwellings per hectare gross (WAPC, 2003). There has been little to constrain its physical growth which has taken place principally in a coastal strip that extends some 130 kilometres north–south along the Indian Ocean (Fig. 1). Perth has an unenviable reputation of being defined as one of the most car-dependent cities. Car ownership and use are the highest of all Australian cities with 723 vehicles per thousand people.

This paper draws on an analysis of local transport and land use planning policy documents to establish the extent to which land use transport integration is, and has been, a key policy direction in Perth. A Delphi survey was employed whereby 14 independent local experts were asked to define the physical attributes of land use transport integration, and then to identify good and poor examples of places in the Perth metropolitan area. The experts represented a range of professional groups including town planners, urban designers, architects, transport engineers, transport economists, transport modellers, transport advocates and transport researchers. The author's reflections as a local practitioner (Schön, 1983) are drawn on, including experience from various state and local government advisory committees, research consultancies and bicycle advocacy.

Context for land use transport integration

The relationship between transport and urban form has long been recognised (Buchanan, 1963; Schaeffer and Sclar, 1975; Gehl, 1987; MTMM, 1995; Westerman, 1998a; Newman and Kenworthy, 1999; Jacobs, 2001; Richards, 2001; Tibbalds, 2001; Jacobs et al., 2002; McGauren, 2002; McManus, 2002; Madanipour, 2003; Headicar, 2003). The form the city takes and its transport network are inextricably linked (Thomson, 1977) and cities have been classified (i.e. the 'walking city', the 'tracked city' and the 'rubber city') by the way in which the dominant transport mode helps to determine the spatial layout of urban areas (Schaeffer and Sclar, 1975; Newman and Kenworthy, 1999). Cautions against adopting these 'reductionist models', suggest they are technologically determinist and fail to recognise the influence of decisions based on social and economic factors and the values and images of influential people and institutions (Selwood, 1979; Brindle, 1996; McManus, 2002; Cuthbert, 2003). Clearly both approaches are linked. These influences are evident in the choices that have been made about transport infrastructure in metropolitan Perth and which have had a long-term impact on city form and the way in which it is used.

Planning and transport policies that espouse the integration of land use and transport must be viewed in the context of the 'urban transport problem' that they aim to address. Discussed by many (Buchanan, 1963; Schaeffer and Sclar, 1975; Goodwin et al., 1991; RCEP, 1995; Newman & Kenworthy, 1999; Potter and Skinner, 2000; Curtis, 2001; Banister, 2002; Vigar 2002) these includes concerns about traffic congestion, traffic crashes, inequitable access to transport and services, unreliable public transport, spiralling costs, air and noise pollution and their impacts on human health, global warming, health impacts of reduced physical activity as seen in reductions in walking and cycling, and the dominance of car use for all journeys no matter how short.

Many of these issues are not new and are captured in Buchanan's (1963) seminal report 40-years ago. While Buchanan recognised the negative consequences of meeting

the demand for car travel, the most commonly adopted solutions were to find the means to accommodate car use. Today reducing car use is identified as the way forward. Traditionally road building was seen as a means of economic advancement, but it is no longer financially feasible or environmentally desirable to build roads to solve congestion. Traffic growth and congestion have a negative effect on the economy. Richards (2001) argues that car use increases trip numbers and travel distance, and disperses the city. Poor choices made about public transport can have the same effect on city form and travel behaviour.

A definition of LUTI would include physical, spatial, behavioural and institutional characteristics. In this paper the focus is on the physical and spatial characteristics in order to achieve a greater depth of understanding of these aspects. Clearly in achieving LUTI all four aspects must be addressed as they are complementary (Rietveld and Stough, 2005; Curtis and James, 2004, on behavioural or institutional aspects). The definition is placed in the context of sustainability, and presumes a holistic approach to providing access while reducing the need to travel. This would mean (in this order) providing alternatives to travel (home deliveries and telecommunications), increasing the opportunity to walk or cycle (by providing physical space and continuous networks), improving public transport options and ensuring more efficient use of cars (Potter and Skinner, 2000; Bertolini and le Clerq, 2003). Where travel is necessary, it would mean providing for easy transfer between modes through both physical location (and infrastructure), information, timetabling and ticketing. A key characteristic of this approach is using land use planning as a means of managing and reducing travel demand. Here the focus is on proximity of activities using an accessibility planning approach, where the objective is to maximise the benefits from interactions between land uses and transport modes, rather than just maximising the performance of the transport network (Curtis and James, 2004).

In Perth there has been a long history of planning strategies and policies promoting LUTI. By the late 1980s this had strengthened in scope and detail and the current policy environment supports a move away from car use towards providing for transport choice. The focus is on achieving changes to the physical form of the city at both the regional and the neighbourhood scale. This includes new approaches to transport infrastructure provision that are more closely integrated with land use and activity. But this paper demonstrates, that despite this policy environment, the government agency response has been a 'windscreen approach', where the priority is for car use first, then public transport, with walking and cycling as afterthoughts, and with limited focus on alternatives to travel. This is in reverse order to the approach defined above. This is despite the Perth community expressing its concerns about the growth of car traffic and favouring a solution of investment in walking, cycling and public transport rather than cars (DOT, 1999; GWA, 2003).

Perth: pre-planning

Initially Australian cities developed a fairly compact urban form, the central business district (CBD provided the focus for services, business and governance (McGauren, 2002), and many daily activities were conducted locally. Cities were designed at a more human scale; land use was mixed and addressed the street which provided for comfortable pedestrian accessibility (although most cities have very wide streets compared to Europe). Perth hugged the Swan River (spreading on average 5 kilometres outwards) from the port at Fremantle to Midland (30 kilometres).

The introduction of streetcars, trams and railways dominated early suburban development from 1881 until the Second World War. Suburban centres developed around railway stations with the street network designed for pedestrian accessibility, thereby placing suburbs in comfortable walking distance of stations as so aptly portrayed by local novelist Tim Winton (1991). It then became possible to meet daily activity needs beyond comfortable walking distance. The result was a 'differently organised and shaped city that radically altered land use and life-style patterns' (Schaeffer and Sclar, 1975, 26). Perth suburbs spread along axial public transport corridors (Selwood, 1979; Gregory, 2003) but the focus of activity was at transport stops. The

> close spacing of stations promoted a form of development that is more typical of tram or light rail systems, with a number of medium-sized centres embedded in a linear form (Ker and Ryan, 1994, 2).

This was despite their radial access to Perth. Trams and buses extended the station catchments.

While little of the development along the early railway network (Perth to Midland, Fremantle and Armadale – see Fig. 1) can be described as 'planned' LUTI, these places have generated and sustained transit-oriented centres. They display many of the physical planning principles now identified as important because they were developed for a 'car-less' population (expert survey). Consequently they have a robust urban form.

Planning the compact city

Planning strategy

As early as the 1930s, the Metropolitan Planning Commission (MPC) acknowledged the need for LUTI (McManus, 1993). The first strategic plan for the metropolitan region prepared by Stephenson[1] and Hepburn in 1955 proposed a compact region with a 60 kilometre north–south limit (Alexander, 2003), although at this scale its

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1   Stephenson was commissioned by the State government. He had worked with Abercrombie on the Greater London Plan, for the British Ministry of Town and Country Planning, on the Stevenage New Town Plans, and was Lever Professor of Civic Design at the University of Liverpool.

compactness is questionable – Amsterdam, the classic compact city, is a quarter of that length. Land use transport integration was to be achieved by creating a series of self-contained communities including land for employment in close proximity to residential areas (Carr, 1979). Two new suburban rail lines were proposed, but also a substantial regional road network focusing on radial routes from the Perth CBD, justified by the fact that Perth was already developing at low densities (Stephenson and Hepburn, 1955, 111).

Metro/regional outcomes

The Stephenson–Hepburn Plan's railway proposals were never implemented but the road network proceeded at speed. The car was popular, seen as a sign of a modern prosperous city and viewed as the main mode of travel, with public-transport provision seen as serving only a social welfare function (MTT, 1961). A second strategic river crossing opened in 1955, heralding the importance of providing car access to the city. In 1968 Perth had only 11 kilometres of freeway but the Metropolitan Region Scheme gazetted a further 230 kilometres of freeway reservations for the future (McManus, 2002). This has worked against Stephenson's ideal of a compact city. Unforseen, employment shifted predominantly from the manufacturing sector to the service sector and the road network facilitated travel into Perth CBD where the service sector dominated. This worked against the notion of people living and working locally in self-contained communities.

The late 1950s saw debate about the removal of the early railways and their replacement with buses, which 'were considered a more appropriate form of transport because the infrastructure required was the same as that required by cars and it was partly funded by the Commonwealth' (McManus, 2002, 198). New suburbs were developed away from railway lines and the car was seen as the primary means of transport. By 1979, the Fremantle line was closed to make way for a proposed freeway, with a busway proposed to replace the rail link (Newman, 1992). Catering for car travel was to dominate city planning from the 1960s until the late 1980s.

Dispersing the City

In every Australian city, car use has increased (Westerman, 1998a) and has provided the terminal challenge to public transport (Gregory, 2003). The decisions of planners and engineers in choosing a particular urban transport system in which to invest also made a significant contribution to the demise of public transport. The state Main Roads Agency has an entrenched resistance to greater priority for public transport (Alexander and McManus, 1992). Road building was until recently mostly funded at a federal level granting it a status above planning for buildings, which is a state

responsibility (McGauren, 2002). Since the introduction of a goods and services tax (GST) a greater proportion of funds come from states. Public transport has rarely been federally funded.

Planning strategy

The 1970 Corridor Plan replaced the 1955 Stephenson–Hepburn Plan. In response to traffic growth the strategy focused on the need to establish an efficient public-transport system to balance the inevitable increase in fuel costs for travel by car (Carr, 1979). It was clearly grounded in a close relationship between land use and transport. However, this was to be achieved with buses rather than rail, sharing the proposed high-speed, high-capacity roads. The plan proposed an urban form based on four corridors each surrounded by non-urban wedges. Regional centres (Joondalup, Midland, Armadale and Rockingham) placed within the corridors were to provide local employment as a means of counterbalancing congestion in the Perth CBD.

The 1990 Metroplan, covering the period to 2021, replaced the Corridor Plan but continued its polycentric approach. The strategy aimed to bring residential land closer to jobs and slow outward growth of the corridors by widening them. A suite of arterial roads were proposed (an outer suburban orbital ring road, an inner-city bypass and widening of arterials accessing the CBD). The strategy also aimed to concentrate employment-generating activities and higher residential densities around public-transport routes while discouraging the location of commercial and community facilities away from the public-transport network. A proposal to limit non-essential parking in Perth CBD was aimed at increasing public-transport use. Twenty per cent of new housing was to be suburban renewal or infill, justified by the argument that this would reduce travel distances and lead to transport improvements.

Metro/regional outcomes

Like the Stephenson–Hepburn Plan, implementation again has been selective. The road proposals were mainly implemented, but land use change around rail stations has been limited (and was never made a statutory requirement) and there has been little attempt to resist proposals for commercial use in poor transit locations. Many local authorities resisted suburban infill spurred by community opposition. This has facilitated the outward growth of the city. The PMR continues to spread in a car-dependent manner based on the justification that low-density cities are difficult to service with efficient public transport, coupled with a culture (shared by the community and professionals) that saw car and road planning as important to the progress and wealth of the city (McManus, 2002). Now, 50 years since the 1955 Plan, Perth has 'spread over two-and-a-half times the Plan's allocated land area' (Alexander, 2003, 5),

running 120 kilometres along the coast. The road system 'enabled low density infill activity, which watered down the relevance of railway corridors' (Henscher cited in Westerman, 1998b, 47). The push for completing the metropolitan road network has resulted in new roads being constructed through existing communities, displacing residents and severing communities (Alexander et al., 1999).

The dispersal of the city provided travel opportunities primarily for those with high mobility levels. While land uses have become separated (Gehl, 1987; Cervero, 1997), they have also concentrated into larger but fewer units, adding to increased distances travelled because of reduced proximity between housing and employment, retail uses and services. 'By the 1970s shopping was no longer local, but centralised into American style malls … isolated from public transport' (McGauren, 2002, 5). The argument has been that, 'with the car, every place is accessible as long as it is served by a road' (Schaeffer and Sclar, 1975, 50), but one should add, 'so long as you have access to a car'!

The 'regional centre' strategy has failed at both the metro/regional and neighbourhood scale. At a regional level the planned 60 per cent selfcontainment has not been achieved as local employment has not happened, resulting in long journeys to work. For example only 23 per cent of those living in the north-west corridor work in Joondalup, the strategic regional centre. The Perth CBD and many other dispersed employment locations draw residents away from these new regional centres. There has been an increase in peak-hour work trips to the CBD and resultant congestion.

Neighbourhood outcomes

At the neighbourhood scale the design of regional centres has resulted in poor LUTI. Stephenson's design for Joondalup, reminiscent of his design for Stevenage New Town, UK, was intended to achieve a CBD-like scale with eight-storey buildings; he envisaged a pedestrian focus with land use in close proximity to the railway station. Instead, Stephenson laments the regressive planning (Stephenson, 1992) where the intensity of development has not been achieved and the railway station, town centre, sports arena and university suffer from separation beyond walking distance. However, Joondalup does have good cycling facilities and, with improved public transport links, this would help to fix the flaws (expert survey). The three other universities are all located outside any regional centre yet they generate a very high volume of trips, mostly by car. Attempts to improve public-transport access have had limited effect.

Most middle suburbs and virtually all outer suburbs developed between the 1960s and 1980s are characterised by their low densities (average six dwellings per hectare) and monoland use (expert survey). Getting to activities, jobs and entertainment is difficult, more so without a car. Streets have been widened to accommodate the car (parking bays, traffic lanes, right and left turning lanes to keep the traffic moving).

Figure 2 Middle suburbia; note limited number of footpaths, single land use, low density and poor connectivity
Source: DPI.

Streets have become high-speed arterial roads at the perimeter of residential cells with internal car-oriented neighbourhood centres. The street layout is difficult to serve by bus and the environment is hostile for walking and cycling (Fig. 2). New residential development built beyond the urban fringe (i.e. Ellenbrook) is also disconnected from regional centres ensuring car dependency for many years (expert survey) until services are built locally to replace long retail journeys and local employment has been achieved.

The approach to street design has altered dramatically in response to planning for the car. The dominant traffic-engineering approach, developed in the 1930s by the new Institute of Traffic Engineers, introduced a functional classification of streets. While safer in theory, more attention was paid to traffic efficiency and speed than to other users of the street (Jacobs, 2001; Westerman, 1998a). Buchanan, while advocating integration, 'buildings and access ways are thought of together' (Buchanan, 1963, 46), his report actually promoted the segregation of land uses into cells surrounded by major arterial roads 'purpose designed for the efficient handling of traffic' (Buchanan, 1963, 46), an approach advocated by Alker Tripp 20 years earlier. Buchanan recognised

that this would involve large-scale redevelopment of cities on a significantly different pattern (Buchanan, 1963, iv), and that this approach had significant impacts – for example his approach actually involved demolishing historic areas of London and rebuilding at huge costs.

In Perth a 1930 Metropolitan Town Planning Commission Report stated 'streets are primarily traffic routes' (cited in McManus, 2002, 194). The 1955 Plan advocated free flow of traffic along urban roads for efficiency and advised against frontage development and parked cars (Stephenson and Hepburn, 1955, 111). The belief that streets should function purely to serve traffic was occasionally questioned during this era. Riverside Drive was originally proposed by the Stephenson–Hepburn Plan as part of an inner-ring freeway 'bypassing' the city centre. Perth City Council opposed this on the grounds that it would cause 'damage to, and alienation of, people from the river foreshore…' (Alexander and McManus, 1992, 8).

Planning practice has been to segregate pedestrian and car traffic on safety grounds. This approach also ensured pedestrians did not hinder the flow of vehicles (Niven, 2002). City streets have been restructured to improve capacities for vehicular movement (de Villiers, 1999), Perth's river foreshore parklands have been reduced by car parks to overcome the CBD parking problem (Gregory, 2003). The creation of pedestrian-only domains was seen as the solution, such as the private shopping arcades in Perth City. The layout of the Perth cultural quarter encompassing the railway station is based on the notion of catering for pedestrians at first-floor level. At first hand this approach appears to favour the pedestrian, but traffic now dominates the street and this form of segregation almost always results in a dispersal of people leaving more dangerous depopulated spaces (Gehl, 1987; Tibbalds, 2001). In the suburbs the internalised streets of big-box shopping centres create pedestrian only space, but all too often overlook getting pedestrians to the front door of the shopping centre. The main entrance is usually surrounded by a sea of car parking and placed some distance from the street network.

Outside pedestrian malls, the pedestrian network is discontinuous with a lack of priority at intersections (Tolley, 2001). Perth suburbs developed in this era have many streets with no footpaths (Fig. 2). Where pedestrians are provided for they often encounter obstacles with vehicles parked on footpaths, bus shelters, signage, litter bins, or the privatisation of the pavement by cafes and retailers displaying their wares. The public domain is diminished with large, brash designs to be viewed from the car windscreen.

Dispersing the city: summary

In summary, the two metropolitan planning strategies produced between 1970 and 1990 proposed a dispersal of the city to regional centres at the periphery of the region, served by public transport and an extensive high-speed road network. LUTI

principles included the notion of self-contained communities at these regional centres and the provision of public transport between these centres and the CBD. Despite this, or because of this approach, the outcome has been away from LUTI to the detriment of sustainable travel. The average kilometres travelled by car per annum has risen from approximately 6000 in 1979 to almost 10,000 in 2000 (WAPC 1999, cited in Curtis, 2001, 00). Trips per capita per day have remained fairly static for car and walking but declined for public transport and cycling. The mode share for all trips shows an increase in car use (from 70 per cent in 1976 to 80 per cent in 2000) with a consequent decline in walking (from 16 per cent to 12 per cent) and public transport (from eight per cent to five per cent), while cycling has remained at 3 per cent (Perth Travel Surveys, cited in Curtis, 2001, 00). At the metropolitan scale employment use has dispersed beyond centres to locations difficult to serve by public transport. At the neighbourhood scale the separation of land uses together with their low density or intensity puts them beyond walking distance. This form together with the design of a street network based on efficiency of car travel has resulted in a city difficult to serve by bus and hostile to walking and cycling.

Integrating the City

Planning strategy

Today there is no single document that provides the policy framework for LUTI. Instead there are a wide range of documents produced at different times by different government agencies, and designed to operate at different levels and via different decision-making frameworks. Collectively these strategies include four main concerns – location of development types; providing for modal choice; limiting car access; and providing public transport infrastructure (Curtis, 1998). Two documents stand out – the Metropolitan Transport Strategy (DOT and MPWA, 1996) which sets mode-share targets aimed at 25 per cent fewer car driver trips by 2029; and the Liveable Neighbourhoods Community Design Code (WAPC, 1997) which follows new urbanism practice (Curtis and Punter, 2004), aiming to create a compact form that encourages local employment with a strong focus on creating an integrated transport network to provide opportunities for transport choice, including shared streets where the car does not dominate.

The physical planning principles that define LUTI today are shown in Table 1. These have been developed with reference to the literature, policy documents and the local expert survey. They are grouped into three key components – access, land use and 'people places'. 'Access' principles involve creating a transport network connected to centres, capable of meeting local and regional travel needs. Many of the daily activities should be served locally. The network must provide for transport choice

Table 1 Land use transport integration – physical planning principles

<center>Access</center>

The Network	• high degree of interconnectedness to urban system (adjacent centres, residential catchments, transit interchanges);
	• balance of access between through-travel and travel to the place; local and regional access requirements;
	• choice of transport options in close proximity to many homes and facilities –the possibility of substituting the right mode for the specific trip.
Activity function (rather than transport function)	• highly connected street network focused on access to centres and transit stops, permeable for people;
	• well designed walkable catchments, high-quality pedestrian experience – safe, well lit, trees, shelter;
	• arterial roads have safe pedestrian facilities, on-road cycle lanes.
Traffic management	• lower traffic speeds, moderate traffic volumes, narrower streets (but not at the expense of conditions for cyclists);
	• effective traffic management;
	• pedestrian priority.
Service	• integrated transport – easily accessible by all modes and interchange between these modes to destinations reached on foot; seamless and safe connections, ease of movement;
	• in operational terms – timetabling; easy to navigate system, high frequency, reliable, efficient public transport service to many destinations – no need for consulting timetables;
	• safe, secure, convenient and comfortable stations, stops and interchanges;
	• accessible by people with disabilities, seniors, children, mothers with prams etc.;
	• cycle friendly; secure cycle storage; connective networks of adequate capacity;
	• good business servicing opportunities.

<center>Land use</center>

Land use configuration	• land use integrated with integrated transport;
	• a robust urban form – can adjust to changes in demand for transport and land use;
	• greater diversity, vibrant mix of land uses (within precincts and within buildings);

enabling local trips to be undertaken by walking and cycling and inter-suburban trips by public transport, with the less frequent trips outside centres and further afield by car. 'Land use' principles focus on locating higher-density/intensity uses close to transit nodes, clustering complementary uses in walking proximity. 'People places' focuses on design at the human scale assuming pedestrian and bicycle priority.

At the metro/regional scale the principles tend to be drawn from the transport discipline. Westerman (1998a) argues that land use location and the transport network must not be planned independently. In planning the transport network the focus should be on equal access to places rather than on provision for through-traffic

<table>
<tr><td></td><td>● high pedestrian trip generating uses at ground floor, housing above in close proximity of transit stop;
● buildings oriented to station/streets/paths;
● active ground floor uses for surveillance;
● frontage development – human scale.</td></tr>
<tr><td>Density/Intensity</td><td>● highest residential density in close proximity to activities (but ensure includes family housing types);
● medium to high residential densities;</td></tr>
<tr><td>Proximity</td><td>● compact cluster of related (compatible) activities (highly visited) in close proximity (walking distance), clustered around rail station/high frequency bus stop;
● more intensive/ high-medium density office, retail and other commercial uses (measured by high worker densities) within walking distance of transport facilities.</td></tr>
<tr><td>Parking</td><td>● car parking areas managed so pedestrian access, amenity and safety not compromised;
● parking provided in shared structures rather than on individual sites;
● car parking behind buildings not fronting street;
● street parking;
● short-term parking but limited commuter parking;
● car-based retailing (drive-thru') and light industry located on periphery of town with good car access.</td></tr>
</table>

'People places'

<table>
<tr><td>Scale and Design</td><td>● human scale – less demand for 70kph scale advertising, more public art opportunities, sense that cars are not the priority mode;
● integration of character and scale of development within precinct;
● respecting existing development (through retention or sympathetic redevelopment);
● diversity of architectural styles;
● legible design – is easily understood for residents and visitors.</td></tr>
<tr><td>Amenity</td><td>● high amenity precincts – a place you want to go to – a destination in its own right;
● community/neighbourly feel – mixed ages – family friendly;
● good 'people places' – public open space, public seating, public art;
● more social encounters due to more walking, cycling, use of public transport;
● busy places.</td></tr>
</table>

(Schaeffer and Sclar, 1975; Yenken, 1995). Common principles include concentrating development in locations that have access to public transport; developing mixed-use, higher densities that can support a choice of transport modes; locating complementary activities closer together; and giving priority to public transport and controlling parking to encourage public transport use. Through traffic should be directed away from 'people places' where streets should be traffic calmed providing space for all modes in a safe, attractive and convenient manner. There should be a strong sense of place including street-oriented uses along arterials (Westerman, 1998a; MTMA, 1995).

At the neighbourhood scale the urban design tradition is strong with a focus on a

physical environment that encourages walking and cycling. Appleyard and Lintel (1972), Whyte (1980), Gehl (1987), Tibbalds (2001), Jacobs (2001) all argue for particular qualities of city space based on designing at a human scale – reducing distance between buildings, activities and across the street in order to maximise the opportunity for contact and observation. It is not just the physical distance that is important but also the quality of the experience – the design of buildings and orientation to the street and mix of uses to serve daily activity needs. They argue for replacement of car-dominated city centres by pedestrian-scale street systems.

Metro/regional outcomes

Public transport is a key focus of most current and emerging metropolitan planning strategies in Australian cities (Gleeson et al., 2004). In Perth the 1980s and 1990s saw a new interest in rail planning but the extent to which the new railways achieve LUTI is questioned. The Fremantle line reopened (1983), existing rail lines were electrified (1992), a new rail line to the northern suburbs (North West Metropolitan Railway [NWMR] was built (1993) and extended in 2004, and a new AUD$1.5 billion railway serving the southern suburbs (South West Metropolitan Railway [SWMR] is under construction (2004). As in the 1950s debate continues about the relative merits of bus and rail. For example, some argue that the NWMR would have been a busway if the decision were based on transport economics and planning criteria (Ker and Ryan, 1994, 4). However, the decision to build the railway was made on the basis of travel-time savings, the problem of bus congestion in the city, the long-term development gains to be realised as suburbs developed in this corridor, and the costing demonstrated that this option would be cheaper in the long term. Newman and Kenworthy (1999) suggest investing in transit systems helps to slow urban dispersal, drawing evidence from earlier work by Jacobs in 1984 and Frost in 1991.

The objective driving the design of both the NWMR and SWMR was the ability to compete with the car in journey times. The railway planners argue that the target travellers have a choice and preference for car use and that this and the low density of development dictate that rail must minimise journey time to be competitive with the car (Ker and Ryan, 1994). These requirements are key factors in route selection and station spacing. The new railways are designed for high-speed rail travel (130 kilometres per hour) with stations spaced 2 to 3 kilometres apart, a different structure from the early railways where stations were on average 800 metres apart. Martinovich and Lawrence (1998) argue for a station spacing of 3 kilometres on the basis that this minimises journey time and reduces rolling stock requirements. At 1 kilometre spacing rolling stock needs are almost double. This reflects planning from only a transport perspective, rather than one where the desired city form and transport operations are considered together. Indeed, Macrae (2004, 000) suggests the SWMR route was

decided on the 'line of least resistance' rather than any spatial plan. This approach to railway planning has resulted in different outcomes for city form and places compared to the early rail lines that were closely integrated with land use. Like freeways, the new railways have facilitated the spread of the urban area. The northern corridor has experienced rapid urban growth following the construction of the electrified line and the pattern is being repeated in the south-west corridor (PaTReC, 2004).

At the crux of the matter is whether urban planning should be led by transport operating requirements or by a future vision of the city's spatial structure, or both. Land use planners and railway planners each believe their approach achieves LUTI. However, land use and spatial structure did not feature in the 10 objectives deemed necessary to deliver the railway (SWMTPSC, 1999, 3). A supplementary master plan does include 'integration of the system with land use, town planning and transport policy objectives', but only after operational planning tasks are met (DP I, 2001, 2).

By making the journey time to Perth the primary objective, stations cannot be provided at the heart of town centres for much of the route. Instead the railway travels along the centre of the freeway relying on car and bus access to draw patronage to stations. Views are polarised as to whether stations should facilitate transit-oriented development or perform a role as simply a transit interchange within a freeway corridor. Clearly station precincts will have different functions dependant on their spatial position, land use structure and position within the transport network. Some precincts will serve as residential feeders, others as transit interchanges and others as town centre hubs. But the railway planners have created mostly transit interchanges, placing stations within a freeway reserve with spacing predicated on larger, car-based patronage catchments. LUTI is poor with isolated transport hubs, residential densities that are too low and beyond walking distance of railway stations. Railway stations are virtually impossible to adapt to an integrated centre concept (expert survey). Thomsons Lake station for example, on the SWMR, is portrayed as an integrated transit-oriented development (Landcorp, 2004). But integration will be a difficult task to achieve with a 100-metre freeway reserve running through the centre of the station precinct. Designed to draw on motorised catchments, 1,200 car parking spaces and 50 peak hour bus movements are to be provided in front of the station. This further limits the opportunity for active complementary land uses in close proximity and good pedestrian access to the station. It is not simply physical integration that is needed but also attention to quality of the local environment, information and signage.

Rockingham, a strategic regional centre, is to be bypassed by the southern railway. The railway planners argue that while there is a strong relationship between Rocking-ham and Fremantle, modelling shows Perth as the significant trip attractor. This is exacerbated by the extension of the freeway linking Rockingham to Perth. On this basis, they argued that the railway should also link Rockingham directly to Perth, as a
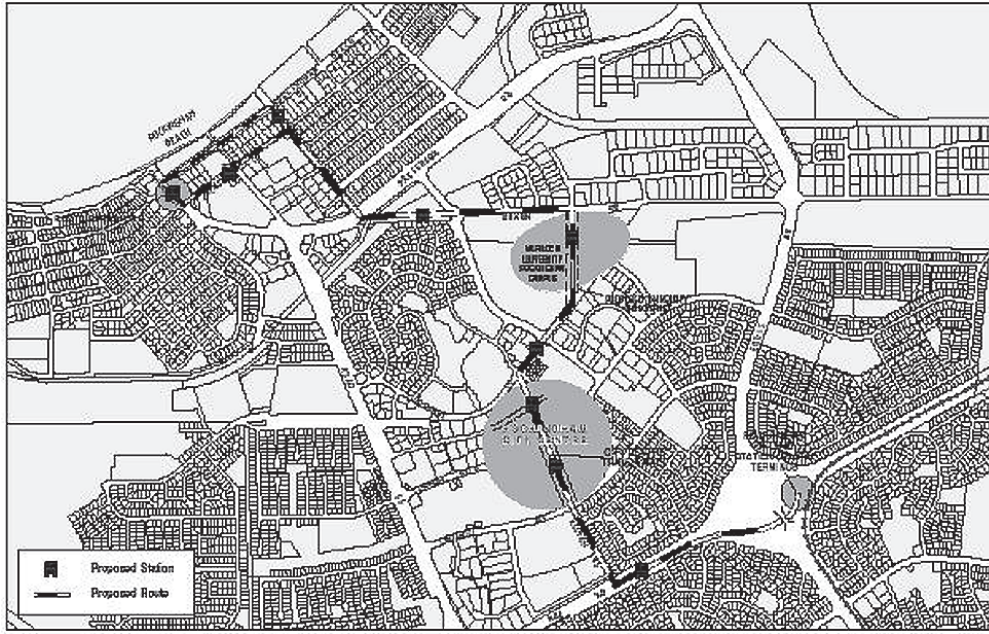
Figure 3 Route for Rockingham city centre transit system recommended by taskforce

competitor to the freeway rather than continue the existing relationship with Fremantle (Martinovich and Lawrence, 1998). By providing this level of regional accessibility, the prospect of attracting jobs to Rockingham is reduced as they are more likely to decant to Perth, ensuring long commutes rather than local employment. Patronage on the NWMR confirms this, being 'dominated by the peaks and [journeys] to Perth as the major destination.' (Martinovich and Lawrence, 1998, 1021). This seems to be the case despite the alignment of the rail through Joondalup Regional Centre in order to support the possibility of balanced two-way patronage. In effect, freeway accessibility from Rockingham has had a significant role in determining the future spatial pattern, which the rail network has mirrored, despite strategic land use plans envisioning a different spatial configuration and set of functional relationships. There are conflicting objectives – should the railway serve inter-suburban trips or local trips? The master plan aims at both and as a result is unlikely to achieve either particularly well.

The absence of city-centre stations at both Mandurah and Rockingham also shows the dominance of operational transport planning rather than concerns of city function and structure. Locating the station 1.5 kilometres from Rockingham city centre creates new access requirements including 1,500 car-parking bays. The local

council pushed for a streetcar system to overcome the separation problem (Fig. 3). Envisaged as operating on its own trackway it would connect the station to the city centre, university campus, and high-density residential development. This would also reinforce Rockingham's role as a strategic regional centre rather than a dormitory suburb. But pressures to contain costs for the railway have resulted in a bus solution. The major weakness of a bus-based system is that it is perceived as less permanent and so limits the commitment to land use development (Dittmar and Ohland, 2004; Rodriguez and Targa, 2004). Express buses with few points of access and fast access to destinations may encourage development as rail does (Dunphy et al., 2004; Currie, 2005), but this configuration does not suit Rockingham's urban structure.

On both the NWMR and SWMR there has been a push by land use planners to direct the railway out of the freeway alignment in order to achieve transit-oriented development. The most advanced of these is Wellard Village, a higher-density, mixed-use development proposed in the outer suburbs. The use of a level of service for public transit has been used by others to determine minimum residential densities required to support transit systems and ranges from 17 dwellings per hectare gross to 41 dwellings per hectare (MTMMA, 1995, 000, citing Pushkarv and Zupan, 1977; Bressi, 1994; Westerman, 1998; Dittmar and Ohland, 2004). Some of this considerable variation can be explained by differences in spacing of transit corridors, service frequency and level of public transport subsidy assumed. Based on the experience of North American cities their applicability to Australian cities is questionable given the different urban structure and investment in public transport. The Western Australia *Liveable Neighbourhood*s planning code (WAPC, 1997) recommends 12 dwellings per hectare gross, even this may prove difficult to achieve given the current metropolitan average of 6 dwellings per hectare gross. Wellard may well prove to be the barometer for transit-oriented new development in Perth.

Within Perth's CBD, the southern railway has been a catalyst for urban redevelopment and provides opportunities for LUTI,

> … the project is at least as much a matter of civic planning and design as it is a matter of routing a railway. This is a classic example of a challenge to coordinate transport and land uses. (PCRAC, 2002a, i).

In selecting the route through the CBD a detailed assessment was made of 15 route-alignment options and 12 station locations (PCRAC, 2002a). The location of stations relative to patronage capture was an important consideration, and employment density within a five- and ten-minute-walk catchment was measured. Although not directly required by the project, the opportunity to remove completely the 'barrier' of the railway line which divides the city has been taken. There have been demands for this since 1901 (Carr, 1979). Design guidelines for the 12 hectare space that could be created if the rail lines were all sunk suggest a precinct of

complementary mixed uses, which can also cater for transfer between the bus and rail stations (WAPC, 2004b).

The ability to closely integrate the new underground station at William Street with the existing platforms at Perth station (600 metres apart) was important. The aim was to experience 'one Perth Central Station' rather than two separate entities by connecting the new platforms 'via a foyer located under the Horseshoe Bridge at the western end of the station' (PCRAC, 2002a, 16), with the creation of an open plaza at the western end. This new public space would provide access to the existing and new platforms, as well as to the bus station. As development proceeds other considerations may deny the integration goal. To clamp down on fare evaders in a 'paid-zone' will deny non-rail users access to the public space, and the Public Transport Authority (PTA) has rejected retail uses within the new concourse area, even though these contribute to an active public space which enhances personal safety.

A new, second, city station has been the catalyst for a proposal of a mixed-use entertainment precinct integrated with the bus station along the river foreshore (Fig. 4). The original plan to construct the railway above grade along the river foreshore was opposed and a decision made to underground the railway. This also gave an opportunity to remove a flyover affording freeway access.
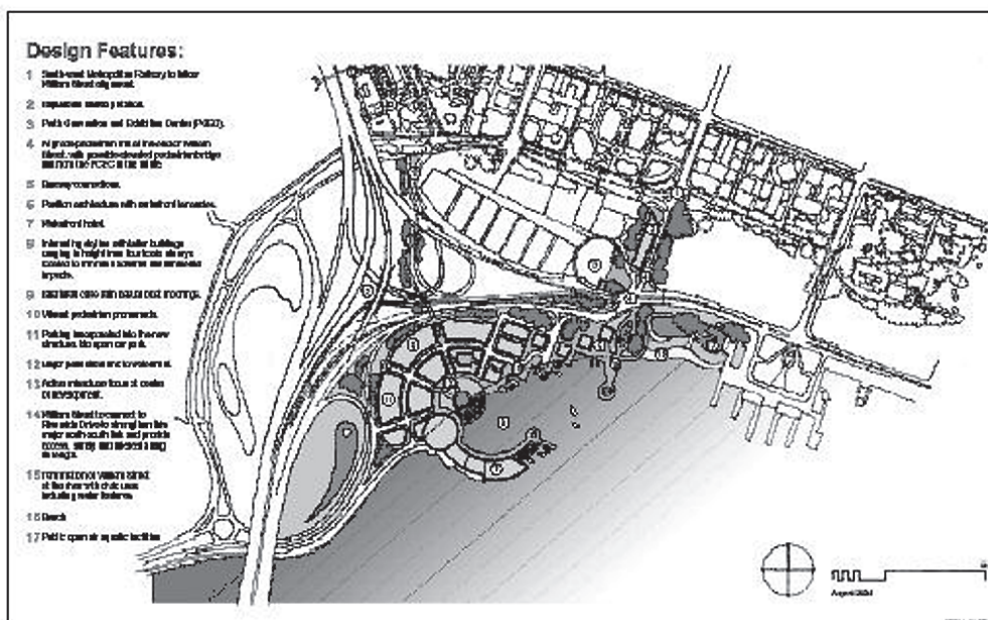

Figure 4 Perth foreshore proposal by City of Perth; using land made available following removal of William Street flyover

Neighbourhood outcomes: public transport

The state government's 'Building Better Train Stations' programme is aimed at improving land use transport integration at existing suburban stations. Outcomes have been mixed, with greatest progress being made where public agencies have control. Two stations (Gosnells and Armadale) on the south-eastern line are being relocated to provide a focal point linking the station to the town centre. At Bassendean the station upgrade included extra car-parking spaces and improvements to pedestrian access, but the creation of a link road across the railway to connect the station and create a 'main street' has not happened (WAPC, 2002). Some suggest there is too much parking within this precinct, densities are too low and that there is too great a separation from the town square. Others argue that this is a robust urban form that will respond to the upgrade (expert survey). While the stations themselves are being upgraded and access issues resolved, land use change is negligible despite the presence (since 1988) of a state development control policy seeking higher densities around railway stations.

The conclusion of the expert group was that an inner-city station precinct redevelopment (Subi-Centro) represented the leading example of LUTI in Perth, although several overseas places were cited as better reference points (Toronto, Vancouver, The Netherlands and Singapore). Created using a development authority process, it comprises a good mix of activity in close proximity to the railway station (sinking the railway helped in this respect) and is well connected to other centres. The street intersections are designed to slow traffic and ease pedestrian access. The grade-separated cycleway running along the railway has been lost. However, off-road cycle-ways have been installed, albeit disrupted by intersections. The development is well integrated with the existing urban fabric, respecting the human scale of existing buildings and safe, quality spaces are provided. The parking spaces provided are adequate without encouraging unnecessary journeys. Figure 5 and Figure 6 compare the integrated city solution (Subi-Centro) with the earlier approach – dispersed city solution (Warwick Station on the northern line, placed in the freeway reserve); stark differences in pedestrial accessibility and in the quality of the public realm are evident.

Not all station projects are success stories. At Claremont workshop proposals for mixed-use higher-density development have been rejected by the local authority. At East Perth industrial land redeveloped for higher-density residential development during the 1990s as part of the Federal government's 'Building Better Cities' programme is praised for its excellent pedestrian, cycle and bus transit service and its fledgling town centre. But there has been a failure to realise the development opportunities oriented towards the station, instead the development turns it back on the railway and pedestrian connectivity is difficult (expert survey). The plan for a new inner-city arterial and river crossing effectively stymied this development approach and cut East Perth off from areas to the north (Ker and Ryan, 1994).
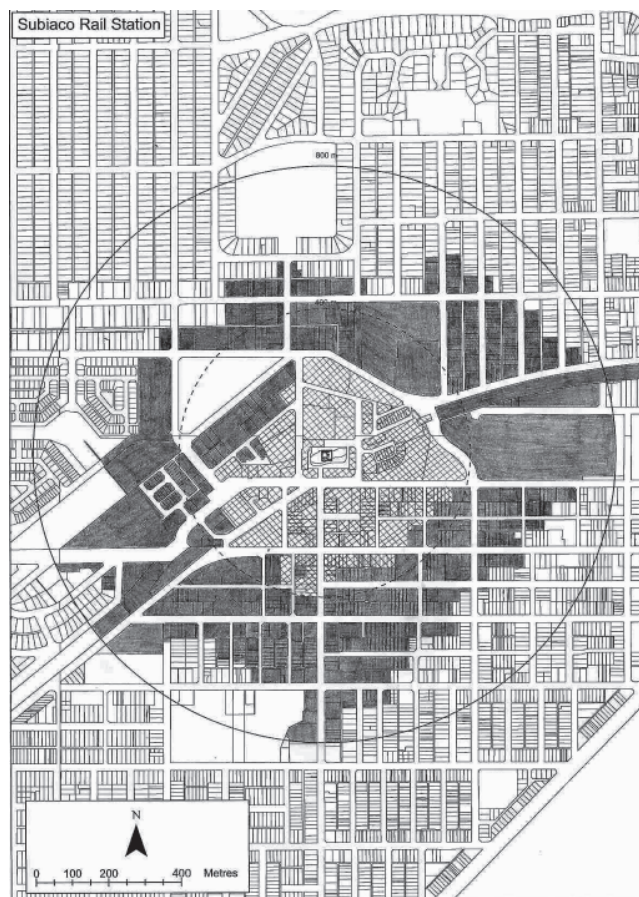
Figure 5 Subi-Centro: (a) mixed use development well integrated with transport (transit, road, cycle and pedestrian); (b) station precinct (800 metres) showing lots (shaded) within a 10-minute walk of station
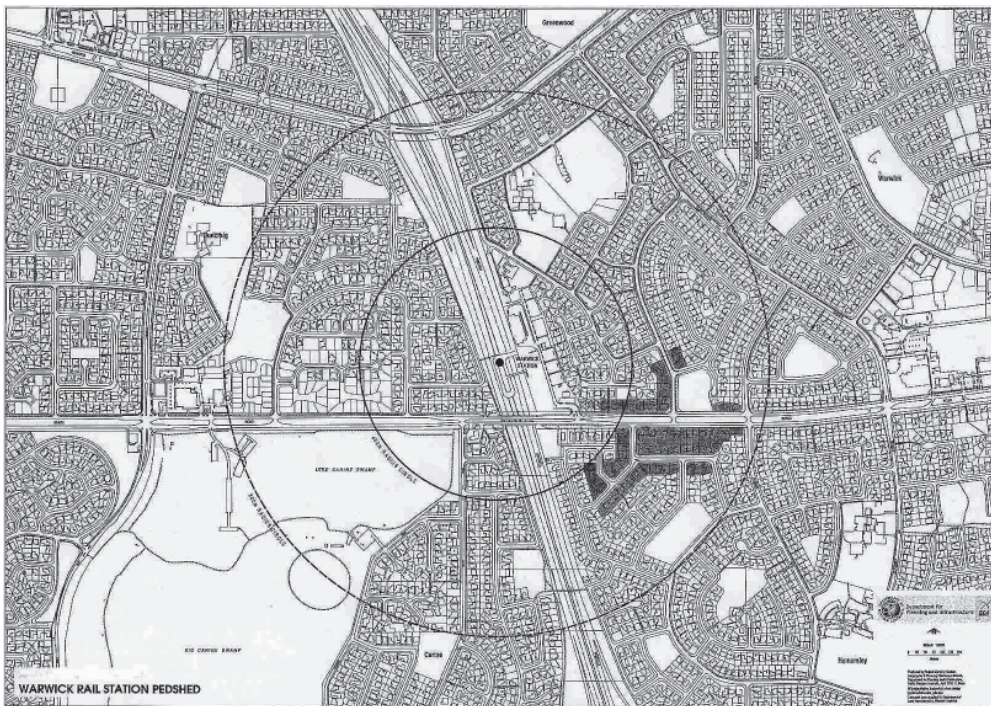
Figure 6 Warwick Station precinct: station centred in freeway reserve (mono-use, poorly integrated with residential use, low level of accessibility by foot); station precinct (800 metres) showing residential lots within 10-minute walk of station

Neighbourhood outcomes: streets

At the neighbourhood level the question of whether to segregate traffic modes is hotly debated. Segregation creates a duller experience, whereas shared streets see a greater proportion of trips transferred from the car (Gehl, 1987, 111). Appleyard et al. (1966) argued for designing roads to link with their surroundings rather than severing them. This has particular relevance for arterial roads skirting neighbourhood cells. These are the very locations retail and commercial uses want to locate in to capitalise on passing car traffic. With the past focus on segregation, access for local people on foot or by cycle is overlooked at considerable cost. The theory that 'segregating modes is safer' is challenged. Data from observation surveys show that where the 'situation is complex, drivers and pedestrians use greater caution' (Jacobs et al., 2002, 110). They argue that streets up to 70-metres wide can function well if designed as multiway boulevards which serve both through movements and local access to land uses abutting the street. The key is in the design of the pedestrian realm that comprises footpaths abutting buildings, service lanes with parking and adjacent footpaths serving transit stops and cycle ways.

It is questionable whether Jacobs's 70-metre wide boulevards enable integration across the street. However, as an alternative to major arterials that divide neighbourhoods they are an improvement with regard to achieving integration and equitable access. The redesign of an outer-suburban town centre (Gosnells) aims to move from a car-oriented design to one where the big-box shopping centre is integrated with the street, providing opportunities for redevelopment and intensification of land uses. It produces a vision of what is possible where forward thinking planners and engineers can agree. The implemented 1999 plan has a street cross section of 50 metres building to building, calming the major arterial road by the creation of a boulevard comprising four traffic lanes, parking and service roads on both sides and a tree planted pedestrian median abutting the carriageways. A new 'main street' intersects this to enable integration with the repositioned railway station. In five years the retail vacancy rate has dropped from 49 per cent to 10 per cent (City of Gosnells, 2004) attesting to the benefits of integrating land use with a major arterial road, and having the railway station at a more human scale.

Since wide streets with high traffic volumes tend to segregate activity (Appleyard, 1972; Winikoff, 1995) reducing street widths helps to promote activity. But romantic ideas of recreating exactly the street cross sections of the early inner suburbs must be avoided where safe access for cyclists is overlooked. The wide street cross sections created in Perth's middle suburbs have enabled retrofitting to provide for cycling but there is much less opportunity in the inner suburbs where street widths are narrower. Bicycle transport is often overlooked by planners and engineers but forms an important component of the integrated city. Instead planners tend to focus on shifting from private car to public transport (trains and buses), or on walkable urban areas.

Schaeffer and Sclar (1975) noted the early potential of the bicycle to increase the accessible catchment of the transit precinct. Physical integration of the bicycle is achieved by providing on-road and off-road bicycle lanes focusing on neighbourhood and town centres, with bicycle parking provided where it can be clearly seen. Integration with the public-transport network is important, not only in providing secure bike parking at stations and transit stops but also in addressing operational matters. For example the current approach in Perth, whereby cycles are banned from peak hour trains and buses do not have bike racks, limits the potential for integrated transport and enlarged destination catchments.

Despite reservations raised by Richards (2001) about the value of bicycle infrastructure, Perth's investment in cycling has provided significant growth in this form of transport. Almost $95 million has been spent in Western Australia on cycling infrastructure since 1997 resulting in a doubling of the number of cyclists on the network to almost 5,300 per day (Suttie, 2004). The first stages of the network have focused on longer-distance commuter cycling by constructing paths along the edges of railway and freeway reserves (functional cycling for commuters), river foreshores and the coast (more suited to recreational cycling). There is also great potential for investment to facilitate local cycle trips which are important given that 45 per cent of all journeys (by all modes) undertaken in Perth are less than 5 kilometres.

The 1990s have seen a renewed planning focus on the pedestrian, 'there is a rising awareness of the importance of walking and the quality of the street environment in which it takes place' (Bendixson and Plowden, 2003, 305). The state's *Liveable Neighbourhoods Design Code* (WAPC, 1997) uses the 'walkable neighbourhood' as its principal building block for city design on greenfield sites. Promoted by Perry in 1929, and later introduced by Stephenson at the British Ministry for Town and Country Planning in 1943 (Stephenson, 1992), a walkable neighbourhood is defined by a catchment of 400 metres diameter, or five minute walk – 'the acceptable walking distances for most people in ordinary daily situations' (Bostardens Grannskab, 1972, cited in Gehl, 1987, 139). The first edition of *Liveable Neighbourhoods* (1997) required footpaths to be installed on both sides of the road. The third edition (WAPC, 2004b) changes this, requiring a footpath on one side only in residential access streets (half of the streets within the suburb), bowing to pressure to reduce installation and maintenance costs. This is a retrograde step, especially given research evidence that lack of footpaths deters pedestrians (Giles-Corti, 2003).

Streets with high residential or worker densities promote pedestrian activity. Jacobs's observation surveys suggest a minimum net density of 37 dwellings per hectare is more likely to produce activity on the street (Jacobs, 2001, 304). *Liveable Neighbourhoods* is unlikely to deliver such activity while it aims for a density of only 12 dwellings per hectare. Using buildings to define the space, orienting them to the street and providing for high pedestrian amenity with trees, lighting and seats are all important

Table 2 Mode choice of residents by suburb (percentage of trips)

Suburb (survey year)	Walking	Bicycle	Motor bike	Car driver	Car passenger	Public transport
			Inner Suburbs			
Subiaco (1998)	18	4	0	57	16	6
Victoria Park (1998)	15	3	1	55	19	7
Vincent (2000)	14	2	1	55	20	7
Fremantle (2001)	13	3	0	52	23	9
East Fremantle (2001)	12	2	1	58	22	5
South Perth (1998)	12	2	0	60	20	6
Claremont/Cottesloe/ Nedlands (2000)	12	3	0	60	21	4
			Outer suburbs			
Melville (2000)	9	2	0	60	24	5
Cambridge (2001)	10	2	0	60	25	3
Joondalup (2000)	10	2	0	57	26	5
Marangaroo (2002)	5	1	0	60	31	3
Armadale (2003)	8	2	1	55	30	4

Source: www.dpi.wa/gov.au/travelsmart

components. *Liveable Neighbourhoods* is strong on these guidelines, but they are only guidelines! Achieving car-speed reductions and the redesign of vehicles to reduce impact on pedestrians in crashes also help to reduce pedestrian injury (Bendixson and Plowden, 2003).

Walking remains a key mode of travel, second highest after the car and practised by almost everyone (Bendixson and Plowden, 2003). Inner urban areas, developed when walking was the dominant mode of travel, remain good examples of LUTI due to their compactness, mix of uses and medium to high density. The well connected pedestrian network puts local activities within walking distance and connects to high-frequency bus routes (Expert Survey). Travel behaviour surveys (see Table 2) attest to the value of this robust urban structure. They show higher levels of pedestrian trips than places developed later under a modernist planning approach where low-density land uses were segregated and connected via a hierarchical street network.

Integrating the city: summary

In summary, the last decade has seen a change in planning approach from 'dispersing the city' towards 'integrating the city' with travel-mode targets aimed at reducing car-

based travel and a suite of policies based on new urbanist principles. There has been a new interest in railways, but their ability to achieve LUTI and sustainable travel outcomes has been mixed. New railways have been planned primarily from a transport perspective and like freeways facilitate the spread of the urban area. Most stations sit within the freeway reserve, their spacing predicated on car-based catchments, making pedestrian scale transit-oriented development difficult. There are exceptions. In the Perth CBD the SWMR has been a catalyst for transit-oriented development. At stations along existing railway lines the greatest progress in achieving improved access and land use change has been where public agencies have control, demonstrating the importance of the behavioural and institutional dimensions to LUTI. The new urbanist approach heralds a new planning focus on the pedestrian, although in practice there has been some backsliding from these principles. Shared streets and boulevards are promoted, in contrast to the past approach to road planning based on segregation of modes. The width of street intersections is still being debated with some arguing for narrower streets to improve integration with land use.

Conclusion

LUTI has been part of planning ideology over a long period, but Perth has strayed further and further from it up to the 1980s when there was some movement towards LUTI which has become more evident in the 10 ten years. The first planning strategy promoted a compact city including the notion of self-contained communities where households lived and worked close to home. The next two metropolitan planning strategies both espoused LUTI – now to be achieved by dispersal to regional centres. The notion of self containment remained. Changes in employment structure saw the shift to CBD-based service-sector jobs and car travel grew, facilitated by the implementation of an extensive high-speed road network. The 'love affair with the car' has seen less focus on access for pedestrians, cyclists and public transport. Experience has shown that the modernist approach to both land use planning and transport planning has resulted in cities where land use is segregated into separate 'cells', a 'functional road hierarchy' prioritises car access and transport modes are segregated. Invariably this 'segregation' has resulted in access for pedestrians, cyclists and even to transit stops being ignored.

In the late 1980s/early 1990s the call to integrate land use and transport strengthened and this has required a different construct for the city based on integration rather than segregation. There has been a strong focus on reducing the fragmentation or separation of land uses and creating a highly connected pedestrian network. Accessibility, proximity and designing shared streets are all aspects of the new approach. By achieving a compact cluster of related activities within walking distance of public transit points there is a clear focus on the creation of human scale 'people

places. The demand for a new approach has been driven by the sustainability imperative, first with environmental concerns including the impacts of traffic (noise, fumes, traffic speeds and trucks), greenhouse emissions and air pollution. Added to this have been concerns about equitable access for all members of the community and, more recently, with a new understanding of the long-term economic impacts of past approaches.

There is evidence that LUTI is slowly being achieved in this dispersed city, with greatest progress being made in recent years. There are small 'islands' of development change where the three key components of LUTI's physical planning principles (access, land use and people places) have been implemented.

At the metro/regional scale, LUTI is a greater challenge with mixed outcomes. Vast areas of the city have been developed according to modernist principles and it will be difficult to re-integrate them. Despite the adoption of LUTI principles, planning is still driven by 'car-centric' principles – the windscreen view of the world. The technical basis for decisions is still car oriented. There is a struggle between the professions to agree on the principles for shared streets and forecasts of traffic use which determine the street network still assume 90 per cent of trips will be by car. The concern of those planning the new railways has been the ability to compete with the car, in part predicated by the extension of high-speed roads which have improved accessibility to the CBD at the expense of regional centres. The objective of transport professionals has been the delivery of infrastructure rather than consideration of a desired city form. Hypermobility is perpetuated. The struggle to achieve full-scale transit-oriented development, apart from a few limited examples along new rail lines, perpetuates automobility.

It would appear easier to achieve LUTI at the neighbourhood scale. Land use change is occurring in traditional inner-city neighbourhoods where the template already concurs with LUTI principles. Transport-based initiatives in middle and outer suburbs, based on improved transport integration in station precincts, have been implemented but land use change is taking longer to realise (i.e. higher intensity of mixed uses). Where transit-oriented development has been achieved to date, it has been most effective where use of a development authority process appears to provide a speedier result – particularly for land use change.

It is unrealistic to think of redesigning Perth entirely to overcome the transport inequities resultant from a dispersed city. In addition, daily activity patterns of individuals are now determined by many forces – some beyond our individual control. Cuthbert (2003) suggests the neocorporate world of global and regional cities dictates our city form. For example, the 'economies of scale' approach to retailing impacts on our spatial behaviour and therefore our ability to travel differently. An LUTI approach needs to cater for many of our activities to be met locally, but must not overlook our interaction at regional level. However, the ability to attract development at local and

regional centres will be difficult to balance against the strong attraction of the CBD for business uses, and against the existing dispersal of activity outside defined centres. Solutions will need to focus on improving integrated transport access to complementary and proximate activities. This requires strong leadership to ensure appropriate land use activity is located in highly accessible places and resisted in locations poorly served by public transport. What is needed is a solution based on a vision for an integrated city. Physical solutions alone will not suffice – social and institutional factors must also be addressed.

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