

Transport Disadvantage in the Australian Metropolis: Towards new concepts and methods

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ABSTRACT

Urban mobility is a key determinant of household social status. The capacity to traverse urban space to undertake employment and to obtain the various goods and services that contribute to social wellbeing is dependent upon the transport options available to households. Contemporary planning for urban mobility is overwhelmingly focused on catering for travel by private automobile. Households that lack the financial or personal capacities to travel by car are potentially at a disadvantage in their ability to achieve social wellbeing. This paper examines the links between household social status and transport disadvantage through a review of concepts for the analysis of transport disadvantage in urban research and policy making. The paper argues that new approaches to understanding transport disadvantage are necessary if we are to begin to address the adverse consequences of constrained or restricted urban mobility. The paper argues that GIS-based analyses offer substantial scope for better understanding urban transport disadvantage. The paper presents findings from a case study of the Gold Coast City that tested GIS techniques for investigating how uneven social geographies and infrastructure provision differentially affect various social groups. The study found that within the Gold Coast many social groups that are potentially vulnerable to transport disadvantage, such as the unemployed and the elderly fared relatively better than the overall population in terms of spatial and temporal access to public transport. By comparison young people on average suffered greater transport disadvantage than the overall population. The study concludes by arguing for greater attention to issues of transport disadvantage and to the development of more sophisticated and empirically richer techniques for the analysis of transport disadvantage.

INTRODUCTION

Access to transport systems and the connection such systems provide to essential economic and social activities is a critical dimension of households socio-economic wellbeing. However, in spite of ongoing social and economic changes in recent decades scholars have been slow to draw the link between mobility, transport and social outcomes. This paper is the first of two articles that undertake a comprehensive conceptual and methodological review of the ways scholars have contemplated the connection between transport disadvantage and social status. We show that transport and mobility are crucial components of social accessibility, and develop this argument in the second article via an empirical examination of the Gold Coast City.

There has been little scholarly analysis of how mobility and access patterns in Australian cities have been affected by the interplay of dynamic social structural change with the slow and imbalanced development of transport services. Overseas literature, especially British (Power 2001), suggests that new patterns of urban social exclusion are intensified by, and indeed partially defined by, the

inadequate supply of transport services and strengthening social demands manifested at the subregional level within cities. This 'mismatch' theme has been anticipated and to some extent was explored in earlier Australian urban literature (Morris 1981). In recent years this has received little attention. Progressively development is witnessing the rise of new, if unexplored, patterns of urban mobility need, generated by the sorts of socio-spatial restructuring outlined above. Overall, the differential impacts of transport supply failures on various social groups are poorly understood. To address this gap in research-based knowledge of urban social mobility, we identify two pressing tasks for Australian scholars:

1. to identify how mobility status is best conceived in the wake of urban structural changes that have produced new patterns of social need and disadvantage, including the concept of 'social exclusion'; and
2. to consider how the variety of methods that have been used to measure social disadvantage and spatial immobility can best be combined and deployed to produce new understandings of transport status in Australia's contemporary cities.

Since the late 1970s urban regions within Australia and other Western nations have experienced major transformations in their socio-spatial structures. Largely, these changes have been driven by economic changes associated with the most recent broad phase in the restructuring of global capitalist production, generally referred to as 'globalisation' (Fagan and Webber 1999). Within many Western cities, particularly those in which national welfare provision is weak, this restructuring process has resulted in greater spatial socio-economic differentiation (Dodson and Berry 2003).

The effects of ongoing globalisation have been particularly apparent in labour markets, both in Australia (Freestone and Murphy 1998; Brain 1999; O'Connor and Healy 2002), and internationally (Sassen 1988; Reich 1991; Standing 1999). For example, Sassen (1991) reported the spatial dimensions of this differentiation in global cities, with high-value informational 'producer services' employment concentrated in the 'global core' of cities, while production work was increasingly located in middle and fringe locations. Noting the implications of these restructuring processes in Melbourne, and their interaction with housing markets, O'Connor and Healy (2002) observed that:

In many respects, the core is job and skill rich, housing-expensive and an increasingly exclusive region. Indeed, a major contradiction within contemporary metropolitan Melbourne is the existence of an economically significant region that is becoming increasingly inaccessible as a place of residence.

It seems that location within the metropolitan urban structure, has become a key determinant of households' and individuals' access to employment and other opportunities (Burke and Hayward 2000; Naess 2005). Burke and Hayward (2000) revealed that limited housing affordability experienced by low-income households was excluding this group from inner areas, forcing them to less expensive outer-urban locations. These changes have impacted disproportionately on disadvantaged groups of society.

The effects of divided cities from urban spatial and structural processes have been of substantial interest both internationally and nationally, with the least affluent end of the socio-economic spectrum receiving the majority of attention. Several authors have asserted that the forms of recent economic restructuring accompanying globalisation have produced new forms of spatially related economic and social disadvantage from those previously experienced in urban settings (Sassen 1991; Madden 1996; Smith 1996). Such divisions have been described as social polarisation (Hamnett 1994), social exclusion (Musterd and Ostendorf 1998), spatial segregation (Abramson *et al.* 1995; Andersen 1998; Cheshire *et al.* 2000) and social marginalisation (Jamieson and Jacobs 1996; Wacquant 1999).

The gentrification of the inner-city in Australian capital cities often obscures its corollary for lower-income groups, namely the displacement of socio-economically weaker and disadvantaged inner-city populations to outer urban locations (Freestone and Murphy 1998). As most of the outer suburbs of Australian cities were developed during the post-WWII shift to automobile-based urban planning, they have the most inadequate public transport services (Mees 2000). Therefore, this socio-spatial restructuring of Australian outer urban areas has implications for transport provision, particularly in terms of social equity (Burnley *et al.* 1997; Cheal 2003).

Exclusionary Urban Structure

Changing urban structure has been implied in exclusionary processes, particularly in the United States (US). As suburban development has decentralised, often re-centring around freeway nodes, so too has employment (Garreau 1991). The result of these patterns is that US inner city residents tend to face reduced access to high quality labour markets and more complex job search processes. Subsequently inner city residents have longer commuting burdens than do residents of the middle and outer suburbs. Spatial structure therefore, is viewed by numerous scholars in the US as implicated in the reproduction of social disadvantage for individuals and households located within inner city locations (Galster and Killen 1995). Such a phenomenon has been referred to as ‘spatial mismatch’ (after Kain, 1968) and has been the subject of much research in recent years (Holzer 1991; Taylor and Ong 1995; Ihlanfeldt and Sjoquist 1998; Wachs and Taylor 1998; Sanchez 1999; Brueckner and Zenou 2003).

The relevance of the US spatial mismatch phenomena to Australia was recently tested in Melbourne. Dodson (2004) found that in contrast to typical US cities, the most socio-economically disadvantaged areas in Melbourne were located in outer-suburban locations, as opposed to the inner-city. As outward suburban expansion has occurred, the number of available outer-urban jobs also increased, gradually reducing spatial mismatch for disadvantaged outer-suburban neighbourhoods. However, Dodson (2004) noted that the transport service quality and employment skill dynamics of this phenomenon remained unexplored. Transport may still play a role in impeding employment accessibility for residents of disadvantaged Australian outer-suburban areas. This issue would be particularly exacerbated if residents of these areas do not possess the skills or qualifications to enable them to obtain employment in employment growth areas. As yet, there is not a sufficient body of Australian literature on this issue to make definitive conclusions about the extent or scale of spatial employment-housing mismatch.

Locational Disadvantage

Limited attention was given to transport issues in relation to social disadvantage in Australia during the late 1980s. By the early 1990s, the concerns enunciated by academics and policy makers prompted a set of studies into the spatial problem of locational disadvantage in Australian cities (Maher *et al.* 1992; Travers Morgan 1992; Badcock 1994; Beer 1994; Maher 1994). In their study, which formed the basis for much of the recent Australian discussion of locational disadvantage, Maher *et al.* (Maher *et al.* 1992) offered the following conceptual description:

Locational disadvantage is one element of a more general notion of social disadvantage. It results from an inability to access or to use effectively the whole range of facilities and resources which not only improve well-being but better position households to take advantage of resources available to improve their longer-term life chances.

Maher *et al.* (1992) argued that locationally disadvantaged areas are deficient in terms of the facilities and resources necessary to enable a ‘satisfactory life’, or, which require residents to undertake long journeys to access such resources. The transport network, and transport services are among the ‘resources’ available to households, and thus inadequate transport can be seen as a key element of locational disadvantage. Maher *et al.*’s empirical study found three categories of locationally disadvantaged areas, in particular older industrial suburbs and outer urban locations.

The Australian Government's *National Housing Strategy* (National Housing Strategy 1992) drew on the Maher *et al.* work arguing:

People without private transport, especially where public transport is not readily available are likely to be disadvantaged. In particular older people, young people and members of a car-owning household who cannot use the car, are more likely to have problems and/or longer travel times to services and jobs.

Yet despite these concerns locational disadvantage persists in Australian cities. But as the work of Gleeson and Randolph (2001), Gwyther (2002) and Dodson (2004) attests, the argument over the existence and causes of locational disadvantage in Australian cities remains under-researched. During the mid 1990s, due to the attention of the Federal Government there were few public transport improvements across outer suburbs of Australian cities. The issue has largely disappeared from the policy agenda and the Federal Government retains no current interest in urban public transport infrastructure, policy or finance. Poor access to transport has, however, been clearly linked to other forms and dimensions of disadvantage, both in Australia and in comparable jurisdictions overseas.

Transport and Disadvantage

Historically, transport has been unevenly accounted for in discussions of urban social disadvantage in the UK, European and even Australasian context. This occurs, particularly in relation to other dimensions of disadvantage such as housing quality, location and affordability, and labour market status. Since the late-1990s however, there has been a growing awareness that transport plays an intricate role in the mediation of social opportunity, most notably in the United Kingdom. In the UK the Blair Labour government's focus on processes of social exclusion has included a strong transport dimension. While social exclusion is a contested concept, it is relatively clear that inadequate transport is a contributing factor in the generation and perpetuation of social exclusion. The UK government's 2003 report *Making the Connections* (Social Exclusion Unit 2003, p.9) clearly identified inadequate transport as impeding people's access to:

- work
- learning
- health
- food shopping
- social activities

This appreciation of the links between transport systems and social exclusion motivated the promotion of 'accessibility' planning. Since the Social Exclusion Unit report, requirements to account for accessibility have been included in UK municipal planning policy. To date in Australia however, there has been little adoption of the 'social exclusion' discourse and effectively no consideration of the links between social exclusion and transport. The overall contribution of transport inequalities to broader processes of social disadvantage also remains largely unconsidered by Australian policy makers.

In Australia, distributional transport impacts have received periodic attention. Morris and Wigan (1979) and Morris (1981) were among the earliest Australian authors to investigate social equity issues in transport research, finding that the needy, young people, disabled persons and the elderly were most likely to have poor access to transport. Since that time, very few Australian studies have investigated the links between household social status, urban location, and access to employment or services, relative to the costs of transport.

One of the better recent examples of empirical research on the spatial dimensions of transport equity in Australia is Cheal's (2003) examination of 'transit rich' and 'transit poor' areas of Melbourne. Cheal found that 83 per cent of Melbourne's population lived outside of transit-rich

areas where transport services operated frequently, every day and offered multiple destination choices. Cheal's (2003) comparison of socio-economic characteristics found that households in transit-poor areas tended to be socio-economically worse off on average, when compared to those in transit-rich areas (Mees 2002).

The issue of the inequitable distribution of public transport services, which can relieve the burden of automobile ownership on low-income households, is reflected in Battellino's (1997) of mode share in Sydney (as reported by Mees (2002)), and Morris *et al.*'s (2002) analysis of mode share and car ownership in Melbourne. Battellino (1997) found in Sydney that low-income outer urban areas had higher household vehicle ownership rates, and public transport carried a lower share of non-work trips, than wealthy areas.

A similar phenomenon to that described for Sydney appears to be occurring in Melbourne. Morris *et al.* (2002) demonstrated that vehicle ownership is much higher in outer urban municipalities than in inner urban locations. This also appears to be the result of the inequitable distribution of public transport services across the metropolitan area. Drawing on Morris *et al.*'s findings, Dodson (2003) suggests that in Melbourne the mismatch between outer areas where housing is affordable and inner areas where public transport service is of good quality, compounds the exclusionary processes operating in the housing market.

Distributional impacts of inadequate transport infrastructure and services are not only spatially expressed. Several societal groups have been identified as more likely to experience transport disadvantage or transport-related social exclusion than others (2003). Various authors have noted the effects of automobile-dominated transport policies on groups who are either unable to drive, or who cannot afford automobile ownership (Bostock 2001). Schaeffer and Sclar (1975) detailed the various privations suffered by the poor, the elderly and the young in terms of their access to transportation. Black's (1995) work on public transport planning also noted 'special groups of users' or the 'transport-disadvantaged' including, the poor, elderly, disabled people, the intellectually disabled and women. Hine and Mitchell (2003) reported that in Scotland, women were more transport disadvantaged than men, rental households suffered greater disadvantage than owner-occupiers/purchasers, and that lower income groups in terms of their income paid more for their public transport, as well as having longer travel times to access the same services as higher income groups.

Debates over transport equity and gender issues have been cited regularly (Turner and Niemeier 1997). Dowling and Gollner (1997) argue that public transport systems are inadequately meet women's mobility needs, due to poor service frequencies, insufficient operating hours, and limited service integration. Mees (2002) argues conversely that promoting road-based transport policies in the name of gender equity will merely reproduce the kinds of car-oriented approaches that created an automobile-dependent urban transport system in which women are likely to suffer transport disadvantage.

Young people constitute a further group at risk of transport disadvantage. Brownlee and McDonald (1992) suggest that transport disadvantage relating to the school journey, and to entertainment and leisure trips, is a significant problem for outer urban youth in Australia. This conclusion is supported by Winter's (1994) study which suggests that inadequate transport constrains the educational and social opportunities for this group. Ridgewell, Sipe and Buchanan (2005) demonstrated that children's school travel is highly constrained depending on where they live within the urban system.

Transportation planning has not always considered socially disadvantaged groups of the population in decision making processes. In addition, these societal groups are often given little forethought when planning for motorways and other automobile dominated infrastructure is undertaken (Fincher

and Jacobs 1998). The assumption that metropolitan freeways are of benefit to all urban residents is a common, if unjustified assumption (Dodson and Berry 2004).

A critical problem in the scholarly and policy appreciation of the connection between household social status and transport disadvantage are the concepts that scholars have available to enable them to comprehend the problem and the methods they have with which to investigate the issue. The next section of this paper examines the methods that scholars have used to investigate the links between transport disadvantage and identifies means of improving how scholarly inquiry can enhance the understanding of the interaction between socio-spatial patterns and the geography of transport provision. The section establishes the basis for the empirical component of the paper, which undertakes an investigation into the interaction of social vulnerability and transport provision within the Gold Coast City.

Methods for understanding transport disadvantage

The review above has revealed various different approaches to understanding the processes of socio-spatial segregation and the related impacts on disadvantaged groups. For example, social exclusion research is closely tied to policy (especially in the UK), while spatial mismatch investigations are often dependent on qualitative spatial-analytical methods (as often utilised in the US). Since the results of many studies are closely tied to the methods used to obtain them, it is highly pertinent to review the major methodological approaches that have been used in transport and urban planning disciplines. Three major approaches are discussed; modelling, socio-spatial and qualitative analysis.

Modelling

Modelling has been a central technique in transport planning since the development in the 1950s and 1960s of computer technology capable of handling complex mathematical equations. Normally, it is deployed at an aggregate scale, opposed to a disaggregate level, depending on the nature of the data. Typically such analysis has been used to apply mathematical algorithms and formulae to estimate traffic patterns and the effects of future planning scenarios on urban transport outcomes. Gravity models and their derivatives often form the basis of these models (eg Waddell 1997) and are often used to measure phenomena such as spatial mismatch (Cervero 1989; Levinson 1998). For many researchers and policy makers, for example Black(1981), modelling eclipsed other, less technical, methodologies to become identical to transport planning.

Most urban transport modelling has been auto-dominated and focused on the needs and desires of auto-dependent transport users to the general exclusion of non-car users (Graham and Marvin 2001). Such an approach is almost *a priori* incapable of understanding transport disadvantage. There is potential for the development of models that address issues of transport disadvantage, particularly relative to household social status. Yet modelling is typically limited in its capacities even when it does attempt to account for social factors. Thus for example, Wang's (2003) transport model found that although low-income workers enjoyed relatively better job proximity, many had very poor job accessibility, due to their limited transport mobility resulting from low levels of motor vehicle ownership.

Yet most modelling approaches remain focused on automobility rather than broader social accessibility. Such conceptualisations assume that less well-off social groups are disadvantaged due to lack of automobile ownership, not because the transport system has been constructed so as to favour automobile travel above all others. The dominance of automobiles is thus not seen as a critical component of the problem (Newman and Kenworthy 1999; Mees 2000).

Socio-Spatial Analysis

A second methodological approach to understanding urban accessibility and transport disadvantage that has been developed and expanded in recent years is the use of spatial analysis. The primary

approach to socio-spatial analysis has been through the use of geographical information systems (GIS). While also at an aggregate level, socio-spatial analysis allows the combination of spatial information with other types of information to enable both mapping of various characteristics of the transport system. The capacity of GIS can range from depicting basic information such as the spatial coverage of the public transport network, or can be used to generate sophisticated multivariate analyses incorporating large numbers of complex calculations.

The empirical meanings that are derived from manipulations of social data remain open to criticism as being inadequately sensitive to the nuances of actual social behaviour. GIS is particularly useful for analyses of spatial disadvantage in relation to transport as it permits relatively easy calculation of spatial metrics. Thus for example the identification of locations where a given level of public transport service is unavailable becomes relatively easy with GIS once the necessary data is available. Wu and Hine (2003) used a 'Public Transport Accessibility Levels' (PTAL) approach to measure transport accessibility in Belfast, Northern Ireland. This approach is a highly detailed measure of the spatial accessibility from any origin point to the public transport network.

While socio-spatial analysis, frequently incorporates GIS, to visualise, analyse and model geographical data, it is often done through quantitative methods which may be innocent of critical topographic or built environment features that are not represented in the Euclidean space of the GIS vector. Social aspects of the urban landscape may be better explored using a qualitative approach.

Qualitative Analysis

A third major methodological stream in research into the links between social status, transport and accessibility is the use of qualitative methods. In this context qualitative methods are taken to include approaches which do not seek to quantify either the patterns of traveller behaviour or the characteristics of the transport system. Often data is collected using interviews or surveys which ask respondents about their travel behaviour or their experiences of travel and access to services.

Hine and Mitchell (2003) used a combination of qualitative survey and focus groups to assess the extent of transport need, and associated transport-related social exclusion in three localities in urban Scotland. The researchers conducted household surveys for each locality, including gathering of basic demographic and household data, socio-economic information, and particulars on vehicle ownership and travel behaviour as well as semi-structured interviews with local authority planners and transport operators. Much of the findings involved conveying non-quantified statements made by respondents, revealing the personal experiences of transport users.

Hamilton and Jenkins (2000) also used a qualitative approach to assess the adequacy of public transport services in meeting women's needs through the development of a set of standards against which agencies responsible for the provision of transport services (local authorities in the case of the UK) could assess the adequacy of those services. Hamilton and Jenkins' approach because they focus on urban transport as an institution for which the service provider (such as a local authority) is evaluated, based on its capacity and success in providing an adequate level of service.

A further qualitative methodology that has been used to investigate transport disadvantage and exclusion is 'community mapping' (Yearly *et al.* 2003; Johnson and Herath 2004). Johnson and Herath (Johnson and Herath 2004) investigated the access to transport and services for residents of the socio-economically disadvantaged area of Goodna in the outer western suburbs of Brisbane using focus-groups, community workshops and ongoing face-to-face discussions with residents. This approach was highly successful in identifying the subtle interplay of welfare policy, location of services, transport infrastructure, local urban design and urban structure in determining households experience of transport disadvantage.

Towards new approaches

This paper has assessed the literature that examines the links between social status and transport disadvantage, and has identified some potential avenues for productive investigation. The review recognised the need to carefully comprehend the links between individual and household socio-economic status and how this affects their transport needs and opportunities within the broader context of urban socio-economic spatial and structural change.

Of the three major methodological approaches considered above we argue that GIS-based techniques offer the greatest current opportunity for advancing methods to investigate the links between social status and transport disadvantage. This view is justified in relative terms; transport modelling risks excessive abstraction based on assumed relationships that are converted into mathematical expressions. Qualitative methods are empirically and experientially rich, yet are intensive in terms of the resourcing required to undertake inquiry. While we acknowledge the limitations of GIS approaches, including for example their potential insensitivity to local conditions that are not apparent in spatial datasets, at the metropolitan level of analysis, GIS appears to offer the greatest potential for methodological advancement. We note that GIS could also be used as a ‘first-sweep’ investigation to identify potential spatial concentrations of transport disadvantage, the local particulars of which could then be assessed through intensive qualitative engagement.

The Gold Coast City Case Study

The remainder of this paper presents a case study in which we seek to combine socio-spatial and transport service data within a GIS framework to comprehend the interaction of social status with transport disadvantage. The purpose of this study is twofold. The first and primary concern is to present what we consider to be a methodological advancement in the use of GIS for social analysis by mapping social patterns with transport services distribution. The second intention is to apply this methodological advance to a specific empirical case study to illuminate the way in which the interaction of social patterns and transport services distribution can impact different social groups both within those groups and relative to others.

The case study focuses on the Gold Coast City (‘the Gold Coast’) located in Queensland, Australia¹. The Gold Coast City is Australia’s sixth largest metropolitan region with a population of approximately 470,000 residents. The city is unlike the larger cities in that it lacks a central activity district or a radial public transport network. Activity is loosely concentrated along the coastal tourist strip to the east of the city, with further concentrations situated along the Pacific Highway to the western edge of the urban area. Much of the Gold Coast comprises low-density suburban form organised around the major road network.

With little public transport infrastructure, the Gold Coast is highly dependent on automobile travel – only 3.8 per cent of work trips involved public transport modes in 2001 (Gold Coast City Council 2003). The majority of public transport services are provided by buses. While a regional rail service connects the western suburbs of the Gold Coast to the state capital Brisbane, this link is poorly integrated with either the city’s bus network or with urban land use activities. In addition to its urban structural characteristics, the Gold Coast city also displays a diverse urban geography, receiving high levels of inter-state immigration comprised of a wide and spatially variegated mix of socio-economic groups (Taylor 2004). In general, the Gold Coast has a higher proportion of low income households and a lower proportion of high income households, relative to either the rest of Queensland or Australia generally. This income situation is reflected in labour force figures; the Gold Coast has lower labour force participation and higher unemployment than either Queensland or Australia (Gold Coast City Council 2003).

¹ This study is the result of a collaboration between the Gold Coast City Council and Griffith University. This relationship in part determined the selection of the Gold Coast as the site of the case study.

Assessing the public transport dimension

The spatial distribution of public transport services provides a gross indication of the degree of 'access' provided to local populations by the system. The Queensland government's Translink agency, which plans the public transport network within the South East Queensland region, holds digitised information on the Gold Coast public transport system, including route and timetable information. Using GIS the route characteristics of the Gold Coast public transport network can be easily mapped.

The basic route structure of the Gold Coast City public transport system relative to the urban area of the city is provided in Figure 1, with the 400 metre distance from each route indicated. Despite some large gaps in service coverage, Figure 1 suggests that the Gold Coast urban area is comprehensively covered by bus routes with some highly limited rail coverage. The gross depiction of the service coverage could be assumed to indicate high levels of service provision within the city relative to population concentrations as Murray *et al's* (1998) study of Brisbane suggested for that city. However the gross coverage is innocent of hourly and daily variations in service operation. Many bus routes operate at higher frequencies during peak morning and evening travel periods and often reduce or withdraw services during weekends. Such temporal variations can dramatically impact upon the access to employment and services experienced by populations. A more sensitive GIS analysis needs to account for such temporal variations in access to public transport services.

Access to public transport services is not solely a measure of distance – service frequencies vary markedly by time of day and day of the week. Comprehending this temporal dimension of public transport service provision is crucial in comprehending the interaction of transport systems with social disadvantage. To account for this temporal influence, public transport timetable information was coded into temporal and qualitative categories via the GIS software. Hence each day was divided into four periods imputed from assumed patterns of travel demand. These travel periods are:

- start of service to 9:30am (morning peak);
- 9:30am until 3:00pm (inter-peak);
- 3:00pm until 7:00pm (evening peak);
- 7:00pm until the end of service (off-peak).

Service frequencies per travel period were calculated and categorised for each bus route. The categories assume that higher frequency equates to higher quality, as suggested by Mees (2000). The categories used in this study are, in descending order of quality:

- at least every 15 minutes (high-frequency²);
- at least every 30 minutes (mid-frequency);
- service interval of more than 30 minutes (low-frequency);
- no service.

The categories above were used to construct a four by four matrix of service frequency by period of the day for each day. As timetables were essentially unchanged between weekdays these were treated equally. Saturday was treated separately while Sunday services were discarded because

² We note that in many jurisdictions a service headway of at least every fifteen minutes would be considered mediocre and not suitable described as 'high frequency'. However in the Australian urban transport context service frequencies of at least 15 minutes would generally be considered high frequency.

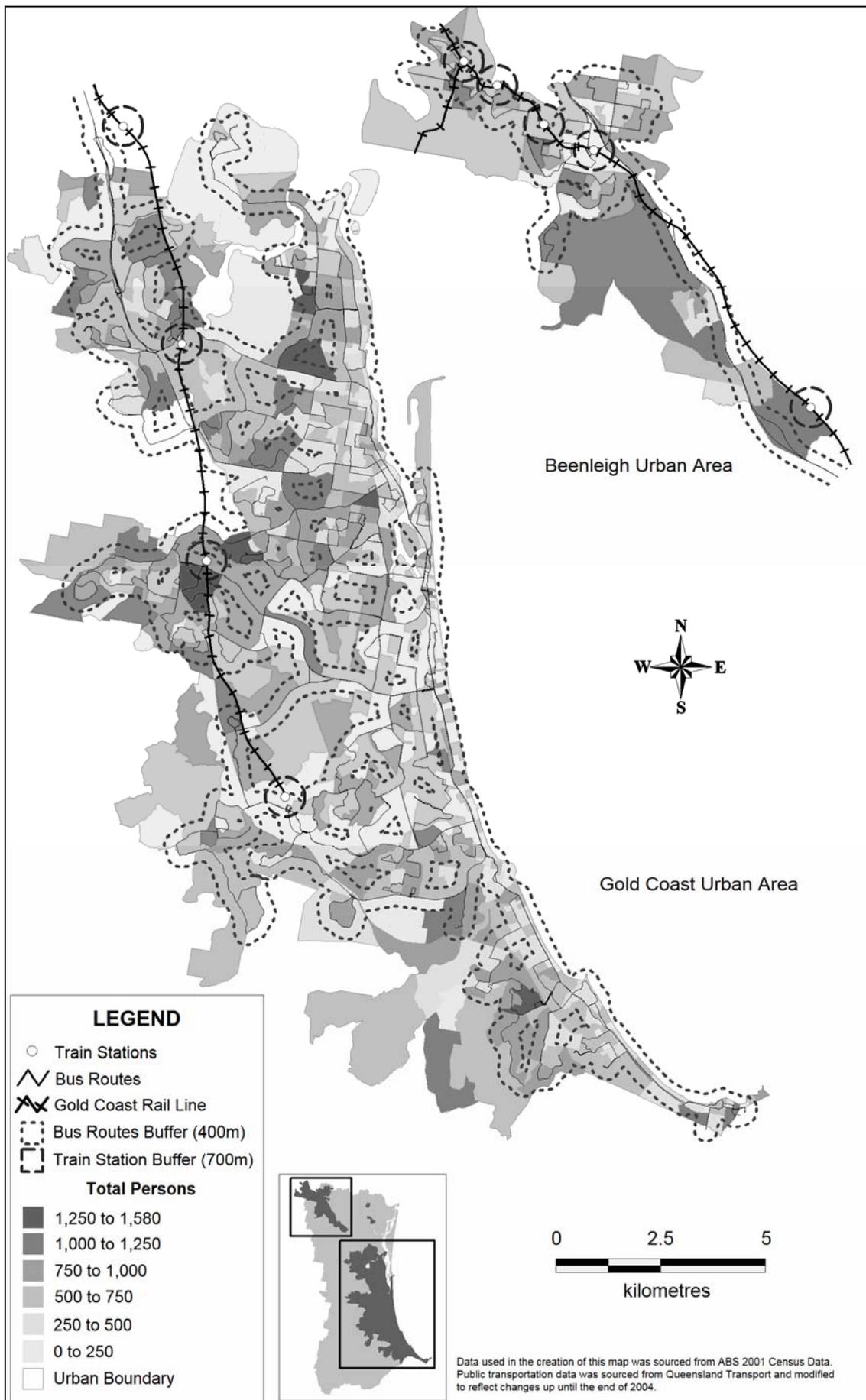


Figure 1: Gross spatial coverage of public transport services relative to population location within the Gold Coast city.

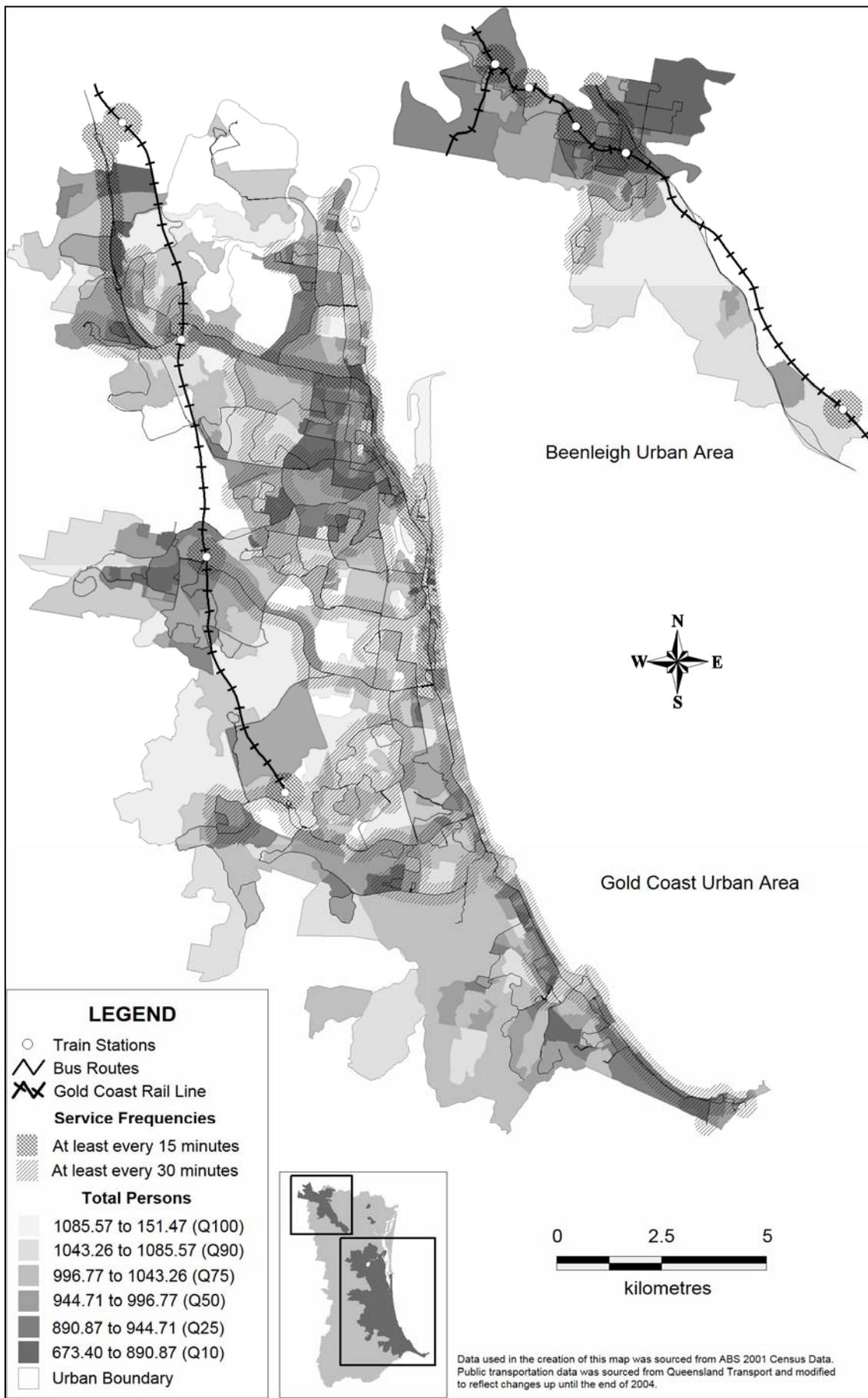


Figure 2: Public transport service coverage and frequencies for the morning peak relative to SEIFA categories within the Gold Coast urban area.

service frequencies were found to be so low that the majority of routes fell into the ‘no service’ category.

Combining social and transport spatio-temporal data

The next phase in our analysis was to combine the specific temporal and service quality categories present in the distribution of public transport services with social data. The first analysis we undertook was of the distribution of SEIFA households within the Gold Coast. This social data was combined with the coverage quality for the morning-peak public transport service period. The results of this combination are presented in Figure 2. There are clearly marked variations in both the spatial concentration of disadvantaged households and in the spatio-temporal access these households have to public transport. Thus disadvantaged households within the northern coastal strip of the Gold Coast, in suburbs such as Labrador and Southport have relatively good access to public transport during the morning peak, relative to low-SEIFA households in western areas of the Gold Coast such as Nerang, Mudgeeraba and Stephens, or in the north near Beenleigh. Table 1 presents quantified service access for low SEIFA households for all periods. The table is spatially insensitive, however it demonstrates the strong variations across time and space faced by SEIFA households who may seek to access public transport.

Table 1: Proportion of low SEIFA households per public transport service quality category for Gold Coast city.

Frequency	Weekdays				Saturday			
	Start-9:30am	9:30am-3:00pm	3:00pm-7:00pm	7:00pm-End	Start-9:30am	9:30am-3:00pm	3:00pm-7:00pm	7:00pm-End
At least every 15 minutes	16.8	9.1	13.3	0.0	0.7	9.1	9.1	0.0
At least every 30 minutes	40.9	38.7	39.3	17.3	29.5	22.3	22.3	13.3
Less than every 30 minutes	33.4	43.2	34.8	39.2	53.8	53.4	52.6	27.8
No Service	9.0	9.0	12.6	43.5	16.0	15.3	16.0	58.9

Notably, a very low proportion of low-SEIFA households had access to high quality public transport, even during the morning peak which might reasonably be considered the time when those in employment would be requiring affordable and effective transport for work journeys. Only 16.8 per cent of low-SEIFA households were had good spatial access to public transport during the morning peak. Clearly the uneven patterns of spatio-temporal public transport provision are having divergent socio-spatial effects as a result of the varied geography of social disadvantage on the Gold Coast. Only a minority of low SEIFA households, no more than 17 per cent received no service at all during all periods.

Transport disadvantage and the elderly

The above discussion concentrates on those households categorised by the ABS as having low socio-economic status. The present study also undertook mapping and analysis of the access experienced by other social categories. By way of comparison we present the results of our analysis of the distribution of the elderly population of the Gold Coast relative to the public transport system. While most of the social groups we considered in the broader study were potentially correlated with high levels of social disadvantage, such as the unemployed or those on low incomes, the elderly were considered a likely sub-category of potential disadvantage, but which displays a different locational geography compared to the low SEIFA households portrayed in Figure 2.

The spatial distribution of the elderly population of the Gold Coast is presented in Figure 3, relative to the coverage of the public transport system for the 9:30 am to 3:00 pm off-peak period. We have selected this later period as the basis for examining the level of transport access for the elderly on the basis that this group is less likely to require access to public transport during conventional working hours relative to the SEIFA groups.

The geography of the elderly within the Gold Coast urban area differs somewhat from the spatial distribution of low SEIFA households. The main relative concentrations of the elderly are in a broad band between two and five kilometres inland along the eastern coastal strip of the Gold Coast ranging from Broad Beach through to Coolangatta. High elderly concentrations also occur in specific locations such as Coombabah and Runaway bay to the north of the marine strip, within Parkwood, Benowa and Nerang. In some of CDs within these localities, such as in Ashmore, the elderly constitute above 60 per cent of the population, a level that is presumably associated with elderly-specific residential sub-markets such as retirement or aged care institutions (Figure 3).

Of particular note is the lack of high frequency services in the Labrador and Southport localities immediately to the northwest of Surfers Paradise. Southport is the site of the major Gold Coast hospitals, services which are potentially highly patronised by those with greater healthcare demands, such as the elderly. While some inter-peak services operate through the middle and northern suburbs of the main urban area of the Gold Coast, our analysis demonstrates that many areas with high proportions of elderly residents have infrequent or no public transport services during this period. Like the public transport access gaps faced by low SEIFA households these provision gaps for the elderly are of serious public policy concern, as they potentially impact on the mobility and extent of social inclusion experienced by the aged population. From a methodological perspective, the combination of social and operational geographic data successfully enables the illumination of these problems, a task that would be technically difficult and highly time-consuming without the availability of GIS software and suitable data.

Comparing complex socio-spatial transport geographies

While our analysis investigated the conditions of a number of groups, for reasons of space our detailed analysis has been restricted to two exemplar populations – low-SEIFA groups and the elderly. To present some of the findings from the analyses of the transport disadvantage faced by other groups we have tabulated the relative access to transport services of particular frequency, not in terms of proportional access, but in terms of the relative access of each group when compared to the average for the overall population. This information is presented in Table 2, with the symbol ↑ used to indicate greater relative access and the contrary symbol ↓ used to indicate relatively poorer access.

Some brief observations from Table 2 are relevant. Low-SEIFA households fared better than the overall population in 15 of the 24 temporal periods assessed. In particular low-SEIFA groups received better or the same service frequency as the overall population during the morning and evening weekday peaks. The unemployed were not as well served by public transport as the overall Gold Coast population during the morning peak but had the same level of access during the evening peak. Of note, the unemployed had much better off-peak weekday access than the overall populations. Low-cost rental households were better off than the overall population for 16 out of 24 of the temporal service periods assessed. Rental households appeared to be better served by high quality public transport during most periods of the day compared to the overall population. Persons under 15 years fared worse than the overall population for high quality public transport across most periods of the day and week. On the basis of our study, young people appeared to be the most transport disadvantaged group in terms of their spatial concentration relative to public transport services. Households without a car were better served by high frequency public transport than the

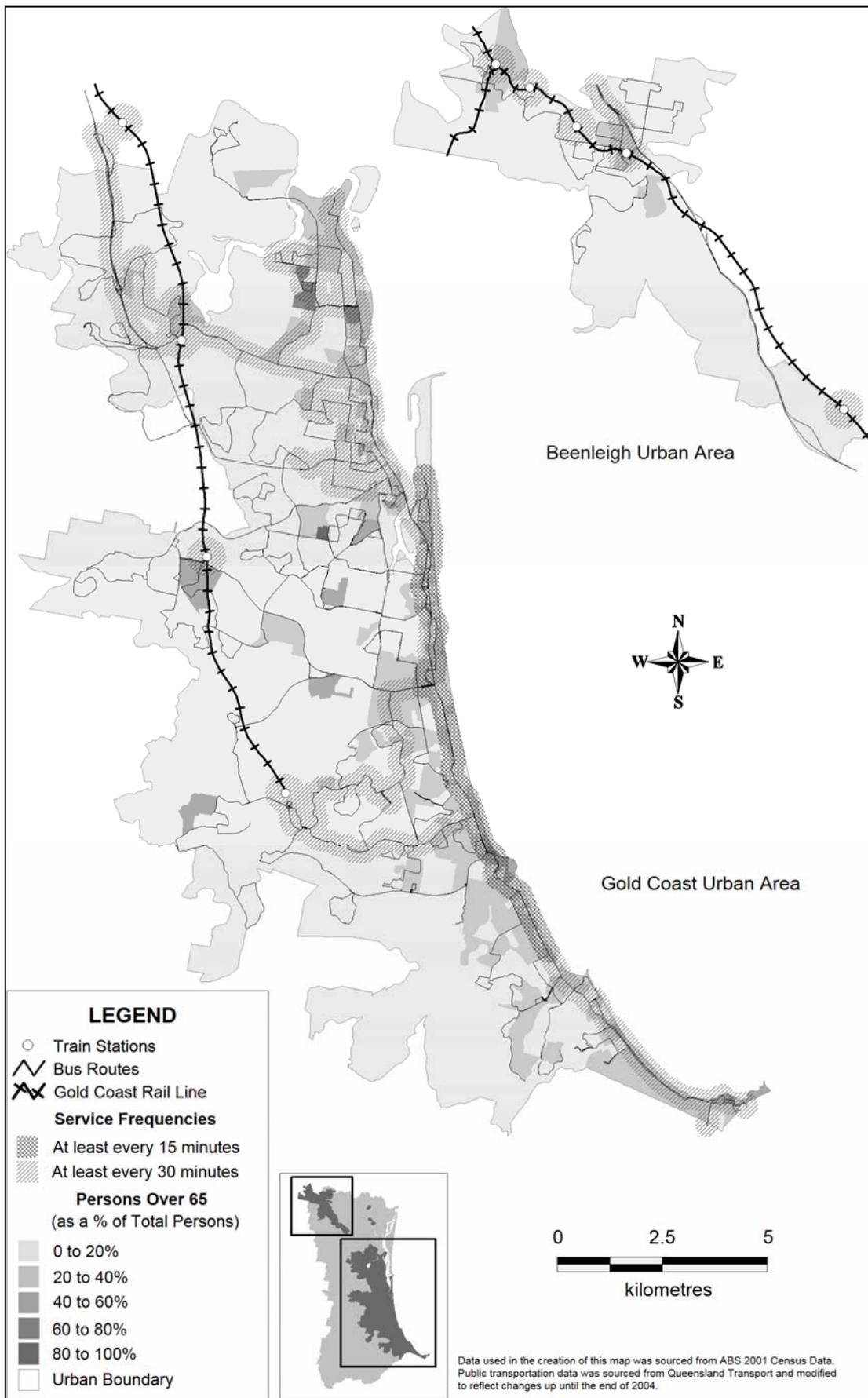


Figure 3: Public transport service coverage and frequencies for the weekday off-peak relative to Elderly population concentrations within the Gold Coast urban area.

overall Gold Coast population during the weekday mornings, suggesting relatively less transport disadvantage for this group than might otherwise have been assumed.

Discussion and Conclusions

Socio-spatial changes driven by evolving economic and social forces in concert with policy shifts continue to transform Australia's cities, including non capital urban areas, such as the Gold Coast. One important dynamic amongst these changes is the interplay of two shifting geographies: the distribution of socio-economic status and of urban infrastructure and services. The above analysis concludes the extensive conceptual, methodological and empirical advancements we have presented in this and a previous paper that has sought to improve comprehension of the connection between socio-spatial patterns and the access to employment and services provided by urban transportation systems.

Our hope is that these analyses, focused on the Gold Coast study, have advanced, if modestly, the Australian scholarly comprehension of urban transport disadvantage and the methods available that can be relatively easily and effectively deployed to understand this problem. Urban policy makers too require high quality information to inform decisions about the distribution of urban infrastructure and the planning of new land-use activities and to make these decisions while appreciating the impacts of change on vulnerable groups.

This study has linked two broad sets of disciplinary capacities that have not historically been closely allied. The analysis of transportation systems has traditionally been the reserve of highly technical disciplines serving mobility objectives with little attention to the broader social and economic patterns, beyond those necessary for modelling of land-uses and traffic flows, and which influence the character of mobility flows. Conversely, social analysts have been largely content to comprehend the distribution of social status and economic opportunity within urban areas to the exclusion of systemic and technical factors, particularly those relating to accessibility and mobility.

Our investigation has been concerned to draw together the social and transport streams to develop a methodology that is sensitive both to social differentiation and to infrastructure distribution within urban areas.

Much of the purpose of this study has been methodological. We do note an overall empirical observation that deserves reiteration. While we have focused in this study on the social geography of various groups, the main empirical finding is that there is strong differential socio-spatial patterning between social groups who are vulnerable to transport disadvantage and relative to the overall population in terms of both their location within the urban structure and also their relative spatial and temporal access to public transport services. While the patterns we explored are particular to the Gold Coast, there is a strong likelihood this differentiation in transport disadvantage would be present in other cities, not only in Australia. This observation is important, because policy makers could easily conceptually combine these groups into the 'transport disadvantaged' and rollout policies to address this disadvantage, without comprehending the distributional subtleties in geographic impact. Hence different policy strategies and instruments may be necessary to address the transport access of the elderly, compared with, for example, young people. In a world of scarce transport resources, optimal use of these resources indicates a need for high quality analysis to inform decision making. Such an observation should not avoid the superiority of the objective of ensuring universally high quality access to public transport for all urban residents (Mees 2000).

While the paper has been concerned to account for social factors in transport research, we are cognisant of the critique that has been made of social analyses that are overly reliant on the use of ABS statistics, particularly Census categories (Gibson *et al.* 1996). A view which adopts already

constituted categories and telescopes down through centrally controlled quantitative data sets can lead to generalisations that elide the subtleties and nuanced dynamics of local-scale social change. The risk is that analysis reduces to dry technical exercises based on maps and statistics without any real appreciation of what is occurring on the ground and in the experiences of the persons represented in the models and plans. This risk has not been entirely overcome in the present study.

We have traded off the rich local scale insights obtainable through methods such as household surveys or ‘community mapping’ for a comprehensive metropolitan-scale analysis. Given the intention to identify the differentiation of localities through social and service geographies, this metropolitan view is appropriate. In this sense we have been able to demonstrate that our methodology is technically efficient at identifying gross service gaps and inadequacies both spatially and temporally. From this study more detailed local-scale studies could be undertaken to

Table 2: Comparison of public spatial and temporal public transport access for selected social groups relative to the overall population within the Gold Coast city.

Frequency	Weekdays				Saturday			
	Start-9:30am	9:30am-3:00pm	3:00pm-7:00pm	7:00pm-End	Start-9:30am	9:30am-3:00pm	3:00pm-7:00pm	7:00pm-End
Low SEIFA								
At least every 15 minutes	↑	↓	↓	-	↑	↓	↓	-
At least every 30 minutes	↑	↑	↑	↓	↑	↑	↑	↓
Less than every 30 minutes	↑	↑	↓	↑	↑	↑	↑	↑
No Service	↓	↓	↓	↓	↓	↓	↓	↓
Unemployed								
At least every 15 minutes	↓	↓	↓	-	↑	↓	↓	-
At least every 30 minutes	↑	↑	↑	↓	↑	↑	↑	↓
Less than every 30 minutes	↑	↑	↑	↑	↑	↑	↑	↑
No Service	↓	↓	↓	↓	↑	↓	↓	↓
Rental Households <\$150 pw								
At least every 15 minutes	↑	↑	↑	-	↑	↑	↑	-
At least every 30 minutes	↑	↑	↑	↑	↑	↑	↑	↑
Less than every 30 minutes	↓	↓	↓	↑	↓	↓	↓	↑
No Service	↓	↓	↓	↓	↓	↓	↓	↓

Table 2 continued

Frequency	Weekdays				Saturday			
	Start-9:30am	9:30am-3:00pm	3:00pm-7:00pm	7:00pm-End	Start-9:30am	9:30am-3:00pm	3:00pm-7:00pm	7:00pm-End
Mortgage Households <\$600 pm								
At least every 15 minutes	↓	↓	↓	-	↑	↓	↓	-
At least every 30 minutes	↓	↑	↓	↓	↓	↓	↓	↓
Less than every 30 minutes	↑	↑	↑	↑	↑	↑	↑	↓
No Service	↓	↓	↑	↑	↑	↑	↑	↑
Persons aged < 15								
At least every 15 minutes	↓	↓	↓	-	-	↓	↓	-
At least every 30 minutes	↓	↓	↓	↓	↓	↓	↓	↓
Less than every 30 minutes	↑	↑	↑	↓	↑	↑	↑	↓
No Service	↑	↑	↑	↑	↑	↑	↑	↑
Persons aged > 65								
At least every 15 minutes	↑	↑	↑	-	↓	↑	↑	-
At least every 30 minutes	↑	↑	↑	↑	↑	↑	↑	↑
Less than every 30 minutes	↓	↓	↓	↑	↓	↓	↓	↑
No Service	↓	↓	↓	↓	↓	↓	↓	↓
Households Without a Car								
At least every 15 minutes	↑	↑	↑	-	-	↑	↑	-
At least every 30 minutes	↑	↑	↑	↑	↑	↑	↑	↑
Less than every 30 minutes	↓	↓	↓	↑	↓	↓	↓	↑
No Service	↓	↓	↓	↓	↓	↓	↓	↓

better tease out the barriers and frictions to public transport accessibility among the various groups we consider. Locally detailed and engaged studies such as those undertaken by Johnson and Sirath (Johnson and Herath 2004), and the types of analysis provided by Lucas (2004) provides a fruitful basis for such further investigation.

Clearly there is much room for further refinement of the methods we have deployed in pursuit and support of better scholarly connections between social and transport systems analysis. The collection of better travel data could assist in this regard, while there is substantial room for greater

sophistication in the local scale units used for the mapping analysis. Some major advances in the combination of temporal accessibility in relation to multiple employment and services locations are possible. At the time of writing (September 2005) a research team within the Urban Research Program has been working on such a refinement of the accessibility modelling procedures. We look forward to the Australian and international scholarly community making further advances in the use of GIS and spatial methodologies in the investigation and examination of the important relationships between social status and transport systems.

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