

Is Transit Oriented Development reducing the activity spaces?

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Abstract

This paper reports on the potential mobility effects arising from the construction of a new suburban railway running 72 kms through Perth's southern suburbs and the corresponding transit oriented development (TOD). The aim of the research is to measure the degree to which the TOD opportunity leads residents to reduce their car travel and to substitute this with public transport.

In this particular paper we investigate the potential modification (reduction) of the activity spaces resulting from TOD and the relationship with location preferences. Work and non-work activities in the neighbourhood are analysed together with physical activity (including cycling and walking). The activity spaces are analysed across 5, 10, 15 walk, and 5 min drive isochrone areas and in conjunction with socio-demographic characteristics of the areas. We compare the behaviour of residents living in four travel zones within one railway station precinct (Bull Creek precinct - a significant generator of trips) located along the new railway.

Our research findings show that workplace and school are significant 'pegs' of activity spaces, outlining their size and shape. The second moments and confidence ellipses tend to decrease in size with distance from the railway station, as result of the socio-demographic profile of the areas. The dominance of commuting in the travel of households located in the 5 and 10 min walking areas influences the spatial extension of the activity spaces. Areas further from the railway station are characterised by a significantly higher number of family members, and especially school age children. Their activity spaces are strongly related to the location of schools. After commuting was accounted for, the activity spaces in all travel zones shrunk considerably, almost 'mirroring' the neighbourhood area.

Summarising, the distance from the railway station and urban features seemed to play a minor role onto activity spaces; on the other hand, family size and car availability have had significant impact on the activity engagement and the size of the activity spaces. They were more strongly conditioned by the time constraints (institutional or personal) compared to the accessibility provided by the transport network.

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Introduction

Considerable research in the last decades has been dedicated to measurable relationships between urban form and activity-travel patterns (Kitamura, Fujii, and Pas, 1997; Cervero, 2005; Ewing and Cervero, 2003; Zhang, 2005) and their impact in relation to the quality of the urban environment (Handy, 2006) and in relation to quality of life (Turksever and Atalik, 2001). In general it is expected that compactness (higher residential density and greater land use mix) associated with good public transport services, as opposed to sprawl (represented by low values in density, continuity, concentration, compactness, centrality, nuclearity, diversity, and proximity - Eidlin, 2005) would result in a reduction of kilometres travelled by car and the substitution by public transport, walking and cycling. It is argued that by increasing the accessibility to local activities, individuals and households will take advantage of the opportunities offered and decrease their travel.

Households may change houses and move to areas of higher accessibility if the housing facilities and costs are suitable for them. Decisions about residential location are usually made in stages and the decision to move or stay is influenced by a range of pull and push factors (Rossi, 1955). Push factors may include an increase in externalities like pollution or crime, changes in housing affordability, dissatisfaction with the current dwelling or changes in family structure. Pull factors include access to quality public services (such as improved public transport), employment, leisure and recreational opportunities or the fulfilment of housing aspirations (Sanchez and Dawkins, 2001). Households trade-off housing and transport costs when making their location decisions (Scheiner, 2005) and these trades-offs lead to the fulfilment of the most important wishes of the family.

The results of studies which explore the role of transport factors in the residential location of households have been mixed. Giuliano and Small (1993) found that their sampled households in Los Angeles, US generally commute more than they need to and this suggests that transport, to the workplace at least, is not a salient determinant of residential location. Challiol and Mignonac (2005) investigated the couple's decision-making process when relocating due to employee relocation and found this is a compromise solution, a function of the occupational and family roles within the couple as well as their expectations of how to organise their life as a couple. However a stated preference experiment exploring residential location choice behaviour in Oxfordshire, UK, found that an increase in travel time to work or to shopping was a good predictor of household relocation (Kim, Pagliara, and Preston 2005). Tillema, Ettema, and van Wee (2005) also found that travel cost (including road pricing) is an important factor influencing residential location choice in The Netherlands. Respondents were more sensitive to travel costs than to housing costs and they valued less negatively travel time vs. travel cost. On the same topic, Arentze and Timmermans (2006) examined the long term spatial effects of congestion pricing: reducing home-work distance or reducing home-based distance to locations for non-work activities. Moving houses or changing jobs was seen by many respondents as a resort to escape rising living expenses.

It is argued that personal attributes and attitudes may have more effect on mobility than the characteristics of the urban form. McQuaid, Greig, and Adams (2001) and Ewing and Cervero (2001) found that socio-economic factors were more significant the purely spatial ones (urban form) in commuting times and mode choice. Kitamura et al. (1997) found that attitudes are more strongly associated with travel than are land use characteristics.

Similarly, Schwanen and Mokhtarian (2005a) argued that the true determinants of travel patterns are attitudes rather than land use (LU). They investigated the effect of lack of congruence between physical neighbourhood structure and preferences regarding LU in the neighbourhood of home and on the distance travelled overall and by mode. Cao and Mokhtarian (2005) observed that individuals and households with particular lifestyles (e.g., extremely “mobile”) will convert the accessibility benefit (e.g., a faster transport mode) into increased distance covered by car, rather than travelling less or switching to public transport, cycling and walking. While Schwanen and Mokhtarian (2005a) found that some families take up opportunities offered by presence of facilities in the neighbourhood within walking distance, they reduce their motorised private travel, and increase or maintain their levels of physical activity.

Both Anable (2005) and Clay and Mokhtarian (2004) investigated attitude and personality impact on travel management and showed that individuals with attitudes favouring travel are more likely to adopt and consider travel-maintaining strategies while those with attitudes less prone to travel (e.g. pro-environmental, community-oriented) would tend to adopt and consider travel-reducing and major location/lifestyle-change strategies. This is supporting the “self-selection” claim in the literature - that a household with a predisposition toward a certain type of travel “self-selects” a residential location enabling the pursuit of that preferred type of travel.

The issue of the self-selection makes an examination of the characteristics of the urban development and the location and travel choice more problematic. Residential location in a particular area and the use of car or other transport modes is a reflection of many influences other than environment; travel and location are related to access to transport and amenities, parking, but also to personal traits (preferences, life style) and household characteristics (size, presence of children or senior family members, income, number of employees, etc.). This emphasises the need for individual treatment of activity, travel, and location patterns, if we want insightful and more accurate estimates of impact of various LU and transport policies on travel and location decisions.

No doubt, the debate on the underlying relationship between urban design and sustainable travel is far from its end due to the controversial or unclear results of previous research (Shay and Khattak 2005, p.18). It is a complex relationship because, whilst land use factors are a determinant of travel behaviour, they are not the only one, nor are they necessarily a causative element (Kitamura, Laidet, Mokhtarian, Buckinger, and Gianelli, 1994; Handy, 1996; Cervero and Landis, 1997; Banister, 1997; Boarnet and Sarmiento, 1998; Stead, Williams, and Titheridge, 2000; Mees, 2000; Hickman and Banister, 2002; Dieleman, Dijst, and Burghouwt, 2002). Demographic factors including income (and therefore car ownership), family structure, age and gender are also determinants (Hanson and Schwab, 1987; Royal Commission on Environmental Pollution, 1994; Nijkamp, Ouwersloot, and Rienstra, 1997; Schwanen et al, 2001), but likewise the values and attitudes of individuals are also determinants of travel (Kitamura et al, 1994; Boarnet and Sarmiento, 1998; Krizek, 2003; Anable, 2005; Schwanen and Mokhtarian, 2005b).

In this paper we aim to tackle one component of this complex picture. We investigate the potential modification (reduction) of the activity spaces resulting from TOD and the relationship with location choice and preferences. We examine this in the context of one

station precinct in order to measure the effect of distance from the railway station site (a single measure of accessibility) on individual's activity spaces.

Activity spaces

The area of urban space used by individuals to satisfy their daily activities is regarded as the activity space or action space. The activity spaces concept has been used with numerous connotations: convex hull containing activity locations visited by an individual within a certain time and money budget (Schöenfelder and Axhausen, 2003), perceptual action space, including potential activity locations/opportunities (Beckman, Golog, and Zahavi, 1983; Dijst, 1999), or approximate measure of the individual's mental map (Axhausen and Gärling, 1992).

Interestingly, the activity space is an integrated measure of the individual's daily activities "repertoire", correlated with the costs of accessing different opportunities. In this respect, it reflects all three processes influencing accessibilities: scheduling of time-space budgets, the nature of the transport system, and the time-space organisation of accessed services – Church, Frost, and Sullivan, 2001; Harvey and Taylor, 2000. Main activities, space- and time-fixed, act like 'pegs' around which the ordering of other activities are arranged and shuffled according to their flexibility (Cullen and Godson, 1975).

Several parametric and non-parametric measures may be used for activity space: confidence ellipses, standard distances (or second moments of activity locations), kernel densities, network bands, and convex polygons. Although each of them stress different elements of travel behaviour and have different assumptions, the activity spaces illustrate the feasibility of carrying out the desired activities by evaluating the spatial spread of activities, both on environmental criteria and socio-economic criteria. This research uses second moments and confidence ellipses to examine household mobility.

The benefits of the confidence ellipses (CE) have been suggested since late 1970s. Zahavi (1979) highlighted their powerful visualisation capability to characterise travel behaviour and activity participation. Newsome et al. (1998) used the confidence ellipse to define the observed activity space (area where people regularly engage in activities) "blended" with space-time prisms. Schöenfelder and Axhausen (2003) applied CE to address issues of social exclusion. Recently, Buliung and Kanaroglou (2006) reviewed GIS tools to investigate spatial and temporal activity-travel behaviour of individuals and households, and applied activity space measures and space-time trajectories for Portland. Their findings are very similar with those found in Sydney by Olaru, Smith, and Ton (2005), who related activity spaces to socio-economic characteristics and elements of urban form in a SEM framework.

The confidence ellipse has numerous properties that can serve for describing the spatial scope and orientation of spatially and temporally linked activities. These properties include: location of centre of ellipse, area, ratio of axes, and orientation (angle with a cardinal point). The position of the centre of gravity can reveal the most significant "attractors" of activities and it is judged with respect to home and work location; the area of the ellipse gives a potential measure of the spread of activities in the urban space; the ratio of major to minor axis will identify corridor influences (thin ellipse) in the daily activity patterns vs. even spatial and temporal distribution of activities ("full" ellipses, close to circles); the

angle of orientation complements the ratio measure in showing impacts of the corridors formed by the most frequently visited locations (e.g., home to main activity - work/education).

The area of the ellipse, A , can be calculated by the covariance matrix of all ordered activity locations of the individual (Schöenfelder and Axhausen, 2003): $A = 6\pi\sqrt{|S|}$ (1)

$$\text{where } S = \begin{pmatrix} S_{xx} & S_{xy} \\ S_{yx} & S_{yy} \end{pmatrix} \quad (2)$$

$$S_{xx} = \frac{1}{n-2} \sum_{i=1}^n (x_i - \bar{x})^2 \quad S_{yy} = \frac{1}{n-2} \sum_{i=1}^n (y_i - \bar{y})^2 \quad \text{and } S_{xy} = S_{yx} = \frac{1}{n-2} \sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y}) \quad (3)$$

In this study, the coordinates of the activity locations (x_i, y_i) were weighted by the frequency of visits (importance), deriving the centre of gravity (cg) of activities, which is the centre of the ellipse.

The ratio of the axes is determined by $\sqrt{\frac{\lambda_1}{\lambda_2}}$, where λ_1 and λ_2 are the solutions of the equation: $\lambda^2 - \lambda(S_{xx} + S_{yy}) + |S| = 0$. (4)

Finally, the orientation is given by the sign of the correlation coefficient between the coordinates of the activity locations.

The second moments of activity location are simply the squared distance between residence location and centre of gravity of all the other activity locations (I_H) or the spread of activities around the centre of gravity (I_{CG}) – see for more details Susilo and Kitamura (2005).

One objective of our research project is to measure the behavioural responses of households to emerging transit oriented development precincts associated with the development of the new railway in Western Australia (WA).

Methodology and data

The government of Western Australia has invested over \$1.6 billion to create a new strategic railway corridor through metropolitan Perth's southern suburbs, adding 72 km to the electrified passenger rail network. This new rail line traverses partly through existing suburban development (disruption has been minimised by routing the railway along the centre of an existing freeway reserve) and partly through 'green fields' (Figure 1). In the former locations redevelopment opportunities are being pursued in order to re-orient the urban area towards the station. The latter also provides new opportunities for TOD, and to further increase accessibility and economic opportunity, the government and the private sector have also planned for new transit-oriented communities at suitable station precincts.

Insert Figure 1 about here

In this research paper we present some early findings from the Bull Creek station precinct (in total we have three station precincts selected for their differing accessibility attributes in our project, later papers will report on all precinct findings). In relation to TOD this station precinct will act primarily as an origin station or transit interchange, the focus here is on achieving a high level of accessibility to the station itself by car and feeder buses without significant land use mixing and 'walk-on' patronage to act as trip attractor.

The limits of the station precincts were established at a five minute drive around the railway station considering the distance between adjacent stations and also known travel behaviour thresholds. Isochrones of actual 5, 10, and 15 minute walking distance were also drawn to identify population groups that may have different propensities to use public transport depending on their proximity to the railway station.

Recruitment and survey instrument

Data was collected during November-December 2006. This is the first wave of a major research study being funded by the Australian Research Council having 11 industry partners interested in the impacts of transit oriented development (TOD) for transport and location. In Bull Creek we interviewed 314 households drawn randomly from a total population of 8073. We set a minimum quota of 50 households in each of the 4 travel zones within the precinct.

The computer-assisted survey included questions about household's current and previous location, reasons for moving in the new areas, perceptions about the urban features in the area (four sets of questions with multiple items on a 7 unit Likert scale), and about their travel behaviour (trip diaries were given to the household for each family member that travelled independently). Socio-demographic information was collected for every household member and a stated choice experiment was also conducted with the person interviewed. Finally, to examine the effect of TOD on location and travel, the interviewees were asked several attitudinal questions related to their perception of LU, and regarding their physical activity in the previous week.

An introductory letter was sent to the randomly selected households one week before the interview. Then an interviewer (student or academic from the two universities participating in the study) contacted the household. If after three attempts in various days and at different times of day the household could not be contacted, we replaced the household with another one from the sampling frame. During the interview (which lasted between 12 and 40 mins depending primarily on the size of the family) the household received trip diaries to be filled in on the set travel day (always a Wednesday). The trip diaries were collected by the interviewers on the day following the travel day. The origins and destinations of all trips were geo-coded and second moments of activity spaces along with the size of the confidence ellipses were determined.

Multivariate analysis of variance was used to assess differences across the four travel zones based on several dependent variables.

Results and comments

Bull Creek Precinct Profile

General descriptive statistics for the precinct and for the sample of households and persons used in this paper are provided in Tables 1 and 2. It is evident that family size (and correspondingly dwelling size and number of students) broadly increases with distance from the station. In addition car availability and the number of available car parking spaces increases with distance from the station. We have also considered a measure of ‘busyness’, on the basis that this is likely a key to the amount of travel by car a person undertakes. In this case ‘busyness’ decreases with distance from the station and most likely relates to the prevalence of larger child-based households.

Table 1 Profile of Bull Creek precinct in relation to metropolitan Perth

Precinct	Population density	Dwellings	Education	Born	Employment (labour force)	JTW	Distance from CBD
Bull Creek	1704 person/km ² living in 492 household/km ²	700 dwellings/km ² from which 521 are separate houses	43.2% >= year 12	58.7% born in Australia	48.2%	62.1% Car Driver only; 6.3% Bus only	12.1 km
Metropolitan Perth	1429 person/km ² living in 348 household/km ²	627 dwellings/km ² from which 447 are separate houses	32.9% >= year 12	62.8% born in Australia	49%	58.3% Car Driver only; 2.9% Bus only	N/A

Source: Australian Bureau of Statistics (2001)

Table 2 Descriptive statistics for travel zones in Bull Creek precinct

	5 min walk	10 min walk	15 min walk	Residual in 5 min drive
	Mean (Std dev)			
Family size	2.3 (1.26)	2.79 (1.53)	2.95 (1.48)	3.06 (1.39)
# bedrooms	3.06 (0.73)	3.28 (0.75)	3.78 (0.76)	3.92 (0.96)
# students	0.52 (0.89)	0.73 (1.07)	0.89 (1.16)	0.87 (1.15)
Average weekly working hours/person (“busy-ness” indicator)	37 (6)	28.5 (10.3)	26 (12.7)	25 (11.9)
Car availability	1.59 (0.91)	1.98 (1.2)	1.91 (0.89)	2.1 (1.09)
Parking space	2.11 (1.19)	2.68 (1.2)	2.71 (1.2)	3.26 (1.3)
# bicycles adults	0.88 (1.24)	1.26 (1.38)	1.16 (1.41)	1.46 (1.48)
# bicycles children	0.48 (0.95)	0.42 (0.86)	0.47 (0.99)	0.48 (0.94)

In relation to the travel profile, Table 3 presents the average reported travel distances and times. MANOVA analysis has shown that there are no significant differences between households living in the four zones around the railway station.

Table 3 Bull Creek: Average travel times and distances/person and day

	5 min walk	10 min walk	15 min walk	Residual in 5 min drive
	Mean (Std dev)			
Daily travel time (min)	60.61 (32.1)	78.13 (42.56)	72.23 (38.18)	68.82 (38.5)
Daily travel distance (km)	35.29 (29.69)	43.26 (33.65)	36.87 (25.9)	37.01 (27.4)

Attitudes to the neighbourhood

in terms of their “valuation” of neighbourhood facilities, MANOVA identified marginally significant differences between people living in the four travel zones (p value for Pillai's Trace and Wilks' Lambda = 0.052 and 0.049). The rating of proximity to transport (and particularly railway station) and urban facilities was highest for households living further from the railway station value. Particularly relevant is the importance households allocated to the proximity of good schools (such as the highly prized Rossmoyne High School located in the 5 min drive area). As shown in Table 4, households considered more important the vicinity of transport and other urban amenities compared to affordability of housing or even the safety in the neighbourhood, most likely because affordability and safety are not an issue for this area.

Table 4 Rating of neighbourhood characteristics by travel zone (Likert scale from 1-min to 7-max)

	5 min walk	10 min walk	15 min walk	Residual in 5 min drive
	Mean (Std dev)			
Schools	4.31 (1.90)	4.96 (1.67)	5.79 (2.01)	6.13 (1.81)
Proximity of urban facilities	4.95 (1.66)	4.72 (1.89)	4.64 (1.93)	5.35 (1.78)
Proximity of transport	5.32 (1.99)	5.15 (1.82)	5.17 (2.05)	5.89 (1.83)
Safety	4.59 (2.14)	4.40 (2.22)	4.27 (1.96)	4.76 (1.75)
Affordability	3.63 (1.65)	3.88 (1.91)	3.27 (1.84)	3.76 (1.71)

Physical Activity

People living in the four travel zones have different propensities to do physical activity (p = 0.037 in the univariate tests), with the more physically active respondents in areas closer to the railway station. The explanation may reside again in the socio-demographic profile of the precinct. Families with younger children (more dominant in the outer zone) have less flexibility in their daily schedules as they have to juggle between work, maintenance activities, caring for children and taking them to various activities.

Table 5 Weekly walking physical activity/respondent

	5 min walk	10 min walk	15 min walk	Residual in 5 min drive
	Mean (Std dev)			
Frequency walking	6.19 (4.95)	5.96 (4.67)	5.58 (4.01)	5.43 (3.98)
Duration walking time (min)	126.6 (71.3)	147.11 (61.6)	143.6 (64.53)	128.14 (67.95)
Frequency intensive physical activity	2.13 (2.71)	1.65 (2.61)	1.61 (1.98)	1.73 (2.54)
Duration physical activity (min)	74.44 (83.14)	58.2 (77.24)	52.6 (80.9)	62.0 (75.5)
BMI	23.8 (4.02)	23.0 (5.85)	24.56 (3.32)	24.0 (5.21)

Activity Spaces

The household activity spaces determined using the second moments and confidence ellipses included all reported activities during a Wednesday normal working day. The distribution of trips by purpose is the following: 20.4% commuting trips, 8.2% for education, 16% for personal business, 14.4% pick-up and drop off, 16.1% for shopping (7.2% food shopping), 12.6% playing sport or spectating, 4.2% eating out, and remaining 8.3% for other purposes. More than 75% of generated trips were by car (59.6% as car driver), with only 6.2% by public transport and 2.4% cycling. Walking trips represented 14.3% of all trips. This profile is typical for metropolitan Perth.

The commuting trips were the longest in terms of distance (15.9 km average) and time (22.5 min. average). Trips for attending ‘sport’ events (note we included walking for exercise in this category) took on average 22.1 min, but as they were mostly walking trips the distances were around 6.1 km. The shopping trips were the shortest – taking in average 12.3 min at 5.45 km (food shopping) and 6.49 km respectively (other shopping). The trips for taking/fetching a person had an average duration of 13.1 min and they were made at an average distance of 6.53 km.

Average trip distances by transport mode are: 11.6 km (car), 16.2 (motorcycles), 15.1 (public transport), 6.2 km (bicycle), and 1.8 km (by foot).

The distribution of trips by mode in every travel zone (Table 6) highlights some of the characteristics of the area:

- the prevalence of families with children in the 15 min walk and 5 min drive is translated in a higher proportion of take/fetch trips. Children are either chauffeured to school and their non-curricular activities or they walk to school (accompanied by adults or by themselves);
- cycling occurs more frequently in the 5 and 10 min walking areas and this may be explained the presence/proximity of cycling facilities (a riverside and a CBD bound off-road bike network);
- patronage of public transport is quite even in the four travel zones, slightly higher in the 5 min walking distance; the opening of the southern railway services is expected

to increase this proportion and improve the non-auto travel, with both health and environmental benefits.

Table 6 Mode choice by distance from the railway station

	5 min walk	10 min walk	15 min walk	5 min drive
Car driver	61.3%	65.5%	61.0%	58.1%
Car passenger	12.6%	11.3%	16.2%	17.1%
Public transport	7.2%	6.0%	6.9%	5.3%
Cycling	4.4%	4.3%	1.3%	2.0%
Walking	13.4%	12.9%	13.8%	16.9%

The relationship between Activity Spaces and proximity to the railway station

The travel zones within the Bull Creek station precinct exhibit similar sizes of activity spaces. Interestingly, activity spaces have smaller values for areas further from the railway station and the confidence ellipses become more elongated in the 15 min walk and 5 min drive areas (Table 7).

Table 7 Activity spaces by distance from the railway station

	5 min walk	10 min walk	15 min walk	5 min drive
	Mean (Std dev)			
Second moment activity space (I_H)	37.2 (37.5)	31.3 (34.4)	27.3 (40.6)	30.9 (57.8)
Distance home – CG activities (km)	6.1	5.6	5.22	5.56
Second moment activity space (I_{CG})	384.3 (876.3)	372.2 (679.9)	180.8 (229.2)	290.5 (601.1)
Area activity space (CE) – km^2	244.7 (251.1)	223.1 (211.2)	166.3 (190.5)	190.4 (280.8)
Ratio axes confidence ellipse	4.81 (5.0)	7.62 (8.5)	9.33 (16.2)	8.92 (12.5)

The findings show the strong influence of commuting in the size and form of activity spaces. In the 5 and 10 min walking zones, where there are fewer families with school age children, the constraints in scheduling daily activities allow couples larger areas of opportunities to be covered. Households living closer to the railway station can travel further for work (6.1 km from home to the centre of gravity of daily activities); they have larger activity spaces (244.7 km^2) due to the spatially scattered activities (I_{CG} of 384.3). In contrast, households living in the 15 min walk and 5 min drive from the railway station are located closer to their work places (5.22 and 5.56 km), have smaller activity spaces (lower than 191 km^2) and more compact (I_{CG} of 180 to 290). In terms of shape, the activity spaces of households living in 5 min walking distance from the railway station are “fuller” compared to the other travel zones.

These preliminary findings support previous research showing a stronger influence of socio-demographic characteristics in travel behaviour and the size of activity spaces and are inconclusive in regard to urban form. Contrary to our expectations, activity spaces for households living in the 5 min walk zone from Bull Creek railway station are larger than for households living further. The size of the activity space is negatively correlated to the size of family and car availability. The results may be explained by the degree of flexibility in the household scheduling of daily activities, with larger families being “tied” to their homes and children’s schools.

Given the powerful imprint of commuting, we have also investigated the activity spaces after removing the commuting trips. The size of the activity spaces halved in all areas and they are now confined to the neighbourhood where schools, shopping, health and community services are located. This time though activity spaces in the 5 min walk from the railway station are smaller than for the 15 min walk and 5 min drive travel zones.

The results have shown that workplace and school versus residence location determine the size and shape of the activity spaces. The general linear models have revealed that the second moments and confidence ellipses tend to be larger in the 5 min walking area due to the dominance of commuting influence in the activity space. After commuting was accounted for, the activity spaces shrunk considerably, overlapping with the neighbourhood area. Distance from the railway station and urban features played a minor role and this was only indirect onto activity spaces: cycling facilities, public transport services seem to be used more frequently in the 5 min walking area. Family size and car availability appeared to have significant impact on the activity engagement and the spatial extension of the activity space.

Future research

This study identified the need for continuing research into the area of travel behaviour, location, and provision of urban facilities. This current paper reports only on the activity spaces across 4 travel zones around one of the new railway stations, scheduled to operate from April 2007. Geocoding locations for the other two station precincts is in progress and we hope to report this at the conference so enabling us to compare different precincts and the activity spaces in those areas.

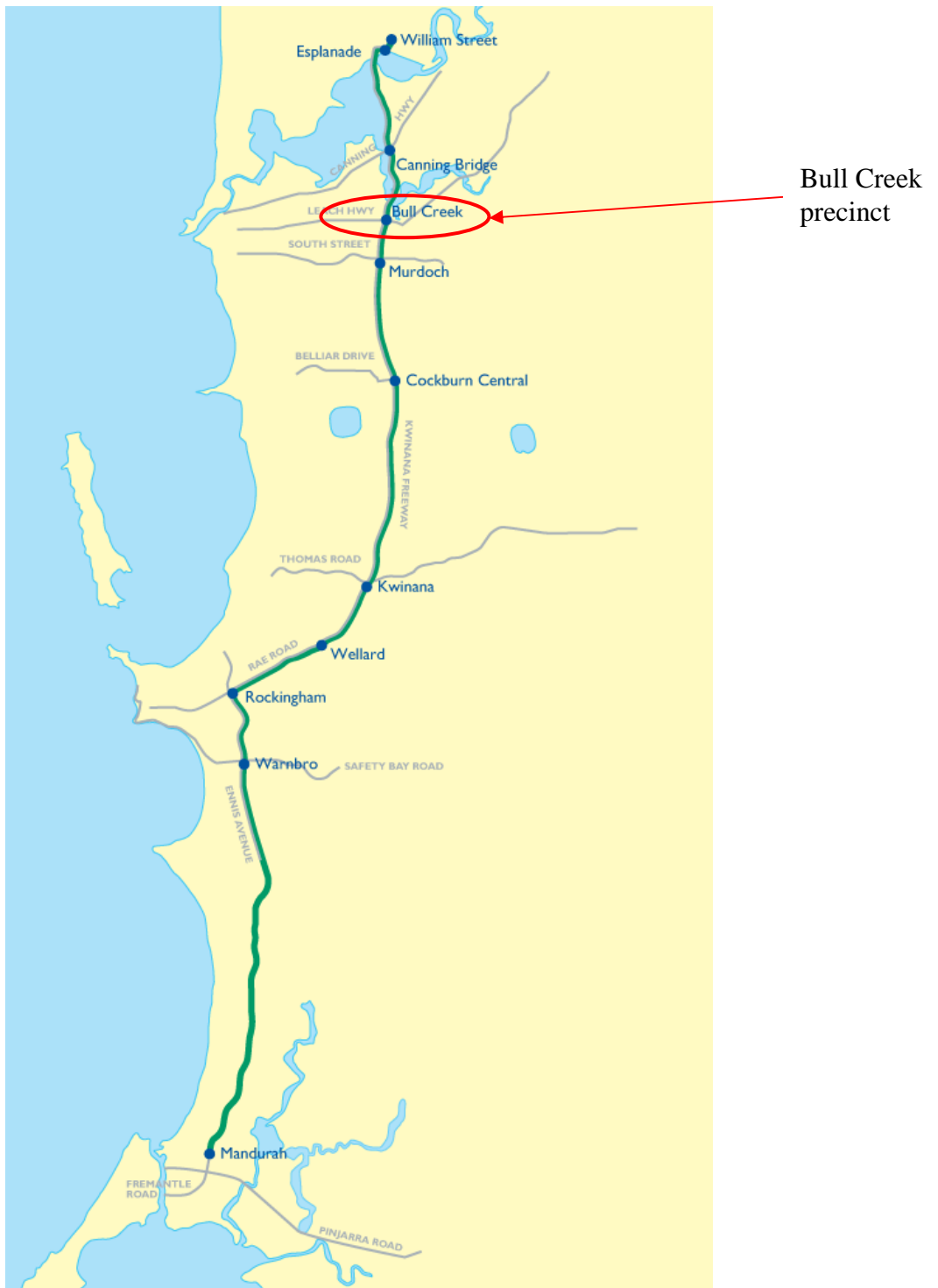


Figure 1 Study area (<http://www.newmetrorail.wa.gov.au/Default.aspx?tabid=207>)

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