CAN EXCLUSION FACTORS BE PRICED?

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Abstract

Social exclusion defines the degree in which an individual is limited in their access to the services and facilities to engage with their local and broader community. Following on from Burchardt (2000) and Scutella et al. (2009), the primary focus is on identifying the degree in which a household is excluded on at least one dimension, transport researchers have extended the research domain by investigating the relationship between the degree of exclusion and the level of accessibility to services. These avenues of inquiry are important because they describe the extent of social exclusion and the contribution of transport disadvantage. However, the results do not provide household valuations of the factors that affect access and, as such; they provide an incomplete basis on which to inform economic evaluation of policy directions. The aim of this research is to estimate household monetary valuations of the key transport accessibility measures of exclusion identified in the literature.

Keywords: social exclusion, accessibility, transport

1 Introduction

Rawls' (1972) suggested that socially responsible public policy decisions should aim to provide the greatest enhancement of welfare to the worst off members of society. It is important for policy makers to employ this type of perspective. If individuals from lower socio-economic backgrounds face limited opportunities, for example, education and employment, then economic output can be eroded. Sen (1997) described four adverse effects of persistent unemployment that are corrosive to the economy:

1) *Loss of current output and fiscal burden:* Not only does the economy lose productive capacity from having unutilised labour force, but there are also additional leakages of providing welfare payments further reducing total economic output;
2) *Loss of freedom:* This describes the severe restrictions put on an individual to be able to integrate with society, to participate in the market economy, and to access the essential services required for them to be a productive member of society;
3) *Skill loss and long-run damage:* Just as people learn by doing, they unlearn by not-doing - by being out of work and out of practice. Also, in addition to loss of skills, people lose cognitive ability by losing their confidence and sense of control;
4) *Psychological Effects:* Unemployment can wreak havoc on the mental state of the individual. Empirical studies, such as Jahoda et al. (1933), Eisenberg and Lazarsfield (1938), Bakke (1940a, 1940b) and Hill (1977) have shown that unemployment is highly correlated with suicide. The work of Robert Solow (1995) has also

> illuminatingly revealed the connections between unemployment, motivational impairment and psychological suffering.

Sen (1997) also outlined the huge strain inequality can put on government social support, particularly health care. Sharp increases in income inequality have coincided with high health inequality. This has developed into breakdowns of hospital systems and medical services, as well as disastrous psychological effects such as depression and alcoholism.

2 Social Exclusion

2.1 Identifying the disadvantaged

Poverty studies have focused on income as a way to identify disadvantaged individuals. The Henderson poverty line is set at the disposable income required to support the basic needs of a family of two adults and two dependent children, while other popular poverty thresholds use a percentage of median income (Scutella et al., 2009). In Australia, a person is considered in a state of poverty if their household income is less than 50% of median income (Healey, 2011, pp1). Over 12% of Australians currently live below the poverty line, this is around two percentage points above the OECD average (OECD, 2008). A major source of poverty in Australia is the change in social structures. Single parent families are a major contributor to poverty; Australia has the fourth highest proportion of children living in jobless families in the OECD, largely led by an increase in single parent families (Social Inclusion Agenda, 2011).

Another major way of perceiving low-income poverty is to analyse households in the bottom quintile of income earners: 35% of these households report only fair or poor health compared, 10% have trouble accessing transport, while two-thirds do not have access to the internet (Social Inclusion Agenda, 2008). Half of the population making up the bottom quintile of income earners are sole parent families (Healey, 2011, pp1).

A failure to share in the prosperity of a nation is not a question of a lack of material goods, but may also include an inability to function socially and economically in society (Healey, 2011, pp4). *"Ultimately poverty must be seen in terms of poor living, rather than just as lowness of incomes. Income may be the most prominent means for a good life without deprivation, but it is not the only influence on the lives we can lead."* (Sen, 2000, pp3)

Townsend's (1979) comprehensive study of poverty in Britain provides a useful framework for broadening our concept of disadvantage. Townsend (1979) identifies poverty as relative deprivation - *"the absence or inadequacy of those diets, amenities, standards and services which are common or customary in society"* (Townsend, 1979, pp915). Alternatively, Sen (2000) uses the notion of *capability deprivation*, that is, an impoverished life is one without the freedom to undertake important activities that a person has reason to choose. What we can gather from Sen and Townsend's perspectives is this idea that leading a disadvantaged life is more than not having a certain level of income. It is about leading a life that contains a certain range of activities. Moreover, these activities are *relative.* The activities will be conditional upon the standard of living of society at a particular time.

2.2 Origin of Social Exclusion

Rene Lenoir (1974) was the first to regard the disadvantaged section of the population as "socially excluded" in his assessment of the French population who were not covered by the social security net. These included: mentally and physically handicapped, suicidal people, the aged, invalids, abused children, substance abusers, delinquents, single parents, multi-problem households, marginal, asocial persons, and other social "misfits" (Silver, 1995, pp63). These people made up around 10% of the French population. The concept has since been extrapolated and is currently used to refer to a range of dimensions which marginalise people and reduce their opportunities to engage in social or political life (Scutella et al., 2009, pp7).

This concept of social exclusion became prominent in Britain under the Blair Labour government in the 1990's when they introduced the Social Exclusion Unit (SEU). The unit outlined social exclusion as *"what can happen when people or areas suffer from a combination of linked problems such as unemployment, poor skills, low incomes, poor housing, high crime, poor health and family breakdown"* (The Social Exclusion Unit, 2004). The unit has addressed a number of different areas including elderly disadvantage, youth unemployment, and teenage pregnancy, repeat criminal offenders, homelessness and transport disadvantage.

What becomes apparent is the breadth and complexity of issues associated with the term social exclusion. A coherent definition and framework for the concept is imperative so that we can identify which individuals are socially excluded, the extent of their exclusion and what type of policies can attempt to alleviate exclusion.

2.3 Definition of Social Exclusion

Burchardt (2000) attempts to fill this definitional void by defining social exclusion based on Townsend's concept of relative deprivation.

"An individual is socially excluded if he or she does not participate to a reasonable degree over time in certain key activities of his or her society and

(a) *This is for reasons beyond his or her control*
(b) *He or she would like to participate"* (Burchardt, 2000, pp388)

The key point here is that for an individual to be socially excluded they must *want* to participate in an activity that is customary or common in society. These activities are multi-dimensional and address various facets of an individual's life to be able to fully participate in society. Burchardt (2000) developed the following four dimensions that addressed a spectrum of activities, which were thought to be important for people to participate in Britain in the 1990s:

1) *Consumption* is having a reasonable standard of living;

2) *Production* is engaging in a socially valued activity such as paid work or volunteering;
3) *Political engagement* is participation in the democratic process, or 'having a voice' in society;
4) *Social interaction* is relations with friends and family – or the opposite of isolation.

The first two dimensions identify the economic contribution of individuals in society. Limited access to the job markets, due to a lack of transport infrastructure or education and training, not only affects engagement in the labour force, but also the level of consumption undertaken by the household. In a sense social exclusion is self-fortifying in that limited access to social infrastructure limits the household's capacity to buy their way out of exclusion.

Most contemporary measures of social exclusion are derived from Burchardt's four-factor model. For example, the Australian government's new social inclusion agenda aims to allow Australians to have the resources, opportunities and capability to:

- *Learn* by participating in education and training;
- *Work* by participating in employment, in voluntary work and in family and caring;
- *Engage* by connecting with people and using their local community's resources; and
- *Have a voice* so that they can influence decisions that affect them (Social Inclusion Agenda, 2011).

2.4 Social Exclusion and Household Location

Housing is an extremely important factor in lower socio-economic consumption decisions. Housing stress has become a debilitating influence on low-income families in the last decade as house prices have increased by 400% while incomes have only risen 120%. Using a measure of median house prices compared to median income, every Australian capital city is rated as severely unaffordable. Sydney, Melbourne, Adelaide, Brisbane and Perth are among the top 14 most expensive cities in the world (Demographia, 2012, pp11). This has led to over one million low and middle income Australians spending more than 30 per cent of their entire budget on housing (Healey, 2011, pp2).

A major determinant on a person's risk of social exclusion is the location of their house. Kelly and Lewis (2002) suggest that spatial frictions may occur that prevent complete integration of a metropolitan labour market, such as access to employment rich areas like the CBD. Donaghy (2004) identifies that the high cost of transport for low-wage workers restricts their ability to engage with the community, reinforces a local lifestyle and increases the likelihood of further social exclusion. This is especially true for their children as subsequent generations of transport-disadvantaged families are then put at further risk of social exclusion; being limited from accessing the education and employment limits their possibility to gain income to become more mobile (Donaghy, 2004, pp683). A major contribution to this problem has been the gentrification of cities, i.e. the movement of high-income and high labour market status populations to previously declining inner urban locations, resulting in housing market price displacing the existing less advantaged residents. This has the effect of driving out low-income households to urban fringes, where they will be put at greater risk of social exclusion as transport, employment and services may be restricted. Households on the urban fringe may be excluded from high paying service jobs, due to spatial labour market segmentation, as these jobs are located in inner city areas, while routine, low paying production work is located on the fringe (Dodson et al., 2004, pp5). Delbosc and Currie (2011) identified that one in fifteen of fringe and regional respondents said they could not find work and half of these said they could not interview because of transport difficulties. Fringe dwelling households are further disadvantaged in the face of rising fuel costs because they have fewer available alternatives of transport. The consequence is that while inner city people have the possibility to walk or cycle more to get to activities, outer suburban people are likely to participate less in activities (Delbosc and Currie, 2011, pp1134). If oil prices and house prices continue to rise we would continue to see residents in fringe and regional areas finding it harder to participate in society.

2.5 Social Exclusion and Mobility

As shown by the location of people's housing choices, the ability of an individual to be mobile is highly significant in reducing their chance of becoming socially excluded. The UK's Social Exclusion Unit identified that problems with transport provision and the location of services can reinforce social exclusion. They prevent people from accessing key local services or activities, such as jobs, learning, healthcare, food shopping or leisure. The unit found that 40% of job seekers say lack of transport is a barrier to getting a job, 50% of 16-18 year old students has trouble with transport costs associated with education, and 31% of people without a car have difficulties travelling to their local hospital. Over 1.4 million people say they have missed, turned down, or chosen not to seek medical help over the last 12 months because of transport problems (Social Exclusion Unit, 2003). Stanley et al. (2011) found that the number of trips a person makes per day strongly reduces their chance of becoming socially excluded (Stanley et al., 2011, pp212). Household mobility decisions are embodied in their housing location choices. For example, Debrezion et al. (2007) explains that dwellings within a 400m range to a station are on average about 4.2% more expensive. A trade-off exists between living in inner city areas, which are more expensive, yet offer more services within walking distances and better public transport, and living in a cheaper outer suburb where they will face higher transport costs. In the UK, motoring costs account for a quarter of all household expenditure (Social Exclusion Unit, 2003). Currie et al. (2010) studied the residential and transport patterns of two different groups, Low income no car ownership (LINCO) and low-income high car ownership (LIHCO) households. LIHCO households chose housing affordability as the greatest influence on their housing choices, intuitively; LINCO chose proximity to public transport as their biggest influence. Around a third of LIHCO households reported transport costs as a major portion of their income, while another third limited travel to reduce costs. LINCO were asked to explain their reasons for not having a car. Over two thirds said alternative travel met their needs. Over half said they could not afford to drive a car. Another third preferred to save money by not owning a car. Moreover, some households may not be able to afford to live in areas where public transport is accessible and may be restricted from engaging in certain activities due to fuel costs and running a car. This gives rise to the notion of car dependency and forced car ownership.

2.6 Social Exclusion and Aging

The Australian Bureau of Statistics (ABS) projects that one in four Australians will be aged over 65 by 2056, with up to 7% of the population aged over 85 (ABS, 2008). Mobility is essential for the elderly to maintain attributes of personal choice and independence, familiar habits, and lifestyle. When the elderly have access to transport, they can reduce personal isolation, participate in recreational activities, obtain goods and services, be able to contribute to community services and groups, as well as maintaining intellectual stimulation (Donaghy et al., 2004, pp683). Seniors without licenses are at severe risk of social exclusion. Even in the inner urban areas of Melbourne, Engels and Liu (2011) found that seniors without access to a car have trouble accessing vital services due to being located in areas that had poor access to public transport. The percentage of the population that is retired is higher in areas that are on the fringe or in rural areas (Delbosc and Currie, 2011); therefore we can infer that social exclusion of non-driving seniors is even more severe in areas further away from the CBD, as they have a lower supply of public transport.

3 Hedonic Price Theory

Hedonic Price (HP) Theory prices goods, which may otherwise be unobservable in the market place. In Section 5 the HP model is applied to data from the low income housing market in order to price exclusion factors such as metropolitan accessibility, public transport, shopping facilities, and education.

3.1 The Consumption of Characteristics Rather than Goods

The HP model is based on a Lancastrian perception of consumer theory. Consumers perceive goods as bundles of characteristics (Lancaster, 1966). A hedonic price model is a relation between prices of varieties or models of heterogeneous goods – or services – and the quantities of characteristics contained in them:

$$P = \beta X \qquad (1)$$

where P is an n-element vector of prices of varieties, X is a $k \times n$ matrix of characteristics, and β is a vector of coefficients that can be interpreted as implicit prices.

Goods are aggregations of characteristics. Heterogeneity within goods is driven by differentiation in the quantities of characteristics. Economic behaviour relates to these characteristics. Utility functions are assumed to rank collections of characteristics and only to rank goods indirectly through the characteristics they possess (Lancaster, 1966). For example, a consumer values an automobile based on its underlying characteristics, like safety, fuel efficiency, speed and size, to name a few. A transaction is a tied sale of a bundle of characteristics, so the price of a variety is interpreted as itself an aggregation of lower-order prices and quantities (Triplett, 1987).

Since consumers derive utility through the characteristics of goods, it is possible to derive changes in the quality of goods through their underlying characteristics (Houthakker, 1952; Lancaster, 1966; Gorman 1980). Hence, if the quantities of the characteristics of a good increase, its quality has increased. This perception of quality underpins Hedonic Price Indexes, further discussed in Section 3.2.

Implicit prices of characteristics and willingness to pay measures can be estimated through the HP Function (Equation 1.0). Consumers purchase the good based upon the price of the good relative to all other goods, their budget constraint and their utility function (Lancaster, 1966, pp133).

$$P(z)= P(z_{1,}z_{2}, \dots , z_{n}) \tag{2}$$

Price, P, is a function of characteristic vector z, where z_i measures the amount of the i^{th} characteristic. The coefficients obtained from the regression analysis are estimates of the implicit price of the characteristics. They are called 'implicit' because the prices are not directly observed in the market place.

3.2 Hedonic Regression Analysis

Hedonic regression is a practically appealing method to account for changes in the composition of heterogeneous goods. The method originated in the field of farm economics during the 1920's. Haas (1922) discovered that the demand for farmland was highly dependent upon the following characteristics: cost of buildings; a land classification index; a soil quality classification index and the distance in miles to the city centre. Waugh (1928) determined that the price variation in fruits and vegetables on the Boston agricultural market could largely be accounted for by their size, colour, shape and firmness.

An important use of hedonic price theory is the construction of quality price indices. A hedonic price index will be able to incorporate quality by accounting for the changes in the underlying characteristics. For example, Court (1939) discovered that the real price of cars actually declined over the years 1920-1937 by accounting for the implicit prices of characteristics, which he described as an index of usefulness and desirability, including items such as horsepower, braking capacity and window area (Goodman, 1998, pp292). In other words the increase in value of the underlying characteristics was larger than the price increase of the automobiles.

Court laid the foundations for Hedonic Price indexes, which was developed by Griliches (1958, 1971). Griliches (1958) analysed the price elasticities of the ingredients of fertiliser, nitrogen, phosphoric acid and potash and discovered that almost all of the variation in fertiliser price is determined by changes in the prices of the inputs.

Hedonic Price Indexes are still used up until this day to account for changes in the quality of complex goods. For example, the ABS (2005) uses a hedonic price index for personal computers that accounts for changes in processor speed, hard drive space and random access memory (RAM).

3.3 The Theory of Implicit Markets: Sherwin Rosen

Sherwin Rosen's (1974) article was highly influential in the development of Hedonic Theory as he identified that the attributes of goods were subject to 'implicit markets'. These implicit markets of underlying characteristics drive product differentiation of goods. Rosen's primary goal is *to "exhibit a generating mechanism for the observations in the competitive case and to use that structure to clarify the meaning and interpretation of estimated implicit prices"* (Rosen, 1974, pp35). Implicit prices of goods are driven by an interaction between bid functions of households and offer functions of suppliers. Rosen assumes perfect competition, whereby producers maximize profit, consumers maximise utility, prices are exogenous for an individual agent, information is perfect, there are a large number of buyers and sellers, and all optimum choices are feasible. Rosen departs from Lancaster on the assumption of indivisibility. He outlines that packages of goods cannot be untied and mixed with portions of another bundle to optimise utility (Rosen, 1974, pp38). Moreover, this means we cannot arbitrage characteristics and must assume diminishing marginal utility.

3.4 Rosen's Model of Consumer Choice

Rosen identifies that utility, U, is strictly concave and is a function of how the consumer values the characteristics, $z_{1,\dots,}z_n,$, of a particular good, and the goods a consumer can purchase with their residual income, *x*. Utility is expressed as:

$$U(x, z_{1,\dots,} z_n) = u \tag{3}$$

An optimal choice is made by a consumer based on their budget constraint (y), y=$p(z_i) + x$, the amount of characteristics in a good, $(z_{1,\dots,} z_n,)$ and their utility function, U. Rosen uses these concepts to formulate the following bid function for a good: ϴ=$(z_{1,\dots,} z_n; u, y)$. If utility is maximised subject to the non-linear budget constraint, we get the first order conditions:

$$U(z_i, x) + \lambda(y - p(z_i) - x) \tag{4}$$

$$\frac{\partial u}{\partial z_i} - \lambda p_i = 0 \tag{5}$$

$$\frac{\partial u}{\partial X} - \lambda = 0 \tag{6}$$

$$\frac{\lambda p_i}{\lambda} = \frac{\partial u}{\partial z_i} / \frac{\partial u}{\partial X} \tag{7}$$

$$\frac{\partial p}{\partial z_1} = p_i = \frac{U_{zi}}{U_{x,}}, i = 1, \dots, n, \tag{8}$$

Marginal utility of money income is denoted as λ. The first derivative p_i is the implicit price of z_i and must be equal to the marginal rate of substitution between the characteristic z_i and x, all other goods. If we set the price of x equal to unity and measure income in terms of units of x: y = x + p(z), we can derive the following second order conditions by maximisation of utility subject to the non-linear budget constrain:

Differentiating (3), where x = y – ϴ, and where p(z) is not sufficiently concave obtains:

$$\frac{U_{zi}}{U_x} > 0 \text{ ; } \Theta_u = -\frac{1}{U_x}\text{; and } \Theta_y = 1 \tag{9a-c}$$

The relation 9a explains the relationship between the utility of characteristics and utility of all other goods. As all other goods represent our residual income, we can interpret the derivative as the marginal rate of substitution between z_i and money income. The partial derivative $\partial \Theta / \partial z_1$ gives the rate at which the household would be willing to change their bid in response to a change in the characteristic z_1, holding utility constant. The bid function, which is the amount the consumer is willing to pay at a fixed income and utility level, is tangential to the price function at the optimum, that is $\frac{\partial \Theta}{\partial z_1} = \frac{U_{z1}}{U_x} = p_i$.

Since $\frac{U_{zi}}{U_x} > 0$, the characteristics a person consumes increases as their income increases. However, this increase may not be proportionate. Higher income groups may desire certain characteristics over others. For example, in a housing market, higher income groups may value proximity to public goods such as parks and beaches, more than their marginal valuation on an additional bedroom. Rosen accounts for this by allowing for a parameterisation of tastes across consumers. The utility function is expressed as U(x, $z_{1,\ldots,} z_n; \alpha$), where α is a taste parameter that differs from person to person.

The theory outlined in this section will be applied using sales prices from the Perth housing market. The price of household sales will be regressed against their characteristics in order to estimate the implicit price, p_i, of each characteristic. Prices of factors like public transport, quality of surrounding education, local recreational amenities, and metropolitan accessibility are embodied in household valuations and, as such, allow us to estimate the value of these factors through a hedonic price model, even though they are not directly observable in the market place. Then, using an example, we can evaluate the impact of location and transport access as a social exclusion measure.

4 Data

This research combines three sources of secondary data: housing market, Census data (ABS, 2006), and transport GIS information from WA Department of Planning and Department of Transport. Section 4.1 describes how the data set was prepared for hedonic regression analysis. Residential house property sales from 23,277 transactions, between July 1988 and March 2012, were made available by Landgate for the greater Perth metropolitan area. The data contains a series of variables relevant for hedonic regression of the sales price and for this analysis we selected suburbs that displayed the lowest socio-economic indicators provided by ABS and were the most remote in terms of transport access.

4.1 Focus of Data on Socially Excluded Households

We applied cluster analysis (two-stage approach, including Ward method with Euclidean distance and followed by quick clustering with seeds from previous hierarchical cluster analysis), to identify suburbs with similar socio-demographic fabric and similar access to various urban services. Through this analysis we are able to differentiate spatially areas with good access from zones of the city, remote in terms of their opportunities for economic and social participation/integration.

Seventeen city-wide and local accessibility (population and employment density, distance from the CBD, road city-wide accessibility, distance from public transport, education, shops, and health services, ABS indicators of socio-economic development), dwelling (median housing prices, average number of bedrooms/dwelling), and household variables (structure, income, education level, employment, car ownership and daily trips to work), classified the 318 suburbs of the city into five types. Table 1 describes the five clusters, which are significantly different from each other at significance level of less than 1% (Multivariate Analysis of Variance, MANOVA tests).

Table 1: Cluster Analysis of Perth Metropolitan Region

Cluster	**Description**
Cluster 1	Inner city, high value land, highest population density, small houses
Cluster 2	Highest income, highly connected locations, highest property values
Cluster 3	Lowest income and car ownership, low property value, lowest socio-economic indicators
Cluster 4	Lowest population density, income and education advantage, suburban housing, largest household size with most children
Cluster 5	Outer coastal suburbs, lowest property values, big houses

Cluster 3, including 82 suburbs, displayed the deepest economic disadvantage, the lowest indicators of development and access to facilities, whereas cluster 5 (21 suburbs) is the furthest in terms of geographical city access and includes the lowest price properties. These 103 suburbs were considered to have significant levels of socio-economic exclusion and further analysed in this research, with a sample of them used in the hedonic pricing analysis (51 suburbs were chosen based on having greater than 25 observations, i.e. 25 transactions during the analysed time period). Finally, the houses in these suburbs were grouped geographically in 13 areas, presented in Appendix.

As the focus of the research is on the consumption patterns of socially excluded households, only sales below $500,000 were used in the analysis. Considering that the weekly repayments for a $500,000 home are of $790.73 (based on the average variable rate, of 6.67% of Australia’s big four banks - CANSTAR, 2011), and the median household weekly income of $1,234 (Australian Bureau of Statistics, 2011), we appreciated that households who can afford homes greater than $500,000 should be excluded from the dataset. A lower bound of $150,000 was set to omit unusual transaction values (as low as $20), assumed to be occurring either between family members or being data coding errors.

Only properties classed as “HOUSE” were considered for the hedonic regression, with household structures such as vineyards, farmland or boatsheds being ignored. The variable used for lot size was Calcarea(VGA), providing the area of the property polygon in ha. The variable describing the area of the house size had to be omitted from the analysis because 70% of the data was missing. Only the most recent sales were used in the hedonic regression as the dependent variable. All the garage and carport variables are combined to one single variable as they all measure the facility of parking space. Some variables have been combined because the ‘service’ of some rooms is assumed to be interchangeable. STUDY was combined with BEDROOM, the FAMILY, GAMES and LOUNGE rooms have been pooled into one variable: RECREATION rooms. The DINING and MEALS rooms have similarly been combined into a variable defined as ‘EATING’. The filtering and augmentation of the variables has narrowed down the dataset to 2,650 observations.

Locational attributes have also been incorporated into the dataset to capture the service of surrounding amenities, transport services, recreational features and aesthetic qualities. Shopping precincts, the central business district, healthcare centres, rivers, oceans, schools, universities, parks and negative locations such as airports have all been geocoded using *Google Maps.* The minimum Euclidean distance has then been calculated between each household and the locational attribute.

Locational effects have been taken into account by the inclusion of dummy variables for suburbs and regions. Table 2 displays the descriptive statistics for each geographical cluster shown in Appendix.

Table 2: Descriptive Statistics By Geographical Cluster

Area	Sale ($)	Age of the house (years)	Lot-size (ha)	Dist. from tertiary ed. (km)	Dist. from shops (km)	Distance from schools (km)	Dist. from train (km)	Dist. from TAFE (km)	Distance from health/ hospital (km)	Distance from river/ ocean (km)	Distance from negative features (km)	Dist. from CBD (km)
South River	365,077	33.42	0.069	10.62	1.36	1.94	1.14	2.89	0.58	1.59	7.34	11.89
Broodale-Kenwick	365,552	28.21	0.069	15.78	**3.20**	1.42	0.98	2.63	1.09	2.03	10.98	19.18
North Coastal	316,637	13.29	0.062	8.09	1.08	2.31	1.87	13.89	*0.45*	4.77	4.56	31.55
North Inner	327,422	*13.06*	0.063	5.31	1.20	**5.93**	2.18	9.42	0.73	1.85	1.53	24.96
Balga	364,180	32.35	0.069	8.45	1.15	1.36	3.73	1.66	0.62	**5.03**	9.53	12.09
Guildford	319,367	**46.98**	0.060	5.65	*0.88*	2.40	*0.75*	4.50	0.79	1.92	4.17	8.44
Midland	*287,703*	23.45	*0.055*	16.61	0.92	3.75	2.54	1.23	1.72	2.51	2.91	19.17
Belmont	326,120	30.36	0.060	8.09	1.80	1.60	2.19	6.59	0.60	1.18	*1.31*	*8.03*
Spearwood and South Lake	386,439	32.91	0.071	4.71	1.19	*1.34*	3.05	9.64	0.92	1.55	3.94	16.45
North Rockingham	364,574	29.12	0.068	7.48	1.59	1.54	1.15	*0.94*	0.53	4.23	5.24	32.12
Rockingham	336,717	26.66	0.066	*2.38*	1.68	1.83	1.30	1.40	0.92	1.92	7.10	38.88
Mandurah	359,334	18.82	0.066	28.94	1.66	1.87	1.17	17.78	0.70	1.26	**33.98**	**65.50**
Two Rocks	**478,389**	26.56	**0.079**	**32.78**	1.08	7.03	**15.70**	**29.38**	**12.89**	*0.73*	*1.30*	56.50

Note: In bold the highest values, in italic the lowest.

Two Rocks has the highest average sale and Midland the lowest. The most established areas are Guildford and South of the River, with new development in the North Inner and Coastal areas. Most houses have access to shops and healthcare within a 2 km radius. The average block size is around 660m^2, which is slightly smaller than the national average of 735 (State of the Environment, 2003). The distance to the CBD reveals the expansiveness of the Perth region, with suburbs located at distances ranging from 4 to 67km from the city. The closest to the city are suburbs in the Belmont area and the furthest Mandurah and Two Rocks.

The spatial distribution of the houses and facilities is presented in Figure 1. The map shows that with few exceptions (Spearwood, Mandurah), the areas potentially excluded are further from the coast, aligned N-S on the inland side of the major Mitchell-Kwinana Freeways and near four of the five the railway lines (Clarkson, Mandurah, Armadale, and Midland).

Although most facilities seem to be dispersed evenly across the metro area, the ‘negative features’ (power lines, airport, water treatment plants) are dominating in the Eastern groups. Figure 2 is a zoom-in view for the Spearwood-South Lake area, an “average” cluster both in socio-demographic characteristics and access to urban facilities.

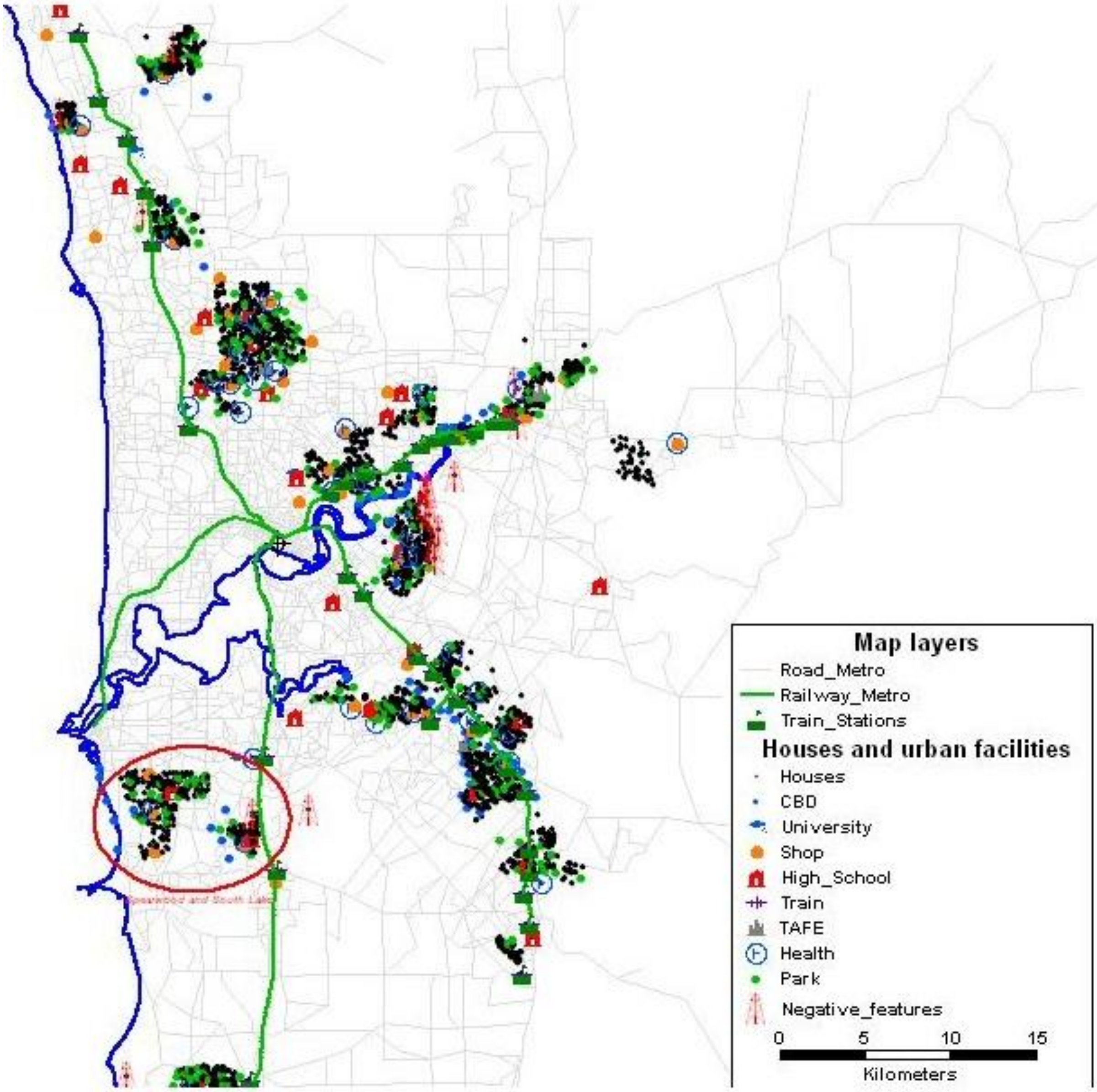


Figure 1: Map of households and locational features

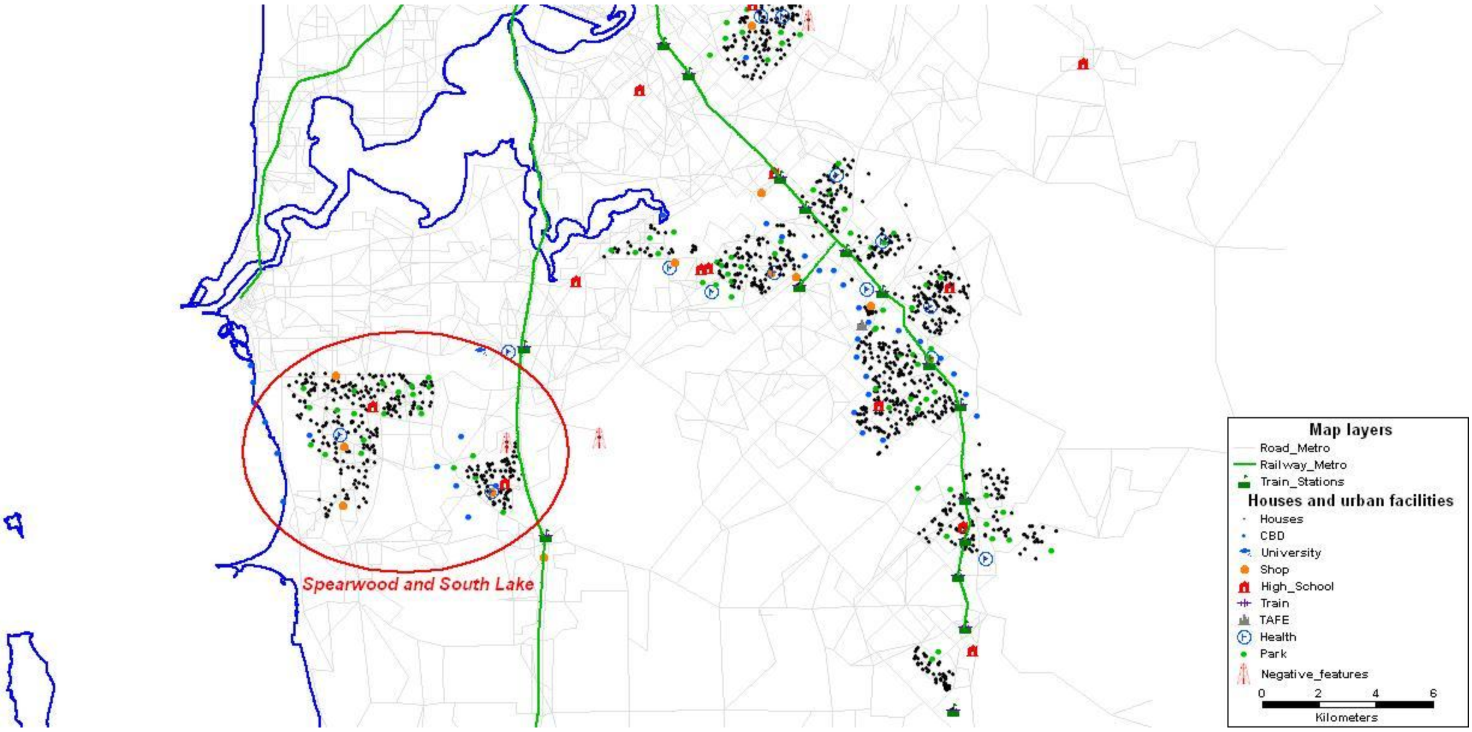
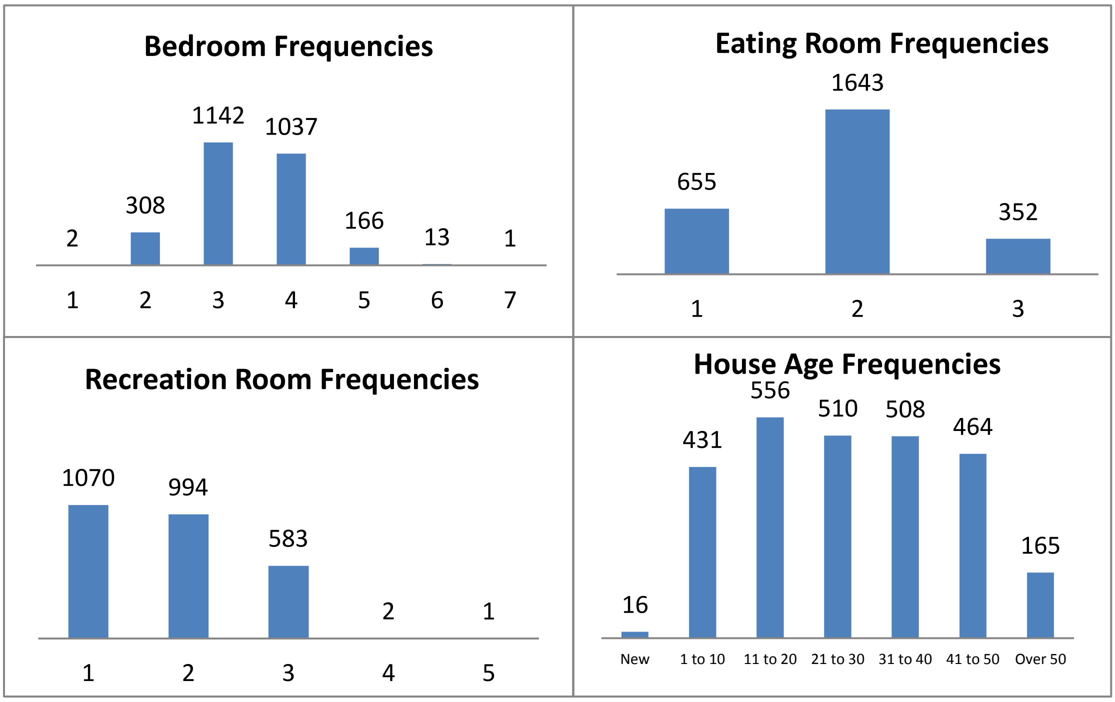


Figure 2: Cluster Example: Spearwood

Overall, the houses in our sample are located at 23 km from the city, have access to a park nearby (in less than 500m), and have a high school or a train station in 2km distance from them. Figure 3 illustrates the room frequencies by their main use. Most houses are either three or four bedroom and have two eating rooms. The majority of houses have less than four recreation rooms, while the house age is fairly evenly distributed.

Figure 3: Structural Housing Characteristics



5 Empirical Results and Findings

Table 3 displays the results of the ordinary least squares regression of the house sales price on each characteristic, where the Price of the house P_h (10) includes the constant, α, the characteristics, z, plus an error term, ε_h. The coefficients, β_k give an indication of the implicit price of each characteristic. The expression of housing price is linear in parameters and includes three categories of characteristics: locality, dwelling features (age, block area, bedrooms), and transport accessibility to various urban services (education, health, recreation, etc.).

$$P_h = \alpha + \sum \beta_k z_{k,h} + \varepsilon_h \quad (10)$$

The overall goodness-of-fit of the model is satisfactory with 91.1% of the variance in the transaction prices explained by the dwelling and location characteristics. The standard error of the estimate ($22,231) of 6.2% of the average house price, confirms again the quality of the model and suggests that outliers and multicollinearity may affect the results of the analysis.

Table 3: Hedonic Pricing Model

Variable	B	Beta	t	p	VIF
(Constant)	16428.757		0.765	0.444	
< 2 bedrooms (D)	5012.119	0.022	0.315	0.753	**140.379**
2 bedrooms (D)	-9824.668	-0.042	-0.621	0.535	**138.045**
3 bedrooms (D)	-454.800	-0.003	-0.241	0.810	4.690
4 bedrooms (D)	-3250.165	-0.021	-1.675	0.094	4.809
CalcArea(VGA) (ha)	**6267695.480**	**0.961**	115.014	**0.000**	2.057
Age: 1-10 (D)	902.499	0.004	0.348	0.728	4.916
Age: 11-20 (D)	-2569.233	-0.014	-1.060	0.289	5.218
Age: 21-30 (D)	**-10836.559**	-0.058	-4.512	**0.000**	4.807
Age: 31-40 (D)	**-9147.196**	-0.049	-3.907	**0.000**	4.553
Age: 41-50 (D)	**4728.895**	0.024	2.126	**0.034**	3.832
South River (D)	**-89793.837**	-0.265	-4.376	**0.000**	107.640
Brookdale - Kenwick	**-91294.175**	**-0.419**	-4.269	**0.000**	**283.186**
North Coastal	**-56006.146**	-0.155	-2.911	**0.004**	83.760
North Inner	**-59365.192**	-0.237	-3.064	**0.002**	**176.306**
Balga	**-82825.273**	**-0.394**	-3.915	**0.000**	**298.065**
Guildford	**-77170.426**	-0.290	-3.942	**0.000**	**158.988**
Midland	**-67083.317**	-0.161	-3.429	**0.001**	65.164
Belmont Area	**-69435.107**	-0.224	-3.683	**0.000**	109.399
Spearwood – South Lake	**-62165.206**	-0.243	-3.350	**0.001**	**154.370**
North Rockingham	**-47251.894**	-0.163	-1.970	**0.049**	**201.317**
Rockingham	**-45984.374**	**-0.189**	**-1.757**	**0.079**	**339.319**
Mandurah	**-70823.044**	-0.259	-2.553	**0.011**	**302.345**

Variable	B	Beta	t	p	VIF
Distance from higher education institution (km)	**1254.735**	0.125	3.062	**0.002**	48.729
Distance from shops (km)	**1777.528**	0.032	3.256	**0.001**	2.829
Distance from high school (km)	**1124.749**	0.026	2.162	**0.031**	4.113
Distance from train (km)	-727.397	-0.017	-1.060	0.289	7.293
Distance from TAFE (km)	330.283	0.025	0.509	0.611	70.523
Distance from health (km)	545.529	0.008	0.442	0.659	10.208
Distance from park (km)	336.296	0.001	0.212	0.832	1.147
Distance from river/ocean (km)	**-839.181**	-0.024	-1.827	**0.068**	5.089
Distance from negative features (km)	**1662.778**	0.187	3.964	**0.000**	65.256
Distance from CBD (km)	**-1492.591**	**-0.320**	-3.824	**0.000**	**206.784**

Note: Variables highlighted in bold are significant at the 5% level

The most significant parameters are for lot size, distance from CBD, and location, followed by accessibility indicators. Most of them have the expected signs, although multicollinearity affects the significance and direction of some relationships (number of bedrooms, distance from shops, parks, schools and health services). The model indicates that land is worth around \$626.77/m^2 and being 1km further from the city decreases the value by \$1,493. This shows that people value broad metropolitan accessibility highly. As indicated, the dummy variables, identifying the geographical area play a big role in the value of houses. The relatively expensive, northern coastal region of Two Rocks was used as the reference. Regions located furthest from the coast seem to be the least expensive (Balga, South River and Brookdale to Kenwick areas), while the southern coastal region of Rockingham seems to be the most similar in price to Two Rocks. This is also reflected in the fact that distance to water features is weakly significant and, as expected, has an inverse relationship between distance and price. Wealthier and more established neighbourhoods are located closer to the rivers and oceans. Hence, the valuation of proximity to the river and ocean could reflect both the recreational and visual aesthetic of the water, as well as the access to high quality established amenities and services in those regions. Five or more bedrooms were used as the reference for the bedroom step function. As expected, they display a general negative trend compared to the larger homes. The variables Eating, Recreation and Bathrooms, as well as the presence of a Pool were removed from the model due to their lack of significance and multicollinearity issues. The age brackets of the house were compared to brand new houses. Older houses are valued less, with the exception of houses over 40 years, for which the building and architectural style are appealing on the housing market. Distance to negative features is highly significant and decreases house prices by \$1,663/ km. Houses that are within close proximity to universities are valued less, possibly due to student housing being located closely. Proximity to shopping centres has a positive sign, suggesting that houses close to shops are valued less. This could be due to the noise and congestion associated with such areas.

Alternative models were estimated using: a) only the structural attributes of the house; b) only the location characteristics; and c) applying aggregated socio-economic characteristics - density, employment, household structure, and indices of disadvantage, resources, education (ABS). The models reveal that only 11% of the variance in the transaction prices is explained by aggregated indicators, 20% by location, with almost 90% of the variation in house prices captured by structural characteristics, particularly calculated land area, age, and number of bedrooms.

5.1 Implications for Socially Excluded Households

The hedonic regression model provides estimated for the transport access indicators, which can be used to assess the relative exclusion of a location/suburb related to others. Compared to the Northern cluster of Two Rocks, being located in the Brookdale-Kenwick area is translated in a decrease of the house prices of $91,394 or living in Rockingham means the house prices are lower by $45,984 (everything else being equal). Proximity to train is valued at $727.40/km, to the river at $839.18, and the distance from negative features or CBD at $1,662.78/km and $1,492.59/km respectively. Using marginal rates of substitution, this may suggest that households in the 51 suburbs selected for analysis, are willing to pay twice as much for access to the city compared to access to the train, or twice as much to be further away from power lines, water plants or other negative features compared to being close to the ocean or to the river.

By applying the regression model structure presented in Table 3, to a hypothetical example of a new housing property on a block of 600m^2 and with 3 bedrooms, we can obtain differences in housing prices by geographical cluster (Table 4).

Table 4: Transport Exclusion Estimates

Average estimated house price	Geographical area	Characteristics of the cluster
$352,277	Rockingham	Well established area (>30 years), 35-40km from CBD, close to the ocean
$352,880	Balga Region	Inner area, with poor access to train and to amenity (river/ocean), 12km from CBD
$359,460	North Rockingham	Older area, closest to TAFE and health services, 35-40km from CBD
$365,292	North-Inner	New developments, quite poorly catered in terms of education access, 25km from CBD
$365,630	North-Coastal	New developments, 30km from CBD
$383,642	Spearwood-South Lake	Large properties, good access to school, shops, health, and to ocean, 16.5km from CBD
$390,153	Midland	Lowest housing prices, smallest properties, isolated in terms of access to education, close to negative features, 19km from CBD
$396,181	Guildford	Oldest housing area, closest to shops, trains, but >2.4km from education, 8.5km from CBD
$396,937	Belmont	Low value properties, closest to the city (8km), but also closest to negative features (airport)
$397,709	Two Rocks	Furthest North from the city (56km), train and education, close to negative features, but highest house prices and lot sizes
$402,122	South River	Good access to urban facilities, only 12km from the CBD
$408,878	Kenwick-Brookdale	Large properties, quite isolated, 20km from CBD
$411,410	Mandurah	Furthest South from the city (66-70km), from higher education, but also from negative features (34km)

Table 4 presents in ascending order the estimated housing prices, by geographical cluster. At the top we notice suburbs from the Rockingham and North Rockingham areas (Rockingham, Medina, Parmelia, Leda, Orelia) and North – Coastal and Inner (Carramar, Iluka, Balga, Balcatta, etc.). They are approximately $50-60k less expensive than the emergent groups at the bottom of the table, including South River, Kenwick-Brookdale, and Mandurah. Good access to facilities, combined with suburban lifestyle seems to be traded-off by households living in those areas. The table also suggests that despite its significance in the regression model, the distance from the city is not the most prominent factor differentiating 'most excluded suburbs' from the 'least excluded' in the group of 51 suburbs we analysed here.

5.2 Conclusions and Further Research

The findings of the Hedonic Regression Analysis indicate that lot size, the regional location, distance to the CBD and distance to negative features (such as water treatment plants, power stations and the airports) are the most influential variables in explaining house prices. The results provide preliminary findings into the valuations low-income households place on certain exclusion factors like broad/complex accessibility to various urban facilities that enable residents to participate in the economic and social life of the community. Limited access to the employment market or to education, due to a lack of transport services, affects engagement in the labour force, the consumption level undertaken by the household, and implicitly their wellbeing. Limited access to health services, to quality amenities, or the proximity to features that negatively affect the environment (pollution, noise), have impact in the quality of living of those residents. The valuations we provide can then help to inform public policy that attempts to alleviate social exclusion and poverty within society, such as public transport infrastructure, government housing and educational facilities. By improving access to these facilities, particularly in areas we have outlined as the most excluded, social welfare is likely to be improved.

Rosen (1974) highlighted that tastes and preferences play an important role in shifting the bid function for certain characteristics. Further research needs to be done in order to discover the influence of demographics, and consumer segmentation, on consumption patterns of household sales. For example, a household of seniors, compared to a young family, will have vastly different implicit prices for public transport, education and accessibility to various locations. Obviously, the affordability may limit the household's capacity to express their way of valorising various urban facilities and future research agendas should account for this endogeneity of implicit prices.

Finally, the presence of spatial autocorrelation is expected to skew the results. This is very common hedonic price analysis of housing markets (Basu & Thibodeau, 1998; Sheppard, 1999; Anselin, 2001). This occurs when population members are related by their geographical location (Dubin, 1988, pp466). Under such conditions a variable is not only influenced by a single location but surrounding locations as well. For example, houses that are close to each other are more likely to be effected by the same variables, and as a result will have correlated error terms. Therefore, further modelling, such as geographic weighted regression, needs to be undertaken in order to account for these problems.

Appendix

Region	Suburbs
1 South River	Beckenham, Langford, Lynwood, Riverton
2 Spearwood	South Lake, Hamilton Hill, Spearwood
3 North Rockingham	Parmelia, Leda, Orelia, Medina
4 Rockingham	Rockingham, Shoalwater, Coolongup, Hillman
5 Mandurah	Dudley Park, Greenfields, Coodanup, Mandurah
6 Kenwick-Brookdale	Gosnells, Brookdale, Kenwick, Maddington, Kelmscott
7 North-Coastal	Merriwa, Iluka
8 North-Inner	Banksia Grove, Carramar, Woodvale
9 Two Rocks	Two Rocks
10 Balga Region	Mirrabooka, Balcatta, Balga, Marangaroo, Koondoola
11 Guildford	Guildford, Eden Hill, Bayswater, Inglewood, Lockridge, Embleton
12 Midland	Midland, Stratton, Middle Swan
13 Belmont Area	Redcliffe, Cloverdale, Kewdale, Belmont

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