

SPATIAL PATTERNS OF URBAN COMPACTNESS IN MELBOURNE: AN URBAN MYTH OR A REALITY

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Abstract

The current Victorian Government Urban Planning *Melbourne 2030* Plan supports a compact city model. The challenge facing local governments is the pressure on development of higher density housing near designated activity centres. Using the Victorian Government official VicMap property datasets for the years 2001 and 2006 in conjunction with dwelling count data from the ABS Census for 2001 and 2006, the transformation of Melbourne from a sprawling city to a compact city structure has been tested in order to have a reality check on the effect of a policy shift in recent years.

Within the Melbourne urban growth boundary, the spatial variability and levels of densification was mapped using a 1x1kilometere grid. Further buffer analysis was applied to evaluate differences between different zones from the Melbourne CBD and from Activity Centres. The ANOVA (Analysis of Variance) results indicate that urban densities across buffer zones around Melbourne CBD are statistically different. It was also revealed that the densification is just not restricted to the target areas (i.e. activity centres) as the evidence of higher density housing can be seen widely across the metropolis. Activity centres are ranked from highest to lowest for the measures of dwelling counts and dwelling density over the time period between 2001 and 2006. The ranking highlights the need for a rethink of the current urban compactness policy as its effect on urban form at the metropolitan level is yet to be seen.

INTRODUCTION

Over the last decade, government agencies and local councils in Australia have been continually developing and adopting land use planning strategies to control and manage urban growth particularly in the outer urban fringe. It has been articulated in the recent Melbourne 2030 Audit report (*Planning for all of Melbourne*, DPCD 2008) that “greater diversity of housing and more dwellings per hectare of land are being delivered by the development industry in response to changes in market demand” (Page 41). The notion of compact city over the decade has become a *cliché* in urban policy debate around the world. Compactness can be defined as high-density or monocentric development (Gordon and Richardson, 1997), while for Ewing (1997) it refers to some concentration of employment and housing and greater diversity of land uses. The concept of compact city has been widely adopted as a planning tool in the developed countries. Jenks et al. (1998) state that the compact city hypothesis combines various concepts of urban planning that potentially can be misleading. Arguably compactness has been seen as a panacea for controlling and regulating urban sprawl to promote a relatively high-density, mixed land-use city structure supported by a more efficient public transport system to encourage opportunities for walking and cycling. There is no doubt that the advantages offered in a compact city model are numerous.

Containment of urban sprawl, better access to services and amenities, reduced car dependency and more frequent use of public transport are some of the advantages of compact city urban structure (Dieleman *et al.*, 1999; Burton 2000). Counter-arguments against the compact city concept such as depletion of open space, overcrowding, congestion and inflated housing market (particularly around high access nodes) deter its adoption as an urban policy (Burton, 2000). Heavy investment of public funds in projects such as inner suburb renewable or urban rejuvenation (e.g. dockland developments in Melbourne and London) can be seen as geo-targeted attempts to attract people and businesses in the inner city areas. It appears that the characteristics of future cities in Australia will be driven by urban policies that promote an urban model where cities are envisaged to be more compact and well connected to employment hubs, amenities and recreational opportunities.

Despite the rhetoric, the real policy implications of recent urban policy change implemented through the Regional Plans such as the 'Melbourne 2030' or 'South East Queensland (SEQ) Regional Plan' on urban form and structure is yet to be thoroughly securitised. Some of the planning constructs, such as a compact city, Transit Oriented Development (TOD), upon which the shift in urban policy framework is founded are neither adequately understood nor empirically tested despite their wider use in regional and master plans (Chhetri *et.al* 2007, Corcoran *et. al.* in press). Often, these constructs are generically defined for the purpose of strategic direction. It can be argued that these constructs need to be defined and deconstructed at a micro-geographic level so that the local effects of the policy change on urban structure and processes (e.g. housing market, accessibility, commuting and employment patterns) can be better understood. The potential implication of land use changes in recent years, for example the effect of densification of inner suburbs on urban morphology, local housing market and social ecology, should be thoroughly evaluated to inform urban planning decisions based on evidence.

This paper evaluates the change in dwelling density patterns before and after the implementation of the 'Melbourne 2030' Plan. Among other factors (e.g. local history, land use, aesthetic quality and soil condition), the morphology of metropolitan Melbourne has been shaped by the spatial configuration of a rail network developed from the year 1880-onwards. This can be directly linked to the process of suburbanisation that has been strongly supported by government (Beed 1981).

A buffer analysis is applied on the property database to map the change in density patterns between different buffer zones around Melbourne CBD and Activity Centres in the period between 2001 and 2006. The findings reflected in terms of dwelling density and counts are also validated using the Census data at a Census Collection District level (ABS Census Data 2001 and 2006). To capture this change in urban density, two main sets of data are employed and these are discussed in the following section.

DATA SETS USED AND DATA PROCESSING

Urban density mapping is based on a number of spatial digital databases of Victoria. These include four core datasets.

First, the State Digital Property layers for August 2001 and October 2006. The layer contains details for each property for Victoria in Australia. The time intervals selected for investigation enable the evaluation of the implication of the policy change before and after the release of *Melbourne 2030* policy.

Second, the VicMap Planning Schemes obtained for July 2001 and August 2006. Planning Schemes for Melbourne metropolitan region were used to exclude non-residential zones to compute the net dwelling density. Four zones were identified and used in the spatial analysis to reflect various combinations of residential zones where dwellings for residential purposes can be built. These zones include:

- i) R1Z: Residential Zone 1;
- ii) R2Z: Residential Zone 2;
- iii) LDRZ: Low Density Residential Zone; and
- iv) MUZ: Mixed Use Zone.

Third, the Urban Growth boundary (UGB) released in October 2006 by the Victorian State Government as a tool to help manage outward growth. The boundary clearly defines the areas where development can be permitted or restricted to protect Melbourne's highly valued open spaces, farming, conservation and recreation areas (Department of Sustainability and Environment, 2007).

Fourth, the Principle and Major Activity centres as identified by the Victorian Government were amalgamated to generate a new GIS layer so that the dwelling density patterns around all activity centres can be computed.

The study area comprising of 31 Local Governments jurisdictions is 10,101 square kms. The mapping has been undertaken using a grid format with 1x1 km grid cell resolution. This resolution of 1km X 1 Km grid cells is not too coarse resolution and has enabled representation of dwelling density spatial patterns. The extent of Melbourne Metropolitan area has been restricted to urban growth boundary (UGB) so that areas outside the growth boundary are excluded from the analysis. The urban growth boundary indicates the long-term limits of urban development and where non-urban values and land uses should prevail in metropolitan Melbourne, including the Mornington Peninsula. Data were then pre-processed for errors and for deriving a refined layer representing only the residential properties within the urban growth boundary. A number of GIS operations were applied to process the data such as Intersection, Clip, Grid Generation, Centroids conversion and Buffer function on the property data from VicMap and the Census.

SPATIAL ANALYSIS

A range of methods were proposed to quantify compactness of cities. Bertaud and Malpezzi (1999), for example, proposed a compactness index called *rho*, that determines the ratio between the average distance from home to central business district (CBD) and its counterpart in a hypothesised cylindrical city with equal distribution of development. More recently, (Galster et al. 2001) defined compactness as the degree to which development is clustered and minimises the amount of land developed in each square mile. (Tsai 2005) applied a range of techniques (i.e. Gini, Geary and Moran and adjusted Geary indices) and evaluated their suitability to measure different aspects of compactness/sprawl for a number of cities. There are two parts of the spatial data analysis reported in this paper measured using Moran's I index. The first relates to urban density mapping at a grid level for the Melbourne metropolitan area and the second part applies buffer analysis to evaluate differences between different buffer zones from Melbourne Central Business District (CBD) and the Activity Centres based on property and ABS census datasets.

Urban Density Mapping

Urban density mapping has been conducted on a grid with 1x1 km grid cell. There are two main reasons for opting for 1x1 km grid cell. First, previous studies have successfully applied this resolution such as Chhetri *et al.*, (2007) and Lau *et.al* (2005). Second, the resolution of 500x500 meters was also tested and was found to be too fine (e.g. too many cells with no dwellings) and thus may have potential in creating redundancy and mis-interpretation of spatial patterns. Whilst, the resolution greater than 1x1 km grid cell has been found to be too coarse, which might not be able to capture the spatial heterogeneity in the distribution of dwellings. The grid was generated for Melbourne metropolitan area within the urban growth boundary. It was centred on the centroid of the Melbourne CBD (Bourke and Elizabeth Street intersection or General Post Office) and the grid cells were then generated to cover the entire metropolis. Using centroids generated for every property, the total number of points within each cell has been counted. The count is then attributed to the grid for the purpose of mapping. Since there are a number of cells that are clipped out from the urban growth boundary, thus their shape has come out as irregular rather than square in some cases. The density in terms of total number of dwellings per square kilometres has been computed to represent the size of the area that a grid cell contains. Within the UGB, the cells that are designated for non-residential purposes are eliminated in addition to cells where the total count was less than 50 dwellings to avoid the inclusion of non-urbanised area or the errors in the data processing.

From the density maps in Figure 1, a number of observations about spatial patterns of dwelling densities can be made.

- First, dwelling density across the metropolis tends to vary quite substantially. Eastern parts of Melbourne due to the historical and geographical factors are densely populated than the western and northern suburbs. Most grid cells along the eastern corridor within the 20 km radius tend to accommodate more than 1,000 dwellings per square km. At this stage, it cannot be concluded that whether these areas have reached their capacity to accommodate more dwellings on a detached

housing neighbourhood. But it can be argued that the Australian dream of owning a house on a large block of land with a big backyard around these areas might have started to disappear as more demand for land supply for medium density housing has been evidenced.

- Second, the dwelling density generally tends to decline from the Melbourne CBD, although a number of other hotspots and cold spots can be identified. A lot more opportunities still exist on the western parts of Melbourne where some of the overdevelopment of eastern and southeastern suburbs can be redirected at a reasonable cost.
- Third, there is a clear indication that transportation network particularly along the railway line and associated railway stations, has a strong bearing on dwelling density pattern. It can be implied that better access to public transport could be a driver encouraging higher dwelling density.
- Fourth, areas along the coast exhibit higher density patterns particularly along the coastal highway. This might suggest that aesthetic quality and proximity to water might have a direct effect on urban form.

Figure 1: Urban density maps of the Melbourne Metropolitan Area for 2001 and 2006 based on property data.

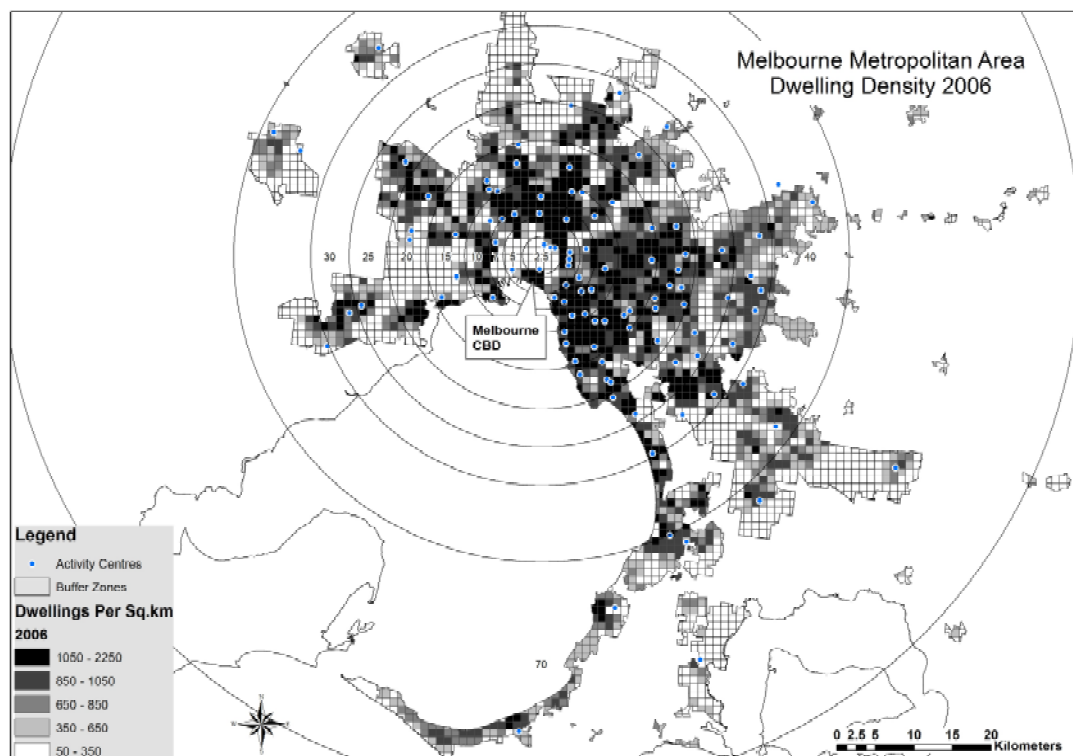
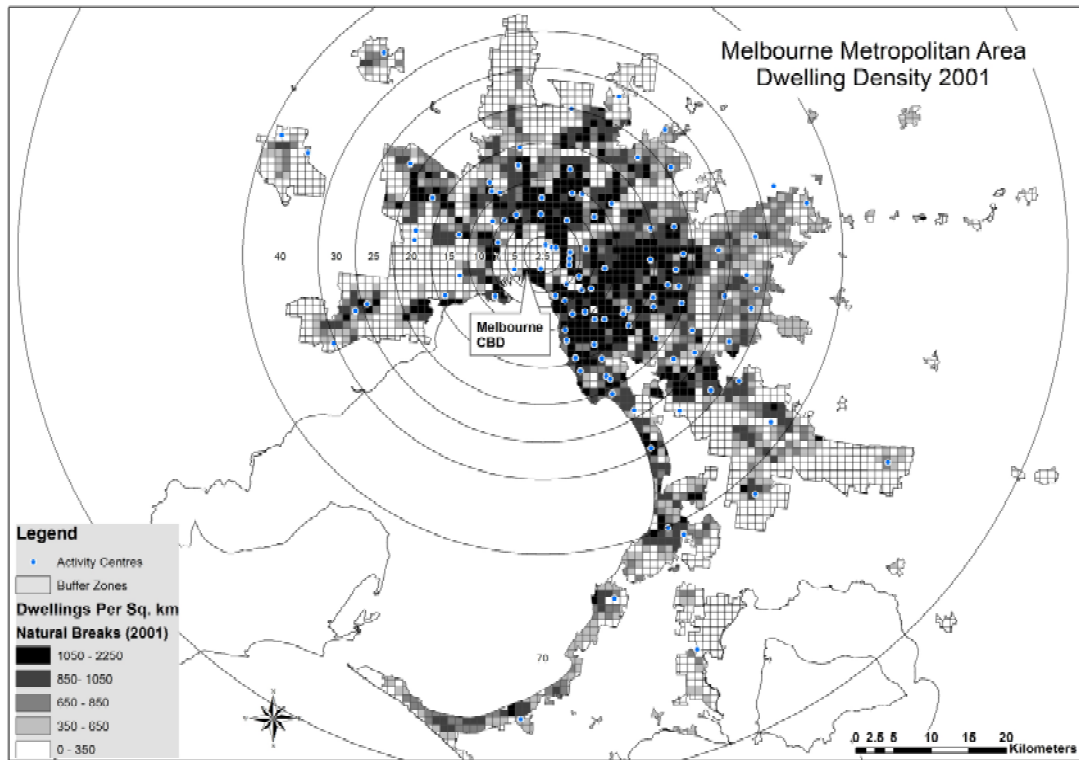
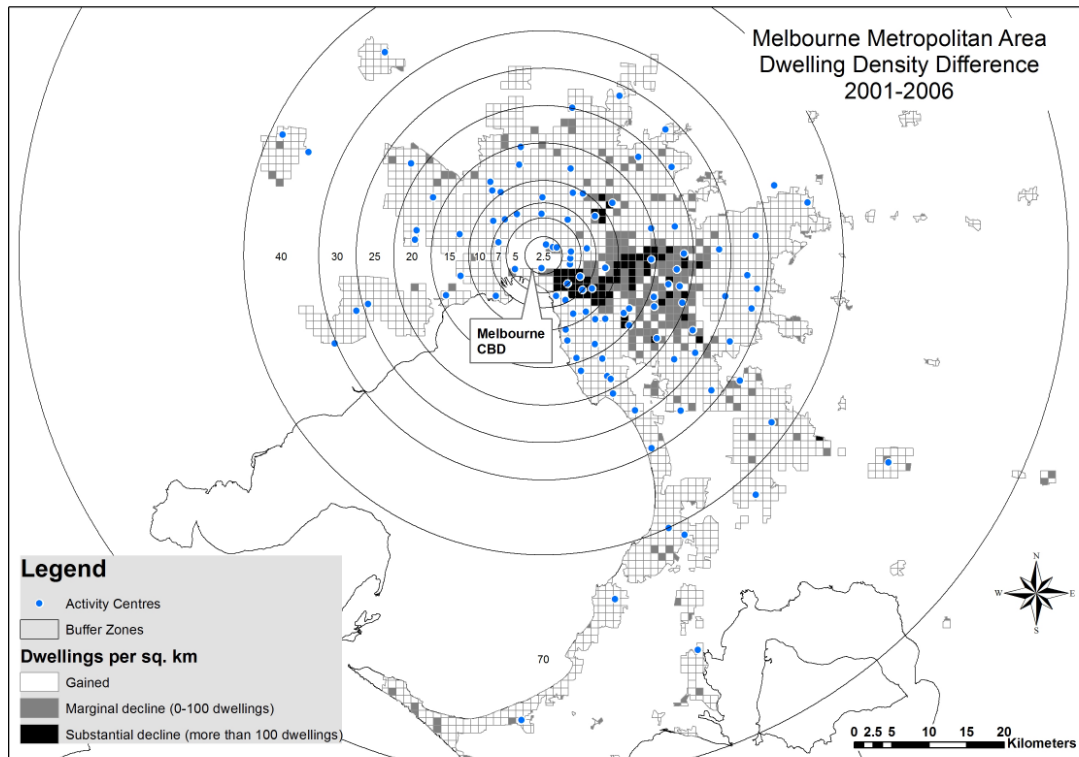


Figure 2: Dwelling density difference map for the Melbourne Metropolitan area based on property data.



Property level analysis

One of the objectives set out for this paper is to evaluate whether the areas targeted under the Melbourne 2030 Plan have become denser after the change in urban policy. To investigate this, buffer analysis has been used to identify zones surrounding the Melbourne CBD and activity centres. A GIS routine has been used to generate a buffer, a zone of a specified distance, around geographic features of interest. Using these buffers, features in other layers can be identified, selected or merged on the basis of the spatial relationships in terms of whether they fall inside or outside the boundary of a buffer.

Growth around the Melbourne CBD

The overlay routine when combined with the count function in GIS calculates the number of properties in each zone radiating from the CBD. The distance zones for buffers were determined based on the Street directory (called Melway). Six buffers centred on the Melbourne CBD were generated to represent the commuting zones based on the Euclidean distance. The innermost zone (0-2.5 km) was deliberately excluded from the analysis because the cadastral data do not adequately store the multi-level properties as spatial (graphical) objects to be counted correctly.

In Table 1, interesting patterns in the distribution of dwellings across different buffer zones have emerged. For the purpose of this study the innermost zone is < 2.5km, inner zone is 2.5-10km, middle zone is 10-20km, outer zone is 20-40km and urban fringe is 40-70km. As expected, the dwelling density in Melbourne declines outward from the city centre (CBD). Dwelling counts over this period has gone up across all zones except in the zone (5-7 km) which has seen a decline. Over the last 5 years, the inner zone started to show a sign of de-densification, the middle zones getting stagnant in some cases manifesting 'hollowing effect' and in contrast the outer zones are becoming more compact than what we could generally expect. In the inner zone the dwelling count in the 5-7 km buffer zone has declined from 65,787 to 62,888 dwellings during 2001-2006 despite the government policy favouring densification of

inner suburbs. The zone (10-20 km), with the largest number of activity centres, which was expected to attract more multi-dwelling developments after the policy change failed to densify in relative terms. In contrast the impact of densification has been felt most in the outer zones (20-30 km). The outer zone (20-40kms) and the urban fringe zone (40-70km) have accommodated 68,198 and 22,674 more dwellings respectively between 2001 and 2006. From the results of the analysis it is clear that the policy of densification and compact city has produced mixed results seen by the dwindling dwelling counts in the inner suburbs and a rapid densification in the outer suburbs. The urban development seems to depict contrasting patterns to what was anticipated to emerge after the urban policy launch in October 2002.

Table 1: Dwelling counts and densities around Melbourne CBD based on VicMap Property data

Distance (km)	Area Sq km	Count 2001	Density 2001	Count 2006	Density 2006	Count Difference	Density Difference
< 2.5*	20	4432	221	11160	558	6728	337
2.5 - 5	59	48545	895	49883	925	1338	30
5 - 7	75	65787	1001	62888	957	-2899	-44
7 - 10	160	130232	928	135448	965	5216	38
10 - 15	392	241483	759	250097	787	8614	28
15 - 20	549	253254	636	263738	663	10484	27
20 - 25	706	142257	404	170835	487	28578	83
25 - 30	863	121785	455	140802	540	19017	85
30 - 40	2198	138865	476	159468	533	20603	57
40 - 70	10361	143440	285	166114	446	22674	161

* Counts may not include medium and high density developments such as apartments and flats

The ANOVA results indicate that urban density across different zones is statistically significant at the 0.05 level, however the bonferroni test suggests that urban densities for the first two innermost zones are statistically insignificant. Similar patterns were noted for dwelling densities for different buffers where the difference between the first two buffer zones was not significant. The purpose of applying the spatial autocorrelation measure is to evaluate whether the pattern and clustering of dwelling density has become more spatially discernible. We have anticipated that higher density housing in the inner suburbs and around the activity centres will accelerate the degree of spatial clustering, that is, the suburbs with high dwelling density are surrounding with similar values and vice versa. The Moran's I (1950) statistic is a commonly used measure of spatial autocorrelation that could be based on binary contiguity between spatial units (Anselin 1988). In the binary weight matrix spatial connectivity is expressed as either a 1 or 0. That is, if two spatial units have a common border of non-zero length then they are considered to be 'neighbours' and assigned a value of 1, otherwise attributed a value of 0 (not neighbours). Moran's I is positive when there exists a positive correlation between sites; negative for a negative correlation and zero when no spatial autocorrelation exists. The Moran's I index calculated for Melbourne metropolitan area using dwelling density derived from property in 2001 is 0.561 indicating the spatial structuring and patterns of urban form. The Moran's I is 0.538 using the property data for 2006. The significant Moran's I index evidenced the presence of positive spatial autocorrelation for the dwelling density across the metropolis. The Z scores indicate that there is less than 1 percent likelihood that these clustering could be the result of random chance.

Growth around the activity centres

The dwelling density patterns around the activity centres (shown in Figures 1 and 2) were also examined to ascertain whether different zones have different dwelling densities. Three buffers zones were generated: 500 metres, 1 km and greater than 1 km. It has been envisaged that the first two zones represent the areas that are within the walkable distance to the train station and the activity centre. Arguably high-density developments are supported around the activity centres by the government to

encourage people to walk to train stations and shopping centres and that in turn promotes a healthier lifestyle. The results produced from buffer analysis (see Table 2) indicate the dwelling densities in the first two zones are not substantially different in both the years 2001 and 2006. For instance, in 2001, there were 928 dwellings per square km within the 500 metres buffer zone from activity centres, which in comparison to 1km buffer are marginally high 911 dwellings per sq km. The negative change in the number of dwelling and the dwelling density in the 500m to 1km zone between the period 2001 and 2006 highlights that fact densification aimed in the policy around activity centres has not occurred.

Table 2: Dwelling density around all activity centres in Melbourne using property data

Buffer Distance (metres)	No of dwellings 2001	Dwelling Density 2001 (per sq km)	No of dwellings 2006	Dwelling Density 2006 (per sq km)	Change in the dwelling (2001-06)	Change in the dwelling density (2001-06)
< 500	928	946	943	962	15	16
500-1000	911	941	905	938	-6	-3
> 1000	604	675	627	706	23	31

Census based analysis

The analysis of property data indicates a presence of a ‘hollowing effect’ around inner suburbs in the Melbourne metropolitan area. The property dataset has topological and geometrical errors when storing attribute information of medium and high-density developments such as apartments and flats. It was noted in the property data that multiple parcels were converted into a single parcel or multi-storey apartment block are represented as a single land parcel. This property database quality problem been recognised as a generic database issue across various property databases in custody of the State and Local Governments. It is thought that the de-densification and ‘hollowing effect’ around inner zone suburbs might have resulted due to the inadequate representation of multi-storey development. Census based dwelling data analysis has been done to validate the ‘hollowing effect’ by calculating household based dwelling counts and densities.

Growth around the Melbourne CBD

Dwelling densities were computed for each census collection district (CDs) from the CData 2001 and Cdata2006. The generated dwelling count and density layers were then overlaid over the buffer rings using the ‘entirely within’ function. There were the following considerations taken in the interpretation of the results (Table 3) with the use of this function.

- Firstly, it excludes those CDs where their centroids lie outside the buffer.
- Secondly, it might have also created a situation where a CD that crosses over the buffer would have been counted inside the buffer. It may be possible that the areas outside the buffer contain the residential land use whilst areas inside the buffer might be designated for non-residential purposes. This was not an issue with property data as it was clipped within the four identified zones where dwellings for residential purposes can be built. More sophisticated spatial disaggregation techniques, such as area-weighted or land use-weighted index, can be applied which are outside the scope of this paper.
- Thirdly, the creation of new CDs in 2006 might have potential in affecting the count calculation. It was noted that in most cases, the CDs around activity centres have not changed much except in the outer suburbs particularly in the western regions of Melbourne. To avoid this, each activity centre has been individually checked and manually excluded or included to be in the same CD as in 2001. The results have been compared between the two census periods (Table 3).

Table 3: Dwelling counts and densities around Melbourne CBD based on ABS Census data

Distance (km)	Count 2001	Density 2001	Count 2006	Density 2006	Count Difference	Density Difference	Change per sqkm
< 2.5*	26814	4396	34870	4385	8056	-11	411
2.5 - 5	77169	3294	75687	2977	-1482	-317	-25
5 - 7	90980	2488	85915	2288	-5065	-200	-67
7 - 10	142038	1433	139192	1387	-2846	-46	-18
10 - 15	232932	1093	232419	1083	-513	-10	-1
15 - 20	228857	938	233348	925	4491	-13	8
20- 25	125685	823	143801	821	18116	-2	26
25 - 30	115455	868	123231	864	7776	-5	9
30 - 40	122270	724	133621	722	11351	-2	5
40 - 70	113244	607	129970	623	16726	16	2

* Counts may not include medium and high density developments such as apartments and flats

Excluding the <2.5km buffer zone, the urban processes of de-densification or 'hollowing effect' observed in the property based analysis (Table 1) are also seen in the 5 to 7 km zone of the Census based dwelling density data. These underlying changes in dwelling density patterns across metropolitan Melbourne might be shaping the urban morphology, neighbourhood character and spatial structure of Melbourne during this time period.

Ranking the activity centres based on dwelling count

Using the cadastral and census data dwelling counts have been calculated around all activity centres and ranked with the highest and lowest changes. There are a large number of activity centres where a negative change has occurred in the dwelling count during the period 2001 to 2006. Using property data, one notable pattern during the this time period is around the inner city suburbs (e.g. Prahran, Armadale, Toorak Village and Malvern) where a substantial decline of dwelling counts has been observed (Table 4). Outer suburban activity centres such as Deer Park-Brimbank Central, Melton, Ringwood, and South Morang on the other hand depict strong dwelling growth. To capture the patterns of growth using Census data activity centres which show the highest and lowest dwelling counts have been ranked in Table 5. Similar growth patterns changes were detected around the activity centres, which indicate a mixed response to the Melbourne 2030 Plan for promoting greater growth around activity centres. The policy appears to be partly succeeded in terms of achieving its objective, though it also marginally failed to successfully implement strong increase in dwelling density around the inner city activity centres. For example, a negative change in dwelling density has been noted in 55 activity centres out of a total of 104. Among them, only 13 activity centres have recorded a substantial decline of greater than 200 dwellings.

Table 4: Dwelling count around the top and bottom 10 activity centres based on the Property data

2001				2006				Change 2001-2006			
Highest	Lowest			Highest	Lowest			Highest	Lowest		
Prahran	8568	Chirnside Park	2	Richmond - Bridge Road	5738	Chirnside Park	2	Deer Park - Brimbank Central	1201	Prahran	-3163
Armadale	6155	Deer Park - Brimbank Central	6	Prahran	5405	Melton	127	Melton*	997	Armadale	-2297
Malvern	5325	Epping	29	Northcote	4877	Epping	172	Ringwood	903	Toorak Village	-2235
Richmond - Bridge Road	5227	Melton	49	Richmond - Swan Street	4598	Keysborough	446	South Morang	777	Malvern	-1356
Toorak Village	5013	Keysborough	132	Brunswick	4586	Port Melbourne	570	Carnegie	743	Box Hill	-971
Richmond - Swan Street	4471	South Morang	158	Reservoir	4534	Hastings	576	Boronia	721	Ivanhoe	-430
Northcote	4448	Melton*	320	Coburg	4479	Werribee	648	Deer Park	702	Clayton	-379
Box Hill	4376	Deer Park	466	Carnegie	4446	Carlton	659	Mordialloc	590	Nunawading	-362
Balaclava	4232	Hastings	540	Balaclava	4415	Altona North	882	Bayswater	581	Glen Waverley	-272
Brunswick	4122	Port Melbourne	568	Caulfield	4321	South Morang	935	Glenhuntly	546	Forest Hill Chase	-258

* Melton - Woodgrove and Coburns Road

Table 5: Dwelling count around the top and bottom 10 activity centres based on the ABS 2006 Census data

2001				2006				Change 2001-2006			
Highest	Lowest			Highest	Lowest			Highest	Lowest		
St Kilda	9981	Deer Park	232	St Kilda	8954	Melton	54	Carlton	1781	Balaclava	-1046
Balaclava	9959	Keysborough	304	Balaclava	8913	Deer Park	303	South Melbourne	1590	St Kilda	-1027
Prahran	9319	Melton*	311	Carlton	8723	Keysborough	331	Fitzroy - Brunswick Street	623	Prahran	-693
Richmond - Bridge Road	7679	Werribee	460	Prahran	8626	Deer Park - Brimbank Central	474	South Morang	583	Richmond - Victoria Street	-480
Fitzroy - Brunswick Street	7047	Altona North	642	Fitzroy - Brunswick Street	7670	Werribee	528	Maribyrnong	554	Brunswick	-382
Carlton	6942	Port Melbourne	659	Richmond - Bridge Road	7468	South Morang	583	Sydenham	545	Lilydale	-365
Carnegie	6809	Diamond Creek	980	South Melbourne	7276	Melton	585	Deer Park - Brimbank Central	474	Diamond Creek	-329
Armadale	6001	Narre Warren - Fountain Gate	983	Carnegie	6569	Altona North	621	Ringwood	328	Armadale	-310
Fitzroy - Smith Street	5986	Sunbury	1158	Fitzroy - Smith Street	6178	Port Melbourne	640	Mordialloc	317	Footscray	-268
Richmond - Swan Street	5967	Endeavour Hills	1337	Richmond - Swan Street	5938	Diamond Creek	651	Endeavour Hills	284	Caulfield	-262

* Melton - Woodgrove and Coburns Road

CONCLUSIONS

This paper provides evidence to assess the change in the dwelling patterns before and after the implementation of Melbourne 2030 Plan. The empirical analysis of the database, which contains details of every property within the urban growth boundary, may enable urban planners and policy practitioners to either formulate a new policy or adjust the current policy based on evidence. The results reported in this paper reveal some expected and other unexpected spatial patterns in Melbourne. Two main conclusions can be drawn about the spatial expressions of dwelling density for the Melbourne metropolitan region excluding the CBD. The dwelling densities across the region are not randomly distributed as the spatial patterns which emerged are spatially correlated. The interpretation can be explained that suburbs with higher dwelling densities being surrounded by high value; whilst suburbs with low values have neighbours with low dwelling densities. The strength of spatial clustering has marginally declined over the period between 2001 and 2006. This might suggest that densification is not just restricted to the areas around activity centres and the inner suburbs but its impact seems to spread out across a wider area. Sub-divisions of larger blocks of land for multi-unit housing developments might have occurred outside the immediate surrounding of the activity centres. The dwelling density change shows an overall pattern of gain in the whole metropolitan study area, but a distinct decline in dwelling counts around eastern and south eastern suburbs which can be seen in the map (Figure 2). Such variability in terms of positive and negative change in the availability of housing supply might have an effect on housing market around these areas of marginal and significant decline in dwelling density. The analysis of property data indicates a presence of a 'hollowing effect' around inner suburbs in the Melbourne metropolitan area. The Activity Centres are ranked to highlight the Highest to Lowest change in dwelling count over the time period 2001 and 2006 using property and Census data. This research would initiate dialogue and discussion within the urban planning community to measure some of the concepts and outcomes of a policy change that potentially affect our society and the built environment. These results have highlighted the need for further rethinking of strategic directions (e.g. a compact city model) propagated for the 21st century Australian cities to compare fully the rhetoric versus reality.

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Brief Biography of Presenter

A graduate of Cambridge University (PhD, 1994) and Lucknow University (MSc 1987), Dr. Shobhit Chandra joined the Centre for GIS at the School of Geography and Environmental Science, Monash University (Clayton) in 1997. Since then he has taught and supervised students for their research training. His research focus is on urban spatial modelling and analysis for sustainability of water resources, natural habitats and urban settlements. He is also working on applications of mobile Augmented Reality technology in real-time spatial visualisations.