

Infill Design Opportunities

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Abstract: Small-scale infill housing in the middle suburbs represents 37% of residential developments in Melbourne (DPCD 2013). The quality and performance of typical infill outcomes is inadequate for the sustainable transformation of our cities. Perhaps more importantly, the extent and distribution of such informal redevelopment is having a significant impact on the existing suburban fabric. This presents a challenging landscape for future regeneration opportunities in these contexts.

If small infill housing could be improved, the market's propensity for this scale and type of project offers a potential vehicle for increasing the diversity and sustainability of future dwelling provision. This paper draws on a research initiative of the Office of the Victorian Government Architect (OVGA) and the Monash Architecture Studio (MAS) to examine the opportunities and constraints associated with the small infill housing in middle suburban contexts. Through a speculative design process, the research identifies alternative housing models that could enhance development outcomes on 1, 2 and 3-lot assemblies – the sites most frequently turned-over for renewal.

Despite the prevalence of small infill redevelopment activity, it continues to be overlooked by formal strategic policies as a substantive means for sustainable urban transitioning or increasing the quality and supply of affordable housing. In fact, Melbourne's recently introduced planning instruments may serve to exacerbate suboptimal development outcomes in middle suburban locations. Building on the 'lessons learned' through the speculative design process, this paper further explores how Melbourne's zoning reforms might impact future infill housing delivery, providing insights for local governments currently in the process adopting the new classifications.

Introduction

Small-scale infill housing represents a considerable proportion of current residential building activity in Australian cities and plays an important role in the supply of affordable housing. In Melbourne, for example, it was found that 58% of all residential projects completed during 2004-2008 yielded less than 9 dwellings. Of those: 30% were knock-down-rebuilds; 50% added 1 dwelling; and 20% added 2-9 dwellings (Szafraniec & Holloway 2012). Other research shows that, during the same period, only 1% of all housing developments in Victoria comprised 20 or more dwellings (Spatial Economics 2011). Despite the prevalence of small scale infill activity, this type of redevelopment does not feature in formal strategic policies as a substantive means for delivering sustainable urban transformations or increasing the quality and supply of affordable housing. Each of Australia's major centres is striving to provide around 50% to 70% of projected dwelling requirements through infill redevelopment (NHSC 2010), however the primary vehicle for achieving these targets is large-scale urban consolidation, i.e. brownfield, activity centre and transport oriented redevelopment in strategic locations (Newton et al 2012). While these intensification models have made a significant contribution to the renewal of inner city areas, they are much more difficult to achieve in middle suburban contexts. In a suburban housing market the cost and complexity of delivering large-scale, higher density building types has proven economically unviable (Alves & London 2012; Productivity Commission 2011; Pradolin 2009).

Large-scale redevelopment in strategic locations will of course continue to be an integral component of the sustainable transitioning of our cities. However, to date, urban consolidation policies have had little influence on the location and type of infill redevelopment taking place across Melbourne's middle suburbs. Spatial analysis of infill projects delivered in the City of Monash in 2002-2006 showed that 98% of redevelopments comprised two to seven dwellings and was broadly distributed across the local government area (Phan et al 2008). Significantly, 80% of new housing was more than eight hundred metres from a nominated activity centre. Phan et al established that the majority of redevelopment was not driven by proximity to transport or nominated activity areas. Rather it was related to the size of land assets and the age of existing housing stock. The fragmented pattern of informal development suggests that small owner/builders are turning-over private land holdings as profitable opportunities arise. Without strategic oversight, small infill redevelopment is of inadequate density and quality to contribute to the sustainable transitioning of our urban environments. Given the extent and distribution of projects undertaken, it could be thought of as a lost opportunity (Newton et al 2011; Murray & Khor 2011; Szafraniec & Holloway 2012). Perhaps more importantly, the recurrence of such outcomes is having a significant impact on the existing built fabric. Not only is it eroding the suburban 'character' our planning instruments seek to protect but it also limits the future potential for urban regeneration in these locations.

Melbourne is failing to reach its infill targets (Fehring 2013); a significant 'gap' exists between the policy aspiration for increased housing supply in established urban areas, and, the mechanisms used to deliver them. The continuing bifurcation of our infill housing market – i.e. large-scale high density inner city development vs. small scale piecemeal middle suburban development – presents significant challenges for affordable housing supply (Rowley et al 2012; Kelly et al 2011a; Birrell et al 2012). The limited diversity of dwellings offered and the locations in which they are delivered is beginning to debunk the equitable and sustainable growth of our cities (Lucas 2013; Tomilinson 2012; Kelly et al 2011a; MAC 2012; Trubka 2010). Recent analysis of Melbourne's Housing Development Data (2004 – 2011) indicates that small scale infill continues to be a predominant form of redevelopment in the middle suburbs. Yet it is still overlooked as a potential strategy for recalibrating the "housing crisis" we are confronted with. In fact, Melbourne has recently introduced a suite of new planning instruments that could exacerbate current housing trends. Rather than "protecting neighbourhoods from inappropriate development" (Minister for Planning 2013), Melbourne's newly introduced zones may have the opposite effect of perpetuating informal development in established residential areas.

Drawing on previous research undertaken by the authors (Newton et al 2011; Murray 2011; Bertram et al 2011) this paper explores how the design of small infill housing could be improved to increase the quality, diversity and sustainability of development outcomes in the middle suburbs. Through a design-led research process, it examines the existing type and distribution infill of redevelopments and speculates on future scenarios under Melbourne's new zoning classifications.

Research Context

Greyfield Precincts

Newton et al (2011) showed that the middle suburbs have capacity to accommodate significant increases in population, however very few appropriate redevelopment strategies have been realised. Two principal factors contributing to the current lack of effectual outcomes in these areas are: individual ownership of middle suburban land titles which inhibits the assembly of suitable

development sites; and an absence of design expertise within the projects that are completed. Infill redevelopments completed on a lot-by-lot basis results in the repetition of car parking, building setbacks and open space provisions, amongst other things. If the renewal of those lots could be coordinated and strategically redeveloped as a precinct, these provisions could be more effectively distributed across the project to enhance the quality, diversity and density of dwellings delivered. The precinct-scaled approach offers an economy of scale that could also provide a range construction and management efficiencies, as well as opportunities for district-wide sustainable infrastructure and public realm upgrades.



Fig 1: Aerial photograph of piecemeal infill redevelopment, City of Monash 2002-2006.



Fig 2: Indicative proposal for coordinated precinct redevelopment on the same sites.

Newton et al (2011) scoped the processes and inputs required to implement the precinct redevelopment model in Australia's middle suburbs. The model was shown to be both feasible and desirable to a range of industry and government stakeholders involved in the residential development industry. However a number of barriers would be need to be overcome for it to be implemented. This paper addresses two specific areas of further research: 1. Development and testing of alternative dwelling design models; 2. Examination of the planning mechanisms required to facilitate better infill housing outcomes.

Design Research

A research initiative of the Office of the Victorian Government Architect and Monash Architecture Studio sought to develop viable and replicable design alternatives for infill housing on 1, 2 and 3-lot site assemblies – the most frequent development types being undertaken in the middle suburbs (DPCD 2013 – analysis undertaken by the authors). Through the projective and spatial engagement with 'real world' sites and issues, the research uncovered potential strategies for improving dwelling densities, diversity, amenity and performance.

This paper outlines the key lessons learned from the speculative design process and expands on the regulatory, industry and market shifts that would be required to enhance infill housing outcomes in middle suburban contexts. The site-specific investigation reveals how the physical attributes, site arrangement and differing suburban contexts can influence the type of development outcomes possible.

New zones

A range of reforms to Victoria's zones was introduced in July 2013. The new residential zones are intended to (DPCD 2013a): improve the range of residential zones to better manage growth and protect and maintain liveability and neighbourhood character; simplify requirements with greater certainty and clearer rules; and allow a broader range of activities to be considered.

Three zones are of particular relevance to the middle suburban infill redevelopment:

- > Neighbourhood Residential Zone (NRZ) which imposes an 8m height limit (2 storeys), allows as of right development for sites above 300m²; allows the number of dwellings to be capped at a maximum of 2 per lot. This zone will predominantly comprise single dwellings, with dual occupancies permissible under certain circumstances.
- > General Residential Zone (GRZ) broadly inherits the former Residential 1 Zone (R1Z). It is expected to comprise single dwellings, dual occupancies, villa units, and in some circumstances townhouses.
- > Residential Growth Zone (RGZ) increases the height limit to 13.5m (4 storeys). It is expected to comprise townhouses and apartments with underground parking.

A series of adjustments have been made since the new zones were announced. Importantly, greater

scope was provided for local requirements to be incorporated in the zoning schedules; 'neighbourhood character' was re-introduced as a purpose of NRZ and GRZ; and stricter conditions on non-residential uses have been placed on GRZ and RGZ (DPCD 2013a). Councils are required to adopt the new classifications, following Ministerial approval, by July 2014. Dwelling supply and/or population targets are not associated with the new zones. It is unclear what parameters are being used for 'approvals'.

Glen Eira has been the first council to implement the reforms, zoning 78% of the LGA as NRZ and 2.2% as RGZ around major railway stations (City of Glen Eira 2013). If this is indicative of the zoning to be adopted by other LGAs, then it is difficult to see how a diversity of medium density infill models will be achieved. It is also difficult to understand how state-level infill targets will be met under the new zones when LGAs are administering the change in isolation, subject to local pressures and priorities. Finally, without other mechanisms addressing the viability of delivering medium and high density housing in these contexts, the zones may only serve to exacerbate the divergence of apartments and small informal developments (refer *Future context for residential infill*).

It is through these viewpoints that the authors approach this paper: an aspirational lens for increasing the quality, diversity and affordability of infill housing in the context of sustainable urban transformation; a macro level lens that considers the supply and demand drivers for enhancing infill housing outcomes and achieving targeted rates of supply; and a micro level lens that begins to translate these issues into spatial design terms, providing insights into specific opportunities for delivering small infill dwelling alternatives. Importantly, the speculative and site-specific exploration offered by the design research has potential to create a feedback loop from the micro implications back up to the macro urban issues.

Current infill development activity – issues and drivers

Small scale infill housing is typically delivered by the domestic building industry. The viability of the sector is contingent on the supply of housing 'products' that can meet stringent price-points set by the particular conditions of this market (Newton et al 2011; Rowley 2012). Driven by cost, small infill redevelopment rarely involves architectural design input. Design is perceived to be a luxury item that attracts unnecessary cost imposts (Alves & London 2012; Burke 2009). As a result, small infill projects lack the most basic of design benefits, such as the advantages of passive design achieved through considerate siting and building treatments. This section of paper examines typical infill housing project and aims to understand the issues and drivers for business as usual development outcomes. It seeks to identify areas where higher levels of design input might provide cost-effective, innovative improvements.

Middle suburban infill activity

Analysis of Melbourne's Housing Development Data from 2004-2011 (Source: DPCD 2013; analysis undertaken by the authors) indicates that 27,229 projects occurred in middle suburban areas during a 7-year period. This represents a yield of 44,995 net new dwellings and 23% of new supply for the total metropolitan area. Of this: 36% of projects were knock down rebuilds; 45% of projects added 1 additional dwelling; 10% of projects added 2 additional dwellings; and 9% of projects added 3+ additional dwellings. 75% of projects achieve densities lower than 32 dwellings per hectare.

Importantly, the analysis shows that 80% of middle suburban infill projects (which consume more than 3000 suburban allotments each year) make negligible contributions to dwelling supply and seldom reach densities consistent with sustainable urban growth. If these development opportunities were able to achieve modest yield increases (e.g. provide just 1 more dwelling), small infill housing could make-up a significant share of Melbourne's infill dwelling targets. The spatial feasibility of achieving this would, of course, depend on the location of projects, the size of allotments and the size/type of dwellings designed.

Standard industry practice

Domestic builders employ very economical construction methods geared towards optimising efficiencies within the cottage building industry. Housing types are standardised for efficient coordination of trades and labour which severely inhibits the diversity of dwellings offered. Driven by cost, industry operations are highly risk adverse, seeking to avoid potential time delays or complexities in the delivery process. In this context, design and construction innovations are difficult to achieve. These, and other, industry conditions effecting the sector's capacity to deliver housing alternatives are discussed in detail elsewhere (Rowley et al 2012; Newton et al 2011; Kelly et al 2011a) and will not be reiterated here. Instead, this paper attempts to provide an evidence base for how these conditions translate into specific spatial design outcomes through a case study analysis of recent infill supply (refer *Potential areas for design enhancement*).

Market demand

In a competitive price-point market, infill housing is also biased towards (perceived) consumer demand. This has led to a series of 'must haves' in a dwelling which do not always correlate with good quality, sustainable and affordable housing outcomes (refer *Potential areas for design enhancement*). Kelly et al (2011) found that the most important dwelling attributes to consumers were the number of bedrooms, followed by the amount of living space provided and detached houses with garages were the preferred type. Interestingly, when asked to consider the "trade-offs" between dwelling type, size, location and cost, 52% of Melbourne respondents would elect to live in something other than a detached house, with 38% choosing medium density housing types (semi-detached & types up to 3 storeys). Detached dwellings currently comprise around 75% of all housing stock Melbourne (Kelly et al 2011).

The research shows the interrelationship between location and dwelling preferences and demonstrates the shortfall in supply of appropriate infill housing in middle suburban areas. It also points to questions relating to 'real' and 'perceived' dwelling demand. One outcome from the research showed that more Melbournians would choose a detached house than Sydney-siders, after having made 'real-world' trade-offs (48% and 41% respectively). Kelly et al (2011) suggest this is in part due to Sydney's higher land values (detached houses are less affordable) but also recognise that the lower proportion of detached housing on offer in Sydney may be shaping consumer preferences. For the purposes of this research, two underlying questions follow: are the demand-side drivers for current infill housing outcomes in Melbourne distorted by the risk-adverse nature of the industry and its resistance to 'test' new dwelling models? Secondly, can speculative design offer a potential vehicle for explicating a diversity of dwelling alternatives to the market and test consumer demand for more appropriate infill housing types that can meet contemporary affordability and sustainability aspirations?

Extant Planning Controls

Current planning processes have a significant impact on the design and delivery of suburban infill housing. Building controls that appropriately aim to mediate the impact of development outcomes (e.g. overshadowing, overlooking, parking provisions) also limit the diversity of dwelling typologies that can be delivered on small, highly constrained suburban sites (Murray and Khor 2011). Planning instruments are also intended to facilitate development by providing increased certainty for developers and managing resident expectations for urban change. In an effort to provide an effective and transparent approval process, quantitative assessment measures are employed (e.g. site setbacks, building heights, site coverage). Streamlining approvals is integral for increasing infill development activity, however standardization of building controls also limits the diversity of potential dwelling outcomes, restricting opportunities for unique design solutions and site-specific development responses. Planning approvals are also contingent on less objective parameters, such as preserving neighbourhood character. In a highly risk-averse industry, familiar building forms and siting strategies are replicated to avoid potential delays in approval processes. The flow-on effect is an informal, self-imposed standardisation within the building industry itself. New planning instruments are required to increase the provision of diverse and affordable infill housing in middle suburban locations (Rowley et al 2012; Kelly et al 2011a).

Potential areas for design enhancement

On-going case study analysis has revealed a range of design quality and performance issues that recur in typical infill dwellings offered to the market. Key housing elements that would benefit from greater levels of design attention are summarised below.

- > **Building orientation**
Standardised housing products 'rolled-out' in different locations are rarely adjusted for site-specific conditions or varying solar orientations. As such, passive design opportunities are not fully taken advantage of. This represents a potential increase in construction cost to meet energy performance regulations, or diminished internal spatial qualities due to lack of natural lighting and ventilation. Compromised outcomes are delivered at the expense of the end-user, who: pays for the additional construction costs; and/or bears the price of the subsequently higher operational costs; and/or forgoes the spatial quality that may be possible on any one site.
- > **Dwelling size and internal planning**
Most of the dwellings examined were of 220-250m² in floor area – on par, or even exceeding, typical single houses on one allotment. Research has shown consumers equate dwelling space with freedom, flexibility and privacy (Kelly et al 2011). Developments will often sacrifice private open space amenity, solar access and natural ventilation to ensure the dwelling is as large as possible. This has obvious

implications for increasing dwelling densities. As well, the internal planning of these dwellings is often very rigid, restricting the types of households that can be accommodated

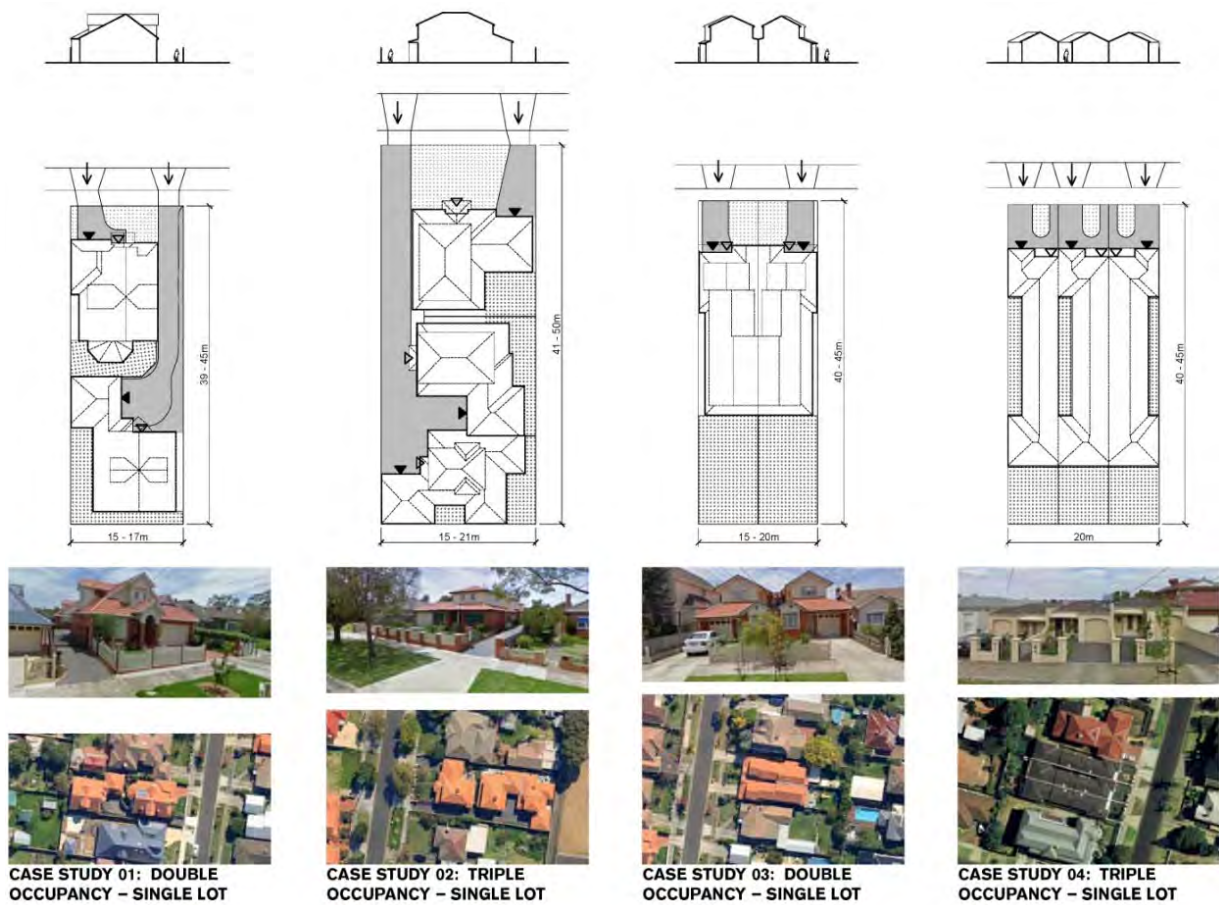


Fig 3: Case study analysis of various infill housing typologies examining siting and orientation, private open space, pedestrian and vehicle access, impact on streetscape A large percentage of available open space is given over to circulation for private vehicles (generally surfaced in concrete, shaded dark grey)

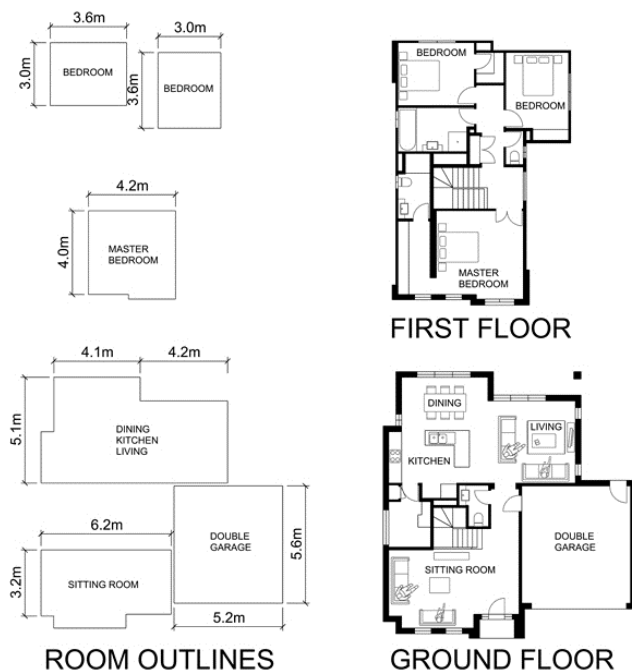


Fig 4: Case study of typical infill redevelopment outcomes in Melbourne's middle suburbs. The garage is one of the largest "rooms" provided, and consumes almost half of dwelling's street frontage.

> Room sizes and numbers

Dwelling size tends to be marketed in terms of the quantity of bedrooms provided, however minimum room dimensions, along with poor internal planning eliminate opportunities for flexible occupations or multiple uses. Future adaptation is likely to be difficult and costly, which is unsatisfactory from a

sustainability standpoint and an unappealing investment for a number of sub-markets, e.g. young families. En suites to main bedrooms are also seen as “must haves” and, interestingly, some redevelopments are beginning to provide one bathroom per bedroom. This is an unnecessary inefficiency that does very little for the flexible occupation of the dwelling while incurring additional construction costs, and increasing consumption of water and resources.

- > Garages, driveways, open space
Driveways typically consume more than 20% of site area (fig 3). Dual occupancies, in particular, are dominated by concrete driveways and offer minimal private open space and soft landscaping. The amount of site area consumed by this also means the dwelling yield of the site is diminished. The combined effect of several infill redevelopments of this type represents a significant loss of green amenity for the surrounding neighbourhood.

Identifying appropriate locations for infill redevelopment

Site selections for design tests

Six middle suburban locations were selected to examine the suitability of different sites and contexts for infill housing development. They were dispersed across the metropolitan region to ensure a range of suburban characteristics were represented. The selection criteria included:

- > *Located within a 7-25km radius from the CBD:* which falls outside common classifications for “inner city living”, where property prices are higher and a different development logic applies.
- > *Suburbs that were developed between 1950-1979:* where physical upgrade to housing stock and infrastructure is required and redevelopment strategies would be most effective (Newton et al).
- > *Proximity to public transport networks:* to maximise opportunities for sustainable urban outcomes
- > *Outside heritage areas:* where typical planning, design and construction processes would apply.

Lot size analysis and site selection

To investigate key spatial issues of infill redevelopment and ensure replicability of design models, the authors sought to identify ‘typical’ lot sizes in each study region. Site area and ‘roundness’ (or the proportion of length and width) are common descriptors of a site’s redevelopment capacity. However it became apparent through the design research that actual site dimensions (length and width) and orientations were needed to determine the spatial constraints for the ensuing design examinations. These variables are integral for determining how many dwellings can be achieved, their arrangement on site, and the vehicular/pedestrian access that is possible.

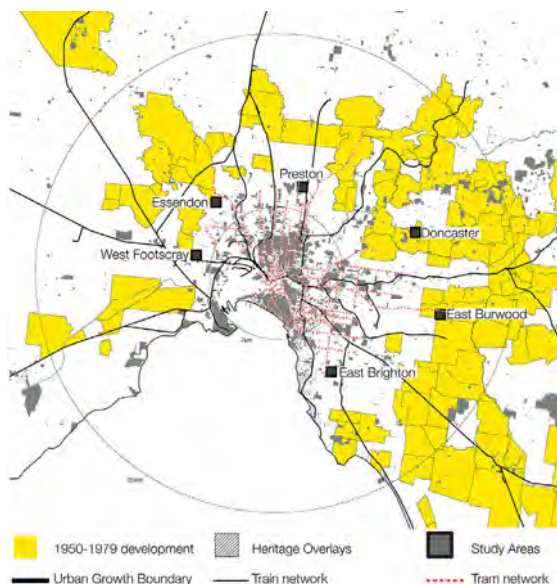


Fig 5: Case study location in Melbourne’s middle suburbs

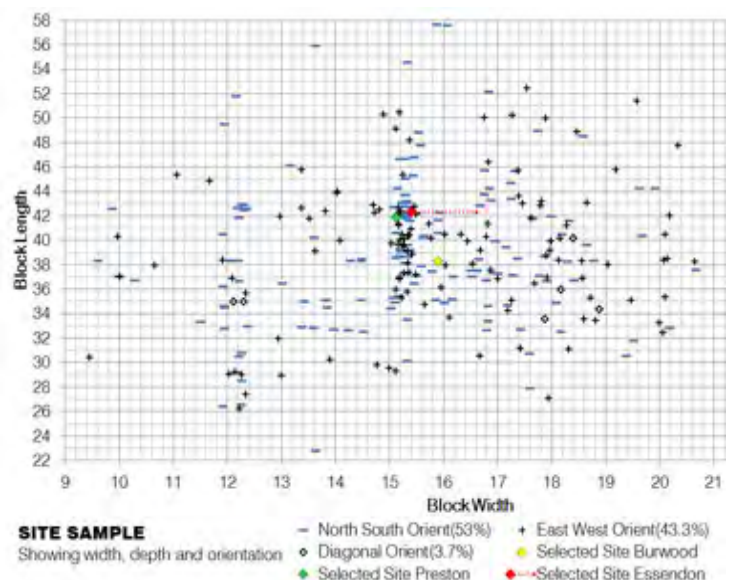


Fig 6: Plot of 300 sample sites, describing width, lengths and orientations
Irregular lots (e.g. tapered sites, sites with re-entrant corners) were excluded. These constituted on average 5% of developable land across the six study areas and would require unique dwelling design and siting solutions.

50 randomly selected sites were sampled in each study region. The discernible clustering of sites around 15-16m in width and 38-43m in length defined a ‘spectrum of replicability’ for the projective design process (fig 6). Three real sites within this spectrum were selected: 1-lot assembly in Essendon; 2-lot assembly in Preston; and 3-lot assembly Burwood. Each site had a different orientation with their street-frontages facing east, south and north respectively. Each context exhibited different levels of redevelopment activity, varied in streetscape and built form characters.

Infill Design Opportunities

Through a projective and spatial engagement with 'real world' sites and issues, this project aimed to identify a range of replicable design strategies for enhancing small infill redevelopment outcomes that could be adopted by the domestic building industry.

Drawing on the review of current infill housing supply, design targets were established to underpin the speculative research:

- > *3-for-1 dwelling replacement*: modest yield increases could make a significant contribution to infill targets without excessively impacting on surrounding neighbourhoods.
- > *1 car space provided on-site per dwelling*: personal vehicles will be needed until public transport services are improved. 1 car per dwelling is considered a reasonable compromise between current market trends and the aspiration for lower levels of car-dependency. It is anticipated that the extent of personal vehicles will decrease as fuel prices increase and car sharing becomes more common.
- > *Optimised passive design*: the design, construction and siting of dwellings should maximise opportunities for solar thermal gains, natural lighting and natural ventilation.
- > *Ground floor access to all dwellings*: all dwellings to be visitable and adaptable for universal accessibility.
- > *Readily available construction techniques with potential for innovation*:
- > *Preserve key aspects of suburban character and amenity*: design solutions must integrate with the existing suburban contexts, maintaining key characteristics and amenity valued by their residents.

'First Principles' Design Method

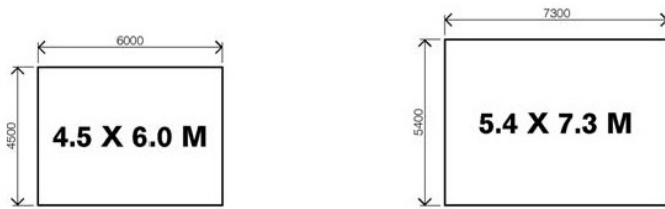
The proposed housing models were developed from the inside out, beginning with an investigation of what makes a flexible room. The dwelling forms evolved with the arrangement of internal spaces, their relationship to a range of outdoor areas and the inclusion of dual egress points. The models anticipate the changing occupation of a dwelling over time and have been designed for easy expansion and adaptation. Finally, the distribution of building volumes on the site and the design of common spaces were configured to maximise the collective benefits offered by multi-unit redevelopments in a suburban context. This 'bottom-up' design approach enabled the project to speculate on and reconsider the market norms, regulatory controls and industry conditions currently constraining the diversity and quality of infill housing outcomes.

Flexible Rooms, Compact Plan

Design for flexibility within the dwelling began with a reconsideration of the basic spatial unit of the house - the room. Rather than provide a series of mono-functional rooms within a large dwelling area, two generous 'flexible room' modules were devised to accommodate different living, working and care arrangements within a compact plan. The proportion and arrangement of each room module was iteratively developed to integrate with an efficient services core (fig 7). The cores can be adapted for universal access including a domestic lift to enable all ambulatory modes to inhabit each level of the dwelling. The single-room width allows for greater responsiveness to differing sites and orientations – solar access and cross ventilation can be optimised through the relocation of window openings. The design employs a "loose fit" approach to the partitioning and fitout of internal spaces, allowing prospective occupants to easily subdivide and adapt the dwelling to their individual needs over time.

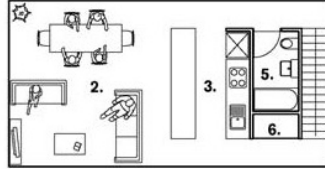
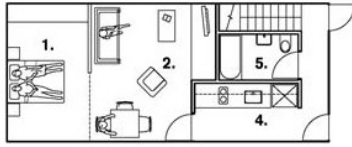
Housing Designs that Anticipate Growth and Changing Occupations

The two flexible room modules can be configured in a variety of ways to generate different dwelling types and sizes. The sequence and direction in which the modules are vertically stacked enables a suite of outdoor spaces to be provided on every level of the dwelling (fig 8). The vertical circulation is carefully designed across both modules to enable stairs to continue to a potential third level dwelling extension and/or a roof terrace. The 'island' core and vertical circulation system facilitates dual egress to the dwelling enabling separate household occupations. The open spaces, independent entries, adaptable services core and circulation work together to support a wide variety of occupations. Home office functions could be separated from private dwelling activities, with a separate entry for employees and clients. The ability to accommodate independent households represents a potential income stream for owner/occupiers, who could choose to rent out one floor of their home as circumstances change. Similarly, a live-in carer could be suitably accommodated and free to come and go without impacting on a resident's privacy or living routines.



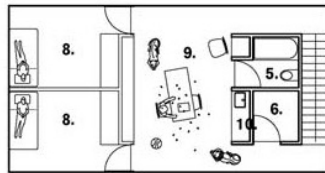
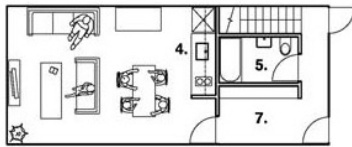
Flexible Room 1

Proportions of module and the relationship to the service core and entry points allows for several occupations requiring larger, open plan spaces, such as a main family room, home office or small shop. Can be partitioned at various points along its length to accommodate smaller, separated occupations such as a small semi-independent ground floor unit or bedsit.



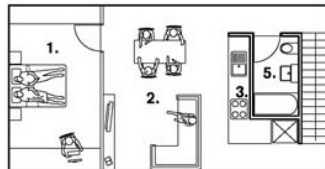
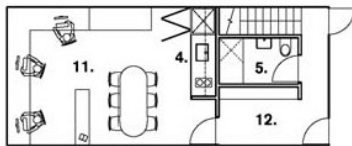
Flexible Room 2

Slightly larger proportions of this module permits both lineal and transverse partitioning enabling a quadrant of related uses. E.g. childrens' bedrooms and play space might be configured together with suitable storage and a "messy" wet area beside the core. Or a one bedroom apartment with secured independent entry points to the dwelling enabling potential lease of different areas/levels of the house.



Compact Core

A range of core configurations are possible combining bathrooms, storage, kitchens, kitchenettes and laundry facilities to suit household make-up. Cores can expand if necessary. Cores adaptable for universal access including a domestic lift to enable all ambulatory modes to inhabit each level of the dwelling. Vertical circulation is integrated into the core to efficiently extend servicing and stair access to every floor.

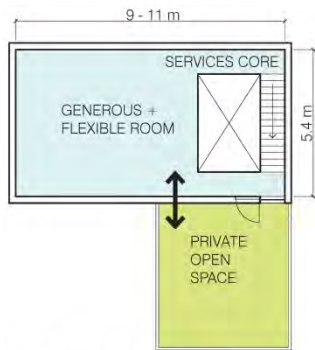


PROPOSED DESIGN MODEL - FLEXIBLE ROOM 1

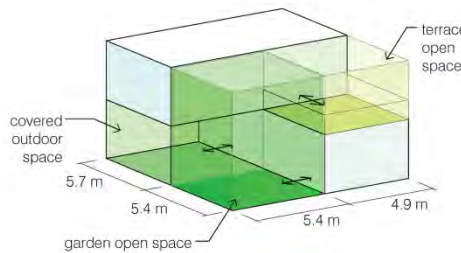
PROPOSED DESIGN MODEL - FLEXIBLE ROOM 2

- 1. Bedroom
- 2. Living + dining
- 3. Kitchen
- 4. Kitchenette
- 5. Bathroom
- 6. Storage
- 7. Study
- 8. Kid's bedroom
- 9. Playroom
- 10. Wash stand
- 11. Office
- 12. Accessible entry

Fig 7: Proposed dwelling modules combining a large, flexible room size with a compact and efficient core

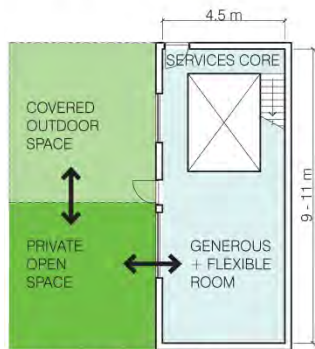


FIRST FLOOR PLAN

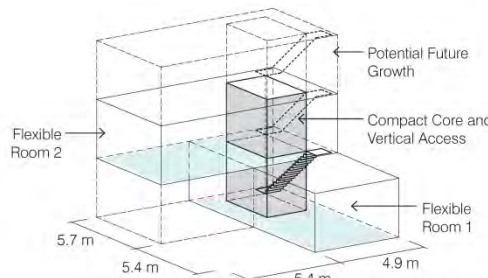


OPEN SPACE CONFIGURATIONS

An important component for high quality infill redevelopments is the inclusion of generous, usable private open spaces that have a strong relationship with the internal spaces of the dwelling. The stacked arrangement of the 'flexible room' modules creates three types of open space: a garden space at ground level, providing opportunities for landscaping, tree cover and productive gardens; a covered open space which could potentially serve a number of purposes including the extension of living activities, an accessible carpark or temporary "drop-off" area, a separate play space for children, work shed or studio; and finally an upper level terrace facilitating independent occupations within the house.



GROUND FLOOR PLAN



ROOM CONFIGURATIONS, COMPACT CORE AND VERTICAL ACCESS

Fig 8: Proposed dwelling modules combining a large, flexible room size with a compact and efficient core

Construction Viability and Potential Innovation

The dwelling model has been developed for viable delivery by conventional domestic building methods. Until macro-level development incentives for medium density housing are implemented, this will continue to be a prudent design approach. The 'flexible room' modules are sized for standard joist/beam spans. Shared party walls are simplified for ease of fire rating and structural masonry walls are located to optimise thermal gains. The modular design also anticipates prefabrication of separate building elements, such as stair and roof assemblies, wet area 'pods' or potential off-site manufacture of full unit modules.

Shared Open Space and Collective Benefits

The approach to this project was to configure and condition open space as a fluid resource that can be incrementally repurposed as needs change. To ensure sufficient shared space was incorporated in the designs, each site was subdivided at a ratio of 1:4, i.e. shared spaces were allocated one quarter of each site (fig 9). These common areas can be relocated in response to the surrounding context. It is initially proposed for use as a collective parking area incorporating permeable ground surface treatments. As vehicle use decreases, the shared zone is transformed into generous open space amenity and common facilities for residents. The driveway is allowed to grow-over with grass, which expands the open space amenity to the fence line. Along the fence additional storage, bike parks and planting could be installed. Short term vehicle access would still be possible via the new "garden lane" but would no longer be its primary purpose.



Fig 9: Subdivision of site and adaptation of shared zones

Infill design outcomes on 1, 2 & 3-lot assemblies

The above strategies were tested on each of the selected sites, resulting in a range of infill housing alternatives that respond to the differing spatial conditions and suburban characteristics of each location (fig 10). A diversity of household occupations is possible on all three sites and generous open space solutions significantly enhance the amenity afforded to both the residents and the surrounding neighbourhood.

Interestingly, as site consolidation increased (i.e. the number of lots assembled), it became more difficult to achieve the targeted 3-for-1 dwelling replacement within the Rescode building limits. This can be attributed to reduced site lengths for the 3-lot case study, which was approximately 5m shorter than the 1 and 2-lot sites. This difficulty could be overcome by using a mix of medium density dwelling typologies (say, low rise apartments in combination with L-type dwellings) but further research is required to test and demonstrate the quality and impact of such outcomes. The design process has revealed the importance of developing a suite of compact dwelling models that can optimise site utilization and be adapted for specific physical constraints.

Each of the design models encroaches on standardised site setbacks in some way (refer fig 10 & 11). However, the design outcomes do not impact on neighbouring properties nor significantly change the built form characteristics of the respective neighbourhoods. Where street setbacks are reduced, design strategies can be employed to provide appropriate levels of privacy for occupants. Such measures, combined with existing nature strips, offer adequate protection from pedestrian and vehicle traffic. In fact, reducing setbacks at the front boundary increases street activation and encourages higher levels of social interaction. Non-residential uses at ground level, such as offices, shops or cafes could provide additional services and facilities for increasing population densities.

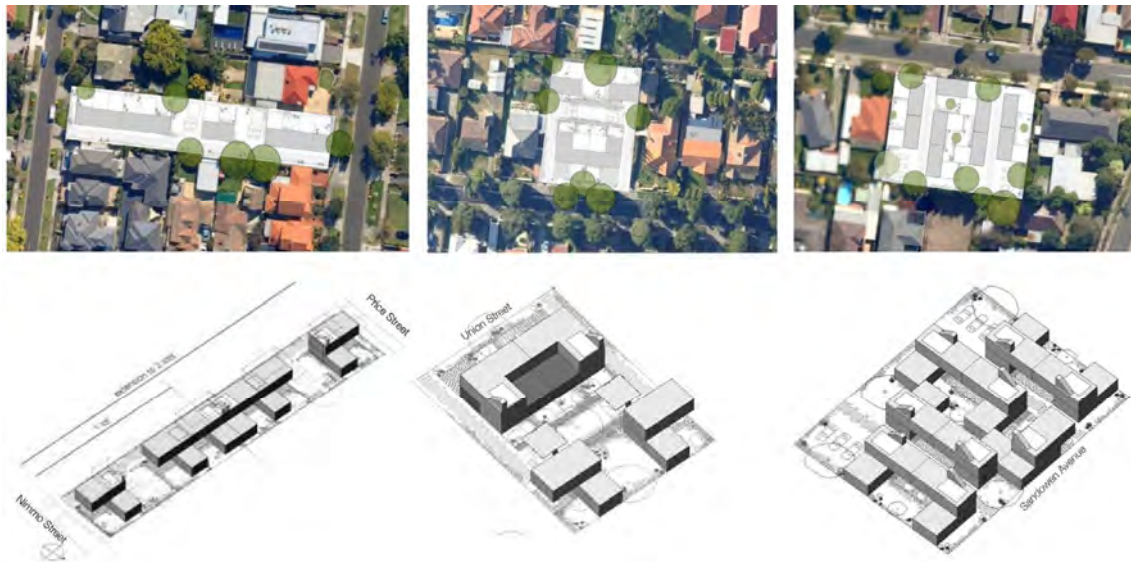


Fig 10:

| | L-HOUSE TYPE | | MANSION TYPE | CLUSTER TYPE |
|----------------------------|---|--------------------------|--|---|
| Number of lots: | 1 | 2 (back-to-back) | 2 | 3 |
| Site W (m) x L (m) | 16.6 x 42.3 | 16.6 x 85 | 30.3 x 41.6 | 47.7 x 36.7 |
| Site Area: | 698m ² | 1,422m ² | 1262m ² | 1751m ² |
| Dwellings: | 3 | 6 | 6 - 7 | 9 |
| Cars: | 3 + visitor | 6 + visitor | 6 + visitor | 9 + visitor |
| Density: | 42 dwellings per hectare | | 48-55 dwellings per hectare | 51 dwellings per hectare |
| Building footprint: | 165m ² | 330m ² | 346m ² | 533m ² |
| Floor area: | 306 - 554m ² | 612 - 1108m ² | 575 - 952m ² | 924 - 1509m ² |
| Open | 533m ² | 1092m ² | 916m ² | 1218m ² |
| Site coverage: | 24% | 23% | 27% | 30% |
| Floor area ratio: | 0.44 | 0.79 | 0.46 - 0.75 | 0.53 - 0.86 |
| Description: | L-shaped, courtyard housing linearly distributed along the length of the site. Rescode profile maintained to neighbouring properties. Ability to extend by infilling covered terrace/ carport space or adding third storey (by extending existing vertical core). Reduced street setback required for central 1/3 of site frontage, however this has minimal impact on amenity of neighbouring dwellings or functionality of street, and aligns with reduced setback of adjacent garage structures. Common 'suburban shopfront' typology adopted to activate and diversify streetscape. | | Combination of 'Mansion' and L-shaped dwellings types distributed in response to existing context. L-shaped dwellings to the rear follow the pattern of surrounding infill developments and informal shed structures. The 2 ground floor dwellings at the front of the site have been adapted for universal accessibility. The dwellings at the rear of the site break the Rescode profile with the second storey abutting the side boundaries, however this would not impact on the neighbours privacy due to presence of rear sheds on adjacent properties in similar locations. | Groupings of L-house type in terraces or rows over three allotments, with courtyards providing private open space and vehicular/ pedestrian access. Parking is grouped at rear of site in shared areas. Mature trees at rear of site are maintained to increase privacy and green cover. Front setback in central section is reduced to provide a small office/ business space with independent visitor's accommodation above - that could be shared by the other 9 dwellings in the group. |

Speculative, site-specific designs for 1, 2 and 3-lot assemblies in Melbourne's middle suburbs

The projective design scenarios have highlighted the way in which current planning encumbrances can inhibit modest density increases in suburban contexts. While regulatory standards appropriately aim to maintain privacy and amenity for residents and neighbouring properties, there is a need to review the extent to which approvals rely on standardised quantifications when considering issues that are, in effect, qualitative. To enhance the density and quality of small infill housing outcomes it will be necessary to increase the utilization of typical suburban allotments and facilitate higher levels of professional design input. This will require the development of new planning instruments that can expediently assess site-specific design opportunities. For example, professional design assessments might be required with development applications, in a similar way to environmental or heritage impact statements. The benefits delivered by higher levels of expert design input (e.g. yield increase, expedited approval) could off-set the additional costs associated with the process and professional fees. The proposed design models can be extended onto adjacent sites or transferred to other locations within the middle suburbs. Further research examining strategies for the replication and extension of the design models would be beneficial.

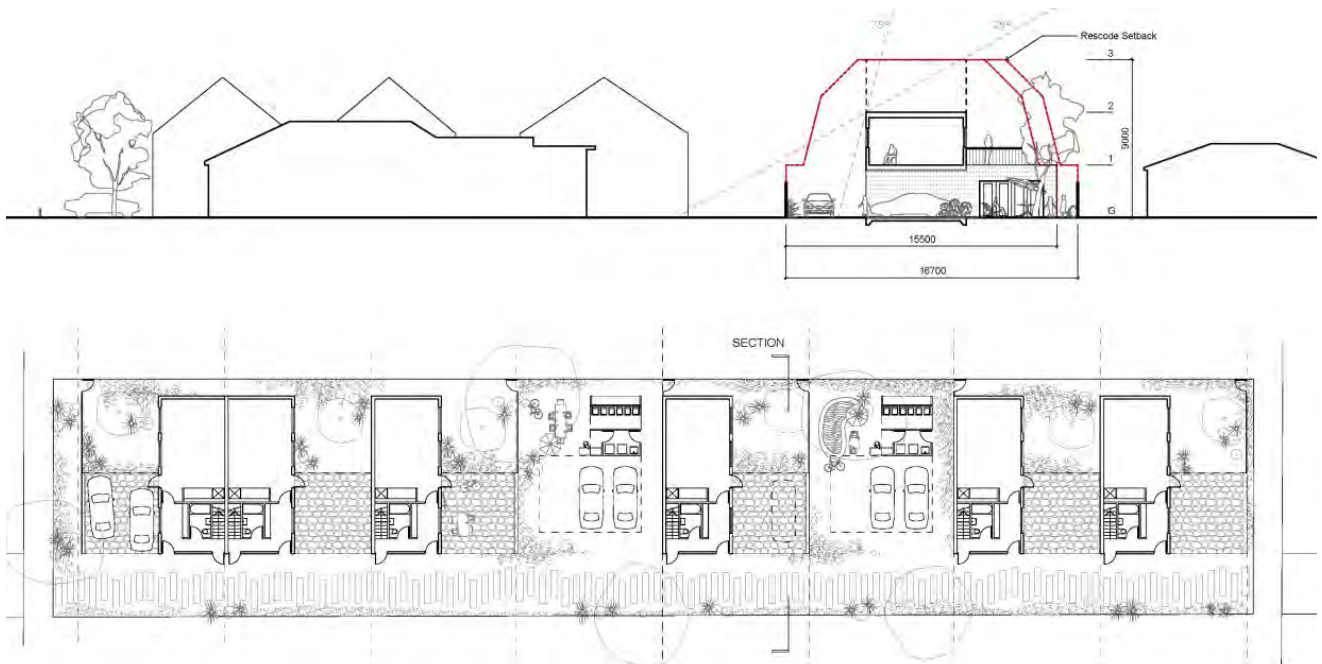


Fig 11: L-House type. (bottom) Site plan - linear distribution across 2 lots adjoining back-to-back. (top) Section – building mass conforms to Rescode profile.



Fig 12: Non-residential uses at ground floor can activate streetscapes and increase social interaction. (bottom) Ground floor plan – potential café, shop or office; (top) First floor plan – private residence: 1 bedroom / studio with private terrace.



Fig 13: Street view of proposed café / office built upto the front boundary of the site.

Future context for residential infill

Drawing on the analysis of current infill redevelopment activity, and the insights provided by the projective design of alternative infill models, we have explored the potential impact of Victoria's zoning reforms on infill housing supply in Melbourne's middle suburbs. Under the new classifications, the above infill models for 1, 2 and 3-lot assemblies would not be permissible within the Neighbourhood Residential Zone (NRZ), each exceeding the maximum of 2 dwellings on a lot (although conforming with 8.5m height limit). Using the City of Glen Eira as a basis, two speculative scenarios have been generated: 1. Glen Eira's allocation of zones recently approved by the Planning Minister where 84% of residential land is zoned NRZ (78% of the LGAs total land area); 2. an alternate allocation of the zones where the NRZ is reduced to 62% of residential land to achieve Glen Eira's projected dwelling requirement of 9,745 to 2031 (VIF 2012).

The scenarios are retroactive constructs, in that they use the quantity and distribution of current infill projects (fig 14, source: Housing Development Data 2004-2011, DPCD 2012) as the basis for projected supply within the new zones. This retroactive allocation reflects current industry conditions geared towards small infill dwellings at one end of the spectrum and high density apartment types at the other. Projects that did not provide a net increase in supply (e.g. knock-down-rebuilds) were

excluded from the scenarios to simulate the full range of development activity. The scenarios calculate revised dwelling yields in these 'existing' development locations based on an anticipated density achievable under their new classification (Table 1). These yields are then multiplied out to 2031. The anticipated densities assumed for the new zones are the same in both scenarios, the operative variable being the quantity of land applied to each classification.

Table 1: Speculative scenarios for infill dwelling supply City of Glen Eira

| | <u>Protected</u> | <u>Incremental Change and Growth</u> | | | <u>High density</u> | | Assumed density for new zones (dw/ha) Real density achieved (based on projects completed 2004-2011) |
|--------------------------|------------------|--------------------------------------|-----------|-----------|---------------------|------------|---|
| | NRZ | GRZ1 | GRZ2 | RGZ1 | MUZ | CZ1 | |
| | 28 | 50 | 35 | 75 | 150 | 300 | |
| | 26 | 31 | 40 | 39 | 37 | 124 | |
| Adopted Zones | 84% | 10% | 4% | 2% | | | % of residential land allocated to new zone |
| | 2843 | 406 | 131 | 77 | 9 | 109 | Number of development projects to 2031 |
| | 2843 | 1446 | 330 | 434 | 209 | 2167 | Net new dwellings supply to 2031 |
| | 38% | 19% | 4% | 6% | 3% | 29% | % of total supply by zone to 2031 |
| | 7,428 | | | | | | Total new dwellings to 2031 |
| | 9% | 15% | 13% | 12% | 19% | 11% | % of land turned over within each zone |
| Alternative Zones | 62% | 27% | 8% | 3% | | | % of residential land allocated to new zone |
| | 1991 | 1055 | 288 | 117 | 14 | 109 | Number of development projects to 2031 |
| | 1991 | 4089 | 693 | 665 | 292 | 2167 | Net new dwellings supply to 2031 |
| | 20% | 41% | 7% | 7% | 3% | 22% | % of total supply by zone to 2031 |
| | 9,897 | | | | | | Total new dwellings to 2031 |
| | 7% | 15% | 14% | 12% | 19% | 11% | % of land turned over within each zone |



Fig 14: Infill redevelopment in the City of Glen Eira (2004 – 2011). Source: DPDCD 2013



Fig 15: Scenario 1 - Adopted zones, City of Glen Eira



Fig 16: Scenario 2 – Adjusted zones along transit corridors City of Glen Eira



Fig 15: Scenario 1 – Adjust zones, distributed greyfield areas, City of Glen Eira



In the first scenario (fig 15), the projected supply to 2031 is around 7,500 new dwellings, representing a 23% shortfall. The greatest proportion of new dwellings supplied is via dual occupancy redevelopments within the NRZ (38%); 29% will be high density types in the Commercial Zone (CZ1);

followed by 19% in the General Residential Zone (GRZ). Only a small proportion of dwellings are anticipated within the Residential Growth and Mixed Use Zones. This is an undesirable outcome for two interrelated reasons. Firstly, imposing lower densities on small infill redevelopments will limit supply. Without a corresponding decrease in demand, affordability of small infill dwellings in the middle suburbs will decline. Secondly, this speculative scenario indicates that the allocation of new zones will continue the bifurcation of current infill dwelling types, working against broader urban aspirations for greater diversity in housing choice in these contexts. Additionally, the as-of-right provision within NRZ may only serve to exacerbate suboptimal dual-occupancy outcomes in the very neighbourhoods it is trying to protect.

In the alternate scenario, the NRZ allocation is reduced to 62% of residential land, with a higher proportion (27%) allocated to the GRZ and slight increases in the RGZ and MUZ. This speculation suggests that, with modest increases in density across residential areas, the LGA's supply target is met, and considerably more housing can be provided at medium densities. Fig 16 and 17 illustrate various spatial configurations that this scenario could take on. The former grows along existing tram and train corridors, while the latter distributes several zones for 'greyfield' regeneration across the residential landscape. The speculative designs undertaken on 1, 2 and 3-lot assemblies provides an indication of the type of transformation that would occur on dispersed infill sites in these areas and the potential enhancements in dwelling quality and diversity that could be delivered.

Conclusion

Very little is understood about the cumulative impacts of small infill housing supply (Szafraniec and Holloway 2012; Rowley et al 2012). This paper brings together several levels of consideration for increasing the diversity, quality and density of small infill redevelopment in Melbourne's middle suburbs: metropolitan infill targets and strategic directions; issues driving current infill outcomes; speculative design explorations around site-specific opportunities; and projective scenarios for infill redevelopment, particularly in relation to Melbourne's zoning reforms in greyfield locations.

Rowley et al (2012) suggest that planning policies requiring housing diversity or affordability should be introduced when land is re-zoned. Without other mechanisms incentivizing a range of medium density development outcomes, it appears that Melbourne's recent zoning reforms will have little new impact on the supply of infill housing. It was not the intent of the paper to be critical of these legislative shifts, rather the authors sought to provide insights for local authorities currently adopting the new zoning classifications.

By improving the design and performance of small infill dwellings, a range of individual and collective benefits can be achieved at the scale of the dwelling, site and neighbourhood. With higher level of strategic direction, small infill redevelopment has the potential to also deliver effective and sustainable urban transformations. The design research presents different spatial design strategies for enhancing the quality, affordability and diversity of dwelling choices. Some are cost-neutral solutions and immediately implementable within typical redevelopment delivery, such as appropriate siting of dwellings to optimise the passive performance. Others will require an integrated approach within government and industry, such as facilitating higher levels of design expertise for this scale and types of development.

The gap between metropolitan infill targets and current supply will require significant shifts in government policy, planning processes, industry practices and consumer demand. This will require a concerted effort across all sectors and disciplines to enable the integration of macro level supply and demand drivers, with the micro level reality of designing and delivering more appropriate housing models. Amongst those required to shoulder the responsibility of affecting positive urban change are design professionals. Greater levels of design knowledge and input will be needed to generate, test and explicate the viability, liveability and quality of small infill housing alternatives. Speculative design offers a potential vehicle to facilitate behaviour change; through the development of a collective urban vision there is potential to recalibrate the misalignments within our existing housing delivery systems.

References

- Alves, T. & London, G. (2012) 'New Housing for a Shifting Urban Paradigm: Housing Development Co-operatives as a More Affordable and Sustainable Alternative for Housing Provision in Australian Cities'. Paper presented to the 6th Australasian Housing Researchers' Conference, Adelaide, 8–10 February 2012.
- Bertram et al (2011) *Infill Opportunities*, research report prepared for the Office of the Victorian Government Architect, <http://ovga.vic.gov.au/news/75-infill-housing-study.html>
- Birrell, B; O'Connor, K; Rapson, V; Healy, E. 'Residential infill and its threat to Melbourne's liveability'. In: Melbourne 2030: Planning Rhetoric Versus Urban Reality, Monash University ePress: Melbourne; 2005.
- Burke, T. (2009) 'Housing, urban sustainability and the design professions', Architect Victoria, Summer.
- City of Glen Eira (2013) Council Wins Height Limits Over All Residentially-Zoned Land, Glen Eira City Council Media Release, http://www.gleneira.vic.gov.au/files/c1d65cc0-7b35-42e3-86c5-a21100e9f10d/05082013_GECC_Media_Zones.pdf, accessed October 2013
- DPCD (2013) Housing Development Data, <http://www.dpcd.vic.gov.au/planning/plansandpolicies/housing/housing-development-data>, accessed October 2013
- DPCD (2013a) Fact sheet - Reformed residential zones, July 2013, http://www.dpcd.vic.gov.au/data/assets/pdf_file/0008/197423/Reformed-Residential-Zones-fact-sheet_July2013.pdf, accessed October 2013
- Fehring, R. (2013) Housing Affordability "...not just about Planning...", Industry presentation; Evan Walker Discussions, Housing Choices Australia, 23 July 2013, http://www.housingchoices.org.au/data/Events/Evan_Walker_Discussions_23_July_2013_RF.pdf
- Kelly, J.F. et al (2011) *The Housing We'd Choose*, Grattan Institute, Melbourne.
- Kelly, J-F. et al (2011a) *Getting the housing we want*, Grattan Institute, Melbourne
- Lucas, C. (2013) - City heads towards two-speed economy, Newspaper article, *The Age*, October 14 2013, <http://www.theage.com.au/victoria/city-heads-towards-twospeed-economy-20131013-2vgse.html>
- MAC (2012) *Melbourne, let's talk about the future*, Government discussion paper prepared by the Ministerial Advisory Committee (MAC), <http://www.planmelbourne.vic.gov.au/discussion-paper>, accessed 30 June 2013
- Minister for Planning (2013), Reformed planning zones to protect Glen Eira, Media Release, http://www.gleneira.vic.gov.au/files/b6f247bd-7a1d-4487-9584-a21100f841a8/130805_-_Residential_planning_zones_bring_protection_to_Glen_Eira_doc.pdf, accessed October 2013
- Murray, S., Khor, L., 2011, Renovating the suburbs, *Architecture Australia*, vol 100, issue 3, Architecture Media Pty Ltd, South Melbourne, Vic, pp. 35-37.
- Murray, S., Newton, P.W., Wakefield, R. & Khor, L. (2011) *Greyfield residential precincts: A new design model for the regeneration of the middle suburbs*, Conference paper, State of Australian Cities National Conference, Melbourne
- National Housing Supply Council (2010), 2nd State of supply report, Commonwealth of Australia, Canberra.
- Newton, P., Murray, S., Wakefield, R. Murphy, C., Khor., L and Morgan, T. (2011) *Towards a new development model for housing regeneration in greyfield residential precincts*, AHURI Final Report No.171. Melbourne: Australian Housing and Urban Research Institute.
- Newton, P., et al (2012) 'Greening the Greyfields: Unlocking the Redevelopment Potential of the Middle Suburbs in Australian Cities', Proceedings of the 33rd International Conference on Urban Planning and Regional Development (ICUPRD 2012), World Academy of Science, Engineering and Technology, Venice, Italy, 14-16 November 2012, Vol. 71 (2012), pp. 658-677.
- Phan T., Peterson, J. and Chandra, S. (2008) 'Urban infill: Extent and implications in the City of Monash', *People and Place*, 16(4), 23-30
- Pradolin, R. (2009) 'Failure to understand market dynamics', Architect Victoria, Summer.
- Productivity Commission 2011, Performance benchmarking of Australian Business Regulation: Planning, zoning and development assessments, Vols 1 and 2, Australian Government Productivity Commission, Canberra.
- Rowley, S. and Phibbs, P. (2012) Delivering diverse and affordable housing on infill development sites, AHURI Final Report No.193. Melbourne: Australian Housing and Urban Research Institute.
- Spatial Economics (2011) Housing Development Data 2004–08 Statistical Summary Report – Metropolitan Melbourne, Department of Planning and Community Development, http://www.dpcd.vic.gov.au/_data/assets/pdf_file/0003/65
- Szafraniec, J & Holloway, J (2012) 'The unplanned source of housing supply: What drives incremental infill housing development?', conference paper presented at 6th Australasian Housing Researchers' Conference, 8-10th February 2012, University of Adelaide, South Australia, http://www.sgsep.com.au/files/AHRC2012_Szafraniec_Final.pdf, accessed December 2012
- Tomlinson R. (Ed) (2012) *Australia's unintended cities: the impact of housing on urban development*, CSIRO Publishing, Victoria.
- Trubka R. et al (2010) *The Costs of Urban Sprawl - Physical Activity Links to Healthcare Costs and Productivity*, <http://www.crcsi.com.au/getattachment/fa19593b-16ff-45b8-9fee-0a3a71aac5cf/The-Costs-of-Urban-Sprawl--Physical-Activity-Link.aspx>, accessed June 2013
- VIF (2012) Data Tables, DPCD, <http://www.dpcd.vic.gov.au/home/publications-and-research/urban-and-regional-research/census-2011/victoria-in-future-2012/vif-2012-data-tables>, accessed July 2013