

## Density

### Fact Sheet by Peter Cotton posted 06 Aug 2008

Density is a key variable in urban design and planning. Different residential densities generate different urban forms, characteristics, housing types and ecological footprints. There are a number of ways to measure density ? although, not all are useful for making meaningful comparisons between different developments. This factsheet highlights the density measures that are most useful to policy makers, planners, designers and others involved in the development process.

#### •Categorised under:

- Feasibility, Planning, Design,
- Greenfield Development,
- Estate Design,
- High Density, Medium Density, Low Density,
- Developer, Local Government,

## Introduction

This Fact Sheet also discusses what are the choices of appropriate residential densities: where they go, what are the considerations that influence their choices, what determines densities other than sizes of lots and types of dwellings, what are the implications of densities, and issues peculiar to low, medium and high density developments. The concept of urban transect in terms of density will also be explored.

The use of density control has played an important role in urban design and planning policies by state and local governments. Between the two extremes of keeping density low to protect the rural or existing low density character of an area, to intensification in built-up areas to maximize use of existing infra-structure and social services, increasing the viability of public transport, and minimizing the ecological footprint of a development, lie other densification and urban consolidation policies that attempt to address urban sprawl and the associated negative physical, social, environmental and financial impacts.

With growing awareness of the scarcity of suitable land, natural resource and primary production protection and consideration of sustainability and the effective use of resources, the argument for increasing densities in appropriate locations to achieve more compact cities has been gaining widespread acceptance among policy

planners and the development industry.

## Overview

<b>Density Considerations</b>	<b>Influences/impacts</b>
Density definitions - "net" versus "gross"	Need to apply consistent measures of residential density Relationship between residential density and population density
Choice of appropriate densities	Locations of activity centres, public transport routes, open space/ parks Topography and Slope Existing vegetation to be retained Relationship to surrounding development - existing/ proposed
Density determinants	Lot sizes Permissible site coverage and floor space Street and lot layout Width of road reserves Street block sizes
Implications of densities	Urban form and character Ecological footprint Dwelling types Built-forms and heights
Low density Issues	Infrastructure costs Urban sprawls Stretched social services Unsustainable public transport system High private car uses - CO2 emission Greater urban footprint and impact on existing natural environment.
Medium Density Issues	Visual and acoustic privacy Private open space Solar access Garage dominance Car parking
High density issues	Visual and acoustic privacy Private open space Solar access Height and bulk Overshadowing Car parking Space between buildings Increased opportunities for anti-social behaviours and crimes

## Density definitions

There is a need to have a consistent and meaningful density measure that can be used for strategic and development planning purposes by authorities, as well as for land valuation and feasibility studies by the development industries. The following are the common measures of density referred to in AMCORD:

### Site Density:

This is the finest level of density measure useful for density comparison between projects. It is the ratio of the dwellings to the site area they occupy, which can be either individual dwellings on their own lot, or multi-dwelling development on their development site. It is more suited for comparisons of projects focussed on individual lots or development sites, or sites identified in a developed masterplan. The use of R-Code in WA is an example of use of site density as a development control tool.

*Source: Practice notes AMCORD*

### Net Residential Density:

This is the most useful measure of density of a housing estate. It is the ratio of the number of dwellings to the area of land they occupy including internal roads plus half the width of adjoining access roads, but not public open space or reserve. Including roads in the calculation is more realistic, as most larger developments have to have roads, even though road widths may vary from estate to estate. Excluding public open space and reserve from the calculation also makes comparison more meaningful as different local authorities may require different standards of public open space provisions. Also, there may be a presence of bush corridors, riparian zones, flood prone areas etc that cannot be built upon and should, therefore, not be brought in to skew the density calculation.

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Net Residential Density as defined by AMCORD / Residential Densities Handbook (DUAP)

• The ratio of the number of dwellings to the land they occupy (including internal public streets plus half the width of adjoining access roads that provide vehicular access to dwellings). •

Standard Block 260 x 150

Land area : 13,104 sqm (1.31 ha)

Dwellings : 24

Net Density : 18.31

*Source: Edmondson Park Locality DCP Template, Liverpool City Council*

### Neighbourhood Density:

This is a very gross measure of density that is rarely used for comparison purposes, as there are too many variables to make a comparison meaningful.

It is the ratio between the number of dwellings to the area of land, inclusive of all land uses: public open space/ reserve, internal roads, residential/ non residential land and half the width of adjoining arterials roads.

### **Urban Centre Dwelling Density:**

Again this measure is of limited use for strategic and development planning purposes. It is used at macro scale to compare densities of regions, towns, cities within and between countries.

### **Population Density:**

All the above density definitions are ratios of dwelling numbers to land areas. For infrastructure and social services planning purposes, population density which is the ratio of the number of people living on a given area of land, is used. This ratio can be extrapolated from the dwelling density by applying the occupancy rates for different types of dwellings. It must be noted, however, that occupancy rates do vary from locations to locations and may change over time.

For the purpose of this Fact Sheet, the focus of the discussion is on dwelling density.

## **Choice of appropriate densities**

Providing housing diversity and choice to meet the differing housing needs of the future residents of an estate involves allocating areas of appropriate densities that generate the desired housing typologies to suit the population.

In principle, higher residential densities should be located near activity centres and along public transport routes to maximize access and convenience to services.

Medium density should be assigned to locations of high amenity, which may coincide with activity centres or neighbourhood parks, such as open space corridors, nature reserves, lake/ water side, as well as in close proximity to public transport routes.

The remaining residential areas can be allocated to lower density housing forms, with the lowest density located at the fringes of an estate bordering non-urban areas.

The choice of locations for different densities is also influenced by the site topography. Slopes of greater than 20% are generally not considered suitable for medium density development due to excessive retaining requirements adding to extra costs.

Sites that have scattered stands of significant trees to be retained may call for cluster housing type development whereby dwellings can be sited and access roads can be located more freely to accommodate trees to be retained rather than following a rigid street pattern. This would generate medium density development, although the overall density including land saved from development may amount to low density.

Another influence on choosing locations of densities is the relationship to surrounding developments. In general, it is good practice to attempt to adopt similar densities at the interface with neighbouring developments or create a transitional zone of densities that would generate a gentle transition between the developments. Obviously, this rule does not apply if the adjoining developments are of undesirable character that would adversely impact on the new estate.

## Density determinants

The principal determinant of density is the lot sizes of dwellings – the larger the lot sizes, the lower the density.

Permissible site cover also determines density. Site cover requirements depend on locations and the intended built forms that relate to the street and block layout whether they are in a built up inner city area, suburban or outer areas. For a given site, having different site cover requirements would produce different densities. For example, low rise apartment buildings in an inner city location edging the street, occupying almost the entire site, would produce a denser development than the same building type in a suburban location where buildings are required to be set back from the boundaries and from the street, and controlled by maximum site cover and minimum landscaped area requirements.

Conversely, different building types with different site covers can produce the same dwelling density. For example, an inner city row of terrace houses can produce the same density as a mid rise apartment building set in a pavilion style within the block with a specified site cover.

Plot ratio or floor space ratio also has a direct correlation to density. For a given site area, applying different plot ratios to the site would generate totally different densities.

Other factors such as differences in width of road reserves and street block sizes all contribute to variations in density but not to the extent that significantly change from one category to another.

## Implications of densities

Different densities generate different urban forms and characteristics, although the correlation to dwelling types may not be as hard and fast if factors such as site cover come into play. In general, however, density measures do give an indication as to what is intended in terms of built form and height, especially when read in conjunction with site cover and plot ratio.

Another implication of density is the ecological footprint. The benefits and costs of different densities in terms of ecological footprint is discussed in the Key Issues Section of this Fact Sheet.

Density allocations can impact on housing affordability. An increase in net residential density can significantly reduce the cost of producing housing. For example, a study by Scott Carver in 1992 suggested that an increase of 20% in net residential density resulted in a reduction of approximately 10% in the cost of producing a dwelling.

Other implications of density relate to the creation of more sustainable, compact cities, generally achieved through the development of higher density housing forms.

## Low density issues

Low density does have its place in the overall urban landscape when applied in the context of compact cities with defined limits. Even with a compact city form there are housing needs that are still best served by low density housing.

However, large tracts of low density housing is considered to be unsustainable as it results in urban sprawl, involves high infrastructure costs, stretches the resources of social services and facilities, is unsupportive of generating viable public transport systems leading to reliance on private car use with consequent increases in emissions, fumes, loss of air quality, and often results in social isolation. The sprawl and greater urban footprint associated with low density development can also put pressure on the natural environment, threatening existing eco systems and bio-diversity, and can alienate the use of productive land for agricultural purposes.

### **Typical lot configurations for low density (12.5 dwellings/ha)**

*Source: Development Code Precinct Planning, The Growth Centres*

## Medium density issues

Housing types associated with medium density housing development can cater for the needs of a range of demographic and socio-economic profiles. The increase in density effectively results in lower costs per unit of producing dwellings, as well as a more efficient use of scarce land resources, infrastructure and social services and facilities.

Denser development where dwellings are placed and residents live in close proximity to each other in tighter spaces brings with it issues that are less common in low density development – issues such as visual and acoustic privacy, adequacy of private open space, solar access, garage dominance, visitor parking etc. A lot more care and skill is required to design dwellings or groups of dwellings to adequately address all of the above.

A reduction in the provision of private open space is normally countered by creating communal open spaces or parks to offer recreational opportunities and amenities for residents.

### **Typical lot configuration for medium density (20.69 dwellings/ha)**

*Source: Development Code Precinct Planning, The Growth Centres*

## High density issues

High density development close to activity centres and public transport routes represents the most efficient use of urban resources. It generates the smallest ecological footprint of all three density types.

High density development experiences similar issues to medium density development, albeit, at a much more

intense scale. The issues of visual and acoustic privacy, solar access and car parking can be dealt with in the design of buildings; and lack of private open space can be offset by provision of communal open space and parks.

With high density development, bulk and height of buildings, potential overshadowing of open space and other buildings nearby, and spaces between buildings are issues that can be dealt with by appropriate siting and the arrangement of buildings on the blocks. To achieve the best outcome, the planning and layout of the blocks in the masterplanning stage must ensure appropriate block sizes, configurations and orientation to allow future buildings to be designed and sited on these blocks to optimum effect.

Another issue associated with high density development is the increase in opportunity for anti-social behaviour and crime due to increased population density, increased anonymity, higher concentration of different social mixes and potential frictions. The planning and layout of the estate must maximize casual surveillance opportunities by ensuring that all blocks address streets or public open spaces and laneways are designed for easy surveillance, and potential places of concealment are eliminated. Read more in the Safety factsheet.

### **Typical lot configuration for high density (38.55 dwellings/ha)**

*Source: Development Code Precinct Planning, The Growth Centres Commission*

## Transect of densities

In principle, with a New Urbanist inspired residential estate, there is to be a gradation of density starting high at the core and gradually decreasing towards the lowest density at the edges. In reality, this gradation may not be as clear or as linear as would be expected due to other mitigating factors such as topography, other specific site features and relationships to adjacent services and facilities, such as public transport and centres.

Nevertheless, the concept of transition or gradation from one density to another can be used to handle the relationships between different building typologies, scales and heights generated by the different densities, in order to avoid stark contrast and visual discordance caused by the juxtaposition of buildings of vastly different densities, and the potential loss of amenity, privacy, and overshadowing of lesser scale developments by high density developments.

The concept of transect of densities ensures that this would not happen.

## Key Issues

### **Benefits**

“Compact Neighbourhood” concept inspired by New Urbanist approach to estate development is characterised by overall density than conventional residential development. Higher density offers a number of benefits that contribute towards achieving sustainability objectives of a development. It enables:

- more efficient use of scarce land resources
- more compact neighbourhood where local activities are within 5 minute walking distance from the majority of dwellings i.e. encouraging walking and cycling and less use of private vehicles for access to local activities with consequent reduction in emission and fumes, improved air quality, improved fitness and health, increased opportunities for social interaction and neighbourliness, improved safety and security
- easy access and convenience to a greater number of residents in higher density areas in and around local activity centres
- higher concentration of activities and vibrancy
- higher population to support a viable public transport system
- greater affordability with reduced cost of land per dwelling
- reduction in impact to the natural environment through reduced environmental footprints
- greater dwelling unit yields and returns.Â

## Risks

The risks associated with higher density proposals may include:

- Objections from sections of the existing community who may view higher density as undesirable
- Difficulty of achieving optimum solar access for all dwellings in multi-unit type buildings, resulting in a proportion of dwellings with compromised solar access
- Increase in opportunities for anti-social behaviours and crimes due to increased population density, increased anonymity, higher concentration of different social mixes and potential frictions
- The market for higher density housing forms may be more limited than for more conventional housing forms.

## Savings

Compact neighbourhoods supported by higher density would produce savings in:

- land resources and investment in infrastructure
- fuel costs from reduced private car use
- time for travel
- health care costs due to better fitness and health from engagement in active pursuits such as walking, cycling and recreational opportunities in parks and open space, and from better air quality.

## Costs

There are a number of costs associated with higher density living:

- Lack of private open space requiring more open space provisions in the public domain to provide amenity to residents.
- Some types of multi-unit buildings in higher density areas are more costly to build to achieve minimum fire and acoustic ratings, because the labour rates are higher for this class of building than for detached houses and because mechanical lifts may be required.

- There may be additional costs e.g. pergolas associated with addressing acoustic and visual privacy issues.
- To keep efficiency in planning and optimising yields on the blocks, some dwellings may be compromised in terms of solar access.
- Generally, higher density developments will require greater up front design input and may incur greater delays in the approval process.

## Barriers

The main barriers to adopting higher density is community acceptance and some local councils that try to preserve the existing low density character of neighbourhoods.

## Benchmarks

There are no known common established benchmarks in relation to density. However, the NSW Government's policy on new release areas specifies a minimum net residential density of 15 dwellings per hectare, which is considered to be the minimum to generate a resident population sufficient to support a public transport system. Other density requirements by local authorities are usually expressed in their Development Control Plans for specific areas and localities and these vary from council to council. These are generally expressed as a minimum lot area or site area per dwelling type and are sometimes expressed in density terms as dwellings per hectare. One known measure that is expressed in terms of dwelling density is the R-codes used in Western Australia.

## Development phase actions

### Feasibility

Appropriate density measures established by the relevant authority for a locality can be used to quickly work out gross development yields and preliminary feasibility for the purchase of a site. More detailed yield analysis with a mix of lot and housing types will require the consideration of different densities to generate the required proportions of lots and housing types to meet the needs of different household types. Research on the demographics of population in the area and similar areas to establish the demands for various types of housing would help define the mix and guide in allocating densities to produce the desired housing and lot types and mix.

### Planning

During the planning stage, it is necessary to determine the policies of governments, both state and local in relation to residential densities for particular sites and localities. The locations of high, medium and low densities would be determined by their proximity to activity centres, public transport routes and public open space, as outlined in the statutory policies and on the structure plan for a particular locality and as agreed with the relevant planning authority. A number of scenarios need to be explored and tested and agreed to by the various stakeholders including government departments and agencies, local authorities, land owners, developers, utility and services providers and local communities.

## Design

Designing for density targets involves considering the following variables: lot size and dimension, site cover, plot ratio, height control, building design and siting in relation to street and lot layout.

For individual residential lots, the lot sizes are the major determinant of density - the larger the lots, the lower the density, and vice versa.

For multi-unit development, site cover working in combination with height control and plot ratio are the main determinants of density, with building design and siting in relation to street and lot layout in urban or suburban locations offering variations to the density outcome. Once decisions are made as to the required density for multi-unit areas, the size and configuration of the blocks or lots must be capable of accommodating the intended densities and anticipated built-form outcomes.

## Construction

No actions in relation to density are relevant during the construction phase of a development.

## Lot Creation

No actions in relation to density during lot creation phase are required.

## Completion

On completion, a review on the built-form outcomes of the development should be made to assess if the development has achieved all expectations, including minimal impacts on adjacent areas. Also to be assessed is the appropriateness of the original choice and location of various densities and whether it could be changed for future projects to improve the liveability and vibrancy of the neighbourhoods and better support the viability of public transport.

### Links

- [Street and lot layout factsheet](#)

### References

Scott Carver Report on Housing Affordability  
AMCORD Practice Notes

### Link to Content

•<http://yourdevelopment.org/factsheet/view/id/58>