APPENDIX A: Methodology

The projections in this report are based largely on census counts and the medium series population projections, 2008 edition. Living arrangements as recorded in the 1996 to 2006 census are projected forward and applied to the projected population, to give the projected number of households in each five years to 2031. Adding vacant dwellings provides the projected number of total private dwellings. Finally, the change in total dwellings plus the replacement of dwelling loss provides the underlying demand for new dwellings to be constructed into the future.

**Projected population**

The estimated resident population (ERP) of Queensland was projected using a cohort component population projection model, based on data from the 2006 census. All usual residents of an area were included in these projections – not only those living in private dwellings but also those living in non-private dwellings, which provide communal accommodation. Details of the state and regional population projections for Queensland can be found in the publication *Queensland’s future population 2008 edition*, Department of Infrastructure and Planning, 2008.
The medium series results of the population projections were used when projecting living arrangements, households and dwellings. The part of the population who live in non-private dwellings were included in the calculations behind these projections, but only the results for private dwellings and households are presented in this publication.

In this report, projected living arrangements and households refer to people living in private dwellings only and the number of dwellings reflects private dwellings only.

As the population of an area changes, the number of households will usually change also. Generally the growth rate of households slightly exceeds the growth rate of the population due to higher rates of growth in the number of smaller households than in larger households. Nevertheless, when projecting small geographic areas, some unexpected numbers may result from particular situations, as illustrated in the following examples.

Population growth in an area may occur without a corresponding increase in the number of households if that population growth occurs in non-private dwellings (for example in staff quarters) or if existing households grow in size. An example of the latter would be a newly settled estate increasing in population as young couples begin to have children.

Small population losses can occur without necessarily reducing the number of households, if existing households lose some household members. However, larger population losses are generally accompanied by a reduction in the number of households.

Projected living arrangements and households

A propensity trend method has been used to project the number of households. It assumes there are two major influences on the projected number of households:

- The projected number of persons in each sex and five year age group
- The projected propensities for different living arrangements, for example the proportion of persons of each age/sex group who reside in particular living arrangements, as measured in the census and projected forward.

The base data for these current projections comes from the 2006 census. Households in private dwellings have been classified into 15 different types of living arrangements. The proportion of usual residents of each sex and five year age group who have a particular type of living arrangement is calculated. These propensities for different living arrangements are then projected forward, but the proportion of living arrangements in the base year is not held
constant. It is assumed that recent changes in the population’s propensity for living arrangements (as recorded in census data from 1996 to 2006) will continue for at least the next 5 to 10 years, but will gradually stabilise.

The projected propensities for living arrangements are then applied to the projected population within each LGA in the years to 2031. The resulting projections of number of persons by age group, sex and living arrangement, are used to calculate the number of private households expected in future years.

‘Not classifiable’ private households have been included in these projections. In approximately four per cent of cases the census collector ascertains that a dwelling is occupied on census night but is unable to make contact with the occupants, and they do not return the census form that is left at the dwelling. It is not possible to identify the types of households involved in these non-contact dwellings. During census processing persons are imputed for these dwellings from other information but their living arrangements and household type are recorded as ‘not classifiable’. Living arrangements were not recorded for four per cent of the Queensland population counted in the 2006 census, and this same proportion of the population has been projected forward as having non-classifiable living arrangements. Consequently there is a discrete category of ‘not classifiable’ households in the household projections.

Using the propensity trend method it is possible to derive negative propensities for future years, at both the statistical division (SD) and local government area (LGA) level. As the propensities in effect represent the proportion of the population in a particular living arrangement, negative propensities are not meaningful. For the current projections, any negative propensities were reset to zero.

To avoid volatility due to small numbers, the past rate of change in propensities is not measured for each LGA but for each SD. This rate is applied to each LGA within the SD. That is, it is assumed an LGA’s propensities will change at the same rate as those for the SD in which it is located.

Other adjustments may also be made, to account for particular local volatility or the effect that increased birth rates will have on the type of new households formed in the future. These are described later in this section.
Projected number of dwellings

The projected number of households feeds directly into the projected number of dwellings in an area. By definition, the number of households equals the number of private dwellings occupied by usual residents, so a projected change in the total number of households translates to a projected change in the number of occupied dwellings.

As well as dwellings occupied by usual residents, account must be taken of those dwellings not required for current occupation by usually resident households. Dwellings not occupied by resident households are effectively ‘vacant’ for the purposes of projecting the usual resident population of an area. These vacant dwellings are either unoccupied or occupied by visitors. They make up the difference between resident households and total private dwellings.

At any point in time there are some private dwellings which are unoccupied – they may be awaiting occupancy because they are new, between owners or available for lease, or all of the usual residents may be away temporarily. Other dwellings may be used by visitors to the area rather than by usual residents of the area – the dwelling may be a second home or a holiday house, used as accommodation for seasonal workers, or rented out on a short-term basis to visitors or tourists.

These vacant dwellings can vary in number quite rapidly, so that changes to the number of resident households may not fully translate into changes in dwelling stock. Population growth in an area may absorb much of the existing supply of vacant dwellings before creating demand for additional dwellings to be constructed. Population losses in an area will generally lead to an increase in the number of vacant dwellings. However, if those losses are caused by households leaving the area and those households resided in mobile dwellings, such as caravans, those dwellings may also be removed from the area rather than simply becoming vacant.

Both occupied and vacant private dwellings may include detached houses, townhouses, flats and units, caravans, houseboats, tents and improvised housing. However unoccupied dwellings in caravan parks and marinas are not counted in the census; nor are they counted in the dwelling estimates in this report.

When deriving dwelling projections from household projections it has been assumed the vacancy rate (ratio of vacant dwellings to total dwellings) will remain similar to that measured
in 2006. This vacancy rate is included in the projected number of dwellings required to house the projected number of households. As a result, a projected increase in the number of households will translate into a slightly higher increase in the projected number of total dwellings.

The projected number of total dwellings is the most relevant figure for assessing future demand for services such as water, electricity, internet access, refuse collection, postal delivery and so on.

**Change in number of dwellings**

The projected change in number of dwellings is the growth of total dwelling stocks from one period to the next. One might view the projected change in total dwellings as a net figure, equal to the number of new dwellings constructed less the number of dwellings lost through demolition or other reasons.

Where the demand for residential land is being assessed against supply, the projected change in total dwelling stock best reflects that demand. This is because the supply of infill land is generally calculated as a net figure reflecting the potential increase in dwellings over a given area. The effects of demolitions and replacements are not involved in either side of this demand/supply equation.

However, the replacement of dwelling stock loss is important to the construction industry and so is used in the calculation of the next statistic, the underlying demand for new dwellings.

**Underlying demand for new dwellings**

If the total number of dwellings (occupied and unoccupied) is to increase, it will be necessary to construct new dwellings. In addition, some new dwelling construction may be needed to replace those dwellings lost through demolition, removal or other reasons. Together, these two factors make up the underlying requirements for new dwelling construction, or underlying demand for new dwellings.

The underlying demand for new dwellings refers to the number of new dwellings that must be constructed to house the population. It comprises the projected increase in total dwellings plus replacement of any dwellings lost. The term ‘underlying’ is used to indicate that this
demand for construction of new dwellings originates from the size of the population. There may also be fluctuations in the market for new dwellings that are created from other sources, such as variations in house prices, mortgage rates, first home owner grants and other, mostly short-term factors.

The underlying demand for new dwellings is a growth figure rather than a stock figure. It is the most relevant growth figure for the housing industry when estimating future long-term demand for construction of new dwellings. For most other purposes the change in total dwellings is more relevant. In greenfield areas where there are no projected demolitions, conversions or removals of existing dwellings, the two measures will be identical.

The increase in total dwellings forms a major component of the underlying demand for new dwellings. In addition, the number of dwellings required can also be impacted by the demolition or removal of existing dwellings or through conversion to offices or professional suites, or through older dwellings becoming derelict. This may occur in older suburbs undergoing urban renewal, where lower density detached houses are replaced by higher density townhouses or units, or perhaps a retirement village. Perhaps older style smaller apartment buildings will be demolished to make way for larger more modern units.

Replacement of dwellings does not increase total dwelling stock, it merely maintains the number of dwellings at a level sufficient to accommodate the projected number of resident households. However, replacement of dwelling loss does result in demand for additional dwelling construction, so its inclusion in the underlying demand for new dwellings is important for the construction industry.

The requirement to replace dwelling stock loss is assumed to be greatest in areas undergoing urban renewal or densification. In Brisbane City, for example, an average of around 800 dwellings per year were approved for demolition or removal over the period 2001 to 2006. This represents about one per cent of the dwelling stock over a five year period.

For these projections it has been assumed that the level of replacement of dwelling loss is equal to 1 per cent of the dwelling stock every five years in Brisbane City, 0.5 per cent for Gold Coast City, 0.25 per cent for other urban LGAs in SEQ and large urban LGAs outside of SEQ, and 0.1 per cent for all other LGAs. It should be recognised that these estimates are indicative only, as insufficient information is available to make precise estimates.
If the total number of dwellings is projected to decline, calculation of the underlying demand for new dwellings may result in a negative figure, but in such cases this is set to zero. This does occur in these LGA projections for some projection intervals, but not across the entire 2006 to 2031 period.

An additional factor to recognise is that a rapid increase in population can be accommodated with the use of temporary dwellings such as caravans, increasing the total dwelling stock with little additional dwelling construction. In areas where there is a substantial supply of temporary dwellings such as caravans used as residences, the number of dwellings can decline sharply when rapid population losses occur as households leave the area.

These projections for underlying demand for new dwellings by LGA are for all private dwellings, including non-structural dwellings such as caravans, cabins and houseboats.

**Occupancy rate and household size**

Household size refers to persons per household whereas occupancy rate refers to persons per dwelling. The inclusion of vacant dwellings in the denominator of occupancy rate means that the average occupancy rate within an area will always be lower than average household size. In this current projection exercise dwelling vacancy rates have been maintained over the projection period. As a result both persons per household and persons per dwelling move together, for example a projected decline in household size translates into a projected drop in occupancy rate.

Average household size and average occupancy rate are fairly crude measures, since they use as their numerator the total resident population, including those who do not reside in households or in private dwellings. However these statistics provide a convenient way to convert population to households or dwellings respectively without having to make an allowance for that part of the population not usually resident in households or private dwellings.

Users of the average household size and average occupancy rate measures should recognise that these statistics may not fully reflect changes at a more detailed level. The ratio of vacant dwellings to total dwellings can be a significant factor in occupancy rates. High vacancy rates in particular LGAs may have implications for the demand for new dwelling construction, as discussed in Section 5.1.
Although the dwelling projections in this report are not disaggregated by dwelling type, the average occupancy rate can be impacted by the mix of dwelling types constructed in an area. Attached dwellings such as townhouses or flats are generally occupied by smaller households than detached houses, and often a greater proportion are vacant at any point in time. As a result, attached dwellings have a lower occupancy rate (typically around 1.0 persons per dwelling lower).

Consequently, if attached dwellings constitute a high proportion of new dwelling growth in an area, the overall average occupancy rate of the area will tend to be lowered. This may occur even though the average number of persons per detached dwelling or persons per attached dwelling may not fall. It is even possible for the occupancy rate of attached dwellings to rise while the overall average occupancy rate falls, if attached dwellings are a sufficiently large proportion of new dwellings.

The following table provides a simple illustration of the above point. The occupancy rate in attached dwellings increases from 2.00 to 2.17 while the rate in detached dwellings remains constant. The high proportion of attached dwelling growth causes the average occupancy rate for all dwellings to fall from 2.50 to 2.44.

**Figure 7.1: Illustration of declined average occupancy rate with increased occupancy rate in detached and attached dwellings**

<table>
<thead>
<tr>
<th></th>
<th>Detached</th>
<th>Attached</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Base Year</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dwellings</td>
<td>100</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>persons</td>
<td>300</td>
<td>200</td>
<td>500</td>
</tr>
<tr>
<td>occupancy rate</td>
<td>3.00</td>
<td>2.00</td>
<td>2.50</td>
</tr>
<tr>
<td><strong>Projection Year</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dwellings</td>
<td>150</td>
<td>300</td>
<td>450</td>
</tr>
<tr>
<td>persons</td>
<td>450</td>
<td>650</td>
<td>1,100</td>
</tr>
<tr>
<td>occupancy rate</td>
<td>3.00</td>
<td>2.17</td>
<td>2.44</td>
</tr>
</tbody>
</table>

**Adjustments required for LGAs**

To overcome specific local issues when projecting at the LGA level, some adjustments have been made to the general household projection methodology described above.

One of the deficiencies of the propensity method is that the projected number of parents (in both couple and lone parent living arrangements) is not explicitly linked to the number of children in those living arrangements. Indeed, the number of children in each living
arrangement has no bearing at all on the projected number of households in the propensity methodology. For these projections a separate calculation was incorporated to check the average number of children per living arrangement, and in some cases the projected propensities were adjusted to ensure that the average number of children per couple with children and per lone parent was not less than one for any LGA in any projection year.

The projected propensity in each age group for each living arrangement is calculated by applying a rate of change to the propensity in the previous period. A propensity which is zero in the base year will remain at zero for every following period. At the LGA level there were a number of instances where all propensities were zero for an age group. This may occur in reality, or it may be an artifact caused by the randomisation of small cells in the ABS census data. The presence of these zero propensities in an LGA meant that the change in age structure over the course of the projection period caused excessive volatility in the numbers of persons in particular living arrangements. To overcome this problem, where all propensities in a particular age group at the 2006 census were zero, each was reset to the propensity of the next youngest age group. This solution provided greater continuity over time in living arrangements containing few persons.

Over the course of the projection process it became apparent that the small numbers of persons with particular age group/living arrangement combinations in some LGAs introduced a high degree of volatility in the projected numbers of households of each type. To dampen this instability, an ongoing monitoring process was developed within the projection system to track each LGA’s share of household types within a statistical division (SD). Where there was excessive volatility in this proportion, or where an LGA had a projected proportion in a particular household type that differed from its projected share of total households, the factors contributing to this outcome were carefully checked. In some cases these outcomes were not consistent with the base year data and were caused by outlier values in the propensity matrix. Where it was considered that these values were unreasonable and likely to be statistical anomalies, adjustments were made to the projected propensity matrix to reduce the misleading outcomes.

A discrete living arrangement category containing usual residents of non-private dwellings (NPDs) is included within the living arrangement matrix to ensure that all usual residents are included, even though they do not live in a private dwelling. This category of living arrangement does not contribute to the count of households at the census, nor to the projected number of households and private dwellings. However, using the propensity
method, there can only be persons in an age group projected in this category if there was an NPD containing persons of that age group in the LGA at the time of the 2006 census. Two situations required particular attention in deriving household projections at the LGA level.

The first example is LGAs where the population projections assume a large influx of population to work at major mining projects. It is assumed that many of these new residents will reside in NPDs known as ‘single persons quarters’, although these NPDs did not exist at the time of the 2006 census. Indeed it is known that this has occurred since the 2006 census in several LGAs. For these LGAs the projected propensities of persons to be in the NPD category of living arrangement were adjusted to better reflect the expected distribution of the population, especially those of young working age. Similarly the propensities for persons to reside in ‘group’ households were also adjusted as it is known that sharing of dwellings by mine employees is common in these areas.

The second situation is those LGAs without a retirement village at the time of the 2006 census, but where the high projected growth of persons in retirement age groups makes it likely that such accommodation will be in demand. In deriving the household projections for such LGAs it has been assumed that such demand will be met by the construction of non-private retirement accommodation, and that a significant number of persons in older age groups will reside in NPDs. The propensities were adjusted in some LGAs to reflect this assumption, as without this adjustment the projected growth in persons living alone was so extraordinarily high as to be considered unrealistic.

**Comparison with previous series**

Compared with the 2007 projections, (Household projections, Queensland Local Government Areas 2007, Department of Local Government, Planning, Sport and Recreation), there have been some changes to the methodology used. One change was to disaggregate every living arrangement by sex as well as age, while in the 2006 series disaggregation by sex was confined to lone parents and lone persons. Another change implemented was to use census data covering 10 years (1996, 2001 and 2006) to calculate the rate of change in propensities averaged. Previously, when census data covering 15 years were averaged, the more rapid rates of change evident in the earlier period impacted significantly on the results.
The treatment of non-classifiable households has also changed. The number of ‘not classifiable’ households has doubled over the decade to 2006 – they accounted for about four per cent of all occupied dwellings in 2006. Previously these non-contact dwellings had been re-allocated across other household types, but for the current projections a discrete category of ‘not classifiable’ households was maintained. For projection purposes the propensity for persons to be recorded in a ‘not classifiable’ household was held constant.

Further reading

The propensity method has previously been used by the Australian Bureau of Statistics (ABS) to project households at the State, Capital City and Balance of State levels (Household and Family Projections 2001 to 2026, ABS 2004).

The same method was also used by the Queensland Centre for Population Research (QCPR) to project household types at the state and statistical division level for the Queensland Government. These 2008 edition household projections for Queensland and statistical divisions, which form the basis for the LGA projections provided in this publication, are available on-line at www.oesr.qld.gov.au. Further explanation of the technical aspects of the propensity method can also be found at this location.

While the propensity method is currently the best method available for projecting households, it is acknowledged it has inherent problems and it is hoped improvements can be made to the methodology in future. A detailed explanation of the methodology used for LGA level projections was prepared for the previous series and is available online at www.oesr.qld.gov.au.