BE WHAT YOU WANT TO BE.

CQUniversity AUSTRALIA

BOWEN BASIN REGIONAL HOUSING DEMAND FORECASTING MODEL: APPLICATION TO FIVE TOWNS

Milestone Report Two

Prepared for Department of Tourism, Regional Development and Industry (DTRDI)

June 2008

Delwar Akbar, John Rolfe and Lindsay Greer

Institute for Sustainable Regional Development (ISRD)
CQUniversity
Building 32
Bruce Highway
Rockhampton QLD 4702
isrd@cqu.edu.au
www.isrd.cqu.edu.au

Queensland Government

Disclaimer: The Institute for Sustainable Regional Development (ISRD) has made every attempt to ensure the accuracy and validity of the information contained in this document. However, the Institute cannot accept any liability for its use or application. The user accepts all risk in the interpretation and use of any information contained in this document. The views and interpretations expressed in this report are those of the author(s) and should not be attributed to the organisations associated with the project. They do not represent an adopted position of ISRD. Please do not reproduce without the express permission of the authors.

Acknowledgements:
The material utilised in the preparation of this document incorporated a wide range of reports, papers, discussions, state government websites and library research. The authors would like to acknowledge a number of organisations who made a contribution to the project and/or this report: Anglo Coal Australia (Dawson Mine), OESR, PIFU, Queensland Department of Housing.

Publication Data:
Akbar, D., Rolfe, J., Greer, L. (2008). Ensuring Sustainable Benefits from Boom Periods: A case study for long term housing policy in the Bowen Basin: Bowen Basin Regional Housing Demand Forecasting Model: Application to Five Towns, Milestone Report 2, provided to the Department of Tourism, Regional Development and Industry (DTRDI).

Project Manager:

……..
Lindsay Greer
Senior research officer

Institute for Sustainable Regional Development
Building 32/2.60
CQUniversity
Rockhampton Qld 4702
Tel: 61 7 4930 9274
Fax: 61 7 4930 6756

Project Director: …….
Professor John Rolfe

ISRD research team:
Professor Bob Miles
Dr Galina Ivanova
Dr Delwar Akbar
Evan Yabsley
Brigitta Yabsley
Sandrine Makiela

Date: June 2008
Reference: ISRD227
Status: Milestone 2 final report

Abbreviations

ABS	*Australian Bureau of Statistics*
ACOSS	*Australian Council of Social Services*
AMCORD	*Australian Model Code for Residential Development*
BBRH	*Bowen Basin Regional Housing (model)*
CH	*Community Housing*
CSHA	*Commonwealth State Housing Agreement*
CQU	*Central Queensland University*
DIDO	*Drive in/Drive out*
DIP	*Department of Infrastructure and Planning*
DoC	*Department of Communities*
DoH	*Department of Housing*
DTRDI	*Department of Tourism, Regional Development and Industry*
EIS	*Environment Impact Statement*
EPA	*Environment Protection Authority*
FIFO	*Fly in/Fly out*
ISRD	*Institute for Sustainable Regional Development*
LGA	*Local Government Authority*
NGO	*Non-Government Organisation*
OESR	*Office of Economic and Statistical Research*
OSHS	*One Social Housing System*
PPP	*Public-private partnerships*
SAAP	*Supported Accommodation and Assistance Program*
SHA	*State Housing Authorities*
SPP	*State Planning Policy*
SPQ	*Single Person Quarters*
TAFE	*Technical and Further Education*
TBL	*Triple Bottom Line*

EXECUTIVE SUMMARY

This report is the second in a series to be submitted to the Department of Tourism, Regional Development and Industry (DTRDI) as fulfilment of the requirements within the approved activity agreement for the project titled, *Ensuring Sustainable Benefits from Boom Periods: A case study for a long term housing policy in the Bowen Basin.*

The report introduces the Bowen Basin Regional Housing (BBRH) model which, while still in preliminary development stage and presented with stated limitations, offers potential forecasting capability for housing demand within regional locations. The report includes a discussion of the conceptual framework of the housing demand model as well as the current application of the model. At this early stage application of the model is limited to an examination of five town locations within the Bowen Basin, Queensland. The model is presented with qualification and will be subjected to ground 'truthing' (comparison between actual and predicted values) which will result in substantial improvement of the model prior to presentation in the final report.

The Bowen Basin is predominantly a coal mining and agricultural region in Queensland, Australia. The recent commodity boom has generated a number of housing pressures in the region, a situation that not only affects individuals and families but also has negative flow on effects for the local and regional economy. Some of the key factors contributing to housing pressure in the region include: housing prices that are increasing at a rate higher than wage increases; a gap in wages between employees in the mining sector and employees in other sectors; a mismatch between housing supply and demand; and, the lack of policy to address this mismatch. An accurate demand forecasting tool can help underpin better policy to deal with such housing problems. The researchers have developed a model, 'Bowen Basin Regional Housing Model' (BBRH), underpinned by relationships between age cohorts, family types and dwelling types. The model can forecast housing needs by family type at the local and regional level over a 20 to 30 year period.

There are twenty towns inside and adjacent to the Bowen Basin region; these were categorised into four types: mining servicing towns/emerging regional hub, mining only towns, mix of mining and agricultural towns, and regional cities. The BBRH model had been applied to five towns in these different categories: Mackay, Moranbah, Biloela, Moura and Theodore. The model predicts various demographic patterns of household and housing trends in different towns. For illustration, there is an increasing trend of demand for separate houses in Mackay and Theodore, while the other three towns either have declining or mixed trends in demand. There is an increasing trend of demand for detached houses in Mackay, Moranbah, Biloela and Moura but other Theodore has both increasing and declining trends. Demand for units or flats are always increasing in every town in the region. Demand for other types of housing is increasing in Mackay and Theodore but declining in Biloela, and there is both increasing and declining trends in Moranbah and Moura. Demand for total private dwellings is only increasing in Mackay and Theodore, and only declining in Biloela but Moranbah and Moura have both increasing and declining trends. The data for all five towns clearly indicates that despite the towns being in the one of the fastest growing regions of the

state with further development prospects, the level of private housing development in these towns is below the state average. The implication of these findings for new prospective developments in the area is that care has to be taken not to exacerbate the housing and labour market pressures.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

SECTION ONE: INTRODUCTION

This report is the second in a series to be submitted to the Department of Tourism, Regional Development and Industry (DTRDI) as fulfilment of the requirements within the approved activity agreement for the project titled, *Ensuring Sustainable Benefits from Boom Periods: A case study for a long term housing policy in the Bowen Basin.* The first milestone report included a review of the aims and objectives of the project as well as a comprehensive review of the current housing issues confronting the Bowen Basin region.

This report introduces the Bowen Basin Regional Housing (BBRH) model which, while still in preliminary development stage and presented with stated limitations, offers potential forecasting capability for housing demand within regional locations. The report includes a discussion of the conceptual framework of the housing demand model as well as application of the model. At this early stage application of the model is limited to an examination of five town locations within the Bowen Basin, Queensland. The model is presented with qualification and will be subjected to ground truthing (comparison between actual and predicted values) which will result in substantial improvement of the model prior to presentation in the final report.

Further to this report ongoing research activities will involve a further refinement of the model, the reporting in detail of extensive stakeholder consultations seeking clarification of housing related issues with the Bowen Basin region, and discussion of housing policy implications in light of the research. While the two reports are structured as stand alone documents they should be read as companion documents that build on each other and as precursors to the final report due at the end of August 2008.

Project Background

The Bowen Basin is predominantly a coal mining and agricultural region in Queensland, Australia that produces about 85% of the coal of this state. Coal production of this region has been growing rapidly since 2004 because of increased global demands for commodities. There are about 33 open-cut mines and 12 underground mines in this region (NRW, 2007).

The boom in the mining industry has increased direct employment by more than 10,000 employees in the five years to 2005-2006, with additional employment through contractors and service industries. This has significantly increased the population of some Bowen Basin communities. For example, the population of eleven key communities in the Bowen Basin has increased by 17.6% from 32,897 in 2001 to 38,687 in 2006[1]. A further increase to 48,650 people is expected by 2021. While coal mining activities are generating a number of positive economic impacts, such as increases in employment and income, there is also evidence of some negative impacts, particularly in the housing sector.

Positive economic impacts from the mining boom include increased employment opportunities and higher income levels. Wage levels in mining are approximately double weekly earnings in the

[1] Information supplied by the Planning Information and Forecast Unit (PIFU) in the Queensland Department of Local Government, Planning, Sport and Recreation.

retail trade and tourism industries (ACIL Consulting 2002). However, the high levels of income in the mining industry mean that there is a discrepancy between house affordability for mining employees and employees in other sectors. The additional workforce growth in mining since 2001 has exerted pressures on the housing market, driving the prices up. Rolfe et al. (2007) identified that the increased workforce demands exceeded available housing levels in most mining towns.

There have been reports of rents in key Bowen Basin centres such as Emerald and Moranbah being as high as $700 and $900 per week respectively for a four bedroom house. In 2006, the cost of housing in Moranbah was about 100% more expensive than Brisbane (the State capital), reflecting a mismatch between housing demand and supply (OESR 2006a). Many accommodation establishments were booked out several months in advance, and examples of 'hotbedding' were reported in some towns[2].

The high rental levels made it uneconomic for people to work in low income jobs. For example it was reported in some mining towns that unless apprentices lived at home or were supported by employers or government, their income levels were actually lower than the amount they would have to pay in rental accommodation. Thus, expansion in the coal mining in the Bowen Basin region has had a measurable impact on housing availability and affordability for both mining sector employees and employees within other industry sectors.

In order to explore these housing problems and provide strategic solutions to the government and the mine operators, the researchers have developed a model, 'Bowen Basin Regional Housing Model' (BBRH), underpinned by relationships between age cohorts, family types and dwelling types. The model can forecast the number of houses needed by family types at the local and regional level over a 20-30 year period.

SECTION TWO: CONCEPTUAL FRAMEWORK OF HOUSING DEMAND MODEL

Housing demand is determined by a number of economic and demographic factors. Demand for housing is an embodiment of a consumer's decision as to how much housing to consume (Belsky et al., 2006). Many theories posit that demand for housing is a function of household income, housing price and the price of all other goods and services (Halicioglu, 2005). A log-linear model can be used to predict the housing demand by using household and housing characteristics:

$$\log x_i = \beta_0 + \beta_1 \log y + \beta_2 \log P_H + \beta_3 \log P_0 + u \quad (1)$$

Here, x_i is the annual real expenditure on housing services, y is income, P_H is the relative price of housing, P_0 is an index of the price of all other goods, and u is a disturbance variable. Using a log form, β_1 is the true income elasticity and β_2 is the true price elasticity of demand for housing.

Ge and Lam (2002) summarize a general function of the quantity demand for houses (Q_d) as follows:

[2] Hotbedding occurs when rooms are let to two different people on alternate shifts so that the room is occupied for up to 12 hours by each tenant.

$$Q_d = \int(G, H_t, D, t) \qquad \text{(t=1, 2, 3, --- n)} \qquad (2)$$

where G stands for macroeconomic variables such as GDP, interest rates, stock exchange index, etc; H represents housing related variables such as house price, income, unemployment rate, etc; and D is related to demographic variables such as population, number of marriages, birth rates, etc. Following Reichert (1990), Eq. (2) can be expressed in natural logarithmic multiple regression form as follows:

$$\ln Q_{dt} = a_0 + a_1 \ln G_t + a_2 \ln H_t + a_3 \ln D_t + \eta_t \qquad (3)$$

Halicioglu, 2005 modified the above formula as follow:

$$\ln HD_t = a_0 + a_1 \ln Y_t + a_2 \ln HC_t + a_3 \ln UR_t + \eta_t \qquad (4)$$

Here, *HD* is the total units of private houses completed, *Y* is the real household disposable income, *HC* is the real average unit cost of dwellings, and *UR* is the urbanisation rate index. The expected signs for parameters are as follows: $a_1>0$, $a_2<0$, and $a_3>0$.

Some researchers argued that true housing demand should be estimated from permanent household income rather than current income. This is because the transitory income component of a household current income biases demand models that use current income and results in underestimates of demand elasticities (Richard and Koc, 2007). The relationship between permanent and current income is shown in the equation below:

$Y_i = Y_i^P + Y_i^T$, where Y_i is current income, Y_i^P is the permanent income component of current income, and Y_i^T is the transitory income component of current income.

Since there is no direct observation of permanent incomes, hedonic regression can be used to estimate permanent income over time. Other explanatory variables that may be modelled to influence permanent income are age, sex, marital status, unemployment status, immigration status, number of workers in the household, whether the household reside in an urban or rural area, occupation and information about the employment status of the head of the household.

Liu et al., (1996) developed a working group housing demand (WGHD) model, which adopts a bottom up approach. It comprises four categories of housing needs with 17 components:

(1) New housing needs: first marriages, re-marriages, divorces, legal immigrants, expatriates, spilling of unextended nuclear family households, spilling of extended nuclear family households and splitting of multi-nuclear family households.
(2) Generated housing needs: clearance of temporary housing areas and cottage areas, clearance of squatters, emergency, natural disaster and compassionate cases, redevelopment of public sector housing, redevelopment of private sector housing;
(3) Other housing needs: adequately housed non-owner occupied households in private sector, inadequate housed households;
(4) Reduction in housing needs and transfers: adequately housed public rental housing households, net outflow of Hong Kong residents.

Richard and Koc (2007) argued that housing demand differs from the demand of most goods because it is durable and it has an investment component. It is both a consumption good and an investment asset. In an attempt to quantify this relationship, they employed an econometric model of housing demand that considers the joint determination of tenure choice and quantify of housing services demanded. The quantity of housing services is considered to be a function of personal characteristics of the household head, household background and the price of housing. The personal characteristics of household head – such as age, race, sex, education, marital status, immigration status and disability status – are important since they capture the tastes and expenditure patterns. Examples of household background variables are household permanent income, household transitory income, household dividend and interest income, household size and moving information.

Ng et al. (2007) identified the difficulty in estimating precise demand for new residential properties because this is influenced by a number of dynamic factors such as demographic change, economic patterns, government policy and the external environment. Econometric models in housing demand forecasting are now facing many difficulties in considering different variables and scales (Marshal and Marsh, 2007). Currently, the econometric paradigm of housing demand forecasting has been shifting into a socio-demographic paradigm as a regional and local housing demand forecasting method. The BBRH model has been developed based on a socio-demographic paradigm, which minimizes the complexity in estimating housing demand.

SECTION THREE: THE BOWEN BASIN REGIONAL HOUSING MODEL

The BBRH model is based on a linear extrapolation of demographic variables and housing types. This is a basic model that can be applied at the local or regional level and can determine specific housing needs such as the number and types of dwellings required for a defined mining area[3]. Here, housing demand has been used to represent housing needs.

The model includes demographic variables and housing characteristics, assuming the value of the variables will increase linearly over time. It is assumed in the model that the propensity to belong to a particular household is expected to change over time with decreasing fertility rates and changes in life style and family types. It is also assumed that every household has a propensity to own a house/unit. The model uses secondary data from the Australian Bureau of Statistics (ABS) and Local Government sources such as the Queensland's Planning Information and Forecasting Unit (PIFU). The model also considers given household size by the local government area, which are adjusted by assumptions on the period of stabilising population growth and/or considering a period for mining boom. The model has three stages of development: input, throughput and output (see detail in Figure 1). These are operated and maintained by VBA programming scripts in an Excel spreadsheet.

The input for the model includes data on population characteristics of the in-scope area such as age and sex, family type by age and dwelling type by family type. Then the model calculates the

[3] Due to cyclical growth patterns within the mining sector accurate, dwelling forecast in mining growth areas are also dependent on timely knowledge of impending development.

percentage of the population in each age cohort and household size by dwelling type; and then forecasts the linear trends of population and rate of change. This is the data processing or schematically the throughput section of the model. Finally the model produces population by family types and dwellings types spanning a thirty year period. From this information, prediction can be made of housing demand.

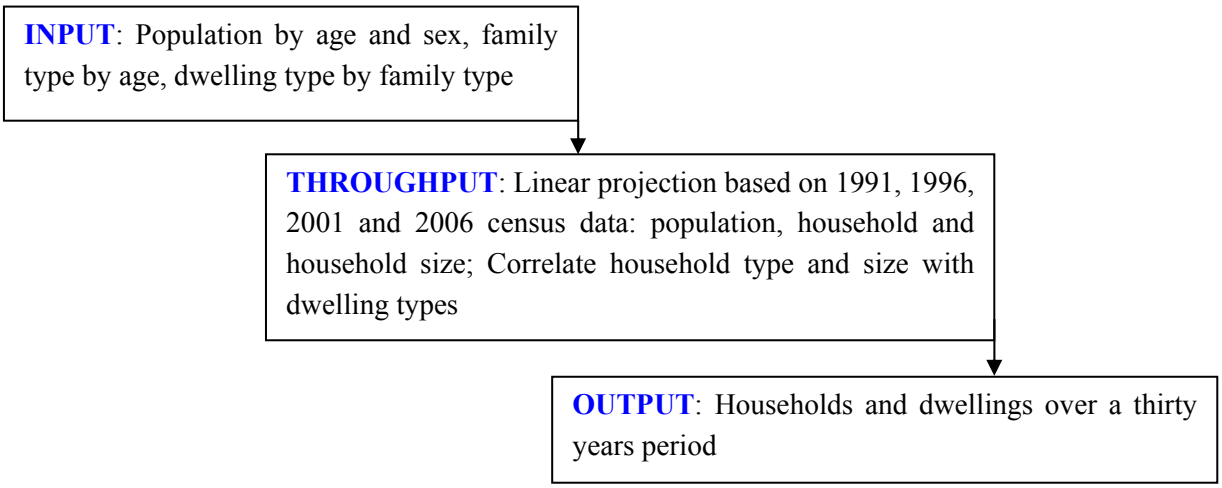

Figure 1: The Bowen Basin Regional Housing model

The BBRH model also indicates the public housing needs based on similar assumptions taken for projecting private dwelling needs. However, without further consideration of specific public housing variables, the projections of public housing need require additional input generated from local housing market knowledge. For instance, government initiatives/policy to construct public housing in a certain area or any emergency situation would not be reflected in this model.

A propensity-based function is applied to estimate the number of people in each age group that would live in a particular family type and relationship in each household. The method is similar to the popular headship count method but is performed at a more detailed level. The propensity to belong to a particular household would be expected to change over time. The model assumes that the probability of a person in a particular age group having particular household characteristics will continue to change until 2026 (based on assumptions about the current Bowen Basin mining boom (Rolfe et al., 2007)); following which it is assumed to remain constant to 2036. Again, family type and relationship in households will still change after 2026 due to underlying demographic changes. Hence, two different scenarios can be developed:

Scenario 1: The probability of a person in a particular age group having a particular household characteristic is assumed to remain constant at the 2006 level;
Scenario 2: The probability of a person in a particular age group having a particular household characteristic is linearly extrapolated to 2026 (based on changes observed between the last inter-census periods i.e. 1996, 2001 and 2006), following which it is assumed to remain constant to 2036.

Although we assumed a constant Scenario 1, the family type and relationship in households will still change due to changes in the demographic characteristics. For example, as the population ages children move out of their family home and hence the number of one-couple families with children could decline while the one-couple families with no children could increase. Similarly, as the population ages, there may be an increase in one-person households and/or people living in an aged care facilities or nursing homes (i.e. non-private dwellings).

The household occupancy rate is applied to the household and family type forecasts to obtain the total number of households. The number of households in the one-couple family with children and one-couple family without children categories equates to the number of couples. The household occupancy rate for the 'other family, unrelated individual living in family household' and 'group household' was obtained from the ABS Census for 1996, 2001 and 2006, and linearly extrapolated to 2031. The final step in the model is to estimate the demand for various dwelling types according to various households and family types. The propensity of a particular household/family to live in a particular type of dwelling was determined from the ABS Census 1996, 2001 and 2006. A change in housing preferences over time due to changes in tastes has not been considered in this model.

SCOPE AND LIMITATION OF THE MODEL

The current BBRH model includes only demographic and housing variables. Demographic variables include number of persons in each age cohort (i.e., 0-4, 5-9, ---,85+ years) and in each household type (i.e., one-couple family with children, one-couple family without children, one parent family, other family, group household and lone person). Housing variables include number of households in each dwelling type (i.e., separate house, semi-detached or town house, flat or unit, other dwelling and dwelling structure not stated). These household and housing types are taken from ABS categories and data are also taken from ABS Community Profile for towns (e.g., Tables B14, 17 and 18 of 2001 and 2006 Census of Population and Housing). Number of persons is correlated with number of households and numbers of household are correlated with number of houses. Here, total number of households equal to total number of houses. We use the household change rate of each household type (based on last three census data) for forecasting number of households in every five years interval until 2026 and here 2006 is the base year. Non-resident population has been linearly extrapolated from PIFU's 2006 and 2007 demographic reports on the Bowen Basin region.

Although this model is based on a linear propensity between household type and dwelling type, this model does not consider lifestyle choice variables (e.g., choice of living place, changing taste in dwelling types, migration trend), economic variables (e.g., income and expenditure pattern and employment period) and supply variables (e.g., land and water availability) or government intervention (e.g., social housing). However, it is very difficult or nearly impossible to include all these variables in one model. But the CQU team is working to further develop the model by incorporating migration trends and land availability. Thus the findings from the current BBRH model could be compared with the next updated model.

SECTION FOUR: A BRIEF BACKGROUND OF THE TOWNS

There are twenty towns inside and adjacent to the Bowen Basin region; seventeen of them are inside the region and three of them adjacent to the region. These towns can be divided into four categories: regional hubs, mining only towns, mix of mining and agricultural towns, and regional cities (see detail in Tables 1 and 2).

Regional hubs tend to service a sub-regional area and develop a secondary industry base, but are smaller than regional towns. On an average, five to fifteen thousand people live in those towns such as Emerald, Biloela and Moranbah. For illustration, Emerald is now an established regional hub and Biloela and Moranbah are in the state of emerging regional hubs. These towns have basic urban and social services. The resident population is growing over time as new developments occur and as the town business capture more expenditure benefits from the surrounding region. These towns are also characterised by moderate to high household growth by young families and singles (PIFU, 2007b).

Table 1: Major towns in and around the Bowen Basin region

Regional council (current)	**LGA (previous)**	**Name of the town (s)**
Inside the region		
Whitsunday Regional Council	Bowen (North)	Collinsville
Isaac Regional Council	Nebo (North-East)	Glenden, Nebo, Coppabella
Isaac Regional Council	Belyando (West)	Clermont, Moranbah
Isaac Regional Council	Broadsound (East)	Dysart, Middlemount
Central Highland Regional Council	Peak Downs (Central)	Capella, Tieri
Central Highland Regional Council	Emerald (South-West)	Emerald, Comet
Central Highland Regional Council	Duaringa (South-east)	Blackwater
Central Highland Regional Council	Bauhinia (South)	Rolleston, Springsure
Banana Shire Council (Banana+Taroom)	Banana (South-East)	Biloela, Moura, Theodore, Thangool, Jambin, Baralaba
Adjacent to the region		
Rockhampton	Rockhampton	Rockhampton
Gladstone	Gladstone	Gladstone
Mackay	Mackay	Mackay

Table 2: Major classes of towns in and around the Bowen Basin region

Town class	**Name of the town (s)**
Inside the region	
Regional hub	Moranbah, Emerald, Biloela
Mining only town	Blackwater, Dysart, Moura, Glenden, Middlemount, Collinsville, Tieri
Mix of mining and agricultural town	Clermont, Springsure, Rolleston, Capella, Theodore, Nebo, Baralaba
Adjacent to the region	
Regional Towns and cities	Rockhampton, Mackay, Gladstone

Mining towns serve largely the mining community and may also serve the agricultural community at a minimum level. Historically such towns have been developed by the mining companies. These towns, such as Moura, Blackwater and Middlemount, have minimum level of urban and social services. Population size of these towns varies between two to ten thousand people. There is

a large non-resident workforce associated with many of these towns where people choose to base in other locations and commute to work for block shift periods. Most resident workers are employed by mine companies and related mine contractors and service companies.

The combined mining and agricultural towns, such as Nebo, Springsure and Theodore, serve both the mining community and the agricultural or pastoral community. These towns had developed to provide basic social services to the rural population or as an agricultural trade centre and have adapted to service of emerging mining industry. Population size of these towns varies between one hundred to one thousand people. Mining activities close to these towns tend to be served by non-resident workers. These towns have minimum urban and social services. These are characterised by small population size, low population growth relative to size and low household growth (PIFU, 2007b).

Regional cities, such as Rockhampton, Gladstone and Mackay, are service, commercial and production centres of the region. Historically, these centres had developed as a service and commercial centre for large hinterland areas, and are contemporary to the other regional cities of Australia. Geo-demographically, these are third level towns in Australia. The town size varies between twenty five to one-hundred thousand people, with extensive urban and social services. These towns are characterised by moderate population growth relative to size, high household growth and the growth in older population (PIFU, 2007b). Most people in these towns are resident population except some domestic and international visitors.

This study focus is on five out of the twenty towns identified in the region. These are Moranbah and Biloela from the emerging regional hub group, Moura from the mining town group, Theodore from the mix of mining and agricultural town group and Mackay from the regional cities group. A brief account of each town is given below.

Mackay

Mackay City is comprised of two statistical local areas; one is primarily urban, and other is primarily rural. Historically, it was established as a sugar producing centre and then as a port city. The population of Mackay was 66,873 persons in 2006; this is an increase of 9224 persons over a five-year period (Table 3). This represents 3.2% population growth per year between the last two census periods, which is much faster than the Australian average. This is one of the fastest growing regions in Queensland and the current high growth experienced by Mackay is currently predicted to continue over the next 20 years (MCC, 2007).

Table 3: Demographic characteristics of the Bowen Basin towns

Town	Year		Population			Family composition				
			Male	Female	Total	Couple with children	Couple without children	One parent families	Other	Total
Mackay	2001	Number	28202	29447	57649	7150	5256	2618	203	15227
		%	48.92	51.08		46.96	34.52	17.19	1.33	
	2006	Number	33691	33182	66873	7103	5221	2601	2406	17331
		%	50.38	49.62		40.98	30.13	15.01	13.88	
	Change	Number	5489	3735	9224	-47	-35	-17	2203	2104
	Change	%	1.46	-1.46	3.20/yr	-5.97	-4.39	-2.19	12.55	2.76
Moranbah	2001	Number	3502	2778	6280	940	493	112	6	1551
		%	55.76	44.24		60.61	31.79	7.22	0.39	
	2006	Number	4304	3486	7790	1037	541	137	17	1732
		%	55.25	44.75		59.87	31.24	7.91	0.98	
	Change	Number	802	708	1510	97	48	25	11	181
	Change	%	-0.51	0.51	4.81/yr	-0.73	-0.55	0.69	0.59	2.33
Biloela	2001	Number	3007	2707	5714	668	473	176	22	1339
		%	52.62	47.38		49.89	35.32	13.14	1.64	
	2006	Number	2944	2781	5725	648	558	181	22	1409
		%	51.42	48.58		45.99	39.60	12.85	1.56	
	Change	Number	-63	74	11	-20	85	5	0	70
	Change	%	-1.19	1.19	0.04/yr	-3.90	4.28	-0.30	-0.08	1.05
Moura	2001	Number	1070	863	1933	235	180	54	4	473
		%	55.33	44.67		49.68	38.05	11.42	0.85	
	2006	Number	1014	877	1891	223	172	50	7	452
		%	53.61	46.39		49.34	38.05	11.06	1.55	
	Change	Number	-56	14	-42	-12	-8	-4	3	-21
	Change	%	-1.72	1.72	-0.43/yr	-0.35	0.00	-0.35	0.70	-0.89
Theodore	2001	Number	224	242	466	45	42	26	0	113
		%	48.07	51.93		39.82	37.17	23.01	0.00	
	2006	Number	226	218	444	48	54	13	0	115
		%	48.65	51.35		41.74	46.96	11.30	0.00	
	Change	Number	2	-24	-22	3	12	-13	0	2
	Change	%	0.58	-0.58	-0.94/yr	1.92	9.79	-11.70	0.00	0.35
Average change		*%*	-0.28	0.28	1.33/yr	*-1.81*	*1.82*	*-2.77*	*2.75*	*1.12/yr*

Source: ABS 2008; PIFU 2007a; DLGPSR, 2007; ABS 2002

Key demographic changes are as follows. Median age has increased by one year (Table 3). There are 927 dwelling units in new residential building approvals between 2006 and 2007, which is 18.8% more than the previous year (MCC, 2007). Median household income in Mackay has increased by $389 between the last two census periods, which is similar to most mining towns in the Bowen Basin Region but much less than that of Moranbah (Table 4). The number of one-couple without children families has been increasing very sharply, while one-couple families with children have decreased modestly between 2001 and 2006 census periods, and one parent families have decreased but in a very low rate (Table 3).

Moranbah

The Moranbah Township is located on the north-eastern side of the Bowen Basin region, and is part of the Isaac Regional Council. The township of Moranbah occupies about eight square kilometres and was originally established by Utah Development Company between 1960s and

early 1970s. It remains predominantly a town supporting the local mining industry. Employment is strongly based on the coal industry and supporting businesses. A range of government and community facilities are provided for in Moranbah as well as a number of accommodation types. Moranbah has day care facilities, kindergarten, preschools, two primary schools, high school, TAFE annex and Open Learning facilities. The town also has a large range of sporting and recreational facilities as well as community groups. The health facilities include a hospital, mental health workers, youth workers, dentists, optometrist, doctors, physiotherapists and alternative practitioners. There are police, fire and ambulance services available.

Projections from the Department of Local Government, Planning, Sport and Recreation (DLGPSR) suggest that the population of Moranbah will increase from 6,280 in 2001 to an estimated 7,790 in 2006 and 11,070 persons in 2011. By 2021, the population is estimated to be 11,750 persons. Besides the resident population, Moranbah accommodates a number of non-resident workers. Non-resident persons tend to stay in company accommodation or work-camps when they are completing a block shift, commuting from their home in larger centres or coastal cities. PIFU (2006) estimated that at June 2006, Moranbah has 1,915 non-resident workers at any one time. Most non-resident workers are employed in the mining sector.

Table 4: Selected socio-economic medians of the Bowen Basin towns

Town	Year	Median age of persons	Median individual income ($/weekly)	Median family income ($/weekly)	Median household income ($/weekly)	Median housing loan repayment ($/monthly)	Median rent ($/weekly)	Average number of persons/ bedroom	Average household size
Mackay	2001	34	350	850	750	850	125	--	3.3
	2006	35	530	1325	1139	1300	200	1.1	2.7
	Change	1	180	475	389	450	75	--	-0.6
Moranbah	2001	31	550	1750	1750	300	75	--	3.6
	2006	29	948	2541	4479	1300	70	1.1	3
	Change	-2	398	791	2729	1000	-5	--	-0.6
Biloela	2001	32	450	1100	900	700	125	--	3.3
	2006	32	534	1363	1162	1018	140	1.1	2.6
	Change	0	84	263	262	318	15	--	-0.7
Moura	2001	33	450	1350	1100	500	75	--	3.3
	2006	32	719	1832	1702	973	101	1.1	2.5
	Change	-1	269	482	602	473	26	--	-0.8
Theodore	2001	39	350	650	550	700	75	--	3
	2006	39	495	1192	927	629	100	1.1	2.2
	Change	0	145	542	377	-71	25	--	-0.8
Mean	***2001***	***27.6***	***320.0***	***790.0***	***660.0***	***550.0***	***80.0***	***--***	***2.6***
Mean	***2006***	***33.4***	***645.2***	***1650.6***	***1881.8***	***1044.0***	***122.2***	***1.1***	***2.6***
Overall Change		***-0.4***	***215.2***	***510.6***	***871.8***	***434.0***	***27.2***	***--***	***-0.7***

Source: ABS 2008; ABS 2002

Demographic changes in Moranbah are summarised as follows. Median age has decreased by two years between the 2001 and 2006 census (Table 4). All types of families have increased slightly between the 2001 and 2006 census periods, except for one parent families, which have decreased at a very low rate (Table 3).

Like many towns in the Bowen Basin, the increase in mining activity and population of Moranbah since 2001 has impacted on housing markets, with increases in house prices and housing rents. The increased workforce, particularly those associated with contractors, exceeded available housing levels in the town. PIFU (2006) reported that there were one thousand single person's quarters (SPQs) available in or near this town, with an approximate occupancy rate of over 80%, and about 500 rooms in hotels/motels, caravan parks and other private accommodation in the town, with an occupancy rate of over 90%. Seventy-eight percent of those rooms were occupied by non-resident workers or other staff on a long term basis (Rolfe et al., 2007). The high demand and limited supply have been impacting on price levels in the region.

In previous mining upturns, mining companies tended to provide housing for employees. However, following the reform process of the late 1990s, the trend is for third-party commercial operators to provide an increasing proportion of worker accommodation, particularly in the form of SPQs. As well, a much higher proportion of workforce responsibilities are now with subcontractors. While many mining companies still provide worker's accommodation, they do not cater for all employees or those of subcontractors.

Biloela

Biloela, situated in the Banana Shire, is a modern town with a well-established business centre (BSC, 2006a), and population at the 2006 census of 5,727 people. It is located 594 km north of Brisbane and 127 km south west of Gladstone. Biloela's economy is driven by pastoral and agricultural enterprises and by the local coal mines. Specifically, local income is generated by livestock slaughtering, cotton production, dairying, wheat, sorghum, lucerne and other grains and cereals. Coal was discovered in the area in the 1890s but it was not developed until 1942 when an open-cut mine was established on the site of the old Callide station. This provides the coal supply for the Callide power station. The town has also benefited from the development of the coal mines at Moura (Bowen Basin Website, 2008).

Demographic changes in Biloela are summarised as follows. Biloela is the largest community in the Banana Shire but the population growth rate is very low i.e., the increase between the last two census periods was 19 people (Table 3). This represents much lower population growth compared to the country's growth. There was no change in median age of persons and median household income has increased by $262, which is lower compared to other mining towns in the Bowen Basin region (Table 4). The numbers of one-couple families without children and one parent families have increased very slightly, while one-couple families with children have decreased between 2001 and 2006 census periods (Table 3). Biloela had the highest number of rental dwellings and dwelling units in the Banana Shire (BSC, 2006a).

Moura

The Moura township is situated in the Banana Shire besides the Dawson River, 200 km southwest of Rockhampton and 192 km west of Gladstone (BSC, 2006b). This is almost exclusively a

mining community with a permanent resident population of 1891 people in 2006. Coal has been mined there since 1961 when BHP Mitsui Coal Pty Ltd began operations, making this one of the longest-established coal mining ventures in Central Queensland. The mine is currently a joint venture of Anglo Coal Australia and Mitsui Coal Holdings. The coal deposit is also a rich source of coal seam methane which provides the feedstock for a major ammonium nitrate plant, a source of fertilizer and explosives (Bowen Basin Website, 2008).

Key demographic changes in Moura are as follows. The population of Moura has decreased by 42 persons between the last two census periods (Table 3), while median age has decreased by one year (Table 4). Median household income has increased by $602, which is much higher than that of most mining towns in the Bowen Basin region (Table 4). The number of one-couple families without children, one-couple families with children and one parent families have decreased between 2001 and 2006 census periods, while the other types of families have increased but at a very low rate (Table 3).

Moura recorded the highest proportion of working age people (72.5%) in the Banana Shire. Unoccupied dwellings contributed to 17.5% of total dwelling stock in Moura (the highest proportion). Moura had the highest proportion of townhouses and also recorded a very high proportion of residents in (predominantly mining sector) staff quarters (BSC, 2006b).

Theodore

The Theodore township is situated in the Dawson Valley in the Banana Shire, approximately 105 km south west of Biloela. The township had its beginnings in 1922 when legislation was passed for the establishment of a major irrigation project in the area. Theodore is a minor service centre for the important irrigation and agriculture industries and increasingly for mine workers. The main irrigated crop is cotton. Dry land crops include wheat, sorghum and mung beans (BSC, 2006c)

It is popularly believed that the town was architecturally designed by Walter Burley Griffin in the early 1920s before he went on to design Australia's capital city, Canberra. There are basic urban and social services in the town. It is anticipated that the town will benefit from the development of nearby coal deposits owned by Anglo Coal Australia (Bowen Basin Website, 2008).

Key demographic changes in Theodore are as follows. The population of Theodore has decreased by 22 persons between the last two census periods while average median age has remained static (Table 3). Median household income has increased by $377, which is similar to most mining towns in the Bowen Basin region but much less than that of Moranbah (Table 4). The number of one-couple families with children and one-couple families without children has increased, while one parent families have declined modestly between the 2001 and 2006 census periods (Table 3). Theodore has the highest proportion of one parent families and lone persons of the Banana Shire and the lowest proportion living in private dwellings (BSC, 2006c).

SECTION FIVE: APPLICATION OF THE MODEL

The Bowen Basin Regional Housing model has been applied to the townships of Mackay, Moranbah, Biloela, Moura and Theodore. The leading input into this model is population projection by age-sex. The model used resident population of Mackay data from the 1996, 2001 and 2006 census periods and resident population of Moranbah, Biloela, Moura and Theodore from PIFU and DLGPRS data and their projections. Where population forecasts were not available, the model used medium type regional growth rates. We used non-resident population for Moranbah, Biloela and Moura from PIFU data to forecast people living in SPQs. Data for non-resident population for the other two towns is not available. Here, we have only applied the second scenario of the model because the mining boom has caused measurable change in household characteristics. For illustration, we assumed the change would occur until 2026, and then remain constant until 2036. This twenty year period of change has been underpinned by data from PIFU (2007), Rolfe et al. (2007) and 2008 field work associated with the Dawson Mine Complex (which covered Biloela, Moura and Theodore Towns). A synthesis of the model's output includes summary tables (Tables 5, 6, 7, 8 and 9) showing the results of population projections for respective towns with associated housing demand by household[4] and housing types.

[4] For census purposes, the total number of households is equal to the total number of occupied private dwellings (ABS, 2002).

Mackay

The model identifies that the number of one-couple families with children in Mackay will be increasing over time (7864 households in 2006 to 9723 households in 2026). The number of one-couple families without children and lone person households will be increasing too (see detail in Table 4). Consequently the model predicts an increased demand for single unit or townhouse type of dwelling structures and separate dwelling type structures.

The demand for total private dwellings is predicted to sharply increase between 2006 and 2011 and then moderately increase in 2016 and afterwards. The demand for semi-detached houses or flats over the same time period is also predicted to increase. Mackay would need to provide 11730 semi-detached houses or units between now and 2026, which is about 587 semi-detached houses or units per year, to meet the increasing demand of single or one-couple family without children households (see detail in Table 5).

Table 5: Mackay household and housing demand forecast: 2006-2036[5]

(A). Population by family type forecast	2006	2011	2016	2021	2026	2031	2036	Change 2006-2036
Population	66,873	88,040	95,879	103,71	111,556	111,556	111,556	44,683
One-couple family with children	30,676	33,973	35,607	36,415	37,926	37,926	37,926	7,250
One-couple family without children	12,965	20,124	25,591	28,227	30,644	30,644	30,644	17,679
One parent family	7,111	8,836	9,695	10,953	11,891	11,891	11,891	4,779
Other family	473	597	635	713	784	784	784	311
Unrelated individual living in family	808	1,446	1,761	1,940	2,114	2,114	2,114	1,305
Group household member	4,892	7,506	8,570	9,410	10,215	10,215	10,215	5,323
Lone person	5,222	6,411	7,422	7,933	8,415	8,415	8,415	3,193
Persons in private dwellings	*62,148*	*81,334*	*87,611*	*94,782*	*101,989*	*101,989*	*101,989*	*39,840*
Persons in non-private dwellings	4,725	9184	6598	8126	9,567	9,567	9,567	4,843
Total Persons	**66,873**	**88,040**	**95,879**	**103,71**	**111,556**	**111,556**	**111,556**	**44,683**
B). Household by family type forecast								
One-couple family with children households	7,864	8,173	8,482	8,791	9,723	9,723	9,723	1,859
One-couple family without children	6,046	9,598	12,464	13,737	14,899	14,899	14,899	8,853
One parent family households	3,159	4,253	4,356	5,211	5,250	5,250	5,250	2,091
Other family households	223	278	292	324	353	349	345	122
Group households	1,664	2,423	2,634	2,759	2,863	2,743	2,632	969
Lone person households	5,008	6,411	7,422	7,933	8,415	8,415	8,415	3,407
Total Households in Private Dwellings	23,963	31,136	35,649	38,756	41,503	41,379	41,264	**17,301**
(C). Housing demand by dwelling type								
Separate house	19,337	21,114	21,229	23,160	24,886	24,885	24,884	5,547
Semi-detached / row / terrace / townhouse	1,390	2,744	4,022	4,364	4,656	4,633	4,612	3,222
Flat / unit / apartment	2,896	6,850	9,982	10,786	11,486	11,391	11,304	8,408
Other	340	427	416	447	474	469	464	124
Total Private Dwellings	**23,963**	**31,136**	**35,649**	**38,756**	**41,503**	**41,379**	**41,264**	**17,301**
Private Housing yield rate	2.59	2.61	2.46	2.45	2.46	2.46	2.47	-0.12
Separate House as % of Total	81%	68%	60%	60%	60%	60%	60%	
(D) Change private dwellings: 2006-2036	**No.**	**%**	**2006**	**2036**			**(E)**	**SPQs**
Separate houses	5,547	32.06	80.69	60.30			2006	DK
Semi-detached / row / terrace / townhouses	3,222	18.62	5.80%	11.18			2007	DK
Flat / unit / apartments	8,408	48.60	12.09	27.39			2011	DK
Other	124	0.72%	1.42%	1.12%			DK= Don't know	

[5] The model is now undergoing improvement; so some findings could change slightly at its final stage.

Moranbah

The model identifies that the number of one-couple families with children in Moranbah will be increasing over time (1247 households in 2006 to 1518 households in 2026). Also, the number of one-couple families without children and lone person households will be increasing; consequently the model predicts an increased trend of single unit or townhouse type of dwelling structures and a downward demand for separate dwelling structures.

Table 6: Moranbah household and housing demand forecast: 2006-2036

(A). Population by family type forecast	2006	2011	2016	2021	2026	2031	2036	2006 - 2036 Change
Population	7,790	11,070	11,690	11,750	11,882	11,882	11,882	4,092
One-couple family with children	4,218	5,104	5,037	5,535	5,190	5,190	5,190	972
One-couple family without children	1,091	1,470	1,424	1,431	1,449	1,449	1,449	358
One parent family	903	990	952	958	965	965	965	62
Other family	34	86	148	148	151	151	151	117
Unrelated individual living in family	57	98	128	129	130	130	130	74
Group household member	169	300	402	404	409	409	409	240
Lone person	324	616	810	813	820	820	820	497
Persons living in private dwellings	6,795	8,663	8,903	9,419	9,114	9,114	9,114	2,319
Persons living in non-private dwellings	995	2,407	2,787	2,331	2,768	2,768	2,768	1,773
Total Persons	7,790	11,070	11,690	11,750	11,882	11,882	11,882	**4,092**
(B). Household by family type forecast								
One-couple family with children households	1,247	1,827	1,488	1,496	1,518	1,518	1,518	271
One-couple family without children households	539	726	704	707	716	716	716	177
One parent family households	131	240	306	307	310	310	310	179
Other family households	17	31	41	34	29	25	22	5
Group households	61	50	43	32	26	22	18	-43
Lone person households	324	616	810	813	820	820	820	497
Total Households in Private Dwellings	**2,320**	**3,490**	**3,393**	**3,389**	**3,420**	**3,412**	**3,406**	**1,085**
(C). Housing demand by dwelling type								
Separate house	2,087	2,942	2,616	2,624	2,656	2,655	2,654	567
Semi-detached / row / terrace / townhouse	62	179	253	254	258	258	258	196
Flat / unit / apartment	81	240	387	375	371	365	360	279
Other	90	130	137	135	136	135	134	44
Total Private Dwellings	**2,320**	**3,490**	**3,393**	**3,389**	**3,420**	**3,412**	**3,406**	**1,085**
Private Housing yield rate	***2.93***	***2.61***	***2.64***	***2.66***	***2.66***	***2.67***	***2.68***	***-0.25***
Separate House as % of Total	***90%***	***84%***	***77%***	***77%***	***78%***	***78%***	***78%***	
(D). Change: 2006-2036	**Number**	**%**	**2006**	**2036**			**(E)**	**SPQs**
Separate houses	567	52.20%	89.95%	77.92%			Year	Number
Semi-detached / row / terrace / townhouses	196	18.03%	2.66%	7.56%			2006	1915
Flat / unit / apartments	279	25.69%	3.51%	10.58%			2007	1717
Other	44	4.08%	3.88%	3.94%			2011	1000

The number of total private dwellings is predicted to sharply increase between 2006 and 2011 and then decline in 2016 and 2021. The demand for semi-detached houses or flats over the same time period is also predicted to increase. Moranbah would need to provide 475 semi-detached houses or units, which is about 24 semi-detached houses or units per year, to meet the increasing demand

of single or one-couple family without children households (see detail in Table 6). The number of singles person's quarters[6] (SPQs) is predicted to reduce by 50% by 2011.

Biloela

The model identifies that the number of one-couple families with children in Biloela will be decreasing as a proportion of total dwellings (591 households in 2006 to 505 households in 2026) (see detail in Table 7). The number of one-couple families without children and lone person households will be increasing; consequently the model predicts an increased trend of single unit or townhouse type of dwelling structures and a downward demand for separate dwelling structures. The demand for total private dwellings is predicted to be decreasing very slowly over the next twenty years. Biloela would need to provide 187 semi-detached houses or units, which is 20 detached houses or unit per year, to meet the increasing demand of single or one-couple family without children households. The number of SPQs will be increased into 1123 in 2011 from 93 in 2006.

Table 7: Biloela household and housing demand forecast: 2006-2036

(A). Population by family type forecast	2006	2011	2016	2021	2026	2031	2036	Change: 2006-2036
Population	5,725	5,795	5,821	5,853	5,889	5,889	5,889	164
One-couple family with children	2,654	2,496	2,246	2,261	2,271	2,271	2,271	-383
One-couple family without children	1,124	1,310	1,490	1,497	1,508	1,508	1,508	384
One parent family	549	462	362	365	369	369	369	-180
Other family	48	50	50	51	51	51	51	4
Unrelated individual living in family household	42	37	27	28	28	28	28	-14
Group household member	140	126	101	102	103	103	103	-37
Lone person	433	412	366	367	369	369	369	-64
Persons living in private dwellings	***4,989***	***4,894***	***4,643***	***4,671***	***4,699***	***4,699***	***4,699***	***-290***
Person living in non-private dwellings	***736***	***901***	***1,178***	***1,182***	***1,190***	***1,190***	***1,190***	***454***
Total persons	**5,725**	**5,795**	**5,821**	**5,853**	**5,889**	**5,889**	**5,889**	**164**
(B). Household by family type forecast								
One-couple family with children households	591	570	549	545	505	505	505	-86
One-couple family without children	557	600	681	695	746	746	746	189
One parent family households	178	194	199	201	202	202	202	24
Other family households	20	22	22	22	23	23	23	2
Group households	38	33	25	24	23	22	22	-16
Lone person households	433	412	366	367	369	369	369	-64
Total Households in Private Dwellings	***1,818***	***1,830***	***1,842***	***1,854***	***1,86***	***1,86***	***1,86***	***50***
(C). Housing demand by dwelling type								
Separate house	1,551	1,491	1,457	1,457	1,42	1,42	1,42	-128

[6] Non-resident population live in SPQs and they are usually either mine workers or mine-work related contractors.

Semi-detached / row / terrace / townhouse	37	52	64	65	65	65	65	29
Flat / unit / apartment	183	244	282	293	341	341	341	158
Other	47	44	39	39	39	39	39	-9
Total Private Dwellings	***1,818***	***1,830***	***1,842***	***1,854***	***1,86***	***1,86***	***1,86***	***50***
Private Housing yield rate	***2.74***	***2.86***	***3.10***	***3.10***	***3.10***	***3.10***	***3.10***	***0.36***
Separate House as % of Total	***85%***	***84%***	***79%***	***78%***	***76%***	***76%***	***76%***	
(D). Change: 2006-2036	**Number**	**%**	**2006**	**2036**			**(E)**	**SPQs**
Separate houses	-128	-	85.33	76.18			Year	Number
Semi-detached / row / terrace / townhouses	29	57.17%	2.01%	3.50%			2006	93
Flat / unit / apartments	158	314.29%	10.05	18.26			2007	299
Other	-9	-17.32%	2.61%	2.07%			2011	1123

Moura

The model identifies that the number of one-couple families with children in Moura will be declining slightly (231 households in 2006 to 223 households in 2026). The number of one-couple families without children will be unchanged between 2006 and 2026; and lone person households will be increasing (see detail in Table 8); consequently the model predicts an increased trend of single unit or townhouse type of dwelling structures and a downward trend of separate dwelling structures.

The demand for total private dwellings is predicted to increase between 2006 and 2016 and then decline in 2021, and then to be increasing until 2026. The demand for semi-detached houses or flats over the same time period is also predicted to increase. Moura would need to provide 94 semi-detached houses or units, which is about 5 semidetached houses or units per year, to meet the increasing demand of single or one-couple family without children households. The number of SPQs will be reducing by 50% by 2011.

Table 8: Moura household and housing demand forecast: 2006-2036

(A). Population by family type forecast	2006	2011	2016	2021	2026	2031	2036	Change: 2006-2036
Population	1,891	1,934	1,943	1,953	1,966	1,966	1,966	75
One-couple family with children	901	937	954	958	966	966	966	66
One-couple family without children	357	357	352	355	357	357	357	0
One parent family	140	95	45	45	46	46	46	-95
Other family	13	19	25	25	25	25	25	12
Unrelated individual living in family household	6	7	7	7	7	7	7	1
Group household member	17	19	21	21	21	21	21	4
Lone person	187	212	237	238	238	238	238	52
Persons living in private dwellings	***1,621***	***1,646***	***1,641***	***1,649***	***1,661***	***1,661***	***1,661***	***40***
Persons living in non-private dwellings	***270***	***288***	***302***	***304***	***305***	***305***	***305***	***35***
Total persons	**1,891**	**1,934**	**1,943**	**1,953**	**1,966**	**1,966**	**1,966**	**75**
(B). Household by family type forecast								
One-couple family with children households	231	229	222	223	223	223	223	-8
One-couple family without children households	174	174	172	173	174	174	174	0
One parent family households	50	53	55	55	55	55	55	5
Other family households	3	3	4	3	3	2	2	-1

Group households	19	21	23	25	27	29	31	12
Lone person households	181	214	237	238	238	238	238	57
Total Households in Private Dwellings	***659***	***694***	***712***	***717***	***720***	***722***	***724***	***65***
(C). Housing demand by dwelling type								
Separate house	508	478	451	445	438	438	438	-70
Semi-detached / row / terrace /	14	31	53	53	53	53	53	39
Flat / unit / apartment	28	51	70	78	83	83	83	55
Other	109	133	138	141	146	148	150	41
Total Private Dwellings	***659***	***694***	***712***	***717***	***720***	***722***	***724***	***65***
Private Housing yield rate	***2.44***	***2.31***	***1.15***	***2.58***	***2.49***	***2.45***	***2.44***	***0.00***
Separate House as % of Total	***77%***	***69%***	***63%***	***62%***	***61%***	***61%***	***60%***	
(D). Change: 2006-2036	**Number**	**%**	**2006**	**2036**			**(E)**	**SPQs**
Separate houses	-70	-106.7%	77.09%	60.49%			Year	Number
Semi-detached / row / terrace / townhouses	39	59.4%	2.16%	7.33%			2006	891
Flat / unit / apartments	55	84.6%	4.20%	11.46%			2007	786
Other	41	62.7%	16.55%	20.72%			2011	471

Theodore

The model identifies that the number of one-couple families with children in Theodore will be increasing slightly over time (62 houses in 2006 to 75 houses in 2026) (see detail in Table 9).

Table 9: Theodore household and housing demand forecast: 2006-2036

(A). Population by family type forecast	2006	2011	2016	2021	2026	2031	2036	Change: 2006-2036
Population	444	456	458	461	464	464	464	20
One-couple family with children	215	211	206	206	207	207	207	-8
One-couple family without children	84	94	99	101	103	103	103	19
One parent family	48	36	23	23	23	23	23	-25
Other family	5	9	14	14	14	14	14	9
Unrelated individual living in family household	5	4	4	2	2	2	2	-3
Group household member	14	16	16	17	17	17	17	3
Lone person	73	89	105	105	104	104	104	32
Persons living in private dwellings	***444***	***460***	***466***	***469***	***472***	***472***	***472***	***28***
Persons living in non-private dwellings	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***
Total persons	**444**	**460**	**466**	**469**	**472**	**472**	**472**	**28**
(B). Household by family type forecast								
One-couple family with children households	62	69	74	74	75	75	75	13
One-couple family without children households	42	46	49	50	51	51	51	9
One parent family households	18	9	6	6	6	6	6	-18
Other family households	5	9	14	14	14	14	14	9
Group households	16	21	21	27	36	53	63	82
Lone person households	73	89	105	105	104	104	104	32
Total Households in Private Dwellings	215	244	268	276	286	303	343	127
(C). Housing demand by dwelling type								
Separate house	185	198	209	211	214	218	227	41

Semi-detached / row / terrace / townhouse	0	0	0	0	0	0	0	0
Flat / unit / apartment	19	36	49	53	58	68	90	70
Other	11	11	10	12	14	18	26	16
Total Private Dwellings	**215**	**244**	**268**	**276**	**286**	**303**	**343**	**127**
Private Housing yield rate	***2.06***	***1.89***	***1.74***	***1.70***	***1.65***	***1.56***	***1.38***	***-0.68***
Separate House as % of Total	***86***	***81***	***78***	***77***	***75***	***72***	***66***	
(D). Change: 2006-2036	**Number**	**%**	**2006**	**2036**			**(E)**	**SPQs**
Separate houses	41	32.52	86.05	66.17			2006	DK
Semi-detached / row / terrace / townhouses	0	0.00	0.00	0.00			2007	DK
Flat / unit / apartments	70	55.27	8.94	26.14			2011	DK
Other	16	12.21	5.02	7.69			DK= don't know	

The number of one-couple families without children and lone person households will be increasing but single person's households will be decreasing (see detail in Table 9). Consequently the model predicts an increased demand for single unit or townhouse type of dwelling structures and a downward trend of separate dwelling structures. The demand for total private dwellings is predicted to increase between 2006 (215) and 2036 (343). The demand for semi-detached houses or flats over the same time period is also predicted to increase. Theodore would need to provide 70 units, which is about 4 units per year, to meet the increasing demand of single or one-couple family without children households.

Key Findings

In general, the model predicts the nature of household and housing trends over the next 30 years, as summarised in Table 10. This indicates the number of one-couple families with children will be declining in Biloela and Moura but it will be increasing in Mackay and Theodore. One-couple families without children will be increasing in all towns except Moura, which has both an increasing and decreasing trend over the projected timeframe. Single parent families will be increasing in all towns except Theodore, where there is a declining trend. *Other family* types are increasing in Mackay, Biloela and Theodore, with the other two towns having both an increasing and declining trend. Group households will be increasing in Moranbah, Biloela and Theodore but the other two towns have both increasing and declining trend. Lone persons will be increasing in Mackay, Moranbah, Moura and Theodore but declining in Biloela.

Table 10: Nature of the general household and housing trend in five towns of the Bowen Basin region

Town	**Household types**																	
	Couple + Children			Couple without children			Single parent			Other			Group			Lone persons		
	I	D	B	I	D	B	I	D	B	I	D	B	I	D	B	I	D	B
Mackay	√			√			√			√			√			√		
Moranbah			√	√			√					√	√			√		
Biloela		√		√			√			√				√			√	
Moura		√				√	√					√		√		√		
Theodore	√			√				√		√			√			√		

Town	**House types**				
	Separate house	Semi-detached house	Unit/flat	other	Total private dwelling

	I	D	B	I	D	B	I	D	B	I	D	B	I	D	B	
Mackay			√			√	√					√			√	
Moranbah			√	√			√					√			√	
Biloela		√		√			√				√		√			
Moura		√		√			√			√			√			
Theodore	√					√	√			√			√			

Note: I = increasing trend; D = declining trend; B = Both increasing and declining trend

With variations in household trends in different towns in the Bowen Basin region, there is also variation of demand for different housing types. There is an increasing trend of demand for separate houses in Mackay and Theodore, but the other three towns either have declining trend or have both an increasing and declining trends. There is an increasing trend of demand for semi-detached houses in Mackay, Moranbah, Biloela and Moura but other two towns have both increasing and declining trends. Demand for units or flats are always increasing in every town in the region. Demand for other types of house is increasing in Mackay and Theodore but declining in Biloela, and there is both increasing and declining trends in Moranbah and Moura. Demand for total private dwellings is only increasing in Theodore and Mackay, and only declining in Biloela but Moranbah and Moura have both increasing and declining trends.

The above findings provide a picture about the number and types of housing needs in five different towns in the Bowen Basin region. The analysis could be replicated for similar towns in the region. Such information may help mining employers, private developers and government in future planning for housing of the area and planning for associated other services.

SECTION SIX: CONCLUSIONS AND FUTURE RESEARCH

Overall the resources boom in the Bowen Basin region can be characterised as impacting positively on towns in the region; however rapid boom conditions bring unique challenges that can amplify planning issues, especially within the housing market. This would appear to be directly the case with Moranbah, Biloela, Moura and Theodore, and to some extent Mackay. The data for all five towns clearly indicates that despite the region being in the one of the fastest growing regions of the state with further development prospects, the current level of housing development in many towns is below the state average. The implication of these findings for new prospective developments in the area is that care has to be taken not to exacerbate the housing and labour market pressures. However, this is difficult to achieve in practice because of limited assessment and mitigation tools. The model fills some gaps in identifying the nature and types of housing needs. These include a downwards trend in demand for private separate housing and increased demand for other housing options, providing information for planners and managers to deal with housing pressures.

In general, the housing issues in the Bowen Basin region have been driven by two key organisational and demographic trends. First, the move to more flexible work operations and the pattern of shift work periods has meant that large numbers of mining employees base themselves at the coastal and urban centres and travel out to the mining communities for shift work periods. Increases in workforce requirements have been largely catered for by the construction of SPQs rather than the construction of new housing in the mining towns. Second, a greater reliance on contractors and mining supply industries has stimulated growth in the mining support sector,

which has tended to be based in larger communities and strategic centres. Both of these trends have meant a higher level of housing development on coastal and urban centres. A key challenge in building a housing model appropriate for mining towns is to predict the location and work patterns of the future workforce, as well as to identify the likely multiplier effects on local employment and demographic factors.

In conclusion, the BBRH model is a housing demand (need) forecasting model based on demographic and housing characteristics of a region. This does not yet include any housing supply variables; also it does not include any macro and micro-economic variables. Key challenges in applying the model to mining communities are to take account of a large non-resident workforce and a propensity for service industries to be located outside of the mining town. It may also be important to factor in non-linear changes in demographic and social trends that impact on housing demand. These may be favoured by influences such as new mining developments, direct or indirect provision of housing by mining companies, and changes in government policy and infrastructure frameworks that impact on demographic movement and housing supply. Strategic issues learned from the model can be used in many other mining towns in Australia, where rapid economic growth creates pressures in housing markets. Further work is needed to refine the model and tailor it to the particular characteristics of mining towns in the Bowen Basin.

REFERENCES

ABS (Australian Bureau of Statistics) (2002), *2001 Census - Community Profile*, Commonwealth of Australia, Canberra.

ABS (Australian Bureau of Statistics) (2008), *2006 Census - Community Profile*, Commonwealth of Australia, Canberra.

ACIL Consulting (2002), *Queensland's mining industries: creating wealth for the community, the sand the nation*, unpublished report for the Queensland Department of Natural Resources and Mines, Brisbane.

Belsky, Eric S., Di, Zhu Xiao and McCue, Dan (2006), *Multiple-Home Ownership and the Income Elasticity of Housing Demand*, Joint Center for Housing Studies, Harvard University, Cambridge, MA.

BSC (Banana Shire Council) (2006a), Our Town Biloela, BSS, Banana. Internet entry: http://www.banana.qld.gov.au/docs/profiles/cp_biloela_11_06.pdf accessed on April, 2008.

BSC (Banana Shire Council) (2006b), Our Town Moura, BSS, Banana. Internet entry: http://www.banana.qld.gov.au/docs/profiles/cp_moura_11_06.pdf accessed on April, 2008.

BSC (Banana Shire Council) (2006c), Our Town Theodore, BSS, Banana. Internet entry: http://www.banana.qld.gov.au/docs/profiles/cp_theodore_11_06.pdf accessed on April, 2008.

Chiu, Rebecca L.H. and Ho, Michael H.C. (2006), Estimation of elderly housing demand in an Asian city: methodological issues and policy implications, *Habitat International*, 30: 965-980.

Clark, W.A.V. and Onaka, J.L. (1983), Life cycle and housing adjustment as explanations of residential mobility, Urban Studies, 20(1): 47-57.

Clarke, J. and Subramanian, A. (2006), Dynamic forecasting behaviour by analysis: theory and evidence, *Journal of Financial Economics*, 80:81-113.

Department of Local Government, Sport and Recreation (DLGSR) 2006, Population and Housing Fact Sheet-Belyando Shire [Online] Date accessed: 24/10/2007 URL: http://www.lgp.qld.gov.au/docs/corporate/publications/planning/demographics/profiles/demographic_and_housing/belyando.pdf

DLGPSR (Department of Local Government, Planning, Sport and Recreation) (2007), A Sustainable Futures Framework for Queensland Mining Towns, Queensland Government, Brisbane.

DoH (Department of Housing), Report: Housing in the Bowen Basin, Queensland Government, Brisbane.

Ge, X.J. and lam, K.C. (2002), 'Building a House Price Forecasting Model in Hong Kong', The Australian Journal of Construction Economics and Building, 2 (2): 57-70.

Gelfand, Alan E., Banerjee, S., Sirmans, C.F., Tu, Y. And Ong, S.E. (2007), Multilevel modelling using spatial processes: application to the Singapore housing market, *Computational Statistics and Data Analysis,* 51: 3567-3579.

Gurran, N., Milligan, V., Baker, D. and Bugg, L.B. (2007), International Practice in Planning for Affordable Housing: Lessons for Australia, Sydney Research Centre, Australian Housing and Urban Research Institute, Sydney.

Halicioglu, Ferda (2005), The demand for new housing in Turkey: an application of ARDL model, paper prepared for "2005 Business and Economics Society International Conference", July 22-25, 2005, Grand Canyon, Arizona.

Hanushek, Eric A. and Quigley, John M. (1980), What is the price elasticity of housing demand, The Review of economics and Statistics, 62 (3): 449-454.

Haughey, Richard M. (2003), Workforce Housing: Barriers, Solutions and Model Programs, Urban land Institute, Washington D.C.

Ioannides, Yannis, M. and Zabel, Jeffrey, E. (2007), Interactions, neighbourhood selection and housing demand, Journal of Urban Economics, paper accepted on 1 January 2007.

Bowen Basin Mining Communities Research Exchange. Central Queensland University, Rockhampton. Internet entry: www.bowenbasin.cqu.edu.au, accessed at 1 April 2008.

Jackson, W. (2003), A life cycle approach to demographic change in Australia, paper presented in 4th International Research Conference on Social Security, Antwerp, 5-7 May.

Jovanoski, S., Stoney, N. and Downes, P. (1997), Modelling the dwelling cycle in the treasury macroeconomic (TRYM) model, paper presented at 1997 Conference of Economists, 29 September to 1 October 1997, University of Tasmania, Hobart.

Kendig,H. L. (1984), Housing careers, life cycle and residential mobility: implications for the housing markets. Urban Studies, 21(3): 271-283.

Liu, E., Wu, J., Lee, V. and Lee, J. (1996), *Study of Housing Demand Model*, Legislative Council Secretariat, Hong Kong.

Marshal, Maria I. and Marsh, Thomas L. (2007), Consumer and investment demand for manufactured housing units, *Journal of Housing Economics*, 16: 59-71.

MCC (Mackay City Council) (2007), Mackay City LGA Profile, MWREDC, Mackay. Internet entry: http://www.mwredc.org.au/regionalprofile/attached_docs/mkylgajun07.pdf accessed on April, 2008.

MWREDC (2000), Vision Mackay – 2010, Internet entry: www.mwredc.org.au/mackaywhitsredc/publications/attached-docs/vision10-16.pdf available on April 2008.

Natural Resources and Water (NRW) (2007), Coal Production, Exports and New Mine Developments [Online] Date accessed: 24/10/2007 URL: http://www.nrw.qld.gov.au/mines/publications/qgmj/2007/mar/article_08.pdf)

Natural Resources and Water (NRW) 2006, Queensland Coal Industry 10 Year Summary 1996/97-2005/06 [Online] Date accessed: 24/10/2007 URL: http://www.nrw.qld.gov.au/mines/coal/pdf/table_1.pdf

OESR (Office of Economical and Statistical research) (2007), Queensland Regional Profile – Mackay Statistical Division, Queensland Government, Brisbane.

Office of Economic and Statistical Research (OESR) (2006), *Queensland Economic Review*, Office of the Government Statistician, Brisbane.

PIFU (Planning Information and Forecasting Unit) (2006), Queensland's Future Population, Queensland Government, Brisbane.

PIFU (Planning Information and Forecasting Unit) (2007a), Bowen Basin Population Report, Queensland Government, Brisbane.

PIFU (Planning Information and Forecasting Unit) (2007b), Household Projections: Queensland Local Government Areas, Queensland Government, Brisbane.

Planning Information and Forecasting Unit (PIFU) (2006), *Full-Time Equivalent population estimates for nine Local Government Areas in the Bowen Basin, June 2006*, report prepared in the Queensland Government Department of Local Government, Planning, Sport and Recreation, Brisbane.

Reichart, A.K. (1990), The impact of interest rates, income and employment upon regional housing prices, Journal of Real Estate Economics, 16: 280-326.

Residential Tenancies Authority 2006, Median Weekly Rental Data for Queensland Major Regional Centres-September Quarter 2006 [Online] Date accessed: 12/12/2006 URL: http://www.rta.qld.gov.au/zone_files/Stats_September_Quarter_2006/sa_all_data_sept_quarter_2006.xls

Richard, Dusansky and Koc, C. (2007), The capital gains effect in the demand for housing, *Journal of Urban Economics*, 61: 287-298.

Rolfe, J., Ivanova G. and Lockie S. (2005), *Assessing the Social and Economic Impacts of Coal Mining on Communities in the Bowen Basin: Summary and Recommendation*, Research Report 11, Socio-economic impact assessment and community engagement to reduce conflict over mine operations research reports, Centre for Social Sciences Research, Central Queensland University, Rockhampton.

Rolfe, J., Ivanova, G., Greer, L. and Timmer, V. (2007), *Housing and Labour Market Issues: A Literature Review for Bowen basin Communities, Research report No. 1. (Unpublished Report)*, Centre for Environmental Management, Central Queensland University, Rockhampton.

Thomas Ng S., Skitmore, M. and Wong, K.F. (2007), *Using genetic algorithms and linear regression analysis for private housing demand forecast*, paper accepted in Building and Environment on 2 February 2007.

Yates, J., and Randolph, B. (2005), Housing Affordability, Occupation and Location in Australian Cities and Regions, Sydney Research Centre, Australian Housing and Urban Research Institute, Sydney.

Zheng, C., Rolfe, J. and DiMilia, L. (2007) "Strategic People Management of Coal Mining Firms in Central Queensland", Management Research News, forthcoming.