

**Responding to Climate Change for Coastal Housing in Regional Queensland:
A Case Study of Zilzie, Rockhampton**

Delwar Akbar & Susan Kinnear

(Sustainable Regional Development Programme, Centre for Environmental Management,
CQUniversity Australia).

Abstract: Climate change is an important challenge for future housing design and location, as well as for the renovation or relocation of existing homes. Climate change events such as sea level rise, sudden heavy rainfall and cyclones and their resulting inundation in coastal areas have been affecting the eastern parts of Queensland (Australia) over the last four decades. This trend is concerning given that urban growth pressures and ‘sea-change’ lifestyles have resulted in an increasingly more concentrated human population along the Queensland coastline.

In its ‘Regional Climate Projections’, the IPCC 2007 described the possible effects of climate change in Central Queensland region: this includes the anticipation that future sea-level rise will directly impact on the coastal settlements located in central Queensland. Zilzie, located within the Rockhampton Regional Council boundaries, is one of the newly developed coastal settlements within the central Queensland region. This baseline study considers the possible impacts of climate change on Zilzie with respect to the current location of residential homes and possible regional housing market dynamics. The work lays a foundation for managing the nexus between coastal housing, climate change, and population growth in the central Queensland region. Future work in this area is likely to include detailed sea-level rise and storm surge modelling and inundation mapping at local level supported by community perception towards future housing design and location. Such work will contribute to the development of a long-term strategic plan for sustainable coastal housing in regional Queensland, as well as elsewhere nationally.

Key words: climate change, housing, central Queensland, Zilzie, community perceptions

1.0 INTRODUCTION

Climate change is one of the key challenges that regional areas of Australia will face in the coming decades. In Central Queensland, a number of other pressures do exist: these include population growth, an aging population, globalisation and market competitiveness, and an over-reliance on resource extraction activities to drive the local economy. However, climate change is unique in that it will influence the full spectrum of issues across the region – from the community, to business and industry, across agriculture, mining and tourism, through to hard and soft infrastructure and regional planning. One of the key impacts is yet to be realised is housing vulnerability, especially in the coastal areas of central Queensland. This paper aims at providing an overview of coastal housing vulnerability using a case study of Zilzie, a newly-developed coastal settlement in the Rockhampton Regional Council area. The paper also considers the role that new coastal housing and land developments can play in climate change mitigation and sustainable regionalisation, via reduced emissions from the residential built environment.

The paper is structured to include firstly, an overview of the relevant state policies and actions for climate change, hazard management, housing and regionalisation. Next, a description is provided of the Seaspray development case study area and its surroundings; together with details of the local Zilzie Planning Scheme. A profile of Zilzie is also provided with respect to its natural hazards and local hazard management options. This is followed by key statistics about the demographic trends, housing stock and housing market dynamics of Zilzie and its surroundings. Finally, all of this material is considered together in the context of future housing at Zilzie, including way(s) to overcome the dual pressures of population growth and climate change in this coastal settlement.

2.0 RELEVANT STATE PLANNING POLICIES AND ACTIONS

Queensland currently has a mix of documents that dictate the state's approach to climate change planning and policy, land use planning for hazard management and in coastal areas, housing and regionalisation. For example, with respect to climate change, *ClimateQ: toward a greener Queensland* is the key strategy by which the state intends to progress to a low-carbon economy (DERM, 2009). This strategy builds on the earlier ClimateSmart 2050 policy (QG, 2007), as well as the ClimateSmart Adaptation Plan 2007-2012. Within the planning and building portion of the

ClimateQ strategy, it is recognised that ‘Queensland’s infrastructure and buildings will come under increasing pressure from a changing climate with expected rises in temperatures, more frequent extreme weather events, storm surges and flooding’. There was also a differential noted between the nature of climate change impacts in densely-populated urban areas and those for regional and coastal townships (DERM, 2009, p. 199). With respect to mitigation, much of the Strategy is focussed on reducing emissions through building design, improved standards for new development and accelerating retrofit of new stock. However, a review of building codes is also being undertaken to better account for the consequences of cyclones, bushfires, floods, hail and drought on housing stock. There has also been a move to incorporate climate change considerations into local disaster management plans under ClimateQ (DERM, 2009a).

For hazard management in Queensland, a key piece of legislation is the State Planning Policy (SPP) 1/03 *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide*, which took effect September 2003. During the development of this policy, a discussion paper noted that “land use planning can play a key part in reducing current and future community risk by identifying in advance the areas with increased risk and ensuring that new development does not occur or occurs in a controlled manner within those areas” (Queensland Government, 2001, p.9). For example, the SPP can be used to define specific natural hazard areas and then develop measures that minimise risks to people, property, economic activity and the environment (see table 1). However, the policy contains “no formal policies or guidelines providing direction or consistency”, and that this has resulted in “some local governments adopting extensive and stringent planning controls for matters such as flooding, bushfires and landslips, whilst others have few or no planning mechanisms or controls” (Queensland Government, 2001, p.10). A further shortcoming of the SPP is its inability to help address issues in established urban areas and existing developments.

Table 1. Examples of natural hazard areas and responses under the State Planning Policy 1/03

Risk	Aspiration of the SPP	How to determine the natural hazard management area	Comments
Flood	<ul style="list-style-type: none"> • maintain the safety of people on the development site • maintain function of essential services & infrastructure 	Define Flood Event (DFE) 1% Annual Exceedance Probability	It may appropriate to adopt a different DFE depending on the circumstances of individual localities
Bushfire	<ul style="list-style-type: none"> • Avoid areas of High or Medium bushfire hazard • Mitigate risk through allotment design and the siting of buildings • Provide firebreaks • Provide road and water access for firefighting 	Bushfire hazard assessment prepared in accordance with Appendix 3 of the SPP guideline or other methodology approved by the Queensland Fire and Rescue Service (QFRS);	If the required studies have not been undertaken to inform an assessment, the area is identified by local government in its planning scheme
Landslide	<ul style="list-style-type: none"> • Maintains the safety of people, property and hazardous materials manufactured or stored in bulk from the risk of landslide 	Landslide hazard assessment prepared in accordance with Appendix 4 of the SPP guideline	If the required studies have not been undertaken to inform an assessment, the area is identified by local government in its planning scheme, including all land of 15% or greater slopes

The State Coastal Management Plan 2002 has also been developed under the *Coastal Protection and Management Act 1995* and includes a policy guideline ‘mitigating the adverse effects of storm tide inundation’, which seeks to avoid or minimise the risks when planning or undertaking coastal development (DERM, 2010). However, the recent review of the State Coastal Management Plan has indicated a need for improvements in coastal planning and management frameworks throughout Queensland. Consequently, a Draft Queensland Coastal Plan 2009 is now available for public consultation and the existing State Coastal Management Plan will soon be repealed (DERM, 2010). Nevertheless, the consultation draft has already reiterated the importance of policies to protect life and property from coastal hazards such as coastal erosion and storm tide inundation, as well as ensuring ecologically sustainable development of the coastal zone.

With respect to housing, Queensland has a Strategic Action Plan for ‘Affordable Housing in Sustainable Communities’ (DC, 2010). This Plan discusses the growth of communities that ‘are resilient and adaptable in the face of change’, ‘make wise use of natural systems and resources’, and ‘have compatibility with the natural and built environment’; as well as housing that ‘responds effectively to the changing character of households and housing need’, and ‘incorporates the principles of universal design, energy efficiency and resource conservation’. It is also acknowledged within the plan that housing and residential development should be planned with the participation of the wider community (DC, 2010). The state also has a Housing Affordability Strategy, released in 2007, which seeks to improve the planning and development assessment process as well as designate land for housing in high-demand regional areas (ULDA, 2007).

Finally, Queensland (as well as the nation generally) has recently shifted to a strong focus on the regionalisation agenda. In March 2010, the State began preparations on a regionalisation strategy for Queensland, designed to allow regional areas to play a greater role in Queensland’s growth management, by attracting and catering for new population (DPC, 2010). This includes specific regionalisation plans for key regional centres such as Rockhampton and Mackay.

Clearly, there is a complex mix of policies, strategies and planning instruments already in existence to guide the development of coastal housing areas. However, what is less clear is the ability of all these to adequately incorporate the elements of both climate change adaptation (infrastructure vulnerability) and mitigation (reduced emissions from coastal residential stock), whilst simultaneously satisfying the states’ regionalisation and affordable housing agendas in a socially appropriate context. For example, Gurran (2008, p. 2) has noted that ‘Australia’s coastal management frameworks are complex, and tend to be distanced from demographic and socio-economic concerns of coastal communities’. Hence, this paper uses a case study of a coastal settlement in central Queensland to examine the nexus between these issues.

3.0 ZILZIE CASE STUDY

3.1 Description of the Seaspray Estate and surrounds

Zilzie is a relatively new development area located at Emu Park on the Capricorn Coast, on the north-eastern boundary of Rockhampton Regional Council (RCC) (Map 1). Within Zilzie, the 'Seaspray Estate' is a community that was designed under Queensland's sustainable home programme (Cumming, 2005) and has been under development since 2004. The 118-hectare Seaspray development consists of a 64-hectare allocation for residential land development, with a further 54 hectares preserved for Natural Park (pre-existing) and the development of public utilities. The total residential yield for Seaspray is in the order of 612 dwellings/units. One of the latest development stages is the Seaspray 'Cocoanut Point' development, which is based on a master plan including medium density housing, a community hall and a village centre (Seaspray, 2005). The Zilzie development area is surrounded by national park in the north and east and a wetland in the south-east; it is also bounded by a main road (Stevenson Road) and some natural vegetation in the west and north-west (Seaspray, 2005). Also, by agreement between the developer, council and the state government, the development has included the creation of additional national park area over the conservation lots 1, 2 and 3 (Map 2).

Adjacent to Seaspray estate development area is the Great Barrier Reef international resort, located further south along Stevenson Road. This resort has a capacity of 2,400 persons through 500 permanent and temporary dwelling units. Of these, approximately 251 lots have been made available for sale within the associated lake-side village estate. A community centre, medical facilities, and golf club which includes a gym, lounge/bar, games room and dining are also planned in the provisions of this estate (LSC, 2007, pp. 71). Also adjacent to Seaspray is a nursing home consisting of 120 beds and 100 independent living units for the retirees. The original development of this facility was for 154 independent living units; however, this footprint was later reduced due to the need for a buffer zone (a 50 meter buffer between the proposed development and adjoining wetland) with the adjoining wetland.



Map 1: Location map of the study area – Zilzie

Source: <http://www.seaspray.com.au/info/location.htm>, available on 13 October 2010



Map 2: Seaspray Zilzie estate

Source: <http://www.seaspray.com.au/residential-estate-living/the-masterplan.htm>, available on 13 October 2010.

3.2 Regional climate change predictions for central Queensland

Historically, the Rockhampton region has experienced a subtropical climate with wet summers accompanied by low winter rainfall. Areas such as the Capricorn Coast experience a slightly milder climate than further inland (Kinnear et al. 2009). Detailed climate change modelling has been performed for selected regional centres of Queensland, which compares the expected climate for 2030 with the averages of historical data from 1961 to 1990 (Knapp and Perkins 2008). For Rockhampton, this modelling indicated that:

- the average annual temperature in the region is expected to rise by 1°C; and
- there will be a further decline of 50-100mm in annual rainfall (comprised of moderately increased late-summer rainfall and substantial decreases in the remaining three seasons).

Climate predictions for central Queensland have also been provided by the state government. These agree with the QFF trends for ongoing warming and drying of the region (EPA 2008). Sea level rise will also be a key product of climate change and will affect areas of the Capricorn Coast, with state forecasts being in the range of 18-59cm (EPA 2008).

3.3 Livingstone planning scheme and Zilzie

A local planning scheme for Livingstone Shire Council (now Rockhampton Regional Council) was prepared under the *Integrated Planning Act* in 2005. It is through this Scheme that local government intends to manage the impacts of development and climate change, and achieve outcomes that are ecologically sustainable, largely by guiding the location and form of development in the area. An essential component of this scheme is for development to minimise the potential adverse impacts of flood, bushfire and land slide on people, property, economic activity and the environment. Thus, part of the development process involves identifying preferred land uses after known and significant physical features and hazard prone areas and other commitments are taken into accounts (LSC 2005a). This is particularly important along the Capricorn Coast and Zilzie area, which is predisposed to a number of natural hazards. Environmental Management Plans also need to be approved by Council prior to commencement of works (LSC, 2004), but these typically deal with issues such as soil erosion, sedimentation and storm water runoff and ignore other potential environmental hazards. Consequently, the planning scheme is the primary mechanism for hazard identification and protection, via the designation of special management areas.

Development proposed within such areas should be assessed against natural feature codes, which describe the specific outcomes in order to protect the development from natural hazards. The main objective of these natural features codes is to maintain a development without physical changes of the land, avoiding alienation and damage, increase visibility and accessibility, and avoid or minimise the risks to the natural and built environment. This objective has been detailed in the specific outcomes tables under 14 different elements (LSC 2005a, Part 1-1), but this study is mainly concerned about consequences of climate change and population growth i.e., bushfire, land slide, storm surges, floods and cyclones.

Under division 12, code 3.27 (*Natural Features Code of specific management area*), the LSC planning scheme addresses some issues regarding hazard management (LSC 2005a). The specific outcomes and actions of these are summarised table 2 below. However, the Scheme has a number of shortcomings. First, it lacks accurate definitions of ‘significant adverse effects’ and/or ‘unacceptable levels of risk’; and this is a key concern, given that climate change may have a substantial influence on what is considered to be an appropriate risk. Secondly, some hazards such as storm surges and cyclones are not properly addressed, despite the likelihood that climate change will see an increase in these events along the Capricorn Coast. For example, within the current LSC planning scheme, the minimum floor level for flood prone areas is not specified for Zilzie, despite it being considered a medium to high storm surge prone area. The levels provided for other areas are quite variable (e.g., Yeppoon coastline 5.1 metre; Yeppoon back beach area 4.5 metres; Emu Park area is 4.9 metre (LSC-CW, 2003, pp29-30)), which makes it difficult to arrive at an appropriate value for Zilzie. Similarly, cyclones were not identified as a hazard, despite 44 cyclones affecting the Shire since 1955, including cyclone David in January 1976, which included wave heights of up to 3.9m and required evacuation of the hospital at the peak of the storm tide, when ocean water overtopped the back-beach area near council chambers (LSC-CW, 2003, pp.6-7).

Table 2 Examples of outcomes and actions for hazard management under the Local Planning Scheme of Livingstone Shire Council (adapted from LSC 2004; 2005a; 2007).

Hazard	Code section	Outcomes	Examples of actions
<i>Bush fire</i>	3.27.2.a (a & d)	<ul style="list-style-type: none"> • Development does not cause significant adverse effects on the protected area • Public safety, lives and property are not placed at unacceptable levels of risk 	<ul style="list-style-type: none"> • Fire risk management • Use of natural firebreaks • Highest intensity of use occurs in least fire-prone areas • Development is sited and designed to minimise bushfire risk • Road layout facilitates easy exits in case of approaching fire • Water available for firefighting
<i>Steep land and land slide</i>	3.27.2.a (e)	<ul style="list-style-type: none"> • Buildings and structures designed, sited and erected to maintain natural landform, natural drainage pattern and existing vegetation • Public safety, lives and property are not places at unacceptable level of risk. 	<ul style="list-style-type: none"> • Development occurs in geologically stable areas • Lots are on land steeper than 15% shall require a Development Envelope Plan • Acid Sulfate soil investigations required for works on or below 5 meters AHD
<i>Storm surges and floods</i>	Schedule 7	<ul style="list-style-type: none"> • reduce property damage • ensure public safety 	<ul style="list-style-type: none"> • Minimum flood immunity standards (4.5 to 5.1 Australian Height Datum; immunity of 0.5% to 2%)[^] • Self assessment

[^]0.5% means 1 in 200 year magnitude tide, storm or flood waters has a 0.5 chance of occurring in any one year; and 2% means 1 in 50 year magnitude tide, storm or flood waters has a 2% chance of occurring in any one year (LSC 2005a, S7-2).

3.4 Natural hazards and hazard management in Zilzie

Seaspray Coconut Point development initially complied with the transitional planning scheme of the (then) Livingstone Shire Council. About 110 lots have already been developed under two stages of project development, and these were compliant with the Comprehensive Development (Coconut Point Place) Zone Code (LSC, 2004). However, whilst the performance outcomes for natural hazards were defined, their relationship with the local planning scheme and SPP was not clarified. For example, Council has identified key problems with the site such as proximity to

protected areas, drainage problems, wetlands, storm tides, bushfire hazards and acid sulfate soils (LSC 2007, pp.71). This area is low-lying, with contours ranging from 2.5 metres AHD to 13.8 metres AHD (LSC 2007). This area is prone to storm tides, bush fire and landslides (LSC, 2003; SPP-QLD 1/03, pp. 14). Zilzie itself is located in the heaviest rainfall area of LSC: in one instance, 380 mm of rainfall was measured in a seven hour period – one of the highest rainfall events measured in Australia (BOM 2002. pp 3). Perhaps the greatest threat to LSC and the Zilzie area are rain depressions, high winds and tropical cyclones.

3.5 Demographic and socio-economic profile

Population growth trends in Australia are now attracting intense levels of interest from all levels of government, and regional areas of Australia have a key role to play in managing sustainable growth. However, the provision of appropriate and affordable housing has been acknowledged as one of the key soft-infrastructure issues that must be faced if new residents are to be attracted from metropolitan areas into regional communities. This must take into account the housing careers and profiles of local residents as well as the housing demand created by changes in industry base and growth across the region (e.g., mining boom and bust cycles).

Table 3 below provides a summary of the socio-demographic features of the Livingstone Part B statistical local area (LPtB), in which Zilzie is located. The median household income is \$817 per week, compared with \$1,027 in Australia; and average housing loan repayments are \$1,108 per month with median rents being \$170 per week (Table 3). The average household size is very similar to the Australian statistic. These figures reflect the fact that various socio-economic and demographic groups of people live in Zilzie, probably drawn to the area by life style choices (i.e., sea change). However, it is also evident that household size in the Zilzie area is becoming smaller compared to other parts of the former Livingstone Shire, which means couple family without children and small size family are increasing in this area.

Table 3: Socio-demographic changes in Livingstone Part B SLAs

Socio-demographic indicator	2001	2006		
	Livingstone SLA	Livingstone Part A SLA	Livingstone Part B SLA (includes Zilzie)	Livingstone Part A+B SLAs
Total population	27017	3904	24,964	28,868
Median age of persons	38	35	41	38
Median individual income	350	589	413	501

(\$/weekly)				
Median family income (\$/weekly)	750	1472	1,065	1269
Median household income (\$/weekly)	650	1452	870	1161
Median housing loan repayment (\$/monthly)	850	1241	1,108	1174
Median rent (\$/weekly)	130	140	170	155
Average number of persons per bedroom	-	1.1	1.1	1.1
Average household size	2.6	3.2	2.5	2.85

Source: ABS 2008 and 2002

The population of the Rockhampton Regional Council LGA (in which Zilzie is located) is predicted to reach almost 120,000 people by 2011, and over 150,000 people by 2031 (mid-series projection) (OESR, 2010). The LPtB area has experienced the fastest population growth of any of the SLAs in the Rockhampton Regional Council area, over the period 2001-06 as well as more recently in 2006-09 (Taylor, 2010). The population dynamics in the coastal areas of Rockhampton Regional Council will continue be moderated by regional growth, stimulation from the nearby Bowen Basin, and the impacts of the Fitzroy regionalisation plan that is being progressed by the State Government. In Central Queensland, the boom in the mining industry has increased direct employment by more than 10,000 employees in the five years to 2005/6, with additional employment through contractors and service industries in the Central Queensland Region includes Rockhampton Regional Council (RRC) (Rolfe et al., 2007). Furthermore, the Queensland Department of Mines and Energy project that about 50 more mining and mineral projects will be developed or resumed within the next fifteen years, and this will boost population within this region (DME, 2008). Already, the impacts of the mining boom (and the associated supply chain) are reflected in the workforce statistics for the Zilzie area: construction, mining and manufacturing are the largest employing industries for residents in LPtB. It is also important to acknowledge the nature of these industries, whereby many people choose to work on-site in the Bowen Basin on a shift basis, but return to coastal communities, such as Zilzie, during breaks.

In terms of regionalisation plans, a new Queensland-wide strategy already includes a \$3,000 boost to the first home owner's grant for those people purchasing homes outside of the south-east corner. These kinds of policies will motivate more people to settle in regional coastal areas, as will the influence of climate change (where warmer, drier conditions will mean living is more comfortable on the coast). On the other hand, population pressures at the Capricorn coast may be

alleviated by the establishment of new Urban Development Areas at several centres in the Bowen Basin. For example, these have included Clinton in Gladstone, Andergrove in Mackay, and large sites in Blackwater and Moranbah during 2010 alone (ULDA, 2010). Nevertheless, the nearby suburb of Yeppoon has been tagged as a ‘fast growth location’ for the state (Rohlin, 2006). Here, almost half of the new residents are aged 25-54 years, but there is also a substantial number attracted in the 65+ age group. Consequently, it seems highly likely that the Zilzie area will continue to grow due to the overwhelming trend for amenity migration (‘sea-changing’), which is already being experienced across coastal Australia (Gurran, 2008). For example, at Seaspray, it seems likely that new residents will be those seeking coastal lifestyle destinations as either an adjunct to working lives in the mines of the Bowen Basin, or for retirement.

Time series data for ‘place of usual residence’ can give useful insights into the mobility of the population of Livingstone Part B. This may be particularly important if large numbers of people are entering the region from different climatic areas, since there is the potential for these people to adapt poorly to the predicted effects of climate change in Central Queensland. Based on the last-available Census data (ABS, 2006), over one-quarter of the residents in LPtB had a different address in the twelve months previous, but the figure rose to over 55% for the five years previous. However, by far, most of the mobile population had travelled from elsewhere in Queensland, with generally only 1-2% originating from New South Wales, and even fewer from the remaining states.

3.6 Housing and land development profile

The area of Zilzie and its surrounds (Livingstone Part B) is one of rapid growth: it achieved the second-highest number of dwelling approvals for the central Queensland region, for the year to June 2010 (Barker, 2010). At the local government (Rockhampton Regional Council) level, urban residential land development activity has steadily increased from 2000 onwards, but peaked in 2006-07, and has slowed considerably in 2008-09 (Barker, 2010). Whilst the highest lot registrations were in the city suburbs of Norman Gardens and Gracemere, many of the most recent lot approvals have also been concentrated into the coastal areas at Yeppoon (68 lots), Lammermoor (36 lots) and Zilzie (26 lots)(Barker, 2010). In the last five years, the number of lot approvals has been approximately twice that of lot production and lot registrations; resulting in a situation whereby many lots can be brought onto the market rapidly, should market demand occur.

Volatile activity levels in urban residential land development have also been recorded across neighbouring local government areas such as Gladstone, the Central Highlands and Banana (Barker, 2010). This is further testament to the impacts of the mining boom on central Queensland's communities.

PIFU (2008, 2009) report a significant decline in the number of residential lots approved and produced in the year ending September quarter 2008 and 2009 because of global financial crisis (Akbar, Clarkson and Rolfe, 2010). The central Queensland region approved 2,125 residential lots in the year ending September quarter 2009. This was a decline of 30% compared with the same period in 2008 when 3,035 lots were approved. Rockhampton approved 787 residential lots in the year to September quarter 2009. This was a decrease of 43 per cent compared with the same period last year when 1,376 lots were approved. Five hundred and fifty eight residential lots were produced in Rockhampton in the year to September quarter 2009. Compared with the previous year when 824 lots were produced, this was a decrease of 32 per cent. About half of the lots were produced in the Livingstone Part B SLA.

The number of lots registered in Rockhampton (RC) in the September quarter 2009 decreased by 53 per cent to 120 registrations compared to 256 registrations recorded in the same period last year. Total lot registrations in the year ending September 2009 were up 20 per cent over the previous year. The number of lots consumed in Rockhampton in the September quarter 2009 decreased by 43 per cent to 351 lots when compared with the same period last year. So residential land approval and production in Rockhampton was very much similar in 2009 compared to the CQ regional average and this is a general scenario for overall Queensland. This is because most land developers did not take risk in producing new residential lots instead of selling the existing one. Therefore the situation may aggravate in future if the climate change threats becoming more apparent to the people.

Census data for LPtB demonstrates that most of the local area is represented by separate houses (86% of the total dwellings), which accommodate over 90% of the residents, with most of the residual being one-storey dwellings. Around 40% of the homes are fully owned, with a further 34% being purchased and the remainder mostly represented by rentals. Over one-third of the homes being purchased have monthly loan repayments ranging from \$750 – \$1,399; but over a quarter of dwellings are in a much higher repayment bracket (\$1,600 or above). Rents in the SLA are predominantly in the mid-range of \$140-274/week (56%), with just 2% of the market

represented by rents over \$350/week. Data from the Queensland Rental Tenancy Authority (2009, 2010) also shows that median weekly rents in the Rockhampton Regional Council area have grown by 16-32% during the period 2007-2010, depending on the housing type. This is useful information when considered in the context of the gross weekly household income (see Table 3), since it will be critical in considering the ability of existing residents to afford new technologies that will help them to adapt to climate change (e.g., insulation, energy efficiency, water conservation). It also helps to examine the ability of residents to influence the choice of technologies through their housing tenure, with purchaser-owners having a greater ability to make structural changes in comparison with (e.g.) rental occupants.

In line with strong growth in resource sector, house prices within the CQ region have substantially increased from 2004/5 – 2009/10. The level of cumulative increase between 2004/5 and 2009/10 within the previous local government areas of Livingstone and Rockhampton are 87.5% and 59.4% respectively (Table 4). Zilzie area has a similar median sale price as like in the Livingstone region.

Table 4: Median sale price for housing from 2004 to 2010

Former LGAs	Year	Number of Sales	Median Sale Price	Annual Increase	Cumulative annual increase relative to 2004
Rockhampton	2004/05	2,263	\$148,500	n/a	n/a
	2005/6	2,285	\$193,000	30%	30%
	2006/7	2,032	\$264,750	37%	67%
	2007/8	1,412	\$295,000	11%	79%
	2008/9	858	\$285,000	-3%	75%
	2009/10	-	\$195,000	12.6%	87.5%
Livingstone	2004/05	1,043	\$240,000	n/a	n/a
	2005/6	1,176	\$281,000	17%	17%
	2006/7	1,043	\$365,000	30%	47%
	2007/8	731	\$418,000	15%	61%
	2008/9	383	\$390,000	-7%	55%
	2009/10	-	\$395,000	4.4%	59.4

Source: Property Data Solutions June 2009 and RP Data 2010 (Free Suburb Profile-<http://reports.rpdata.com.au>, accessed on 6 May 2010).

It is interesting to note that the volume of annual house sales appears to have peaked for the most places in the CQ region and the single largest annual increase in median sale prices for housing occurred prior to 2007/8, suggesting that the excessive demand for housing experienced in 2005-2007 within the CQ region may have been partially offset by an increase in housing supply and

completed house lots (Akbar, Clarkson and Rolfe, 2010). There has been a decline in sales in most areas in 2009/10, which is likely to be a consequence of the global financial crisis.

4.0 DISCUSSION

The Seaspray development at Zilzie represents an area that is prone to several natural hazards such as fire, storm surges and flood, and cyclones. These kinds of events are likely to increase in incidence under climate change. Unfortunately, some reports have indicated that it is not clear whether the ongoing development is complying with the SPP and/or LSC Planning Scheme 2005. Therefore, although the LSC Planning Scheme is unclear about specific responses to hazard mitigation for people and property, there remains a clear need for surveywork to determine the risks to land, property and people under modelled climate scenarios for the Capricorn Coast. This exercise would be valuable in applying to any other newly developing coastal settlement in central and northern Queensland area.

Housing affordability will be a key determinant in the population changes of Zilzie. Already, mild population decline is being experienced in nearby Emu Park and Mulambin, and this reflects affordability patterns with high-earning couples moving to the area to replace families (Taylor, 2009). There is also speculation that many houses have been built within the storm surge buffer zone (50 to 100m from the sea shore line) in the Livingstone Part B SLA, which are currently not severely affected by the climate induced calamities but in future there is a possibility that these houses would be flooded and need to be relocated, which may create serious affordability and availability crisis.

This paper provides a case study and useful commentary around climate adaptation in housing, and the ways in which communities can prepare for climate change. Land use planning and disaster management plans are key mechanisms by which the impacts of climate change in Queensland can be addressed. However, the choices of developers and of residents are also clearly important in reducing climate vulnerability of, and emissions generated, by residential housing stock. The ClimateQ strategy has called for 'locally relevant climate change responses ... supported by regionally and locally specific data' (DERM, 2009, p. 120). For Zilzie, This will require a detailed determination of the impacts of climate change, including mapping of

the sea-level rises, storm tide and surge inundation levels (including a consideration of elements such as vegetation, buffering and slope of coastline), and bushfire risk. This should be followed by a risk assessment framework to evaluate land use areas which are compatible with housing development and an indication of the risk borne by existing properties. Local and regional preventative measures should then be considered in the context of appropriately planning for coastal housing in Central Queensland. Within this, local government officers have a key role to play in using local knowledge to formulate local best-practice responses, such as guidelines for the future directions of land use and settlement planning.

A further question may be the role that 'sustainable' housing developments like Zilzie will play in the overall transition of Queensland to a greener state. The ClimateQ strategy has noted that the currently available planning tools do not allow for the accurate estimation of emissions resulting from local planning schemes and housing developments; this is resulting in an information gap about the 'carbon implications of different building designs, features, layout and orientation' (DERM, 2009). However, it has already been estimated that emissions from the residential building sector in Australia will rise by 78% to 2050 (ASBEC, 2008). Work by Wang et al. (2010) has shown that adapting to climate change in Australia will require key changes in the heating and cooling energy requirements of existing housing stock. Therefore, there are opportunities for both the developers and residents in Zilzie and Seaspray's to participate in climate mitigation by (for example) adopting proactive measures for energy efficiency in newly constructed homes, and by retrofit of existing housing stock. However, the question of how to improve the environmental performance of houses without impacting on affordability remains a key challenge (DERM, 2009). There is also the opportunity to use further stages of the Seaspray development as a case study to provide the necessary information to build a planning tool capable of forecasting emissions from the residential sector. For example, this may include modelling the impacts of different mixes of dwelling types (separate, semi-detached or unit-style homes) on overall resource efficiency. The impacts of climate change on residential insurance costs in regional, coastal suburbs such as Zilzie may also be of interest, in the context of contributing to the costs of living in regional areas.

5.0 CONCLUSION AND FUTURE DIRECTIONS

This paper has considered some of the constraints around the physical management of coastal growth in Central Queensland (hazard management, land use planning), as well as some of the socio-economic and housing issues around climate change vulnerability and responses in coastal communities.

Some of the key recommendations arising from this study include:

- detailed climate mapping is still required to show the likely extent of sea level rise, storm surge and tidal inundation in coastal areas such as Zilzie under different climate change scenarios;
- there should be a formal strategy (planning framework) that allows for the construction of new homes to be guided by information on the expected climate change in the local area (as an adjunct to state or commonwealth building codes);
- there also needs to be the development of planning policies that address climate change risk in existing residential areas (not simply new developments); and
- local government, developers and residents should be involved in decision-making about new and existing housing areas and how these might cope with expected climate change, as well as contribute to reduced carbon emissions;

It is also clear that further work is also needed to answer questions such as how demand for coastal housing will change into the future, as a result of the intersection between population growth (more demand), climate change (potentially, less available allotments), and change to market values (a combination of demand-supply, but also people's perceptions on the risks of purchasing and living in homes that are near to natural hazards and vulnerable to climate change impacts).

In addition, other points that may need to be considered in future studies may include:

- exploring the trend for smaller household size, but larger homes – due to the implications in resource efficiency and climate change mitigation;
- identifying the expected average lifespan of new homes in Seaspray, and an analysis of their ability to account for climate change 50+ year's hence?

- identifying the average age of existing homes elsewhere in Zilzie – how far behind are they in terms of having the newly available energy efficiency technologies, and what retrofitting effort will be required to transit them into climate adapted and climate mitigation housing?
- what impact(s) do factors such as median age, wealth status, family composition, education background and other parameters have on resident's propensity to understand and respond to climate change?

6. REFERNCES

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

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

Akbar, D., Clarkson, I. and Rolfe, J., 2010, Impact of GFC in Housing Market in Regional Australia: Lessons from the Central Queensland, APNHR Conference Proceedings, Beijing.

ASBEC (Australian Sustainable Built Environment Council), 2008, The Second Plank – Building a Low Carbon Economy with Energy Efficient Buildings, Australian Sustainable Built Environment Council, available online at <http://www.asbec.asn.au/>

Barker, Ross, 2010, Residential development trends in the Fitzroy Region, presentation at the Rockhampton Population Information Session, Office of Economic and Statistical Research, 1 September 2010, Rockhampton.

BOM (Bureau of Meteorology) (2002), *Significant Weather*, June 2002. Internet access: mhtml:file:/F:\Livingstone%20urban%20resilience\LSC_Zilzie. Accessed on 25 August 2007.

BOM (Bureau of Meteorology) (2007), *Severe Tropical Cyclone Larry*, March 2007. Internet access: http://www.bom.gov.au/weather/qld/cyclone/tc_larry/. Accessed on 10 September 2007.

DC (Department of Communities), 2010, Affordable Housing in Sustainable Communities Strategic Action Plan, Queensland Department of Communities, available online at http://www.housing.qld.gov.au/partnerships/affordable/publications/sustainable/3_policy.htm

- DERM (Department of Environment and Resource Management), 2009a, *ClimateQ: toward a greener Queensland*, Queensland Department of Environment and Resource Management, Brisbane, available online at <http://www.climatechange.qld.gov.au/pdf/climateqreport/climateqreport.pdf>, ISBN 9311662183101.
- DERM (Department of Environment and Resource Management), 2009b, *Draft Queensland Coastal Plan, Draft State Planning Policy Coastal Protection*, August 2009, available online at http://www.derm.qld.gov.au/coastalplan/pdf/policy_coastal_protection.pdf
- DME (Department of Mines and Energy) 2008 *Bowen Basin Mining Project, July 2008 (unpublished data)*, Regional DME Office, Rockhampton.
- DPC (Department of the Premier and Cabinet), 2010, *Qld Growth Management Summit: regionalisation strategy for Queensland media release*, Queensland Department of the Premier and Cabinet, available online at <http://www.cabinet.qld.gov.au/mms/StatementDisplaySingle.aspx?id=69179>
- EPA, 2008, *Climate change in Queensland: What the science is telling us*, Queensland Government Environmental Protection Agency, Brisbane. Cumming, Gillan (2005), *Green light for a smart design. Sunday Mail*, 02 October 2005.
- EPA, 2010, *Information Sheet – coastal development, development applications within areas subject to storm tide inundation*, Environmental Protection Agency, Brisbane.\
- Gurran, N. (2008) *The turning tide: Amenity migration in Coastal Australia. International Planning Studies*, **13**, 391-414.
- Kinnear, S., Mann, J. and Miles, RL. 2009, *ClimatePrimer CQ: a scoping study of business awareness and preparedness for climate change in the Rockhampton Region*, report for Rockhampton Regional Development Limited, CQUniversity Australia, 107 pages.
- LSC (Livingstone Shire Council) (2001), *Livingstone Facilities Needs Studies*, LSC, Yeppoon.
- LSC (Livingstone Shire Council) (2003), *Fire Hazard Strategy Report*. LSC, Yeppoon.
- LSC (Livingstone Shire Council) (2004), *Livingstone Shire Council Planning and Development Committee: 18 May, 2004 – Minutes*. LSC, Yeppoon.
- LSC (Livingstone Shire Council) (2005a), *Livingstone Shire Council Planning Scheme 2005*, LSC, Yeppoon.
- LSC (Livingstone Shire Council) (2005b), *Local Disaster Management Plan – Cyclone and Storm Sub Plan*. LSC, Yeppoon.
- LSC (Livingstone Shire Council) (2005c), *Local Disaster Management Plan*, LSC, Yeppoon.

- LSC (Livingstone Shire Council) (2007a), *Livingstone Shire Council Planning and Development Committee: 20 March, 2007 – Minutes*. LSC, Yeppoon.
- LSC-CW (Livingstone Shire Council and Connel Wagner) (2003), Capricorn Coast Storm Tide hazard Investigation For Livingstone Shire Council – Final Report. LSC, Yeppoon.
- OESR, 2010, Population and housing profile, Rockhampton Regional Council, April 2010, Office of Economic and Statistical Research, Queensland Treasury, Brisbane.
- QG (Queensland Government) (2003), State Planning Policy, 1/03 – Mitigating the adverse impacts of flood, bushfire and landslide. Queensland Government, Brisbane.
- QG (Queensland Government), 2007, ClimateSmart 2050 Queensland climate change strategy 2007: a low-carbon future, Queensland Government, Brisbane, available online at http://www.thepremier.qld.gov.au/library/pdf/initiatives/climate_change/ClimateSmart_2050.pdf
- Rohlin, C-J, 2006, New residents in fast growth locations, Planning Information and Forecasting Unit, Queensland Department of Local Government, Planning, Sport and Recreation, available online at <http://www.oesr.qld.gov.au/products/presentations-papers/new-residents-fast-growth-locations/new-residents-fast-growth-location-s.pdf>
- Rolfe, J., Petkova, V., Lockie, S., & Ivanova, G. 2007, *Mining impacts and the Development of the Moranbah Township. Research Report 7. Impacts of the Coal Mining Expansion on Moranbah and Associated Community*. Central Queensland University, Rockhampton.
- Seaspray (2005), Seaspray Master Plan. Internet access: <http://www.seasprayliving.com.au/>
- Taylor, Alison 2010, Local population trends in Fitzroy SD, presentation at the Rockhampton Population Information Session, Office of Economic and Statistical Research, 1 September 2010, Rockhampton. \
- ULDA (Urban Land Development Authority), 2007, Queensland Housing Affordability Strategy, Urban Land Development Authority, available online at http://www.ulda.qld.gov.au/01_cms/details.asp?ID=15
- ULDA (Urban Land Development Authority), 2010, 'Our Projects', Urban Land Development Authority, available online at <http://www.ulda.qld.gov.au/default.asp>.
- Wang, X., Chen, D. & Ren, Z. (2010) Assessment of climate change impact on residential building heating and cooling energy requirement in Australia. *Building and Environment*, 45, 1663-1682.

Queensland Government (2001) 'State planning policy on land use planning for natural disaster mitigation and development assessment', discussion paper, September 2001, Department of Emergency Services, Brisbane.