Building Local Government Resilience through Scenario Planning

Coastal Settlement in the Burnett Mary: Addressing Climate Change and Population Growth

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# Table of Contents

1. Introduction 4
   - Purpose 4
   - Rationale 4
   - Climate Change 5
   - Setting the Scene 6

2. Residential Snapshot 6
   - Population Growth 6
   - Aging and Climate 7
   - Residential Infrastructure 8

3. Tourism and Recreation Snapshots 9
   - Overview of the Tourism Sector 9
   - Tourism Scenarios 9
   - Economic Importance 10
   - Recreation Snapshot 11

4. Potential Impacts 12

5. Scene Setting Scenarios 16
   - Scenario 1: Early Adaption to Climate Change 16
     - Addressing Sea Level Rise 17
     - Stormwater Management 18
     - Water Supply 19
     - Stormwater Management 19
   - Scenario 2: Storm Surge and Land Use, Cadastre and Road Length 20

6. Summing Up 23
   - Appreciating the Situation 23
   - Liability and Litigation 23
   - For Further Consideration 24

Annex A - Best Practice Guidelines 25
   - Strengthening the Enabling Environment 25
   - Decision Making Support 25
   - Mainstreaming 26
   - Implementation 26
   - Review 26
   - A Systematic Approach 27
1. Introduction

Purpose
This working paper is the third in a series entitled “Building Local Government Resilience through Scenario Planning”. This work was commissioned by the Burnett Mary Regional Group (BMRG) and focuses on the implications of climate change for the residential, tourism and recreational sectors. Also the paper investigates policy and planning responses that may reduce the vulnerability of infrastructure associated with these three sectors of the regional economy. Two scenarios are offered to view climate change impacts on infrastructure, 2026 and 2070. Specific modelling has been conducted to look at potential increases in the area of land on the coastal margin of the region that could be affected by storm surge.

This Working Paper focuses on the study area shown in Map 1 and covers the Regional Council areas of Bundaberg, Fraser Coast, Gladstone and Gympie. Additionally, it includes what was the Mirriam Vale Council area that is now encompassed by the Gladstone Regional Council. The purpose of the paper is to:

- provide snapshots of the drivers: recreation, tourism, recreation and climate;
- determine the general types of infrastructure in demand for each sector and broadly identify the climate change implications for that infrastructure and investigating scenarios; and
- provide an overview of recommendations and best management practices.

Rationale
The rationale for the paper lies in the fact that that it is most important to understand the dynamic relationships human settlements have with the environment and the multiple pressures of natural and human drivers on infrastructure demand, maintenance and construction is most important. Drivers are the underlying causes for change and include climate and socio-economic change as well as national and international policy.
Climate Change

Changes in weather and climate conditions that have been observed across Queensland and within the Burnett Mary Region over the last 60 years are consistent with global predictions. That is: rising temperatures; changes in the timing, location, frequency and intensity of precipitation; and rising sea level. A more detailed picture of the climate situation is given in the Overview: Climatic Variability and Climate Change: Scenarios and Projections.
**Setting the Scene**

The lens provided through this paper allows policy makers and planners to view the compounding affects of both human and natural drivers together. The past two decades have seen substantial population increases in many of Australia’s coastal communities in what is now being referred to as the ‘sea change’ process or phenomena.

History shows that there will be significant changes in the natural and human landscapes as a result of population growth, changes in tourism and recreation and climate change. The Department of the Environment and Heritage (2006) clearly articulates in their *Climate Change Impacts and Risk Management: A Guide for Business and Government* report that our climate will become warmer, with different patterns of rainfall, less available moisture retained in the soil and more severe storms will occur in Australia. Model outputs from SimCLIM show extreme possibilities for new climate regimes based on different global circulation models and emission profiles. The purpose here is to assess the driving forces holistically and then plan to adapt settlement patterns and infrastructure to meet these new parameters.

The Queensland Department of Infrastructure and Planning (QDIP 2008) estimate the current population of the Wide Bay-Burnett region to have totalled 264,856 in 2006 and project 2026 populations to rise between 32.2% to 347,530 (low series projection) and 50.9% to 399,684 (high series projection), with a medium growth projection estimating a 39.5% increase to 369,359. The tourism and recreation sectors are also projected to grow and evolve as demographics and tastes drive change in those industries. The associated pressures new land demand on coastal margins for residential, tourist and recreation, as well as infrastructure development will need to be framed within a better understanding of climate change implications in this region. As a result, observed climate variability and future climate change scenarios have been developed to help inform policy and planning.

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**2. Residential Snapshot**

**Population Growth**

The Study Area is projected to grow by 85,475 people by 2026, bringing the total population within this area to 305,392 people. Over 90% of the population growth in the study area is projected to occur in Bundaberg and Fraser Coast which have coastal margins. While the population data here is geographically generalized it does demonstrate a number of trends that will lead to potential infrastructure vulnerability due to climate change. Pressures to develop and occupy the coast for subdivisions, marinas, roads and drainage are increasing, particularly given the escalation in beach-front property prices and the associated amenity that these locations provide.

In order to accommodate the projected population growth within the Study Area, it has been estimated that an additional 49,577 dwellings will be required. These
dwellings will use an additional 8,224 hectares of land. If this was to be achieved it would represent a 54% increase in the current land area used for residential dwellings.

![Figure 1 - Changes in Population Demographics](image)

Projections for the population profiles of the future indicate that there is a general trend for the 44 and over cohort to become an increasingly dominant part of the demographic picture. This trend is significant, for example Miriam Vale will have a large 2006 cohort of 44-64 year olds moving into the 65 and over category in the next 20 years.

While the proportion of the population age 65 and over is expected to grow, it needs to be recognised that the population itself will have grown. The cohorts of people 24 years and below are expected to either maintain their size or slightly shrink in real numbers but becoming significantly smaller compared to the growth of the other age groups in the profile.

**Aging and Climate**

With the demographic structure for this region reflecting the aging, the reality of climate change has many implications. Primarily, there are several health related and access to health care facilities issues to consider especially with respect to comfort. Also older persons have higher incidence of heat related illnesses, reduced capacity to deal with extreme events, and increased susceptibility to disease vectors. In addition, taking certain types of medications can reduce how the human body copes with heat.
Residential Infrastructure

There is a wide variety of infrastructure that is associated with the residential sector. Figure 2 provides an overview for the residential sector and divides it into two groups: Required infrastructure and Supportive Infrastructure. The section on Scenarios on “Potential Impacts” outlines potential vulnerability of infrastructure and the section on Scenarios specifically highlights potential storm surge damage to land use, cadastre and road length.

Figure 2 – Infrastructure Requirements
3. Tourism and Recreation Snapshots

Overview of the Tourism Sector

Tourism is a significant part of the social and economic picture of this region. Tourist demand can be readily segmented into: the origins of the tourist ie domestic or international; and trip duration, daytrips and overnight stays. Key observations with respect to tourism in the Burnett-Mary Region are that:

- the visitor numbers for domestic tourism is the mainstay of the regional tourist industry;
- annual tourism rates are quite volatile and seasonally dependent; and
- the majority of international and domestic visitation is in the larger coastal nodes, particularly Bundaberg and Hervey Bay.

Table 1 – Visitation Levels

<table>
<thead>
<tr>
<th>Government Area</th>
<th>International Visitors (visitor nights est.)</th>
<th>Domestic Overnight (visitor nights est.)</th>
<th>Domestic Day (visitors est.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bundaberg RC</td>
<td>332,000</td>
<td>1367,000</td>
<td>351,000</td>
</tr>
<tr>
<td>Gladstone RC</td>
<td>68,000</td>
<td>310,000</td>
<td>No data</td>
</tr>
<tr>
<td>Gympie RC</td>
<td>119,000</td>
<td>1,048,000</td>
<td>428,000</td>
</tr>
<tr>
<td>Fraser Coast</td>
<td>770,000</td>
<td>2,519,000</td>
<td>No data</td>
</tr>
<tr>
<td>Totals</td>
<td>1,289,000</td>
<td>5,244,000</td>
<td>779,000</td>
</tr>
</tbody>
</table>

Tourism Scenarios

Queensland Tourism (QT) is projecting an increase of 1.7% per annum for growth in international visitor numbers and an increase of 2.1% per annum for spending.

The domestic market is not seen to be as stable as the international market and two scenarios have been developed by Queensland Tourism that show an adaption to new demands of domestic tourists or a status quo approach which is projected to create major declines in domestic visitor rates. The scenarios are summarised as follows.

QT Scenario A:
- increase of 1% per annum in both domestic overnight and domestic day visitor numbers; and
- increase of 13% per annum in spending for both domestic overnight and domestic day visitors.
QT Scenario B:
• decrease of 19% per annum for change in both domestic overnight and domestic day visitor numbers; and
• decrease of 7% per annum for change in spending for both domestic overnight and domestic day visitors.

Economic Importance

Tourism is a major economic sector in the region and is vulnerable to the variances of international and national economic drivers. As well, it is a sector that is vulnerable to changing climatic conditions.

The economic impact of tourism in a Queensland context is summed up as follows:

• Tourism contributes $8.8 billion to the Queensland economy and accounts for 4.5 percent of Queensland’s Gross State Product (GSP)
• Tourism generates $3.9 billion annually as an export earner
• Tourism employs 119,000 Queenslanders or 5.7% of all persons employed
• Takings from accommodation for the year ending June 2008 for Fraser Coast, South Burnett and Bundaberg totalled $497 627 000

Key tourist attractions and activities in this study area include:

- Nature based activities
- Active outdoor activities
- Cultural and heritage
- Local attractions
- Rest and relaxation

The overall peak season for tourism occurs between July and September and the low season is between January and March. “Whale Watching” is the primary tourist attraction in the area with visitations occurring between August and September. The occupancy rates vary with the seasons and range between 39% and 67%. Planning for tourism must consider seasonal shifts when considering the possibility of new climate regimes. Future infrastructure demand in the tourism sector will be significantly driven by a need to provide high quality, accessible facilities for a growing tourism market while maintaining the desired holiday ‘experience’.

Transport infrastructure is another factor that needs to be taken into account in developing scenarios covering settlement and infrastructure in a climate change context. Figure 3 shows that currently the private car is the dominant form of transport and may grow. This has implications for the provision and maintenance of roads. The vulnerability of roads is a key factor to be taken into account when considering proactive responses to climatic variability and change, especially with the deterioration of road surfaces under protracted hot conditions.
The recreation sector is recognised as an important part of the community lifestyle and attracts many tourists to the study area. Tourists and residents often end up doing the same things in the same locations (Wall 1998). As such, the recreation sector represents a significant overlap between the resident population driver and the tourism driver. Consequentially, the recreation sector generates demands and impacts that can be directly related to the key socio-economic drivers of the tourism and residential sectors.

Key pressures in the recreation sector are:

- providing recreation activities to suit the changing population and demographics of the residents and tourists;
- demand to provide additional, high quality facilities; and
- a shift from organised sport to activities undertaken by individuals.

Based on current Queensland Department of Transportation ownership data and projected population data there will be significant increases in boats and bicycles to 2026 in this study area. This will have implications for infrastructure development and infrastructure vulnerability to Climate Change (bike paths, lanes and boat ramps).
4. Potential Impacts

Information on the potential impacts of climate change has been sourced from documents produced by the Australian Greenhouse Office, CSIRO, New Zealand Ministry for the Environment and the New Zealand Climate Change Office. The information consolidated from these sources shows that impacts can be considered as being general, strongly connected to the coastal margins and have implications with respect to stormwater, water supply, waste water collection and treatment, transport, telecommunications, power and gas. Additionally, climate variability and climate change needs to be considered in relation to land based waste management facilities and emergency services.

General Considerations

- Increased temperature reducing comfort levels in buildings.
- Impacts on underground infrastructure due to chemical and physical changes in the soil.
- Increased mortality and morbidity resulting from:
  - exposure to cancers and related illnesses resulting from increased UV radiation;
  - increased occurrence of dengue fever and other vector-borne diseases;
  - increased illness due to declines in water quality in waterways; and
  - increased occurrence of heat stress and related health impacts for the elderly and very young during heat waves and days with extreme temperatures.
- Increased damage to infrastructure due increases in the frequency and intensity of floods, storms and wind Decreased water resources at all times including increased risk of water shortages during droughts.
- Higher rates of building deterioration and associated maintenance costs due a greater range of temperatures.
- Increased risk of failure of electrical equipment (air conditioning units and pumps) due to over heating during peak periods of demand (heat waves and days over 35°C).
Coastal Margins

- Increased frequency of inundation and, in some cases, permanent inundation of coastal infrastructure and utilities.
- Damage to or loss of buildings, infrastructure and foreshore recreation areas due to sea level rise, storm surge or coastal erosion.
- Increased risk when using foreshore due to erosion of dunes, cliffs and other features.
- Increased erosion and/or exceedance of seawalls, jetties and other coastal defences.
- Increased repair costs or loss of use of coast based amenities due to sea level rise, storm surge or coastal erosion.
- Increase risk of accidents and boat damage due to changed sediment deposits.
- Changes in the extent of flood plains.
- An increase in coastal erosion which could shift the coastline inland by hundreds of meters.
- Increased mobility of sand dunes with associated implications for development immediately behind the sand dunes.
- Increased demand for dredging particularly in ports and estuaries as increased sediment is washed into waterways.

Stormwater Systems

- Increased quantities of pollutants entering the stormwater system as runoff due to the extended length dry periods between rain events.
- Increased flooding due to inundation of stormwater outlets by sea level rise, storm surges and localized flooding associated with more intense rainfall events.

Water Supply Systems

- Decreased available water as inflow to water storages are impacted by a range of factors including: decreased groundwater recharge, decreased runoff as a result of the dryer soil conditions and increased evaporation.
- The need for additional treatment of water from storage dams in order to address deteriorated water quality.
- Loss of ground water resources due to increased salinity.
- Increased evaporation loss from open reservoirs and dams.
• Possible flooding of pump stations due to sea level changes and storm surges.
• Increased risk of pollution of water in dams due to increased frequency and intensity of bushfires.

**Wastewater Collection and Treatment Systems**
• Increased potential for corrosion and odours as a result of increased sewage concentrations driven by increasing ambient and seasonal temperatures.
• Changes in intensity of rainfall events impacting on inflow and infiltration to wastewater network.
• Increased incidence of sewer overflows due to increased rainfall intensity during storms.
• Reduced volume of flows to sewer during dry weather resulting in blockages and surcharges.
• Impacts on energy systems resulting in reduced reliability of power supply and failure of sewage pumping and treatment equipment.

**Transport Systems**
• Increased potholing and loss of surface condition due to embrittlement of the bitumen and other heat related pavement deterioration.
• Washouts particularly after long periods of surface softening followed by intense rainfall.
• Increased frequency, depth and duration of flooding across roads and potentially, rail and airports.
• Potential warping of steel railway lines due to extreme temperatures.
• Loss or damage to roads from coastal erosion, flooding or sand blown onto the road surface.
• Longer disruptions to transport movement as a result of increased storm intensity.

**Telecommunications, Power and Gas Systems**
• Permanent or intermittent flooding of substations, exchanges, manholes, pits and other facilities due to increased intensity of rainfall events, sea level rise and storm surge.
• Increased damage to above ground telecommunications and electricity infrastructure due to storm events and flooding.
• Increase blackouts and brown outs due to excessive demand for electricity and associated system failures.
• Increased frequency and extent of bushfire disruption to telecommunications, electricity gas networks.

• Arching faults of transmission lines due to decreases in rainfall and increased variation in wet/dry spells.

• Increased disruption of underground systems due to soil subsidence and erosion.

Land Waste Management Facilities

• Changes to ground water resulting in increased potential for leaching of pollutants.

• Increased intensity of rainfall resulting in increased pollutant runoff and discharge.

• Increased risk of bushfire impact.

Emergency Service Facilities

• Increased demand for facilities and staff due to increased incidence of food and water-borne disease.

• More frequent facility isolation due to flooding and bushfires.

• Failure of essential equipment due to overheating, particularly hospitals during heat waves.

• Lack of available potable water during extreme events.

• Increased demand for facilities and staff due to increased occurrence of heat stress and other related morbidity.

• Direct storm damage to facilities.

• Increased injuries and associated increase in demand for emergency facilities during and following more extreme storm events, cyclones and bushfires.

• Increased demand for facilities and staff due to increased occurrence of airborne dust, pollen and pollution.
5. Scene Setting Scenarios

The following two scenarios are “scene setters” for dealing with climate variability and change in the coastal margins of the Burnett Mary Region. The first set of scenarios describes the potential outcomes of early adaptation to climate change impacts for the years 2026 and 2070. They are qualitative and are developed from the perspective of having taken a positive planning and policy approach. While a range of other infrastructure will be impacted by climate change, there has been a focus on infrastructure which is considered to be at greatest risk in the region. The second set of scenarios have analysed GIS data to project impacts due to storm surge. As such, they demonstrate a quantitative approach to scenario plan setting.

Collectively, the two set of scenarios have highlighted the positive benefits that are obtained by early adaptive action for coastal communities and infrastructure. By implementing appropriate planning and policy measures, the need for expensive reactive responses to climate change can be avoided and risks of climate change impacts can be reduced for both the community and infrastructure along the coastal.

**Scenario 1: Early Adaption to Climate Change**

The scenario for the year 2026 has been provided as it represents the end of the period typically being considered for land use planning in the Burnett-Mary Region. While the scenario for the year 2070 is simply intended to describe the possible implications for coastal communities and infrastructure on an extended but realistic intergenerational time frame.

**2026 The Generation of Change Scenario**

Education programs and regular updates of climate change scenarios has kept the community informed of climate change impacts and associated risks, and increased acceptance of climate change initiatives particularly from a social and economic perspective.

Regional land use and infrastructure plans have included strategic level climate change adaptation strategies since 2010. Through improved understanding of roles and responsibilities, there have been a number of complimentary initiatives including funding and alignment of incentives to reduce risk associated with climate change.

While bushfires have become much more frequent and intense, the damage associated with bushfires has not increased accordingly. This can be attributed to the review of the bushfire risk analysis and the strong bushfire management guidelines and policies which were developed soon after bushfires were recognised as a climate change impact that was likely to have some of the first impacts in the region.

Design guidelines for all foundations and underground infrastructure have also been upgraded. Through discussion with local government representatives from other regions, it has been identified that these guidelines have been successful in reducing the impacts of soil slumping and increased soil salinity, both of which are generated by intense rainfall followed by extended dry periods.
Addressing Sea Level Rise

It was recognised that sea level rise, storm surge and coastal erosion, in general, would have a slower incremental impact on all infrastructure in the coastal zone. This allowed some time to develop strategic and local initiatives to address the potential for permanent or periodic flooding and loss of land. As a result, new development is tightly regulated based on the risk analysis that has been undertaken.

The risk analyses have also been used with environmental, social and economic considerations, to identify the actions that would be undertaken in different zones along the coast. Capacity to manage demands for infrastructure has improved significantly since coastal zoning was introduced. Tailored development guidelines and policy now supports local government approaches for those zones which are to be defended, those zones where adaptation of infrastructure is still possible, and avoidance of infrastructure in zones identified as areas where there would be retreat from sea level rise, storm surge and coastal erosion. The risk assessment process has provided an opportunity to develop and utilise a range of incentives and disincentives to promote relocation of residents and business.

As much of the coastline, including many locations which had existing defence systems, were already impacted by coastal erosion, action to defend the coast has not been as effective as expected. However, the initiatives using soft engineering have been found to be the most cost effective options. In addition to a greater capacity to prevent loss of land, these options have not contributed to the erosion issue by transfer impacts to other parts of the coastline which are not protected.

Water Supply

In 2010, future water shortages were identified as the highest short-term priority. As a result, a comprehensive assessment of the water supply, wastewater and stormwater systems was undertaken and new planning and policy was implemented based on the water budget that was developed. This approach made it possible to plan for the following eventualities:

- A general reduction of available water due to higher temperatures, reduced rainfall, longer dry periods including droughts, increasing evaporation, increased groundwater salinity and significantly reduced rainfall runoff;
- Capacity to obtain additional water through stormwater collection, sewer mining and a range of demand management options;
- Capacity to treat water from dams and reservoirs in the future as reduced flows, bushfires and other factors impact on water quality in these storages;
- Capacity to reduce flooding impacts due to more intense rainfall events;
- Capacity to manage the wastewater collection and treatment to address reduced flows and associated implications of increased salinity of wastewater and increased dry weather blockages;
- Protecting the natural attractiveness of the region by maintain environmental flows whilst also providing as much potable water as possible; and

The water budget approach has also improved capacity to argue with state government agencies regarding appropriate levels of population growth and sustainable management of the residential, tourism and recreation sectors.
**Stormwater Management**

While the impacts of flooding have increased, the extent of the flooding has been managed. After a review of the stormwater system was undertaken, the implications of changes in rainfall intensity and frequency were used to formulate risk mapping. This has been a very successful approach to addressing flood risks, particularly with respect to the cost of retrofitting stormwater infrastructure.

**Land Use**

The need to climate proof residential buildings, offices and similar structures has been recognised. As a result of local government advocacy, the Building Code of Australia has been adjusted to provide for separate climate zone areas across Australia. Much of new development now has design features which will improve thermal comfort during very hot summers and reduce the risk of damage from very large storm events. A range of strategies have also been implemented in order to improve the rate of retrofitting of existing buildings.

Once the flooding component of the integrated water study was completed, planning targeted a review and, where possible, upgrade of roads which provided emergency access to residential and tourist facilities. Most key access points have now been rebuilt or alternative access points have been identified. In all cases, design guidelines now required a level of redundancy to be built into road heights in order to reduce the risk of isolation from sea level rise, storm surge and flooding.

**Roads**

It is now council policy to limit development of new roads on coast unless they are located in low risk areas or built to withstand localised flooding and overtopping by storm surge.

**2070 Benefiting from Proactive Change Adaptation Scenario**

The risk evaluation used to target adaptation responses has proved to be extremely effective. It has now reached a level where public pressure has considerably eased for decision makers as the actual changes in climate variability have justified the hard decisions of 2010. The incorporation of the regional-level climate change adaptation strategies into the Federal level climate change strategies has also had significant advantages. Most importantly, it has improved access to sufficient funds to implement on-ground initiatives.

Proactive management of bushfire risks has been successful. Insurance companies have recognised this and premiums for bushfire related insurance are lower in this region than most others. The design guidelines for all foundations and underground infrastructure have also been a success. While some damage could not be avoided, there have been comparatively fewer insurance claims and litigation associated with underground infrastructure failure.

**Addressing Sea Level Rise**

Since the implementation of the zoning requirements, there has been a low level of impact on new infrastructure in the coastal margins. This highlights the effectiveness of the risk zoning and strong land use management.
Unfortunately, planning and policy initiatives for existing infrastructure have not been as successful. In nearly all cases, the flooding and erosion has impacted on development which was approved when land areas for development were limited and the risks of developing in flood plains and low-lying coastal areas had not been quantified. This has exposed local governments to large insurance and litigation claims. Fortunately, this risk was recognised and initiatives to buy back land or relocate the impacted coastal population have been occurring. While this forced council to develop new coastal nodes, the overall cost was lower than the costs of taking no action and the new nodes are sustainable, self contained centres in low risk locations.

**Water Supply**

Decentralised water supply, wastewater and stormwater systems are now becoming the norm. This has been a trade off, with the increased demands for asset management being balanced by reduced demand on the centralised systems and avoidance of some of the disruptions associated with impacts of flooding, soil slumping and pump failure due to overheating.

**Stormwater Management**

While the planning for the stormwater system was sufficient to 2026, it became apparent that, in some areas, impacts in highly developed residential areas were not preventable. The strategic “buy back” program has been reasonably successful in securing the houses at greatest risk.

Because of the early implementation of interventions, storms and severe winds are not causing the same rates of damage when compared to those regions where there has been limited action to address climate change.

Built in redundancy has been effective. Sea level rise exceeded expectations but reviews of the original planning had identified the potential for this to occur and contingency planning has been undertaken. No loss of life due to lost access during the cyclones over the last 5 years. Access was cut but emergency options worked to plan.
Scenario 2: Storm Surge and Land Use, Cadastre and Road Length

The following graphs illustrate potential impacts storm surge may have on landuse cadastre and length of road on the coastal margins over the 2026 to 2070 time period in the coastal margins of Fraser Coast Regional Council, Bundaberg Regional Council and Miriam Vale. While increases of impact are seen in the 2026 period, more significant impacts are projected in 2070.

Areas of concern are in Rosedale which may see over 60% increase in risk to storm surge by 2070; Craignish and Boonooroo Plains in Fraser Coast which may see a 90 and 70% increase of road length affected by storm surge. In Bundaberg, Yandaran sees the greatest percentage increase in road length affected by storm surge and while Avondale area may be more susceptible to general inundation.
6. Summing Up

Appreciating the Situation

- Sea level rise and coastal erosion will be a dominant issue along the coastal margin as they have a high potential for economic and social disruption.

- The implications of climate change are very broad and the potential interactions are environmentally, socially and economically complex. As a result, action to address climate change needs to be pursued from a broad, integrated perspective.

- In many cases, climate change adaptation will simply add additional priorities to planning

Liability and Litigation

Important questions arise when considering the projected impacts due to the culmination of climate change drivers and population pressures.

1) How do governments proactively consider climate change impacts when approving new development and subsequent litigation when impacts occur?

2) How do governments manage developers and home owners who will not support climate change caveats on current or new development?

It is apparent that every government agency needs to clearly articulate its desired outcomes in relation to managing climate change and to ensure that requirements to address climate change are reasonable and relevant. This approach will only be feasible if an appropriate, multifaceted risk assessment is undertaken and utilised to determine the nature and extent of options that are relevant to different land uses and infrastructure.

Arguably, there is a need to plan now to reduce risks, liability and the potential for litigation. As the life of buildings and supporting infrastructure is in most cases between 50 and 75 years; infrastructure and urban development that is approved now will still exist at the time when communities are likely to see more widespread impacts from sea level rise and storm surge.
For Further Consideration

- Develop and implement best practice guidelines.

- Obtain or develop a one metre Digital Elevation Model (DEM) in order to facilitate climate change impact and risk assessments.

- Follow ‘Key Principles for Responding to Climate Change’ identified by the New Zealand Climate Change Office, Victorian Government, and Australian Water Association, when developing and implementing climate change related projects and projects where climate change impacts can be expected.

- Develop processes and criteria to ensure that cross-sectoral issues are identified and considered when developing and implementing responses to climate change.

- Utilise the criteria for assessing the impact of climate change on council functions when making planning and policy decisions.

- Utilise checklists such as the ‘Checklist for Implementing Climate Change in Local Government Plans and Strategies’ by the New Zealand Climate Change Office, to review relevant local government plans and strategies.

- Implement appropriate processes at a regional level which will ensure that there is co-ordination and collaboration on climate change adaptation and mitigation initiatives across local governments in the region.

- In order to facilitate the development of local government climate change adaptation and mitigation initiatives, engage with key regional stakeholders such as the Burnett Mary Regional Group, the University of the Sunshine Coast and relevant State Government Agencies.

- Develop a multi-disciplinary climate change working group within each Council for the purpose of implementing these recommendations and the best practice guidelines. Representation on the team should address, as a minimum, finance, strategic land use planning, statutory land use planning, economic development, social planning, parks and recreation, water supply and waste water treatment and infrastructure planning and construction.

- Lobby the State Government to implement a joint initiative to evaluate the impacts of climate change and, based on the outcomes, develop complementary local and regional planning provisions and appropriately aligned infrastructure planning.

- Seek assistance to determine data requirements which would facilitate a climate change risk analysis and the determination of community resilience to climate change impacts.

- Investigate opportunities to engage with the community in order to determine their level of understanding of climate change implications, both locally and regionally, and their desired approaches to climate change adaptation.

- Facilitate the development of climate change education and awareness programs.
Annex A - Best Practice Guidelines

This guideline identifies best practice options for climate change adaptation which, from a planning and policy perspective, could be utilised to climate proof coastal communities and infrastructure. This guideline represents a strategic approach to the implementation of climate change initiatives. Essential strategic elements which should be addressed as a priority are identified in italics.

Strengthening the Enabling Environment

In order to facilitate the delivery of adaptation initiatives, it is essential that institutional arrangements are reviewed and, where necessary, developed in a way which will enable implementation of projects and programs. High priority options include:

- Development of regional climate change strategies utilising a risk management approach. The strategies should address statutory and non-statutory actions as well as funding arrangements.
- The regional climate change strategies should be incorporated into regional plans for growth, infrastructure and water resource management in order to ensure that, at Wide Bay, state and national levels, institutional arrangements and actions are aligned and complimentary.
- Climate change scenarios should be used to raise public awareness of the implications of climate change. Public consultation should then be undertaken in relation to identification and development of preferred risk reduction strategies.
- Annual reporting on climate change initiatives should be undertaken for all adaptation initiatives.

Decision Making Support

In order to implement adaptation initiatives, it is important to develop the relevant support tools for decision making. High priority options include:

- Selected staff should undertake professional development programs in order to increase their capacity to develop and implement adaptation initiatives.
- Scenarios need to be developed to identify, for both decision-making and public consultation, future changes in climate variability and the implications this may have for local government.
- Local actions and priorities to adapt to climate change will need to be determined using a comprehensive risk-based assessment process. This approach should consider the vulnerability and adaptive capacity of ecosystems and human systems when determining feasible and environmentally appropriate responses are decided.
- Infrastructure for water supply, wastewater and stormwater need to be reviewed and appropriate adaptation initiatives identified. Based on development of a water budget, integrated initiatives will be required to: provide future water
supply; protect future water sources; prepare for droughts and severe flooding; and, manage the risks resulting from selected management options.

**Mainstreaming**

For climate change adaptation to be effective, it must be reflected in all key planning instruments. This is essential if the full range of economic, social and environmental implications of climate change is to be addressed. High priority options include:

- Incorporate climate change scenarios into policy and decision-making processes, including strategic plans, planning schemes and other land use plans, annual reports and local environment plans.
- Build funding for climate change programs and projects into budgets and budget processes.
- Expand hazard mapping of coastal zones based on climate change
- Encourage cost effective adaptation to climate change through early planning and full lifecycle analysis of infrastructure. This should include options to facilitate the retrofitting of old infrastructure including funding.

**Implementation**

In addition to incorporating strategic approaches, it will be essential to ensure that appropriate on-ground outcomes are achieved. High priority options include:

- Manage residential, tourism and recreational activities in climate sensitive areas through zoning and regulation.
- Building hazard and risk management for climate change impacts into development approval processes.
- Determine a preferred approach in relation to managing existing infrastructure in climate sensitive areas (i.e. whether to defend, adapt or retreat)
- Limit growth expansion and/or connections to parts of infrastructure systems (i.e. stormwater and sewage systems) in climate sensitive areas.
- Review all design standards for buildings and infrastructure in order to reduce risk from increased climate variability. Key matters to address would include: extreme storms; increased flooding; increased storm surges and reduction of bushfire risk.

**Review**

Climate change adaptation requires the implementation of projects which are to address implications for the future. As a result, there is a need for periodic reviews of all planning and policy initiatives in order to ensure that optimum outcomes are being achieved. High priority options include:

- Reporting is built into all on climate change initiatives including performance indicators.
- There must be periodic review of climate change scenarios and projections.
A monitoring regime should be designed and implemented to track impacts of climate change and identify triggers for action.

**A Systematic Approach**

A systematic approach will be essential for developing and implementing these initiatives. It is recommended that local governments should utilise the IPCC recognised, Climate Change Adaptation through Integrated Risk Reduction (CCAIRR) management framework to develop a more comprehensive approach to implementing climate change adaptation initiatives.