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PLANNING FOR CLIMATE CHANGE BY QUEENSLAND COASTAL COUNCILS

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Abstract

The *Queensland Coastal Plan* requires councils to prepare coastal hazard adaptation plans for those parts of their urban areas at risk from a projected sea level rise of 80cm by 2100. This paper reviews adaptation actions in climate change strategies prepared by four urban Queensland coastal councils (e.g. Cairns, Gold Coast, Redland, and Sunshine Coast), and one community-based climate adaptation action plan for Bribie Island in Moreton Bay. The actions in these climate change plans are analysed for their adaptive response categories: *Emphasising Nature*, *Emphasising Development* and *Managed Nature* (Vasey-Ellis, 2009), along with *Council Governance* of climate change, and *Emphasising Communities.* Climate change planning and infrastructure responses by Queensland coastal councils mainly focus on protecting coastal development from erosion and other climate hazards, and building community resilience, supplemented by 'soft' environmental actions protecting nature. While some climate plans included actions for shoreline erosion, coastal inundation, and storm surges, only one addressed sea level rise impacts on buildings and heritage (i.e. Redland).

Introduction

Climate change adaptation and mitigation is now a key issue for local governments, especially coastal councils (Nursey-Bray, 2010; Vasey-Ellis, 2009). In Queensland, climate change impacts on coastal areas include the effects of tropical cyclones, storm surges, flooding, sea level rise (SLR), tidal inundation, and shoreline erosion. Recent news articles highlight planning issues, building codes, insurance risk, and the cost of impacts on coastal areas from tropical cyclones (Bita, 2011), state-wide flooding during summer 2010/2011 (*The Courier Mail,* 2011; Williams & Bita, 2011), and SLR impacts on Queensland's coast (Abel et al, 2011; Collins, 2011; Houghton, 2011; PIA, 2011; Williams, 2011). A projected SLR of 1.1m by 2100 will affect low-lying infrastructure and buildings in LGAs of coastal Queensland, mainly Brisbane, Gold Coast, Moreton Bay, Fraser Coast, Mackay, and Townsville (DCCEE, 2011a). The Local Government Association of Queensland established a Coastal Councils Adaptation Taskforce (C-CAT) in early 2011 to address this risk, with 16 coastal councils now members. There is also a Queensland representative on the National Coasts and Climate Change Council, the mayor of Bundaberg. The new *Queensland Coastal Plan* requires councils to prepare coastal hazard adaptation plans for those parts of their urban areas at risk, related to a projected SLR of 80cm by 2100, with related guidelines for coastal management, protection and hazards (DERM, 2011). The growing impacts of coastal development, climate change and sea level rise are key issues in Southeast

Queensland (Abel et al., 2011; Dedekorkut et. al., 2010; Wang et al., 2010). Moreover, *'...ongoing coastal development and population growth in areas such as Cairns and South East Queensland...are projected to exacerbate risks from sea level rise and increases in the severity and frequency of storms and coastal flooding by 2050'* (IPPC, 2007, cited in SCC, 2010, p. 13). Councils applying for state government grants for new infrastructure projects must address adaptation to minimise climate impacts (DIP, 2010). In planning for climate change, councils thus need to promote adaptive capacity which is *'the ability of built, natural, and human systems to accommodate changes in climate (including climate variability and climate extremes) with minimal potential damage or cost'* (SCC, 2010, p. 56). Council planning for Queensland coastal areas focuses on hazards and risk management, with new planning guidelines to assess risks to communities and a three to five year phase in of coastal hazard plans to allow councils time to prepare adaptation strategies (DERM, 2011).

Queensland coastal councils

There are 35 coastal councils in Queensland, covering half (47%) of all councils in the state. In total, there are 73 councils across Queensland (city, regional, shire, & Aboriginal shire); with a separate Weipa Town Authority managing this mining town on Cape York Peninsula. The coastal councils comprise four city councils (i.e. Brisbane, Gold Coast, Redland, & Townsville); 14 regional councils (i.e. Bundaberg, Cairns, Cassowary Coast, Fraser Coast, Gladstone, Gympie, Isaac, Mackay, Moreton Bay, Northern Peninsula Area, Rockhampton, Sunshine Coast, Torres Strait Island, & Whitsunday); eight shire councils (i.e. Aurukun, Burdekin, Burke, Carpentaria, Cook, Hinchinbrook, Mornington, & Torres); and nine Aboriginal shire councils (i.e. Hope Vale, Kowanyama, Lockhart River, Mapoon, Napranum, Palm Island, Porpmuraaw, Wujal Wujal, & Yarrabah). The coastal shire and Aboriginal shire councils are all located in North Queensland, Cape York and around the Gulf of Carpentaria. This paper focuses on coastal councils in South East Queensland, and the Cairns council.

Climate change impacts on Queensland coastal areas

Some 85% of Queensland's population lives on or near coastal areas, with 73% of Queensland's coastline comprising open sandy beaches (DERM, 2011). The coastal local government areas in South East Queensland (SEQ) are among the top ten areas at risk of inundation from flooding, sea level rise (SLR) and storm surges (Dedekorkut et al., 2010), with 245,000 people at risk of SLR impacts by 2030 (Wang et al., 2010). Over 70% of commercial buildings in SEQ are located within 5km of the shoreline; with the *SEQ Regional Plan 2009-2031* allowing for 502,000 more houses along the SEQ coast by 2031. Climate change impacts on Queensland's coastal areas include: more severe tropical cyclones (e.g. Cyclone Yasi, 2011 and Cyclone Larry, 2006); storm surges; flooding; sea level rise; coastal inundation (high tide/king tide/storm tide); beach/dune erosion; shoreline recession; and estuary instability. These climate impacts affect beaches, dunes and shorelines and cause damage to coastal buildings, roads, electricity, ports, airports, schools, hospitals, industrial sites, landfills, recreation areas, water and sewerage plants; and emergency facilities. The climate change impacts on coastal infrastructure from SLR and storm events include: structural damage and fatigue; accelerated degradation of foundations and materials; increased ground movement; groundwater changes; and flooding (DCCEE, 2009).

In coastal Queensland, up to 4,700km of roads, 570km of railways and 1,400 commercial buildings are at risk from SLR of 1.1m by 2100 (DCCEE, 2011a) (Table 1). Key Queensland airports are also located in vulnerable low-lying coastal areas prone to flooding, such as Brisbane, Cairns, and Coolangatta on the Gold Coast. With 0.8m SLR by 2100, the

Queensland Coastal Plan states 94,000 buildings will be partially inundated (with 10,650 buildings in Brisbane); while 65,000 properties will be affected by storm surge inundation. In SEQ, almost 9,000 homes are within 110m of erodible shoreline; 32,500 homes are exposed to a 2.5m storm tide; with 61,500 homes at risk from storm tides by 2030 (DERM, 2011). Queensland has the highest number of at risk residential buildings in Australia's coastal zone located within 55m (n=5,400) or 100m (n=15,200) of 'soft' coastlines. Between 48,300 and 67,700 houses, worth $15 to $20 billion, are at risk from SLR of 1.1m by 2100 (DCCEE, 2011b). Despite this high level of exposure and vulnerability to climate change impacts in Queensland (Bajracharya, Childs & Hastings, 2011), few coastal councils have completed a climate change risk assessment (i.e. Moreton Bay, Redland) or climate change plan.

Table 1. Buildings and infrastructure in coastal Queensland affected by sea level rise (1.1m by 2100)

Residential Buildings:
Moreton Bay/Sunshine Coast (1,850-2,250 buildings within 100m; 430-800 buildings within 55m); Mackay, Gold Coast, Fraser Coast, Bundaberg, Cairns

Commercial Buildings:
Gold Coast (n=166-243); Moreton Bay (n=155-226); Fraser Coast (n=167-213); Townsville (n=117-199); Mackay (n=95-193); Bundaberg, Sunshine Coast

Light Industrial Buildings:
Mackay (n=336-502); Moreton Bay (n=156-250); Brisbane (n=160-247); Gold Coast, Townsville, Bundaberg, Rockhampton, Fraser Coast, Sunshine Coast, Whitsunday

Roads:
Mackay and Fraser Coast (352-475km); Gold Coast (301-408km); Rockhampton (305-395km); Moreton Bay, Burdekin, Bundaberg, Townsville, Carpentaria, Sunshine Coast

Rail: Burdekin (78-104km); Mackay, Bundaberg, Rockhampton, Whitsunday (33-69km), Sunshine Coast, Townsville, Isaac, Cairns, Hinchinbrook

Source: *Climate Change Risks to Australia's Coast* (DCCEE, 2011a, b)

Climate change adaptation responses

This paper reviews adaptation actions in climate change strategies prepared by four urban Queensland coastal councils (e.g. Cairns, Gold Coast, Redland, & Sunshine Coast), and one community-based adaptation action plan for Bribie Island, *Climate Proofing Bribie* (Chapman, 2010). The actions in these plans are analysed for their adaptive response categories: *Emphasising Nature*, *Emphasising Development* and *Managed Nature* (Vasey-Ellis, 2009), along with *Council Governance* of climate change, and *Emphasising Communities.* The adaptation options in coastal planning include: Relocate and prevent development or unsustainable land use, Designate protected land, Create setback buffers, Create wetlands and revegetate vulnerable areas (*Emphasising Nature*); Private insurance for vulnerable properties, Developers accept full risk, Elevate buildings and change building codes, Build hard structures (*Emphasising Development);* and Beach nourishment, Build artificial reefs (*Managed Nature)* (Vasey-Ellis, 2009). The climate actions stated in climate change strategies for Cairns, Gold Coast, Redland, Sunshine Coast, and Bribie Island are analysed according to which main adaptation response category they best fit.

The category, *Emphasising Nature,* focuses on protecting the environment (e.g. beaches, dunes, habitat, park land, plants, waterways, and wildlife) to buffer the effects of climate change on nature and also to protect developed areas from climate hazards. The category, *Emphasising Development*, focuses on protecting the built environment through insurance,

building codes and engineering responses to limit damage to council, public and private property (i.e. assets, infrastructure, hazards, and risk). *Managed Nature* refers to 'natural' engineering options such as replacing beach sand by pumping or trucks. *Emphasising Community* refers to public access, consultation, engagement, health risks, or safety issues in regard to climate impacts. *Council Governance* refers to internal council processes for dealing with climate change issues through frameworks, leadership, policy, strategies, staff training, and reports. Climate impacts affect both communities and councils. Climate change planning and infrastructure responses by Queensland coastal councils mainly focus on protecting coastal development from erosion and other climate hazards, and building community resilience, supplemented by environmental actions protecting nature as a buffer.

Climate change strategies by Queensland coastal councils

Only five Queensland coastal councils have prepared climate change strategies or action plans, including Brisbane (BCC, 2007), Cairns (CRC, 2009, 2010), Gold Coast (GCCC, 2010), Redland (RCC, 2010), and Sunshine Coast (SCC, 2010). These climate change plans cover the main urban centres in SEQ and the far north Queensland coast, with these larger coastal councils also leaders in the Cities for Climate Protection program (Table 2). A climate change plan was in progress for Moreton Bay Regional Council, between Brisbane and the Sunshine Coast, with actions approved by council members in September 2011 for this plan. The Bribie Island community in the Moreton Bay council area has already developed their own climate adaptation plan with SEQ Catchments (Chapman, 2010). Three SEQ coastal councils have also prepared shoreline erosion management plans, a coastal dune policy, and beach nourishment programs for key beaches (Table 2). Only one inland Queensland council, the Southern Downs, had a climate change adaptation action plan.

Table 2. Climate change and coastal strategies by Queensland coastal councils

Brisbane City Council	*Brisbane's Plan for Action on Climate Change and Energy 2007*
Cairns Regional Council	*Climate Change Strategy 2010-2015* Beach protection/erosion control: Clifton Beach, Holloways Beach
Gold Coast City Council	*Climate Change Strategy 2009-2014* Gold Coast Shoreline Management Plan (2009); Ocean, Beaches and Foreshore Strategy (2012) Planning Scheme Policy 15: Management of Coastal Dune Areas; Northern Gold Coast Beach Protection Strategy; Kirra Beach Restoration Project; Tweed River Entrance Sand Bypassing Project; Beach nourishment: Southern Palm Beach, Burleigh Beach, southern GC beaches
Redland City Council	*Confronting our Climate Future: Climate and Energy Action Plan 2010-2015*
Sunshine Coast Council	*Climate Change and Peak Oil Strategy 2010-2020* *Waterways and Coastal Management Strategy 2011-2021* (Coastal Foreshores: 2 climate change actions-CF7 & CF8); Beach nourishment: Noosa Main Beach, Mooloolaba Beach; Beach protection/erosion control: Noosa Spit/Dog Beach.
SEQ Catchments (Moreton Bay RC)	*Climate Proofing Bribie: A Climate Adaptation Action Plan 2010* Shoreline Erosion Management Plan (Bribie Island, Southern Pumicestone Passage, Redcliffe, Woorim-Bribie Island); Beach nourishment: Woorim

The climate change action plan for Brisbane City focused on carbon mitigation and eco-efficiency measures (i.e. energy, water, waste, transport) and minimising negative impacts of climate change from storms, flooding and heatwaves. Adaptation strategies in the plan were amending the City Plan to reduce exposure to flooding and storm surges, and disaster management planning. The adaptation actions all related to risk management measures: *'Funding adaptation measures such as relocation of buildings and infrastructure from high*

risk areas as necessary' (Action 3c); *'Upgrade the Q100 flood level; Enhanced stormwater and flood-related infrastructure requirements'* (Action 13a)*; 'Require forward planning for Council assets, especially water supply, wastewater treatment plants, stormwater, roads and bridges'* (Action 22a)*; 'Establish flooding and storm surge response plans'* (Action 23a)*;* and *'Understanding sea level rise and storm surge impacts on Brisbane'* (Action 30a). Only two adaptation actions addressed coastal impacts in this Brisbane climate action plan. State planning policies on flooding still don't consider SLR or storm surge impacts (PIA, 2011). This paper now reviews adaptive actions in climate change strategies by four other urban coastal councils, Cairns, Gold Coast, Redland, and Sunshine Coast, and for Bribie Island.

The climate action plans for Bribie Island, Cairns, Gold Coast, Redland, and Sunshine Coast included strategies for climate change mitigation and adaptation, environmental protection and building community resilience to climate change (Table 3). Specific actions for adaptation were included in the strategies for Sunshine Coast (n=25) and Cairns (n=9). The Sunshine Coast adaptation actions were further divided between *Objective 5: Identify and plan for climate change risks* (n=14), and *Objective 6: Adapt to the impacts of climate change* (n=11). The climate strategies for Bribie Island, Gold Coast and Redland included a mix of both mitigation and adaptation actions in key areas, including the natural environment (i.e. biodiversity, shoreline, & water), planning and infrastructure (Bribie, Gold Coast) or development and council assets/services plus community safety and resilience (Redland). The Cairns strategy had a 'transition' section with nine actions about community resilience. Specific actions for council governance and leadership on climate change responses were included in strategies for Cairns, the Gold Coast, and Sunshine Coast. The Bribie Island plan included sections with community concerns about shoreline and emergency management. Other climate actions for mitigation and/or energy use in the Cairns, Redland and Sunshine Coast climate change strategies were not included in this analysis of adaptation responses.

Table 3. Adaptation actions in Queensland council climate change strategies

Climate Proofing Bribie: A Climate Adaptation Action Plan 2010*

Climate actions (n=71)

Biodiversity (n=23 actions); Planning and Infrastructure (n=22 actions), Shoreline Management (n=10 actions); Water (n=10 actions); Emergency Management (n=6 actions)

Cairns Regional Council Climate Change Strategy 2010-2015

Climate actions (n=36)

Adaptation: (9 actions), plus Transition (9 actions), Leadership (18 actions)

Gold Coast City Council Climate Change Strategy 2009-2014

Climate actions (n=35)

Governance and Leadership (17 actions), Research (5 actions), Infrastructure (5 actions), Advocacy and Awareness (4 actions), Planning and Regulation (4 actions)

Redland City Council Climate and Energy Action Plan 2010-2015

Climate and energy actions (n=98)

Council assets (n=25), development (n=19), resilient community (n=16), community safety (n=13), council services (n=12), natural environment (n=11), council performance (n=2)

Sunshine Coast Climate Change & Peak Oil Strategy 2010-2020

Climate actions (n=52)

Adaptation: (25 actions*),* plus Leadership (27 actions)

Objective 5: Identify and plan for climate change risks (n=14; 5 sub-actions in 5.4 land use)

Risks and vulnerabilities, land use planning, disaster planning and health, coastal management

Objective 6: Adapt to the impacts of climate change (n=11)

Natural landscape, water saving measures, council assets/infrastructure, adaptation opportunities

*Note: Moreton Bay Regional Council is responsible for implementing 85% of the 71 actions in the *Climate Proofing Bribie* plan

Adaptation response categories in Queensland council climate strategies

The relevant actions in the five climate change strategies were analysed according to which main adaptation response category they best matched. These included the three adaptation response categories employed by Vasey-Ellis (2009) to assess Victorian coastal planning: emphasising development, emphasising nature and managed nature, along with two other response categories, council governance and emphasising community, added by the author. This analysis highlighted the varied responses to climate adaptation actions by councils (Table 4). The Cairns, Sunshine Coast, and Gold Coast strategies focused on council governance to implement climate actions, along with actions emphasising nature to protect the environment, assets, and public areas. Emphasising nature was the main adaptation response in the community plan for Bribie Island (n=52, 73%), and council plan for Redland (n=48, 49%), by protecting the environment and facilities from adverse climate effects. Emphasising community was the second adaptation response category in the strategies for Redland, Bribie Island, and Cairns, with actions focused on community resilience and safety from climate hazards. There were only two actions for the response category, managed nature, with an artificial reef (Bribie Island) and controlling vegetation for fire management (Redland). The beach nourishment and sand replenishment at beaches on the Gold Coast, Sunshine Coast and in Cairns (see Table 2) were not mentioned as actions. Climate actions in the four council plans focused on protecting council, public and private property in at-risk coastal areas, along with mitigations actions to reduce council and community emissions, and insurance for council assets. This is due to the high level of coastal development and population growth in both SEQ and in Cairns, and council liability to reduce risk from climate impacts through planning and adaptation. Overall, in these five climate plans, the total actions by adaptation response categories were: emphasising nature (45.8%), council governance (25.3%), emphasising community (20.2%), and emphasising development (8.2%). The council plans had a key focus on governance actions (33% vs. 0 in Bribie plan).

Table 4. Adaptive responses in climate change plans by Queensland coastal councils

Adaptive Categories	Bribie Island	Cairns*	Gold Coast*	Sunshine Coast*	Redland*	Total Actions	Council Actions*
Emphasising Development	4	4	4	6	6	24 (8.2%)	20 (9%)
Emphasising Nature	**52**	8	7	**19**	**47**	133 (45.8%)	81 (37%)
Emphasising Community	14	9	5	8	23	59 (20.2%)	45 (20.3%)
Council Governance	0	**15**	**19**	**19**	21	74 (25.3%)	74 (33.4%)
Managed Nature	1	0	0	0	1	2 (0.6%)	1 (0.4%)
Total Actions	71	36	35	52	98	292	(221)

Coastal climate change adaptation actions were included in strategies for Bribie Island, Redland and the Sunshine Coast. The climate plan for Redland City included actions for sea level rise impacts and coastal inundation of beaches and foreshores (Table 5), to protect natural and built environments. Planning options, legislation, and costs were all considered for Redland assets and areas vulnerable to inundation by storm tide, flooding or sea level rise. Some 22 actions (out of 98) addressed coastal climate change impacts on Redland council assets and infrastructure including landfills; beaches/foreshores; and public open space. These coastal adaptation actions were for storm tides/surges/water (n=14), sea level rise (n=9), and coastal inundation (n=9). Coastal wetlands were listed as soft infrastructure.

Table 5. Redland City coastal adaptation actions for climate change impacts

Redland City Council Climate and Energy Action Plan 2010-2015
1. Emphasising Nature
Investigate options, develop strategies, costs and scenarios for defending or retreating from sea level rise impacts along foreshores and the coastline (Action 2a)
Determine location of at risk coastal and marine infrastructure (under future climate scenarios for storm tide/flooding and sea level rise) (Action 2a)
Complete storm tide hazard, sea level rise, flooding and inundation mapping of areas of the city not currently mapped (Action 7a)
Investigate planning options (including Redland Planning Scheme mechanisms) that reduce the impacts of sea level rise on existing development exposed to inundation risks (Action 7b)
Advocate the State Government regarding enabling legislation to provide Council with the mechanisms for land resumption or compensation in response to sea level rise predictions (Action 7d)
2. *Emphasising Community*
Developing community engagement mechanisms for planning responses to sea level rise along foreshores (Action 7b)
3. *Council Governance*
Complete the registering of existing stormwater infrastructure on the asset register (Action 2a)

Coastal adaptation actions in the Sunshine Coast climate change strategy addressed longer-term changes in sea level and temperatures and climatic extremes from storms, cyclones and floods. Responses included vulnerability and hazard mapping of major risk areas due to climate change along with coastal erosion and inundation impacts in coastal management. There was only one coastal adaptation action (of 15) in this strategy, *'Develop a coastal management strategy with shoreline erosion management plans where appropriate'* (SCC, 2010, p. 51). Storm surges are eroding popular Sunshine Coast beaches such as at Noosa. Coastal adaption actions in the Bribie Island plan also relate to shoreline management (n=9) due to erosion of beaches on both sides of the island. The actions address community involvement in preparing a shoreline erosion management plan, and other 'soft' options such as groundcover on dunes, protecting mangroves, education about dunes as a wave buffer, an artificial reef to protect beaches, and reducing impacts from boat wash and propellers. Climate planning needs to protect coastal ecosystems as a vital climate buffer and defence.

Conclusions

This paper reviewed adaptation actions in climate change strategies by four Queensland coastal councils, Cairns, Gold Coast, Redland, and Sunshine Coast, and for Bribie Island. The climate change strategies for Cairns, Gold Coast, and the Sunshine Coast mainly focused on council governance of climate actions, while adaptive actions emphasising nature were the main focus of the Bribie and Redland plans. The adaptive actions by the four urban coastal councils focused on emphasising nature (37%), council governance (33%), emphasising community (20%), and emphasising development (8%). Emphasising nature (64%) was also the main adaptive response of Victorian coastal councils (Vasey-Ellis, 2009). Queensland coastal councils adopted a mix of adaptive strategies similar to Victoria, but coastal climate hazards and actions were only considered in the Redland (n=22), and Bribie Island (n=9) plans. In Queensland, there is less protection of coastal ecosystems and liability laws favour developers with a lower priority for nature-based adaptation options and growing pressure for built defences to protect valuable coastal assets (Abel et al., 2011).

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