URBAN BEACH VENUES: VULNERABILITY AND SUSTAINABILITY IN THE FACE OF CLIMATE CHANGE

Dr Mike Raybould
Bond University, Australia
Dr David Anning
Griffith University, Australia
Dr Liz Fredline
Griffith University, Australia
Dan Ware
Griffith University, Australia

ABSTRACT

This paper investigates the threats to beach venues posed by climate change and attempts to identify strategies that might be adopted by coastal managers and event managers to ensure that beaches continue to be viable event and recreation venues into the future. Analysis of coastal management research, local council records and tender documents, maps and plans of coastal works identifies six specific strategies for minimising the impacts of climate change on beach venues. These strategies aim to protect existing beach venues, increase the supply of alternative venues, minimise the event tourism impacts of negative media coverage of beach erosion events, or encourage adaptive actions by event managers. The implications for event managers of each of these strategies are discussed.

KEYWORDS

Coastal Management; Event Venues; Climate Change

INTRODUCTION

Urban beaches provide a range of leisure services; as open space for unstructured and structured leisure and sport activities, as tourist attractions, and as venues for organised participant and spectator events. Urban beaches particularly provide much needed public space and event venues that are easily accessible to city populations and showcase the tourism and leisure assets that the city has to offer (Jimenez, Gracia, Valdemoro, Mendoza & Sanchez-Arcilla, 2011). There are already significant costs involved in maintaining beaches (AECOM, 2010) and these assets are predicted to come under increased threat from some of the physical processes associated with climate change (Department of Climate Change, 2009). Government agencies around the world are forced to weigh the social and economic benefits provided by beaches against the costs of providing usable beach space and climate change is likely to put greater pressure on those decisions. This paper investigates the threats to beach venues posed by climate change and

attempts to identify strategies that might be adopted by coastal managers and event managers to ensure that beaches continue to be viable event and recreation venues into the future.

Some of the biggest special events ever held, and certainly the biggest live music events, have been staged on urban beaches. In 2006 the Rolling Stones played to 1.5 million people on Copacabana Beach in Rio de Janeiro, Brazil. However, that is dwarfed by Rod Stewart's 1994 New Year's Eve concert on the same beach which was watched by a live audience of 3.5 million people (Rohter, 2006). When Sydney hosted the Olympic Games in 2000, Bondi Beach featured prominently as the venue for beach volleyball, as Copacabana Beach will for Rio in 2016. Images of these iconic venues are broadcast to over 3.5 billion viewers (International Olympic Committee [IOC], 2012) and serve to enhance the image of the destination for future post-event tourism. An important question is whether events that use the beach in such a manner will be possible by 2050. Predictions in a costal risk and hazard vulnerability study (Worley Parsons, 2011) suggest that significant proportions of Bondi Beach will be unusable by that date.

In Australia, 85 percent of the population live within 50 km of the coast (Australian Bureau of Statistics [ABS], 2004) and Ellison (2011) claimed that beaches comprise a significant element of Australia's national identity. Urban beaches such as Bondi, Cottesloe, St Kilda and Surfers Paradise have become recognised as iconic venues just as much as built venues like the Melbourne Cricket Ground (MCG) and Flemington Race Track. In Australia, just like Brazil, the coastal strip and urban beaches are often the focal point of special celebrations with an estimated 1.5 million people lining the shores of Sydney Harbour for New Year's Eve (New Year's celebrations, 2014). The quantity and quality of beach space available for recreation is subject to diurnal tide cycles, seasonal cycles of erosion and accretion, and long term processes caused by longshore movement of sand in response to variations in wave orientation (Short & Trembanis, 2004). This has long provided challenges for event managers attempting to use this public space. In addition, rising sea levels and changing weather patterns associated with climate change present a long term threat to the sustainability of this amenity in many areas of the world that requires a coordinated response by all levels of government (Antarctic Climate and Ecosystems Cooperative Research Centre [ACE CRC], 2008).

This paper starts by reviewing literature related to beach erosion and the threat that climate change poses to beaches. The paper then describes the generic coastal management adaption responses to climate change. The research phase of this paper is conducted through analysis of secondary data related to coastal management, including published works, research reports, local council records and tender documents, maps and plans of coastal works. It uses Australia's Gold Coast as a case study through which to explore the costs and benefits, and implications of various coastal management strategies. The research identifies six specific strategies for minimising the impacts of climate change on beach venues and the implications for event managers of each of these strategies are discussed.

LITERATURE REVIEW

Threats to beach venues and costs of maintenance

Beaches have all the inherent weather-related challenges of other outdoor venues for recreation and hosting of events. They also have a number of unique traits, given their position at the interface of the land, sea, water and aerial environments. Chief among these is the fact that the physical characteristics of the beach space change in terms of width, aspect and slope in response to tides, wave height and orientation, and the response of the ocean to climate phenomena with very long timescales, such as the Indian Ocean Dipole and the El Nino-Southern Oscillation (ENSO) index (Short & Trembanis, 2004). Thus, the usable area of the beach changes hourly, monthly, seasonally and over even longer cycles.

Special events might use any combination of the surf zone, the beach and the dune system for participants, spectators, event staging, transport and logistics. From a geophysical perspective each of these identifiable zones plays a role in transport and storage of sand in a dynamic system. This paper therefore adopts a definition of the beach as 'a system that extends seaward to the depth at which wave action ceases to impact on seabed sediments and landward to the practical limit of the beach/dune system formed by a vegetation line or built structure such as a wall' (Raybould, Anning, Ware & Lazarow, 2013, p. 20). As such, the beach system provides a variety of venue environments and staging opportunities to event managers stretching from the near-shore surf zone and swimming areas to the beach and back beach (Figure 1).

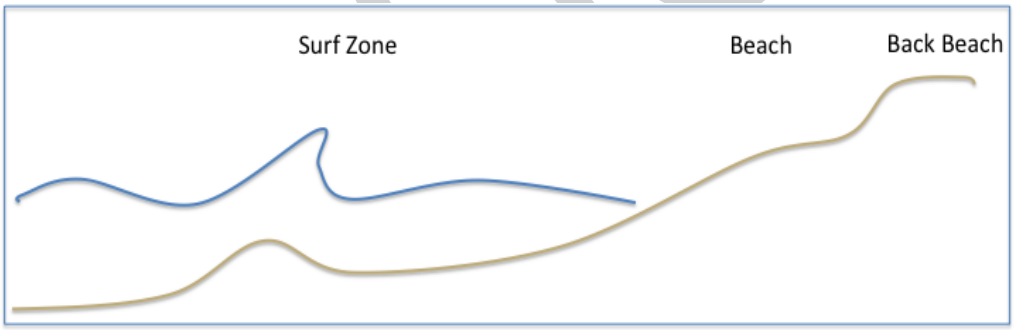

Figure 1: Beach zones and definitions

Key: Surf zone – from mean low water springs to the seaward extent of the breaking wave zone
Beach zone – from mean low water springs to the frontal dune
Back beach – landward of the frontal dune to the highest extent of unconsolidated sediment
Note: intertidal zone not shown but extends between mean low water springs and mean high water springs

Sandy beaches comprise about 20 per cent of the global coastline (Bird, 1993) and of these about 70 per cent are in retreat with only about 10 per cent accreting seaward (ACE ARC, 2008, p.12). The balance of erosion and accretion on sandy beaches depends on four factors: changes in frequency and magnitude of storms, changes in mean sea-level, changes in prevailing wave direction, and availability and size of sediment sources and sinks (Department of Climate Change, 2009)

The costs of maintaining beaches and providing beach related recreation services can be substantial for coastal councils. Typically councils must budget for repair and maintenance of beaches and dunes, beach cleaning, provision of lifeguard services, and maintenance and capital works to enhance the foreshore. For example, studies in Queensland, Australia, by Blackwell, Raybould and Lazarow (2013) found that the Gold Coast City Council spent AUD$20.05 million on beach and foreshore management in 2010-2011. This represented expenditure of almost AUD$40 per resident and was comparable with expenditure of almost AUD$35 per resident on the Sunshine Coast, a coastal region further to the north in Queensland. These expenditures are currently justified by the substantial tourism revenue associated with beaches in the regions but it is almost certain that these costs will increase as a result of hazards related to climate change (AECOM, 2010).

Beach recreation space: vulnerability and climate change

Climate change is expected to present a number of management challenges for sandy shorelines and these are summarised in Table 1.

Sea-level rise and shore-line recession

Whilst the erosion impacts of large storms are substantial and visible, they are part of a natural cycle of erosion and accretion. A serious and unidirectional threat to the long-term survival or persistence of sandy beaches comes from a rise in sea levels, which causes shoreline recession, and also exacerbates inundation issues associated with existing storm erosion events, through raising the original or standing water level. This has the effect of greatly increasing the frequency of flooding events (Geoscience Australia, 2013), even on hard coastlines which do not experience shoreline recession. The Department of Climate Change (2009) estimated that a 10 cm rise in sea level would result in flooding events that currently occur once a year increasing in frequency to at least twice a year and in some places four to six times a year. Importantly, the relationship between sea level rise and the frequency of inundation events that will reduce the utility of public beaches is non-linear. With a 50cm rise in sea levels the frequency of a flooding event that currently occurs once a year will increase in places to at least 100 times a year and in some places 1,000 or 10,000 times a year (ACE CRC, 2008).

The Bruun rule provides a rule-of-thumb for estimating the response of 'soft' shorelines to a rise in sea levels, with recession of the shoreline typically in the order of 50-100 times the vertical sea-level rise (Bruun, 1962). The Fifth Assessment Report (AR5) from the Intergovernmental Panel on Climate Change (IPCC, 2013) predicts that under the 'business as usual' emissions scenario, sea levels will rise by between 52cm and 98cm, with a mean of 74cm, by 2081-2100 (p. 1182). Applying Bruun's rule, a rise of 74cm would be expected to result in recession of beaches by between 37 and 74 metres.

Shoreline recession of the scale predicted by IPCC (2013) and ACE CRC (2008) may mean a total loss of beaches in some areas, and is a real threat to tourist destinations which rely upon beach visitation as a major drawcard (Jones & Phillips, 2007). The Gold Coast is a prime example, with recent surveys finding that 74% of visitors identified beach-going as the top activity (Tourism Research Australia, 2013).

Table 1: Direct and indirect climate change impacts on beaches

Climate change (driver)	Principal direct physical and ecosystem effects	Potential secondary and indirect impacts
Sea-level rise	Increased inundation of coastal zone	Disruption of coastal economy, tourism impacts
	Increased coastal erosion	Displacement of residents in impacted areas
	Increased risk of flooding and storm damage	Damage to coastal infrastructure
	Saline intrusion into surface and groundwater	Health impacts associated with water quality changes
Altered wave climate	Increased wave run-up	Enhanced erosion
	Altered erosion and accretion balance	
Storm frequency and intensity changes	Increased wave heights, run-up and storm surge	Increased storm damage
	Poleward shifts in cyclone and hurricane storm tracks	
Ocean acidification	Impacts on reef-building corals	Reduced storm protection function, less resilient and functional reefs

(Adapted from Aboudha & Woodroffe, 2006)

Storm damage

Around the world storms have threatened the integrity of heavily used urban beaches and, as described above, this will be exacerbated by rises in sea level. The problems and costs of storm damage to beaches are particularly well documented on the east coast of the USA (Houston, 2002; 2013). By the mid-1990s, Trembanis, Pilkey and Valverde (1999) estimated that the United States was already spending US$100-150million per annum on sand nourishment to maintain beaches. Many of the beaches on the east coast of Australia have also been shown to be vulnerable to storm damage (Department of Climate Change, 2009). On open coastlines, storm erosion can result in very large differences in the spatial extent of a beach in a relatively short period. An example of the magnitude of this change in beach width is shown in Figures 2a and b, which are taken from a fixed location above Collaroy-Narrabeen beach, on the northern beaches of Sydney, Australia.

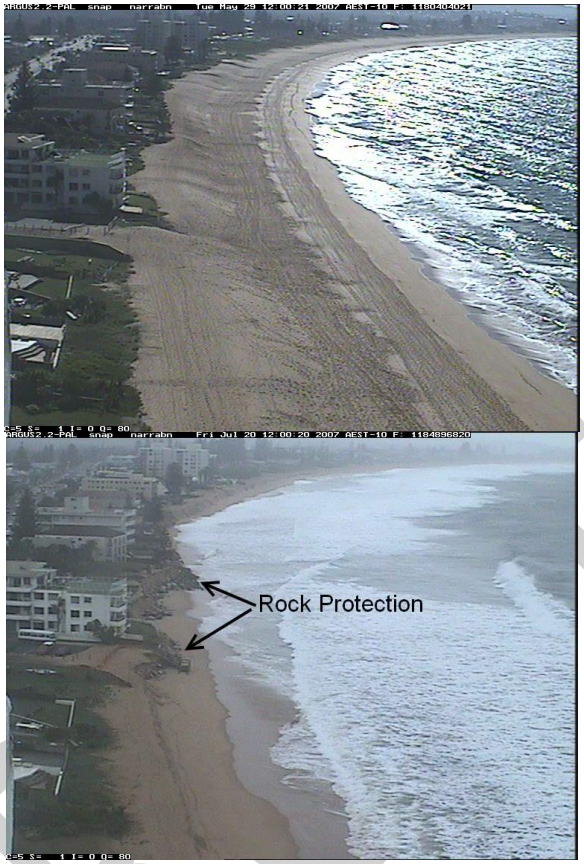

Figure 2(a): Wide beach at Collaroy. **Image taken at 12pm, May 29, 2007.Figure 2(b):** Narrow beach at Collaroy. Image taken at 12pm, July 20, 2007.
Rock protection clearly exposed. (Source: Water Research Laboratory [WRL], 2007).

The images in Figure 2(a) were taken at the same time of day and at approximately the same time in the tidal cycle. Although the images were taken only 10 weeks apart, it can be seen that the beach width differs markedly. This variability in supply of beach recreation space presents challenges for event planners trying to estimate how much space will be available for a future event. The costs of repairing storm damage to beaches can be high but the economic incentive of hosting major events and the need to provide an adequate venue, have sometimes been the catalyst for repair projects. In 2013 Sunshine Coast Regional Council commenced a AUD$2m beach replenishment project at Maroochydore beach designed to nourish the beach with over 200,000 m^3 of sand and increase the beach width to 40 meters (Sunshine Coast Council, 2014). This project was justified, in part at least, by the need to ensure adequate beach width for events and particularly the National Surf Titles to be held on the beach in 2016 (Atkinson, 2011; Bruinsma, 2014).

Generic coastal management adaptation responses to climate change

Coastal communities around the world are considering the options available to them for responding to the impacts of climate change (IPCC, 2013). A number of generic adaptation options for management of coastal locations and assets have been identified and these are summarised in Table 2. There are three classes of responses; those which seek to defend or protect the existing at-risk assets, those that relocate the assets to a less risky location, and those that attempt to adapt them to reduce their sensitivity to the risk. These are termed the Protect, Retreat and Accommodate options (IPCC, 2013).

Retreat options involve abandoning land and structures in vulnerable areas and relocating or rebuilding infrastructure landward of threat lines to allow the beach to respond naturally to erosion events. While this may be viable in relatively undeveloped areas, it is likely to be an unattractive option in developed areas where the costs of removing infrastructure and buildings outweigh the alternative strategies. For example, on the Gold Coast, Australia, there are over 2,300 residential buildings within 50m of the mapped shoreline (Department of Climate Change, 2009), that is, within the recession distance predicted by the Bruun Rule in the absence of any consolidation or terminal structure. There are also a large number of non-residential buildings and infrastructure at risk on the Gold Coast due to projected climate change impacts. Whilst asset replacement values are not available, the upper level SLR projections would see impacts on a total of 243 commercial buildings, approximately 250 light industrial buildings and up to 408 kilometres of roads within the Gold Coast local government area (Department of Climate Change and Energy Efficiency, 2011, p16).

Protection strategies involve engineering responses which may be hard structures or beach nourishment combined with dune stabilisation programs. Engineered seawalls provide excellent protection for property that lies behind them but do nothing to protect the beach and can actually increase scouring of the beach through greater wave reflection (Johnathan, Russell & Huntley, 2001). Offshore breakwaters and artificial reefs can reduce the erosion hazard due to large storms, but cannot offset recession due to sea-level rise. Groynes can increase the width of the beach by capturing sand in places with significant longshore drift, but are expensive to construct and change the visual appearance and recreation amenity of the beach. Thus, hard engineering strategies have limited value in maintaining sustainable beach venues for recreation or events.

In some locations soft engineering responses and activities designed to accommodate climate change impacts are likely to be the most financially viable and practical options for maintaining beach venues and are the focus of this research.

Table 2: Adaptation responses to climate change impacts

Coastal Adaptation Strategy (IPCC, 2013)	Specific examples		Implications for beaches as recreation and event venues
Protect Protection of vulnerable areas especially, population centres, economic activities and natural resources	Hard protection	Offshore breakwater Groynes	More secure for land-based activities, less appealing for water-based activities and may be less visually appealing
		Artificial reefs	Implications for wave riding may be positive or negative depending on design. Potential positive implications for fishing and diving
		Seawall	Greater security for events held in adjacent parkland, potential reduction in beach width due to scouring. Visual impacts if exposed, access dependent upon design
	Soft protection	Nourishment Dune rehabilitation	Increased security for land-based events, neutral or positive for visual amenity and maintenance of water-based attractions
Retreat Abandonment of lands and structures in vulnerable areas and resettlement of inhabitants	Planning controls to restrict development within the hazard zone		Possible negative impacts in reduction in accessibility and built services such as toilets, showers and BBQs
	Planning controls to require removal of structures based on proximity to hazard		Maintenance of natural coastal processes and recreation environments
Accommodate Continued occupancy and use of vulnerable areas	Hazard management	Monitoring	Limited direct impact
		Emergency response and planning	Limited direct impact
		Land-use changes	May influence accessibility and visual amenity
		Insurance	May influence the levy for flood insurance
		Revegetation	Positive implications for visual amenity and maintaining natural process which may enhance wave riding
	Structural	Building guidelines	Limited direct impact – may improve/maintain aesthetics
		Drainage	Reduced stormwater erosion impacts on beaches

METHOD

This research aimed to identify the threats to beach venues posed by climate change and to review the strategies available to coastal managers and event managers to minimise the impacts of climate change on beach venues and events that use them. The research was conducted through a largely qualitative analysis of secondary data related to coastal management, including published academic papers, research reports, local council records and tender documents, maps and plans of coastal works. It uses Australia's Gold Coast as a case study through which to explore the costs and benefits, and implications of various coastal management strategies.

Case Study: Beach events in destination development on the Gold Coast

Gold Coast City is located in South East Queensland on Australia's east coast and is widely recognised as Australia's premier beach destination. The residential population of just over 500,000 is swelled each year by approximately 4.3 million overnight visitors, with about 20 per cent of them coming from overseas, and an additional 6.8 million day visitors (TEQ, 2014a and 2014b). The tourism industry in the region is responsible for over 35,000 full-time equivalent jobs and approximately 16 per cent of gross regional product (Business Gold Coast, 2012).

The key natural attraction in the region is the 52 kilometres of sandy beaches (Tourism Research Australia, 2013.). However, this coastline has a long history of beach erosion and climate change is likely to exacerbate this problem (Department of Climate Change, 2009). Local and state governments in this area have committed substantial resources to preserving beach amenity for local and tourist recreation use (Blackwell et al., 2013). In addition to the natural attractions, the Gold Coast has built a reputation around theme parks, nightlife, and special events. Events have played a critical part in positioning the Gold Coast as a tourist destination. In the post-war period of the 1950s the legendary 'Pyjama Parties', run by Bernie Elsey on the beach (Russell & Faulkner, 1999), set the tone for the Gold Coast as the party capital, a theme that is still dominant in marketing the modern Gold Coast.

A review of event calendars for the Gold Coast shows how important the beach is as a venue or backdrop for special events. Table 3 provides some examples of current events on the Gold Coast and attempts to classify them in terms of scale and how each of them uses the beach.

Table 3: Examples of major events hosted on Gold Coast beaches in 2014/15

	Role of the beach		
Scale	Events held on the beach with the beach and / or surf as the main theme	Events held on the beach with the beach as open space and some other theme	Events held off the beach but with the beach as a significant backdrop and providing visual appeal
Major events: National or International attractions	• Quiksilver Pro and Roxy Pro • Coolangatta Gold • 2015 Australian Surf Lifesaving Championships • Australian Sand Sculpting Championships	• Swell Sculpture Festival • Bleach Festival • Opera on the Beach • Schoolies Week entertainment	• GC 600 (Previously Indy Car GP). • Broadbeach Blues Festival • Gold Coast Airport Marathon • Opera in the Park • Cooly Rocks On
Local events: Primarily local or intrastate attraction	• 2014 Queensland Surf Lifesaving Championships • Beach Bash Gold Coast • Burleigh Ocean Swim • Cooly Classic Ocean Swim • Queensland Beach Volleyball Tour • Netfest Beach Netball Tournament • Various SLSQ sanctioned events e.g. Ocean Roar IRB Premiership Series	• Carols on the Beach • New Year's Eve Fireworks • Surfers Paradise Festival – Launch It Beach Concert • Private weddings	• Broadbeach Christmas Carols • Beachside Markets

Source: Visit Gold Coast (2014); TEQ (2014); Surfers Paradise Gold Coast (2014).

The region hosts a number of major events for which the beach and / or the surf are the venue and main themes. The annual Quicksilver and Roxy Pro surfing events are Association of Surfing Professionals (ASP) World Championship Tour events which claim to have attracted 52,000 spectators in 2011 (Dixon, 2012). The iconic Coolangatta Gold endurance event celebrated 30 years in 2014 and the Australian Surf Lifesaving Championships celebrated 100 years at its return to the Gold Coast in 2015 (Surf Lifesaving Australia, 2014). The latter event is one of the most lucrative on the Gold Coast event calendar and was expected to attract around 11,000 competitors plus supporters, and to inject over A$25 million in to the local economy over 9 days of competition (Calligeros, 2012).

A range of other events, which do not have a direct beach or surf theme, use Gold Coast beaches as venues and this underscores the importance of beaches as urban public space. Events in this category include the Bleach Festival, a 17 day celebration of music and art featuring Opera on the Beach, which claims to attract 63,000 visitors (Bleach Festival, 2014); seasonal community celebrations such as Carols on the Beach and New Year's Eve fireworks; entertainment and activities related to the 'Schoolies' festival, an end of school celebration for graduating high school students; and regular music concerts (Visit Gold Coast, 2014). Even when the beach is not directly used as the space for the event it frequently forms an important backdrop for spectators and media coverage such as that seen during the Gold Coast 600 motor racing event (and between 1991 and 2008 the Indy Car Grand Prix) and the Gold Coast Marathon, and it is likely to be featured prominently during the Gold Coast's hosting of the Commonwealth Games in 2018.

RESULTS

Management strategies for minimising climate change impacts on beach venues

Analysis of coastal management literature, research reports, local council records and tender documents, maps and plans of coastal works reveals six key strategies available to coastal managers and event managers to minimise the impacts of climate change on beach venues. Coastal management strategies seek to either, protect and preserve existing beach venues, or to offer alternative venues with similar characteristics. Event management strategies highlight the need to adapt and have contingency plans to deal with reduced quantity and quality of beach space. These options are summarised in Table 4 and each is discussed in detail in this section.

Increase resilience of existing beach venues

Two 'soft engineering' techniques are commonly used to increase beach width and resilience to storms. Beach nourishment involves increasing the volume of sand in the beach system and the width of the beach by importing sand from other sources (Gold Coast City Council, n.d.). Beach scraping also aims to speed up natural recovery and reduce beach recession by moving sand from the intertidal zone to the back-beach or dune system with excavators and may be used independently or in conjunction with beach nourishment (Carley et al., 2010). Both techniques can be used to increase the carrying capacity of the beach for events and general recreation and reduce the negative impacts associated with congestion (Chapman & Hanneman, 2011). They also increase the resilience of the beach to storm damage, thereby providing greater assurance for event managers that the venue will provide adequate space for their needs. The effectiveness of beach nourishment strategies can also be enhanced by constructing offshore reefs to dissipate wave energy. Detailed designs for this strategy are currently being tested for implementation at Palm Beach on the Gold Coast (City of Gold Coast, 2014a).

Beach nourishment is relatively expensive and constrained by the availability of sand deposits. Substantial beach nourishment projects have been conducted in Miami, Florida (Houston, 2002) and on the Gold Coast (Gold Coast City Council, n.d.) since the 1970's to repair storm damage. However, given the scale of shoreline recession predicted to occur as a result of climate change induced sea-level rise (ACE CRC, 2008) and challenges associated with the availability and cost of application of sand (AECOM, 2010), this approach is likely to be economically justifiable in the longer term only at the most heavily visited beach locations with a large supply of cheap and local sand, such as the Gold Coast.

During the 1970s and 1980s Miami Beach, Florida, was renourished at a total cost of US$52 million but Houston (2002, p. 10) argued that the expenditure was easily justified by the US$2.4 billion annual revenue foreign tourists spent in the city - about 50 times the initial capital investment every year – and that foreign tourists visiting Miami Beach pay more in local and state taxes each year than the Federal Government spends nationally on beach nourishment projects. Houston (2013, p. 6) estimated that for every US$1 spent on beach nourishment Miami Beach received almost US$1,800 in foreign exchange.

Table 4: Management strategies for minimising climate change impacts on beach venues

Basic Strategy	Actions / Examples	Key benefits
Increase resilience of existing beach venues	• Beach nourishment and grooming / shaping. • Off-shore controls to reduce erosion.	• Maximises the usable beach space • Improves access for people and equipment • Minimises beach losses during storm events.
Increase surf and back-beach recreation space	• Construction of offshore reefs (for surfing events). • Park development – green areas behind the beach.	• Provides buffer to erosion • Increases supply of recreation amenity (i.e. surf breaks) - reduces congestion • Provides event and recreation space close to the beach.
Increase supply of alternative recreation sites	• Provide facilities and promote alternative water / open-space recreation environments, e.g. lakes, rivers, dams, etc.	• Provides alternative event venues with similar characteristics • Select locations which are climate-resilient • Reduces congestion on eroded urban beaches
Increase accessibility of substitute beaches	• Improve access to remote beaches or beach areas with difficult access. • Provide ramps, stairs, more parking - manage environmental impacts	• Reduces congestion on heavily used urban beaches • Opens up alternative beach venues
Communication strategies	• Communication plans to provide accurate information about beach conditions and expected repair rates after erosion events • Tourism communication strategies to counter negative media coverage of erosion	• Enables event managers to plan for changed conditions • Minimise losses in event attendance and tourism visitation caused by negative media coverage

Event selection and adaptation	• Plan events that are relatively insensitive to changes in beach conditions • Use beaches, or parts of the beach, where there is ample off-beach space for spectators and logistics	• Reduces the operational risks to the event if the beach is eroded

In locations where there is substantial annual tourism revenue and infrastructure to protect expenditures on beach nourishment may be justified through cost-benefit analysis. Raybould and Mules (1999) performed a cost-benefit study of a proposed beach management program for the Gold Coast which required large scale beach nourishment and the construction of an artificial reef (Figure 3) made out of very large geotextile containers (sand bags). The benefits of the project were estimated as avoided losses of tourism revenues resulting from major erosion events. The analysis revealed a benefit to cost ratio of at least 17 to 1, using relatively conservative factors in the analysis (Raybould & Mules, 1999).

Recent erosion events have again focused attention on repair options for Gold Coast beaches and two recent studies have attempted to provide economic evaluations of beach nourishment works. Cooper and Lemckert (2012) estimated the cost of nourishing Gold Coast beaches to offset shoreline recession due to a 1m rise in sea-level by the year 2100 to be AUD$11 million. However, this estimate seems conservative compared to recent estimates by Gold Coast City Council (2013) that it would cost AUS$20 million dollars to protect beach amenity in the region for only 30 years. Raybould and Anning (2014) conducted analysis of this proposed AUS$20 million beach nourishment project for northern and central Gold Coast beaches. Based only on avoided loss of recreation and tourism values they estimated benefit-cost ratios of 3.82 for the project at a 5 per cent discount rate.

Figure 3: Narrowneck artificial reef, northern Gold Coast, Australia
(Source: City of Gold Coast, 2012)

Increase surf and back-beach recreation space

It is possible to increase recreation amenity values of already heavily used beaches through provision of coastal walkways and parks and open space behind the beach. In some locations (e.g. Manly beach in Sydney) this open space actually receives greater visitation than the sandy beach itself (David Boardman, Chief Lifeguard Services Manly Council, personal communication, 2009). In this model of coastal resource management, the beach may actually become a sacrificial buffer zone rather than the focal point of recreation. In a similar way off-shore surf amenity can be increased by construction of artificial surf reefs which can serve a double purpose as control points for erosion (Couriel & Carley, 2010).

On the Gold Coast, beaches such as Broadbeach, Burleigh and Coolangatta have extensive parklands at the back of the beach which have been enhanced with facilities to provide public space for recreation and events. However, in Surfers Paradise, where private ownership of land and early development came right up to the beach-side Esplanade road, providing additional recreation space behind the beach was not an option. As an alternative the Gold Coast City Council commissioned the Surfers Paradise Foreshore Development Project in 2011. The design brief called for a project that would provide '…a high quality foreshore environment and multiuse precinct that caters for a range of recreational activities and events' (Gold Coast City Council, 2011, p.5). The $25 million project links the restaurant and nightclub precinct of Cavil Avenue with the beach and provides a 20m wide pedestrian promenade and bikeway; terraces, stairs and ramps leading to the beach; beach volleyball courts with seating and night lighting; and grassed areas with picnic facilities and barbecues for families (Place Design Group, 2014). The project has enhanced this area's value as an event venue and tourism attraction with the new precinct hosting regular music concerts, beach volleyball competitions, and night markets three nights a week (Major Events-Surfers Paradise, 2014).

Increase supply of alternative recreation sites

Lakes, rivers, and estuary beaches provide alternatives to ocean beaches as locations for water-based recreation and it is likely that they would be acceptable substitute venues for some events, although some of the benefits of urban beaches relating to easy access would be lost for more remote venues. There is also potential for the transferred recreation activity to increase the social and environmental impacts on the substitute sites, which previously were not subject to the same pressures (Chapman and Hanemann, 2007). There are a number of good examples of projects designed to increase the number and capacity of alternative recreation sites in the Gold Coast region using available inland tidal waterways and artificial reservoirs in the hinterland. Sites in the sheltered inland Broadwater at Jabiru Island, Paradise Point, Labrador and Southport have been developed to provide substitutes for ocean beach recreation and feature netted swimming enclosures or swimming lagoons, landscaped parklands and beach-type facilities (City of Gold Coast, n.d.). While these sites are not perfect substitutes (they don't provide amenities for surfers), they do fulfil people's desire to recreate near water and many would argue provide a safer recreation experience, more suited to young families, than the ocean beaches.

The largest of the Broadwater developments is the Southport Broadwater Parklands (Figure 4) that are being constructed on a combination of existing open space and reclaimed land using sand from navigational dredging and nearby residential canal estates. The design objectives for this project specifically called for an events space that could accommodate major events such as the Gold Coast Marathon, Pan Pacific Masters Games and the 2018 Commonwealth Games (Healthy Waterways, 2011). In addition to multi-use space there are playgrounds, a children's water park, and a large netted swimming enclosure. The first stage of the redevelopment cost

AUD$32 million, including AUD$10 million in land reclamation, and was completed in 2009. The second stage was completed in 2010 and cost a further AUD$8 million (Healthy Waterways, 2011). Stage 3 includes further land reclamation and redevelopment of the aquatic centre in time for the Commonwealth Games, to be held on the Gold Coast in 2018. It has an estimated cost of AUD$10.5 million (City of Gold Coast, 2014b).

Water features in the Gold Coast hinterland have also been developed for recreation and event space in recent years. The Hinze Dam Visitor Centre and Parkland was completed in 2012, at a cost of AUD$2.8 million ("Hinze Dam visitor centre opens", 2012). This site provides an educational centre, café, car parking, landscaped parklands and picnic areas. It will be one of the locations for the Commonwealth Games in 2018 and is being considered as a venue for music concerts and other events (Potts, 2014).

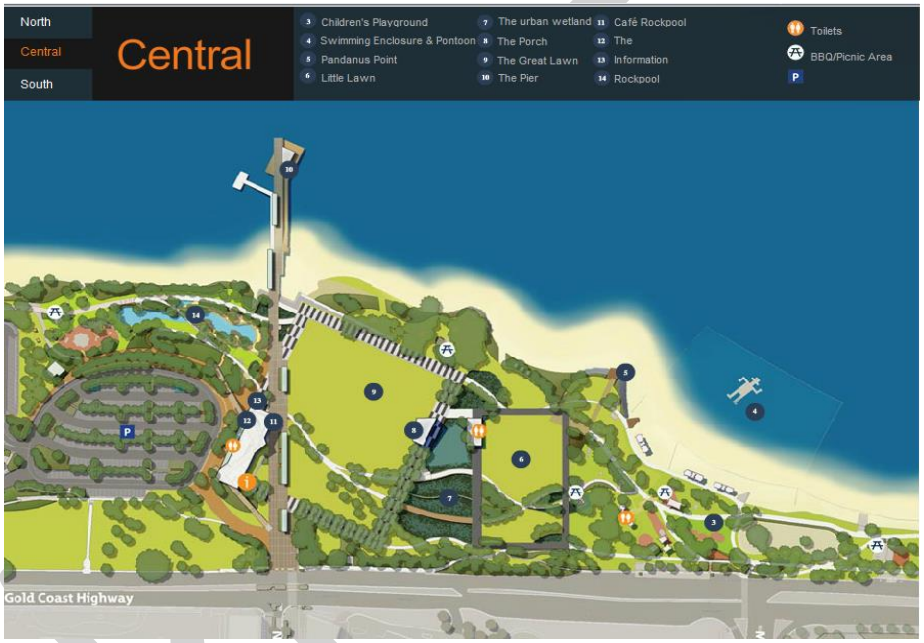

Figure 4: Broadwater Parklands (Central).
(Source: City of Gold Coast, 2013)

Increase accessibility of substitute beaches

Raybould et al. (2013) found that road access, parking and lifeguard services were critical factors in beach selection for most users but in some popular beach destinations in Australia these may be very limited outside the main metropolitan areas. Improving access and services at alternative beach locations would reduce congestion at existing locations and spread the risk associated with climate change impacts, as the alternative sites are likely to display different vulnerabilities and sensitivities. On the other hand, existing users of these alternative beach locations are probably attracted by the more natural beach setting and increased development and visitation may result in reduced utility for this group.

Communication strategies

Two stakeholder groups might benefit from effective communication strategies: event planners and event attendees. Event planners need information about expected beach conditions for the event. They are not coastal managers or engineers so they need this information from

professionals. They might also need advice about how the event could be adapted in the event of reduced beach space (or changed conditions e.g. changed positon of surf bars, gutters, and rips) and engineering solutions to cope with reduced space or reduced access. Beach management agencies should recognise event planners as stakeholders and effective communication channels should be established between the two groups. Representation of beach management agencies on regional tourism organisations (RTO) or event planning committees might contribute to this.
Potential event visitors need accurate information about beach conditions and how this will affect the experience. Australian residents and visitors to the Australian coast are conditioned by previous experience and marketing material to expect a high quality of amenity each time they visit the beach. This provides challenges when the conditions do not meet expectations, resulting in negative perceptions of their beach recreation experience. Expectations of permanent access or high quality beach environments can be moderated by public information and education (Moyle & Croy, 2009).

Raybould et al. (2013) found there was a high level of acceptance among both tourists and residents of beach erosion as a natural part of the dynamics of the coastal environment, particularly in the more remote or natural beach locations (e.g. Augusta, Minnie Waters). This parallels with findings in Sydney, where the visitor responses to beach erosion were moderated by the erosion history of the location, and a visitor's previous experience with beach erosion (Anning, 2012). These findings suggest that there is potential to influence visitor's expectations and attitudes related to the beach destination or venue and, thereby, to moderate the economic impacts of beach erosion events by providing factual information about the current and future state of the beaches and other coastal resources. This could take the form of a Beach Status Report, similar in content to the snow reports issued by mountain resort destinations. It could contain such things as beach width, height of erosion scarps or sand cliffs, and the best time of the day or best location to visit on each day.

Event selection and adaptation
Event managers must plan how they will use the space available to them. One adaptive measure to deal with the linear nature of the beach as a venue is to match this with events or activities that encourage movement along the shoreline and are unaffected by decreased beach widths. Many coastal jurisdictions in Australia are now hosting sculpture festivals that are spread along coastal walkways. Examples can be seen in the Sculpture by the Sea (Sculpture by the Sea , n.d) festival hosted by Waverley Council in Sydney, which began in 1996 and takes place along the coastal walk between iconic Bondi Beach and Tamarama. Companion events now take place in Cottesloe, Western Australia, and Aarhus, Denmark, and similar events occur in other locations, including the Swell Sculpture Festival on the southern Gold Coast. Accessibility and parking are also challenges for the use of the beach as an event venue, and ones that will become more serious as the beach itself narrows. Given that the beach is bordered on one side by the ocean and the landward side is often backed by private or public infrastructure, reaching the event venue can prove challenging, particularly for those with limited mobility. Alternative transport options may help to resolve parking problems.

CONCLUSIONS

This paper discusses some of the issues surrounding the sustainability of beaches as event venues. In destinations, popular because of their beautiful beaches, the hosting of events on the beach has helped to reinforce the destination image. It also provides a unique selling point for the event which many destinations are unable to offer. Beaches have always been vulnerable to impact from tides, storm activities and other natural processes as well as additional damage

associated with human activity. Recent research though has shown that human activity on the planet is increasing average temperature and contributing to climate change. This change will be associated with rising sea levels which will exacerbate the problems for beach venues.
The paper has identified six key strategies that might be employed to minimise the climate change impacts on beach venues. One of the most attractive options is to restore and increase resilience of popular beaches with programs such as beach nourishment. These programs are expensive but the expenditure can be justified on beaches which attract substantial tourism revenues to the region.

Another strategy outlined in the paper, which is particularly suitable for events which do not require the water per se, is to make greater use of the recreational space provided by the back-beach and foreshore. These areas can be more easily site hardened and developed to provide amenities and facilities that augment the event experience. The beach itself still provides a highly attractive backdrop for the event. Substitute recreation sites such as lakes, rivers and less popular beaches in more remote locations may also provide an alternative venue for events; however, they lack the appeal of iconic beaches, often have fewer facilities and may be associated with transport difficulties. Finally the paper discussed the importance of communication between coastal managers and engineers and the event community including event managers and consumers. There is evidence to suggest that consumers are tolerant of changing beach conditions if they are informed and understand that it is a natural process.

In conclusion, the beach is an attractive recreation space and it is therefore unsurprising that event organisers have sought to use it as a venue. Climate change will intensify the natural changes which beaches experience and may contribute to them becoming less reliable venues. However, there are strategies, as outlined in this paper, which can be employed and help to ensure that beaches can continue to be used as event venues into the future.

REFERENCES

Aboudha, P. A., & Woodroffe, C. D. (2006). *International assessments of the vulnerability of the coastal zone to climate change, including an Australian perspective*. Australian Greenhouse Office, Department of Environment and Heritage..

AECOM. (2010). *Beach sand nourishment scoping study: Maintaining Sydney's beach amenity against climate change sea level rise*. Report prepared for Sydney Coastal Councils Group Inc. Retrieved September 15, 2014, from http://www.sydneycoastalcouncils. com.au/sites/default/files/beachsandnourishmentscopingstudy.pdf

Australian Bureau of Statistics (ABS). (2004). *Year Book Australia, 2004* (cat. no.1301.0). Canberra, Australia: Australian Bureau of Statistics.

Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC). (2008). *Position analysis: Climate change, sea-level rise and extreme events: impacts and adaptation issues.* Retrieved September 10, 2014, from http://www.acecrc.org.au/access/repository/ resource/6a319168-bba3-102e-bf5a-4040d04b55e4/PA01_SLR_FIN_090828.pdf

Anning, D. B. (2012). *Estimation of the economic importance of beaches in Sydney, Australia, and implications for management* (Doctoral dissertation), University of New South Wales, Sydney. Available from http://www.unsworks.unsw.edu.au/primo_library/

Atkinson, B. (2011, November 16*).* Green light expected for Maroochy sandpumping. *ABC News*. Retrieved September 22, 2014, from http://www.abc.net.au/news/2011-11-16/green-light-expected-for-maroochy-sand-pumping/3674054

Bird, E.C.F. (1993). *Submerging Coasts: The Effects of a Rising Sea Level on Coastal Environments*. Chichester, UK: Wiley.

Blackwell, B., Raybould, M., & Lazarow, N. (2013). Beaches as Tourism Assets: Is There Public Underinvestment in their Conservation? In C. A. Tisdell (Ed.), *Handbook of tourism economics: Analysis, new applications and case studies* (pp. 443-467). London: World Scientific Books.

Bleach Festival. (2014). *Bleach Festival*. Retrieved September 23, 2014, from http://bleachfestival.com.au/

Bruinsma, R. (2014, June 20). Aussie surf titles to be bonanza for the coast. *Sunshine Coast Daily*. Retrieved September 24, 2014, from http://www.sunshinecoastdaily.com.au/news/aussie-surf-titles-to-bebonanzaforcoast/2298402/

Bruun, P. (1962). Sea-level rise as a cause of shore erosion. *Journal of Waterways and Harbours Division,* 88**,** 117-130.

Business Gold Coast. (2012). *Tourism industry fact sheet*. Retrieved Septermber 18, 2014, from http://businessgc.com.au/index.php?page=tourism

Calligeros, M. (2012, June 18). Surf lifesaving titles moved after three deaths. *Brisbane Times*. Retrieved September 17, 2014, from http://www.brisbanetimes.com.au/queensland/surf-lifesaving-titles-moved-after-three-deaths-20120618-20irm.html

Carley, J.T, Shand, T. D., Coghlan, I. R., Blacka, M. J., Cox, R. J., Littman, A., Fitzgibbon, B., McLean, G., & Watson, P. (2010). *Beach scraping as a coastal management option.* Paper delivered at the 19th NSW Coastal Conference, Batemans Bay, 10-12 Nov 2010. Retieved September 25, 2014, from http://www.coastalconference.com/2010/papers2010

Chapman, D.J. & Hanneman, W. M. (2001). Environmental damages in court: The American Trader Case. In A, Heyes (ed.) *The Law and Economics of the Environment.* (pp. 319-367). Cheltenham, UK: Edward Elgar.

City of Gold Coast. (n.d.). *Parks and recreation*. Retrieved September 27, 2014, from http://gcparks.com.au/Park-finder.aspx

City of Gold Coast. (2012). *Northern Gold Coast beach protection strategy*. Retrieved October 7, 2014, from http://www.goldcoast.qld.gov.au/northern-gold-coast-beach-protection-strategy-6044.html

City of Gold Coast. (2013). *Broadwater Parklands Map (Central)*. Retrieved September 25, 2014, from http://gcparks.com.au/map.swf

City of Gold Coast. (2014a). Palm Beach Shoreline Project: Project Update, May 2014. Retrieved January 27, 2015, from http://www.goldcoast.qld.gov.au/documents/bf/pbsp-project-update-may-2014.pdf

City of Gold Coast. (2014b). *Broadwater Parklands Stage 3*. Retrieved September 25, 2014, from http://www.goldcoast.qld.gov.au/thegoldcoast/broadwater-parklands-stage-3-19737.html

Cooper, J.A.G., & Lemckert, C. (2012). Extreme sea-level rise and adaptation options for coastal resort cities: A qualitative assessment from the Gold Coast, Australia. *Ocean & Coastal Management, 64*: 1–14.

Couriel, E., & Carley, J. (2010). *Surfing reefs – Dollars and Sense*. Paper presented at the 7th International Surfing Reef Symposium, Sydney, March 11, 2010.

Department of Climate Change. (2009). *Climate Change Risks to Australia's Coast. A First Pass National Assessment.* Canberra, Australia: Australian Government.

Department of Climate Change and Energy Effciency. (2011). *Climate Change Risks to Coastal Buildings and Infrastructure. A Supplement to the First Pass National Assessment.* Canberra, Australia: Australian Government.

Dixon, G. (2012). *Quiksilver and Roxy Pro Event Guide*. Retrieved September 25, 2014, from http://www.roxypro.com.au/2012/eventguide.fr.html

Ellison, L. (2011). Flagging spaces: exploring representations of ownership on the Australian beach. *Ejournalist, 11*(1), 14-28.

Geoscience Australia. (2013). *OzCoasts: Australian Online Coastal Information*. Retrieved September 26, 2014, from http://www.ozcoasts.gov.au/climate/sd_fqa.jsp

Gold Coast City Council. (n.d.). *Gold Coast beach nourishment*. Retrieved October 8, 2014, from http://www.goldcoast.qld.gov.au/documents/bf/fs-gc-beach-nourishment.pdf

Gold Coast City Council. (2011). *Surfers Paradise Foreshore Redevelopment - Project Brief Extract*. Gold Coast City Council. Retrieved September 25, 2014, from ftp://homebu8.lnk. telstra.net/BWC/PROJECTS/

Gold Coast City Council (2013). *Three-point plan for coastal protection*. Retrieved September 23, 2014, from http://www.goldcoast.qld.gov.au/three-point-plan-for-coastal-protection-document-17454.html

Healthy Waterways. (2011). *Broadwater Parklands.* Retrieved September 27, 2014, from http://waterbydesign.com.au/broadwater-parklands/

Hinze Dam visitor Centre opens. (2012, March 15). *Australian Design Review*. Retrieved September 28, 2014, from http://www.australiandesignreview.com/news/18175-hinze-dam-visitor-centre-opens

Houston, J. R. (2002). The Economic Value of Beaches: A 2002 Update. *Shore and Beach*, 70(1), 9-12.

Houston, J. R. (2013). The Economic Value of Beaches: A 2013 Update. *Shore and Beach*, 81(1), 3-10.

International Olympic Committee (IOC). (2012). Marketing report: London 2012. Lausanne: International Olympic Committee.

Intergovernmental Panel on Climate Change [IPCC]. (2013). *Climate Change 2013: The Physical Science Basis.* Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK: Cambridge University Press. doi:10.1017/CBO9781107415324.

Jimenez, J.A., Gracia, V., Valdemoro, H. I., Mendoza, E. T., & Sanchez-Arcilla, A. (2011). Managing erosion-induced problems in NW Mediterranean urban beaches. *Ocean and Coatal Management, 54*(12), 907-918. doi:10.1016/j.ocecoaman.2011.05.003

Johnathan, R.M., Russell, P.E. & Huntley, D.A. (2001). Field measurements of sediment dynamics in front of a seawall. *Journal of Coastal Research*, 17, 195-206.

Jones, A. & Philips, M. (2007). Tourism resorts closed for business? Climate change, erosion threats and coastal tourism: Future choices for sustaining coastal tourism destinations. *CAUTHE 2007: Tourism: Past Achievements, Future Challenges.* Sydney, Australia: Council for Australian University Tourism and Hospitality Education

Major Events - Surfers Paradise. (2014). *Calendar of events*. Retrieved September 26, 2014, from http://www.surfersparadise.com/whats-on/major-events

Moyle, B. D., & Croy, W. G. (2009). Media in the previsit stage of the tourist experience: Port Campbell National Park. *Tourism Analysis, 14*(2), 199-208.

New Year's celebrations. (2014, January 1). New Year's celebrations: Australia ushers in 2014 with dazzling fireworks. *ABC News*. Retrieved September 27, 2014, from http://www.abc.net.au/ news /2014-01-01/australia-ushers-in-2014-with-dazzling-fireworks/5180426

Potts, A. (2014, September 25). Hinze Dam site could be turned into a concert and events precinct. *Gold Coast Bulletin*. Retrieved September 24, 2014, from http://www.goldcoastbulletin.com.au/news/hinze-dam-site-could-be-turned-into-a-concert-and-events-precinct/story-fnj94j0t-1227069582731

Place Design Group. (2014, May 26). Surfers Paradise foreshore redevelopment. *World Landscape Architecture.* Retrieved September 18, 2014, from http://worldlandscapearchitect.com/surfers-paradise-foreshore-redevelopment-surfers-paradise-australia-place-design-group/

Raybould, M., & Anning, D. (2014). *Cost-benefit assessment of major nourishment components of the City of Gold Coast Three-Point Plan for Coastal Protection*. Report prepared for Gold Coast City Council.

Raybould, M., Anning, D., Ware, D. & Lazarow, N. (2013). *Beach and surf tourism and recreation in Australia: Vulnerability and adaptation*. FRDC Research Report # 2010/536. ISBN: 978-0-646-90467-2

Raybould, M. & Mules, T. (1999). A cost-benefit study of Australia's Gold Coast beaches. *Tourism Economics, 5*(2), 121-139.

Rohter, L. (2006, February 19). The Stones Rock 1.5 Million in Rio Days Before Carnival. *New York Times*. Retrieved September 25, 2014, from http://www.nytimes.com/2006/02/19/international/americas/19stones

Russell, R. & Faulkner, B. (1999). Movers and shakers: Chaos makers in tourism development. *Tourism Management, 20*(4), 411-423.

Sculpture by the Sea. (n.d.) *Sculpture by the Sea*. Retrieved September 28, 2014, from http://www.sculpturebythesea.com/Home.aspx

Short, A. D. & Trembanis, A. C. (2004). Decadal scale patterns in beach oscillation and rotation Narrabeen Beach, Australia: Time Series, PCA and Wavelet Analysis. *Journal of Coastal Research,* 20**,** 523-532.

Sunshine Coast Council. (2014). *Maroochydore sand renourishment*. Retrieved September 26, 2014, from http://www.sunshinecoast.qld.gov.au/sitePage.cfm?code=maroochy-sand

Surf Lifesaving Australia. (2014). *The 'Aussies'*. Retrieved September 24, 2014, from https://sls.com.au/aussies

Surfers Paradise Gold Coast. (2014). *What's on*. Retrieved October 7, 2014, from http://www.surfersparadise.com/whats-on

Tourism and Events Queensland (TEQ). (2014). *Event Calendar*. Retrieved September 27, 2014, from http://teq.queensland.com/Events

Tourism and Events Queensland (TEQ). (2014a). *Gold Coast Social Indicators 2013*. Retrieved September 16, 2014, from http://teq.queensland.com/Research-and-Insights/Domestic-Research/Regional-Summaries/Gold-Coast

Tourism and Events Queensland (TEQ). (2014b). *Gold Coast Regional Snapshot December 2013.* Retrieved September 16, 2014, from http://teq.queensland.com/Research-and-Insights/Domestic-Research/Regional-Summaries/Gold-Coast

Tourism Research Australia. (2013). *Gold Coast Visitor Profile and Satisfaction Report, November 2013*. Retrieved September 20, 2014, from http://www.tra.gov.au/documents/vps/

Trembanis, A., Pilkey, O., & Valverde, H. (1999). Comparison of beach nourishment along the U.S. Atlantic, Great Lakes, Gulf of Mexico, and New England Shorelines. *Coastal Management*, 27, 329-340

Visit Gold Coast. (2014). *Event calendar*. Retrieved September 22, 2014, from http://www.visitgoldcoast.com/whatson/

Water Research Laboratory [WRL]. (2007). Image archive. Retrieved September 22, 2014, from http://ci.wrl.unsw.edu.au/current-projects/narrabeen-collaroy-beach/image-archive/

Worley Parsons. (2011). Waverly Council Coastal Risks and Hazards Vulnerability Study. Report to Waverly Council. Retrieved January 27, 2015, from http://www.waverley.nsw.gov.au/__data/assets/pdf_file/0009/42786/Waverley_Council_Coastal_Risks_and_Hazards_Vulnerability_Study_Part_1.pdf

AUTHOR CONTACT DETAILS
Mike Raybould
Bond University, Australia
mraybould@bond.edu.au

David Anning
Griffith University, Australia
d.anning@griffith.edu.au

Liz Fredline
Griffith University, Australia
l.fredline@griffith.edu.au

Dan Ware
Griffith University, Australia
d.ware@griffith.edu.au

JOURNAL CONTACT DETAILS
Special Edition Editors
Popi Sotiriadou
Griffith University, Australia
p.sotiriadou@griffith.edu.au

Brad Hill
Griffith University, Australia
brad.hill@griffith.edu.au

Executive Editor
Charles Arcodia
c.arcodia@griffith.edu.au

IJEMR Website
www.ijemr.org

The *International Journal of Event Management Research*
is a double-blind, peer reviewed journal.

ISSN 1838-0681