

# **Coastal Communities and the Currents of Vulnerability**

**A novel approach to Australian sea level rise adaptation research**

Maximilian Maddison

Supervisor: David Schlosberg

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## **Declaration**

This is to certify that the content of this research is substantially my own, and where any part of this work is not my own, I have indicated this by acknowledging the source of that part or those parts of the work.

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## **Abstract**

Sea levels are rising at an unprecedented rate. Using a novel approach in Australian sea level rise (SLR) adaptation research, this Honours thesis uses three case studies in New South Wales - Botany Bay, Lake Macquarie and Collaroy-Narrabeen - to consider the broad threat of rising sea levels to coastal communities. First, document analysis of current sea level rise adaptation plans shows that each local council perceives “adaptation as resilience”, prioritising the exposure of the built-environment over human vulnerability. However, using socio-spatial mapping highlights the inadequacy of current approaches, which by neglecting the currents of social vulnerability create incomplete perceptions of risk. Evidence of potential climate disadvantage – the simultaneous threat of ecological exposure and social vulnerability – in both Botany Bay and Lake Macquarie, is augmented by the identification of a vulnerable sub-population in Collaroy-Narrabeen. These findings underline the inadequacy of each councils’ risk-based adaptation policies. Last, the community-based research used in this dissertation demonstrates three clear benefits: (1) enabling community members to assign the factors that contribute to their own vulnerability; (2) highlighting social factors integral to individual and community vulnerability; and (3) including the voices of marginalised residents excluded from current decision-making processes. The research concludes by recommending that risk-management approaches adopt social vulnerability assessments to ensure existing disadvantage isn’t compounded by rising sea levels or adaptation planning.

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## **Abbreviations**

ABS – Australian Bureau of Statistics

CCAP – Climate Change Adaptation Plan

CZMP – Coastal Zone Management Plan

DCCEE - Department of Climate Change and Energy Efficiency

IPCC - Intergovernmental Panel on Climate Change

IRSAD – The Index of Relative Socioeconomic Advantage and Disadvantage

LGA – Local Government Area

LMCC – Lake Macquarie City Council

MJA – Marsden Jacob Associates

NCCAP - National Climate Change Action Plan

NSW - New South Wales

SEIFA – Socio-Economic Indexes for Areas

SLR – Sea level rise

SLRAP – Sea-level rise adaptation plan

WMO – World Meteorological Organisation

## **Introduction**

### **Research Problem**

The threat of rising sea levels to coastal communities is globally evident. Recent data compiled by the World Meteorological Organisation (WMO) revealed that ice sheets in Antarctica and Greenland were melting faster than ever before, while rising sea levels and intense tropical storms had already contributed to humanitarian and economic catastrophes in the Bahamas and Mozambique (WMO, 2019). The Intergovernmental Panel on Climate Change (IPCC) projects that sea levels will continue to rise, up to 40 cm by 2050 and up to 90 cm by 2100. However, the IPCC defines this range as “medium-confidence”; the actual rise could be much higher, dependent on whether the Arctic and Antarctic glaciers melt and, if so, when (El-Zein, 2019). Combined with the increased frequency and intensity of extreme weather events that will accompany rising sea levels, the complexion of coastal communities globally will change dramatically. In Australia, 85 percent of the population lives within 50 km of the coast and coastal regions hold significant economic, social, environmental and cultural value for the entire Australian populace (Clark and Johnston, 2016). Evidently, Australia is precariously placed to feel the brunt of rising sea levels.

Resultantly, many nations, communities and individuals have begun adapting to the inevitable impacts of rising sea levels. The way in which societies adapt will determine whether future coastal communities have the necessary tools to deal with the manifold socio-environmental problems that will emerge from rising sea levels. However, current governmental approaches to climate change adaptation, particularly in relation to sea level rise (SLR), apply limited risk-based assessments of the potential impacts (Collins, 2016).

Approaching SLR adaptation from this narrow understanding of adaptation is problematic for two reasons: (1) risk-based assessments tend to focus on biophysical concerns - i.e. built infrastructure, ignoring vulnerability factors that positively or negatively enhance an individual's ability to prepare, recover and respond to external stressors; and (2) the narrow scope ignores the wider social implications that contribute to the well-being of people and communities. The failure of councils to consider these issues risks compounding existing disadvantage within Australian society.

The research questions that emerge from the observations above involve two related investigations. The primary line of investigation considers whether socio-spatial mapping can identify socially vulnerable residents; while the second line of inquiry asks whether local councils' SLR adaptation plans (SLRAPs) are responsive to vulnerable community members' concerns.

This Honours research attempts to address the above by incorporating a novel methodology within SLR research to assess case studies focusing on New South Wales (NSW), Australia. The research is broken into three components. First, document analysis enables assessment of each council's current adaptation plan. Second, the construction of socio-spatial maps illustrates uneven geographies of social vulnerability, enabling identification of potential climate disadvantage. Last, community-based questionnaires move away from top-down, elite-driven research towards a community-based "bottom-up" planning model that provides residents with a forum to voice their concerns.

## **Research Findings and Significance**

The contribution and findings emerging from this research have significant ramifications for climate change adaptation within Australia at the local council level. By utilising socio-spatial mapping, a novel approach within Australia SLR research that integrates ecological and socioeconomic data, the uneven geographies of social vulnerability become clear. For example, the demonstration in this thesis of potential climate disadvantage in Botany Bay and Lake Macquarie underlines the inadequacy of the narrow, risk-based assessments currently applied by local governments. Moreover, while potential climate disadvantage isn't evident in Collaroy-Narrabeen, the existence of a socially vulnerable sub-population demonstrates the necessity of using socio-spatial mapping to identify and recognise the uneven geographies of social vulnerability that exist within Australian coastal communities. In addition, the additional findings of this research highlight community desire for greater recognition and inclusion of disadvantaged residents, demonstrating that communities support the implementation of transformational adaptation policy. The use of socio-spatial mapping methodology to effectively identify residents facing climate disadvantage, combined with the ease of construction, provides councils with an inexpensive tool that can identify vulnerable residents, ensuring existing disadvantage isn't compounded by rising sea levels and adaptation policy.

The research offers one major original contribution to the literature and three additional findings.

### ***Major finding & original contribution - Identification of climate disadvantage in Australia***

This Honours research is the first in Australia to use socio-spatial mapping to identify climate disadvantage related to potential sea-level rise (SLR). While this methodology has gained

prominence globally, particularly in flood-disaster literature from the United Kingdom (UK) (see Lindley et al., 2011), it has remained unused in Australian SLR adaptation literature. It is therefore not surprising that evidence of high exposure to rising sea levels and high social vulnerability within Lake Macquarie and Botany Bay points to a failure of current risk-management approaches to adaptation at the local government level.

Even within Collaroy-Narrabeen, an area of high affluence and minimal social vulnerability, socio-spatial maps identified a subpopulation with high social vulnerability, potentially a point of concern during future SLR-related extreme weather events. This unprecedented use of socio-spatial mapping within Australian SLR research highlights the effectiveness of the methodology and provides local governments with a simple, efficient and inexpensive tool for incorporating social vulnerability concerns in wider SLR adaptation frameworks.

#### ***Additional finding - First analysis of multiple Australian local councils SLRAPs***

At the time of writing, this Honours research is also the first Australian analysis of multiple sea-level rise adaptation plans (SLRAPs). The findings of this research highlight that each local council conceived adaptation as “resilience”, revealing that coastal councils prioritise retaining the same basic societal structure. While Collins (2016) assessed Australian council’s climate change adaptation plans (CCAPs) more broadly, evidence that coastal councils perceive sea-level rise adaptation as “resilience” demonstrate the importance of undertaking analysing these areas separately. These findings, which contradict Collins’ assertion that the majority of Australian CCAPs could be categorised as adaptation as “transition”, reveal that councils’ SLRAPs aim to protect the status quo, the result of political dynamics arising from economic and population growth and rising coastal property prices.

The literature demonstrates that approaching adaptation in this way, focusing on biophysical concerns rather than including marginalised groups, enables unsustainable or socially unjust practices to persist (Pelling, 2011).

***Additional finding - First Australian assessment of local councils' sea-level rise adaptation engagement strategies***

Using questionnaire responses across three case studies provided insight into whether local councils' engagement strategies were effective in ensuring community members were aware of, and involved in, SLR adaptation decision-making processes. The results overwhelmingly demonstrated that current strategies are ineffective in engaging residents, with only 12% aware of their local council's SLRAP. Moreover, almost three-quarters of participants said they wanted a greater voice in future SLR decision-making processes. Combined, these results point to procedural inauthenticity, inadequacy or insufficiency in current participatory processes, emphasising the need to incorporate more deliberative forms of engagement into NSW coastal governance mandates.

***Additional finding - First NSW research assessing multiple communities' considerations of "fair" adaptation***

The assessment of community perceptions of "fair" adaptation across multiple locations was the first research of its kind within NSW. Similar research, undertaken by Graham et al. (2015), assessed local residents' perceptions of distributive and procedural fairness across five coastal towns in Victoria. Extending this research into NSW provides greater insight into the desires of communities regarding future SLR adaptation policies and processes. The evidence of procedural issues within current engagement strategies demonstrates the importance of community-based research, giving residents a forum to articulate their concerns. Moreover, questionnaire results supported Schlosberg et al.'s (2017) finding that

a discursive disconnect exists between risk-focused governments and transformational-minded residents concerned with human vulnerability.



## **Chapter 1 Literature Review**

This chapter has two purposes: (1) a review of the current risk-management and vulnerability literature; and (2) outlining a gap in the literature that emerges at the intersection between adaptation planning, social vulnerability and socio-spatial mapping.

### **1.1 Risk-management**

Risk-management frameworks are a common feature of leading climate change adaptation frameworks both in Australia and overseas (European Commission European Commission and European Environmental Agency (2013). Recognised as a framework for long-term climate change adaptation plans under conditions of uncertainty (Jones and Preston, 2011; Jones, 2014), risk-based approaches to adaptation policy have been prevalent across all three levels of Australian government – Federal, State and local – since 2007 (Waller and Barnett, 2015; Productivity Commission, 2012)

Predominantly, risk-based approaches to SLR adaptation are oriented towards the risk of rising sea levels to the built and natural environments (Department of Climate Change, 2009). Guided by “technical rational” models, a likelihood-consequence scale is applied (Standards Australia, 2009). Each technical-rational model has common characteristics: setting policy objectives; ensuring information on cause and effect is sufficient and available; and identifying and implementing optimal problem-solving options (Head and Alford, 2008).

### ***1.1.1 Risk management approaches in Australia***

As mentioned above, risk-management approaches to adaptation have been prevalent across Australia since 2004. Reviewing the CCAPs of Australian local governments, Collins (2016, v) demonstrates that the majority of local councils prioritised biophysical concerns (i.e. built infrastructure) over socio-political factors such as marginalised community members. Ramm (2018, 31) identified six Australian coastal adaptation case studies that focused either on maximising monetary benefits or minimising projected costs. Consequently, local councils approach adaptation planning through a resource-metric frame, which attempts to conceive the risk of SLR entirely in gross economic value (Department of Climate Change, 2009; Productivity Commission, 2012). For example, the Department of Climate Change (2009, 17) calculated that the social value of Gold Coast beaches to the local community was equivalent to the value of tourism: \$106-\$319 million.

### ***1.1.2 Issues in risk-management approaches***

Despite their wide usage in Australian climate change adaptation planning, considerable doubt remains as to the efficacy and equity of purely technocratic approaches. Pelling (2003) asserts that traditional risk assessments downplay political, economic and social forces in the rush to provide policy makers with clear recommendations. Breaking down unquantifiable vulnerability factors into three components (exposure, resistance and resilience) enables Pelling (2003, 48) to demonstrate how conventional risk assessments prioritise exposure at the expense of other factors, minimising risks to the societal status quo.

Minimising the risk to the status quo ensures minority groups are excluded from decision-making processes. Powell and Powell (2011) support this view, suggesting that risk

assessments of exposure misrepresent the lifestyles of immigrant and indigenous communities. Ottinger asserts that scientific knowledge, production practices and the authority attributed to experts “all help to create an uneven terrain for diverse communities” (Ottinger, 2018, 89).

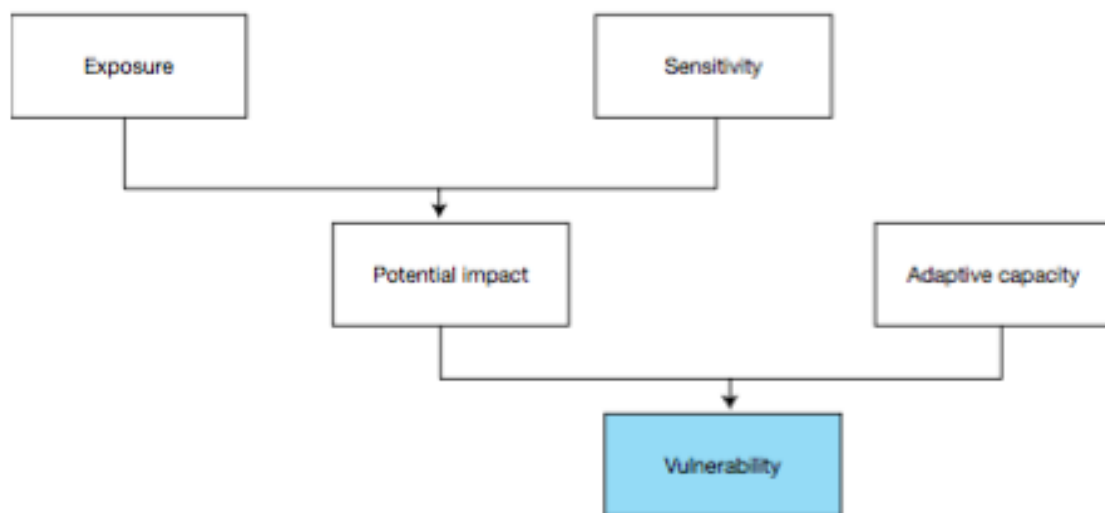
In addition, as outlined throughout the literature, risk-management approaches may be inappropriate for dealing with the complexity of climate change adaptation. Zafrin et al. (2014, 332) notes that the pressures faced by coastal governance are compounded by climate change, creating “super wicked problems”. Researchers also question whether current decision-making processes are capable of solving these complex issues. Auld et al. (2007) assert that economic rationales and the quest for “certain” scientific outcomes have created a science-centred analytical dependence, which inhibits risk-taking and innovation in response to complex problems. Augmenting these issues at the local level is the fear of litigation (Standing Committee on Climate Change, 2009). Preston et al. (2008a, 64) note that government authorities in SLR-threatened development areas are in a difficult position, at risk of being sued either for “taking no action or taking wrong action”. To overcome these issues, the climate justice literature has proposed including vulnerability assessments to complement risk-management assessments.

## **1.2 Vulnerability**

Although the concept of vulnerability is widely applied throughout the literature, disagreement remains over the components that contribute to vulnerability (Paavola and Adger, 2006). Traditionally, the vulnerability of individuals, built infrastructure and the ecological environment has been perceived as consisting of two factors: exposure and

sensitivity. Lindley et al. (2011, 29) define “exposure” as the degree to which an exposure unit (e.g. person or place) comes into contact with an external stressor; and “sensitivity” as the degree to which an exposure unit has the propensity to be affected (adversely or beneficially) by this exposure. Fusel (2007) defines the application of vulnerability to these areas as “risk-hazard approaches”. These approaches conceive vulnerability as the probability of a hazard and the magnitude of the hazard, solely focusing on exposure and sensitivity, while neglecting the contextual environment in which hazards occur. This approach has been widely adopted within Australian climate change adaptation planning (Collins, 2016). However, theorists have noted that “risk-hazard” approaches exclude the contextual environment in which hazards occur (Cinner et al., 2012).

*Figure 1.1 Components of vulnerability*



*(Source: Spickett et al., 2008)*

O'Brien et al. (2004) differentiate between assessments that include the contextual environment by coining two perspectives of vulnerability: starting-point and end-point.

Whereas vulnerability as an end-point represents “climate change minus adaptation” (Adger, 2006), the starting-point view considers vulnerability in terms of the political economy, where varied socio-environmental factors mean hazards and opportunities are converted into either negative or positive impacts (O’Brien et al., 2004).

The climate justice literature focuses on the relationship between existing disadvantage and climate change. The term “vulnerability” connects key concerns of climate change adaptation scholarship to those in moral philosophy (Paavola and Adger, 2005, 604). Kelly and Adger (2000) (328) define vulnerability “in terms of the ability or inability of individuals and social groupings to respond to, in the sense of cope with, recover from or adapt to, any external stress placed on their livelihoods and well-being”. The concept of adaptive capacity enables theorists to consider the contextual environment that contributes to an individual’s ability to manage external stressors. Lindley et al. (2011, 28) define adaptive capacity as “the ability of an exposure unit to adjust and therefore avoid negative impacts (and conversely to benefit from positive impacts)”. The contextual environment is an important indicator as it recognises that similar levels of exposure and sensitivity can have differing impacts based on the contextual capacity of those communities (Collins, 2016). Moreover, assessing the contextual environment highlights how risks from current climate variability and future climate change are unevenly distributed between households, communities and societies (Paavola and Adger, 2006, 5). Cinner et al. (2012) outline several factors that contribute to an improving adaptive capacity. While a single blueprint can’t be applied to every community, the authors asserts that reducing poverty, improving literacy and delivering good governance are key starting points (ibid). However, in order to improve the adaptive capacity of individuals and communities, governments will need to broaden their

understanding of adaptation. In his typology of adaptation, Pelling (2011) defines three stages of adaptation: resilience, transition and transformation. Transformation, the radical form of adaptation, results in people learning how to reorganise social and socio-ecological relationships, processes and values (Pelling, 2011, 88).

### ***1.2.1 Social Vulnerability***

Although including the individual’s contextual environment is an important step for understanding starting-point vulnerability, theorists argue that current understandings of adaptive capacity neglect social factors that contribute too individual and community well-being. England and Knox (2016) assert current approaches focus on personal and environmental factors (see Table 1.2), while neglecting social conversion factors such as the strength of social networks, income inequalities and the characteristics of neighbourhoods. While these factors are currently unconsidered by climate policy, they are an essential component in an individual’s ability to recover and respond to external stressors (especially vulnerable individuals) (ibid).

*Table 1.1 Categories of social vulnerability*

<b>Categories of social vulnerability</b>	<b>Example</b>
<b>Personal: Biophysical factors</b>	<ul style="list-style-type: none"> <li>• Health</li> <li>• Age</li> </ul>
<b>Social: Ability to prepare, respond and recover to disasters</b>	<ul style="list-style-type: none"> <li>• Social isolation</li> <li>• Information, language and local knowledge</li> <li>• Insurance</li> </ul>
<b>Environmental: Increase or “enhance” exposure</b>	<ul style="list-style-type: none"> <li>• Housing or neighbourhood characteristics</li> </ul>

*(Source: Lindley et al. 2011)*

Lindley et al. (2011, 8) breaks social vulnerability down into three categories (see Table 1.2). Personal (i.e. sensitivity) includes biophysical factors such as health. Social factors (i.e. adaptive capacity) refers to the ability to prepare, respond and recover to disasters, and includes social isolation, access to information and insurance. Environmental factors (which increase or “enhance” exposure) include housing and neighbourhood characteristics. Recognising that social vulnerability enhances the threat of climate change is crucial. As Banks et al. (2014) note, climate change is likely to compound disadvantage and poverty while, conversely, poverty increases vulnerability to climate disadvantage. The authors define the combination of exposure to the impacts of climate change and high social vulnerability as “climate disadvantage” (Banks et al., 2014). As outlined by Collins (2016), the benefits of a more comprehensive understanding of starting point vulnerability is prevalent through two areas: the recognition of vulnerable groups and mental health.

#### ***1.2.1.1 Vulnerable groups***

Current approaches to adaptation policy that fail to consider socio-political factors conceive the risk of rising sea levels homogenously, creating incomplete perceptions of risk (Preston et al., 2011). Collins (2016) asserts that people affected by pre-existing vulnerabilities in Australia are more likely to be affected by climate change than other Australians. Moreover, the social impacts of external stressors will mean marginalised groups will be disproportionately impacted. In their review of vulnerability to flooding and extreme heat, Lindley et al. (2011) noted five groups who were particularly socially vulnerable (see Table 1.2).

Table 1.2 Socially vulnerable groups

<b>Factor of social vulnerability</b>	<b>Example</b>
<b>1. Poverty and deprivation</b>	Inhibited residents' ability to prepare, recover and respond to external stressors
<b>2. New residents</b>	The lack local knowledge, the potential to experience language difficulties and community transience
<b>3. Mobility and access</b>	Low access to medical services or transport
<b>4. Sensitivity</b>	Areas with high proportions of elderly residents or young children
<b>5. Enhanced exposure</b>	Environmental characteristics e.g. lack of trees or housing characteristics that would accentuate or mitigate the severity of floods

*(Source: Lindley et al., 2011, 94)*

Similar research conducted by Brunckhorst et al. (2011) in Australia assessed the social vulnerability of the Hunter and Central Coast regions of New South Wales (NSW). The authors demonstrated that several areas with a high proportion of elderly residents were particularly socially vulnerable. In addition, Preston et al. (2008b) highlighted the high vulnerability of Botany Bay and Rockdale to SLR.

As noted in the “place attachment” literature, experience of a locality can be a vastly different experience for the privileged sections of society compared to the vulnerable (Schlosberg et al., 2018), primarily stemming from the provision of self-efficacy and assurances of a “manageable environment” (Groves, 2015). Gurrán et al. (2008) assert that locations with greater social resources, such as higher household incomes or community stability, residents have greater capacity to adapt to climate change.



### **1.2.1.2 Mental Health**

Holistic adaptation policy also requires a more comprehensive understanding of the factors that contribute to well-being. An important component of wellbeing currently unconsidered in Australian risk-management approaches is mental health. As illustrated by Berry et al. (2010), climate change may directly affect mental health by exposing people to trauma. Several researchers have identified post-disaster mental-health as a key variable that affects adaptive capacity (Collins, 2016). Haines et al. (2006) notes that, following natural disasters, industrialised countries are more likely to be afflicted by mental health disorders than the spread of infectious diseases. Without recognising and planning for the impact of climate change on mental health, councils understate the full threat of rising sea levels. Yet Collins (2016) showed that the majority of Australian councils' CCAPs neglected mental health entirely.

### **1.2.2 Capabilities approach**

To ensure that SLR adaptation recognises vulnerable groups and mental health risks, policy-makers will need to reconceptualise the way they conceive human well-being. Current resource-metric approaches, which measure human well-being by the amount of resources an individual possesses, are critiqued throughout the literature (Lindley et al., 2011; Sen 1999). Instead, theorists have proposed conceiving well-being in terms of individuals' basic needs capabilities that enable them to develop and design free and productive lives for themselves (Sen, 1999).

In *Women and Human Development* (2000) Martha Nussbaum outlines a list of 10 "central human functional capabilities" that she considers core to the fulfilment of human dignity: life; bodily health; bodily integrity; senses, imagination and thought; emotions; practical

reason; affiliation; other species; and control over one's environment. Holland (2008, 323) augments Nussbaum's list of capabilities with the inclusion of a meta-capability – sustainable ecological capacity - asserting that many of her 10 capabilities rely on the natural environment. In addition, other theorists have critiqued Nussbaum's individualistic focus. Noting injustices occurring at both group and community levels, Schlosberg and Carruthers (2010, 17) argue for extending the capabilities-based approach to communities. Last, the capabilities approach can be In their research on disadvantage, Wolff and De-Shalit (2007) demonstrate that while financial resources provide momentary respite from poverty, the provision of societal structures enables individuals to draw on other types of resilience in the long term, thereby creating "fertile functionings"; in other words, enabling benefits elsewhere (ibid). Hence, while resources have an important role in the realisation of functionings (Sen, 2009), a more complete understanding of human well-being is required. Schlosberg (2012, 458) argues that adopting the capabilities approach within climate adaptation frameworks can be used to "identify and physically map vulnerabilities caused by climate change."

### **1.3 Mapping vulnerability**

Socio-spatial mapping has been used extensively throughout the literature, particularly the hazards and disaster literature, to identify populations vulnerable to external stressors. However, as Cutter et al. (2003) notes, vulnerability maps have ignored social vulnerability throughout the literature, a result of the difficulty in quantifying social losses. Consequently, research comparing the social vulnerability of places has been sparse; instead, considerable attention has been given to mapping biophysical vulnerability and the vulnerability of the built environment (ibid, 243). Moreover, O'Brien et al. (2004) assert that vulnerability to

climate change analysis has predominately been assessed in isolation from other external stressors, despite recognition that exposure to multiple stressors is a significant and real concern (O'Brien and Leichenko, 2000). Focusing on India's agricultural sector, O'Brien et al. (2004, 303) identify regions that are "double exposed": exposed both to the impacts of climate change and to economic globalisation. Despite recognition that the dual threat of exposure and social vulnerability will enhance the threat of climate change to disadvantaged individuals and communities, there remains negligible Australian research that identifies what Banks et al. (2014) define as "climate disadvantage".

In the Australian literature, the neglect of vulnerability mapping that considers other external stressors is particularly apparent, with only three examples of vulnerability mapping exist; one which assesses social vulnerability and ecological exposure simultaneously. As discussed above, Brunckhorst et al. (2011) and Preston et al. (2008b) assessed the vulnerability of the Hunter and Central Coast and Sydney coastal councils respectively. However, neither of these assessments considered exposure. While deeper understandings of social vulnerability are crucial, further research in regions facing "double exposure" would provide a basis for ensuring existing disadvantage isn't exacerbated by climate change adaptation. The only example of Australian research incorporating both exposure and vulnerability is the spatial mapping study undertaken by Loughnan et al. (2013). The authors used spatial mapping to consider Australian populations vulnerable to extreme heat, and concluded that in order to reduce heatwave mortality and morbidity, climate forecasts needed to be considered alongside socio-economic data (Loughnan et al., 2013, 90). Similar research is prevalent in the climate justice literature in the United Kingdom. Lindley et al. (2011) integrated extensive data-sets in their research, utilising several disadvantage indicators to consider the dual threat of exposure to flooding and

extreme heat and social vulnerability to vulnerable communities across England. However, despite the practical and moral imperatives of including socio-spatial mapping within adaptation frameworks to consider climate disadvantage, this gap remains in Australian SLR adaptation research.

#### **1.4 Intersection between adaptation planning, social vulnerability and socio-spatial mapping**

The emerging gap within the literature becomes apparent where adaptation planning, climate justice and coastal governance overlap and interact. As outlined by Collins (2016), the majority of CCAPs within Australia are focused on ecological exposure and biophysical concerns, limiting their focus to the built and natural environments' exposure to rising sea levels. Yet the climate justice literature identifies several significant issues with approaching adaptation from this narrow, resource-based perspective. Instead, the literature argues for the adoption of social vulnerability frameworks to complement current risk-management adaptation plans.

However, while these two discourses exist simultaneously within the literature, and the use of socio-spatial mapping in the overseas disaster and hazards literature has grown substantially in the preceding decade, the methodology's usage within Australia remains sparse. The exceptions are Loughnan et al. (2013), who assessed the vulnerability of Australian populations during extreme heat events, and Brunckhorst et al. (2011) and Preston et al. (2008b), who used socio-spatial mapping to demonstrate the social vulnerability of coastal populations (albeit both Brunckhorst et al. and Preston et al. excluded simultaneous analysis of ecological exposure, neglecting the potential for to assess climate disadvantage from rising sea levels).

Moreover, a lack of research into the social factors that contribute to the vulnerability of Australian coastal residents is evident. While strides have been made in identifying and including social factors within the Australian adaptation planning literature, as Ramm (2018) remarks, a deeper understanding of what residents' value, how residents assign values and how these might conflict with SLR are fundamental questions for future research.

Schlosberg (2012) further argues that incorporating communities in both the mapping of their own vulnerabilities and the design of adaptation policies is necessary to satisfy both the recognition and participatory capabilities. This thesis demonstrates that using socio-spatial mapping, a novel approach within Australian SLR research, enables the identification of potential climate disadvantage within NSW coastal communities. In addition, augmenting socio-spatial mapping with community-based research has three benefits: (1) enables residents to identify the factors that contribute to their own vulnerability; (2) identifies and recognises social factors integral to individual and community well-being; and (3) provides marginalised residents an opportunity to access and influence decision-making processes.

Consequently, this research provides local governments with a tool to identify residents particularly vulnerable to rising sea levels, ensuring that adaptation doesn't exacerbate pre-existing disadvantage. Furthermore, it provides councils with a less resource-intensive community engagement process than has been previously used in adaptation planning research.

## **1.5 Chapter summary**

This chapter provides an overview of the current adaptation literature. Initially noting the several underlying issues prevalent in risk-based approaches, theorists highlight the benefits of including vulnerability with adaptation frameworks. In addition, the moral and practical

imperatives of mapping vulnerability and incorporating local input are discussed. By incorporating social vulnerability, local governments can begin to recognise the varied threat that rising sea levels pose to coastal communities, in particular vulnerable individuals.

## **Chapter 2 Methods and Methodology**

This chapter outlines the methods and methodology that guided this Honours research. It is comprised of three sections: (1) the rationale for the selection of each case study; (2) the appropriateness of each methodology utilised in the mixed-method approach; and (3) the strengths and limitations of the chosen method. The chapter also provides a rationale for applying a mixed-method approach, which combines both quantitative and qualitative methods to incorporate three avenues of inquiry: (1) document analysis of current SLRAPs; (2) socio-spatial mapping; and (3) questionnaires.

Community-based research facilitates a “bottom-up” understanding of SLR and adaptation planning, giving residents an opportunity to have their knowledge and insights included in local SLR adaptation policies. Further, using case studies as a methodological strategy enables a robust, multifaceted understanding of each local government’s responsiveness to the concerns of community members and the effectiveness of socio-spatial mapping in identifying socially vulnerable residents.

This research adopts a “realist” version of constructivism. Ontologically, a realist approach posits that a real world exists independently of human consciousness and language. Yet, also embracing a constructivist epistemological position recognises that knowledge, values and ethics are constructed at both the individual and social level (Evanoff, 2005).

### **2.1 Case study selection**

Three case studies were selected: Botany Bay, Collaroy-Narrabeen and Lake Macquarie. Creswell (2018) defines case studies as strategy of inquiry in which researcher

explores a program, event, activity, process or individuals in depth. Moreover, as Yin (2003) demonstrates, case studies have been broadly used in understanding local communities and studying local services and initiatives in different fields of social sciences. Limiting the case studies to New South Wales, the selection criteria comprised two factors: (1) individual communities' socioeconomic composition; and (2) the differing impacts of SLR (coastal erosion, inundation or increased extreme weather events) on each community studied. The variance between both these factors across case studies enabled a robust understanding of community vulnerability and the appropriateness of SLRAPs. For example, whether the approach of Northern Beaches Council to Collaroy-Narrabeen (a predominately affluent, Anglo-Saxon area) differs from that of Bayside Council (who oversees the ethnically diverse and socioeconomically less affluent Botany Bay region). These factors enabled a comprehensive analysis of SLR adaptation policies, climate disadvantage and community concern.

The variance between case studies allowed a compressive assessment of SLR, adaptation planning and community beliefs, providing insight into both the responsiveness of each council and the effectiveness of socio-spatial mapping in identifying vulnerable community members.

### ***2.1.1 Local governments***

Each case study falls within a local government area (LGA). The selection of local governments for this research – rather than their State or Federal counterparts – reflects the policy vacuum that has emerged at the higher levels of governance within Australia since climate change adaptation frameworks were first adopted in 2007 (Collins, 2016).



Consequently, without a legislative or legal framework created by state and federal jurisdictions, local councils have become responsible for SLR adaptation by default.

However, the literature indicates that “place-based” policy may be the most effective framework for government to deal with the impacts of SLR (Clarke and Harvey, 2013). SLR is likely to change the complexion of hundreds of Australian coastal communities, requiring nuanced adaptation plans that understand the idiosyncrasies of each local area. Researchers therefore conclude that local governments can generate better outcomes for their communities by implementing geographically and socio-economically suitable SLR adaptation policies.

Assuming local councils maintain their current role as central actors in SLR adaptation, their relationships with stakeholders, particularly community members, will be critical to policy development. Ensuring that adaptation decisions are perceived as fair and transparent is essential for cultivating trust within communities, and between community members and government (Reed, 2008).

### ***2.1.2 Community-based research***

Despite the seemingly self-evident value of ensuring community members’ voices are heard in local government planning processes, this aspect of public policy development has been widely ignored in the Australian literature, particularly concerning SLR. The literature often considers community groups to be analogous to the wider community (Zafrin et al., 2014). Yet this assumption has several notable flaws. First, the inability of marginalised community members to gain access to decision-making processes means decisions often reflect the views of privileged residents. Second, as McManus (2014, 4) asserts, even if marginalised

community members gain access to decision-making processes, it can't be assumed community groups will operate in a way that promotes the most equitable and sustainable outcomes, noting these groups display diverse needs and power structures. The importance of including community members from differing backgrounds in planning discussions is demonstrated in each case study presented in this Honours thesis, as each case study portrays a different cross-section of Australian society and presents a different local experience with SLR, resulting from contrasting climatic and non-climatic factors.

## **2.2 Methods**

Implementing a mixed-method design, this research utilises both quantitative and qualitative methods, combined with socio-spatial mapping. As Plano Clark and Creswell (2008) assert, mixed method designs provide rich information to better understand the phenomenon being studied. Moreover, not only does the mixed method approach help validate the data, it also helps obtain deeper and wider knowledge about the issue (Olsen, 2004). The mixed-method approach used in this research consists of three methodologies: (1) document analysis of SLRAPs; (2) socio-spatial mapping to identify potential climate disadvantage; and (3) questionnaires gauging community members' opinions.

### ***2.2.1 Document Analysis***

Document analysis was used to assess the substantive content and priorities of each local council's SLRAP. The policies selected were confined to each council's most recent SLRAP. As discussed by Bowen (2009) analysis of each policy consisted of three stages: skimming (superficial examination), reading (thorough examination) and interpretation. The reading and interpretation stages involved thematic analysis: identifying the specific adaptation framework used; considering whether non-resource based factors were included as a

potential cost of adaptation; and assessing the extent of community engagement involved in the adaptation planning (ibid).

This research adopted a framework developed by Collins (2016) to analyse CCAPs, which distinguishes between adaptation plans according to whether they are biophysical-based or inclusive of socio-political concerns. Additionally, Pelling's (2011) typology of adaptation was utilised to categorise each adaptation plan. At the time of writing, assessment of multiple councils' adaptation plans had only been undertaken within the Australian literature by Collins (2016), and only in reference to CCAPs, rather than focusing on SLRAPs.

Differentiating between CCAPs and SLRAPs enables this research to consider whether the political dynamics of beachfront and waterfront residents alters councils' adaptation approaches.

### ***2.2.2 Socio-spatial mapping***

In the literature on disaster and hazard management, a variety of approaches to socio-spatial vulnerability maps can be discerned. While Australian SLR research has used socio-spatial mapping to identify social vulnerability, the use of mapping to highlight the simultaneous threat of exposure and social vulnerability is only evident in research conducted by Loughnan et al. (2013) considering the threat of extreme heat to vulnerable populations. However, as Lindley et al. (2011) note, emphasising either biophysical vulnerability or social vulnerability results in different analysis and assessments. Focusing on social vulnerability and ecological exposure simultaneously combines the two leading approaches to adaptation.

The adoption of socio-spatial mapping within this research - considering potential climate disadvantage arising from SLR – is a novel approach within Australian SLR research. The Climate disadvantage maps used in this research were created using two free and publically accessible maps: the SEIFA Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) (ABS, 2016c) were combined with Coastal Risk (2019) SLR ecological exposure projections. The climate disadvantage maps were constructed by overlaying Coastal Risks' (2019) ecological exposure projections with the Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) data provided by the Australian Bureau of Statistics (ABS). Combining these datasets demonstrates the existence of uneven geographies of social vulnerability in each locality studied, while also identifying potential climate disadvantage. With both these maps available online and as will be demonstrated throughout each case study, this novel approach to SLR research provides coastal councils with an effective and simple tool identifying pre-existing disadvantage, ensuring individual and community vulnerability isn't compounded by rising sea levels or adaptation planning.

### ***2.2.3 Questionnaires***

#### ***2.2.3.1 Sampling***

A physical questionnaire response was designed for residents of Botany Bay, Collaroy-Narrabeen and Lake Macquarie. Identical questions were asked of residents in each location. Implementing closed and open questions elicited both quantitative and qualitative data, providing rich insight into respondents' perspectives on SLR and adaptation policy, while also enabling residents to identify factors that contributed to their own vulnerability. As Graham et al. (2018) note, the use of quantitative and qualitative methods in combination is consistent with other environmental justice research, with mixed methods

used in iterative stages to understand how stakeholders perceive issues and decision-making processes.

### ***2.2.3.2 Data Collection***

In total, 52 questionnaire responses were obtained across the three case studies.

Community members approached in public spaces were asked to complete written questionnaires. The number of responses is comparable with the 49 survey responses in Kreller and Graham's (2019) research about community perceptions of SLR adaptation; and with the 42 survey responses in McManus et al.'s (2014) study of perceptions of fair climate change adaptation. This sampling method enabled access to a large cross-section of individuals. Sampling was undertaken across two days in each location: Botany Bay on 17 and 23 July 2019; Collaroy-Narrabeen on 16 July and 28 August 2019; and Lake Macquarie on 27 and 28 July 2019. As discussed, the samples obtained from each case study were mostly representative of each district's overall population, with minor discrepancies in each (see Table 3.1; Table 4.1; and Table 5.2).

As noted above, climate change adaptation literature makes extensive use of survey responses as a research methodology. However, only in one Australian case are surveys conducted across multiple communities (see Graham et al., 2015), and this research was confined to considering the values of Victorian coastal communities. Thus, considering the perspectives of NSW coastal communities remains an undeveloped field of research, particularly in regards to SLR adaptation.

### **2.3 Ethics Approval**

Ethical approval for the questionnaire was obtained from the University of Sydney Human Research Ethics. All questionnaire responses were voluntary, with respondents able to withdraw from the research at any point. Respondents were also given the choice of remaining anonymous.

### **2.4 Analysis of data**

Questionnaire data was analysed using two methods. The qualitative data obtained from open-ended questions was assessed using representational thematic text analysis, while closed-ended questionnaire were analysed using Excel. Both analytical techniques giving insight into the consistency of answers within and across case studies.

#### ***2.4.1 Text Analysis***

Open-ended questionnaire data was analysed using representational thematic text analysis. This manual mode of analysis enabled a nuanced interpretation of manifest meaning, rather than solely content, which isn't possible using computer analysis (Popping, 2015). Cross-referencing coding across case studies enabled consideration of consistency, ensuring reliability. The method involves of assigning a theme to selected text fragments (ibid).

#### ***2.4.2 Excel analysis***

Excel was used to analyse closed-answer question data. Categorical questions produced continuous data, with Excel used to tally answers, providing insight into the consistency of answers within and across case studies.

## 2.5 Strengths and limitations

Despite the notable advantages of using a mixed-method approach, limitations to this approach are evident. Within the literature, three methods of socio-spatial mapping are used: regression, composite index methods, and data reduction methods (Lindley et al., 2011). Each method utilises extensive data sets to assess the impact of hazards (ibid). However, time, resource and expertise limitations meant these approaches were not appropriate for this research. Consequently, the increased frequency and intensity of extreme weather events that will accompany higher sea levels aren't incorporated into the socio-spatial mapping used in this research. Moreover, the likelihood that society will fundamentally change over the next 80 years means socio-spatial projections are likely to be inaccurate by the turn of the century. Finally, the wide margin of error, resulting from the limited questionnaire sample size, means extrapolating onto the wider community is difficult.

Despite these limitations, the potential for climate disadvantage is evident across Australian coastal communities, demonstrating the need to include social vulnerability frameworks within coastal governments SLR adaptation plans. The uneven geographies of social vulnerability are clear in each case study, pointing to the inadequacy of the narrow risk-management plans currently in place. Socio-spatial maps provide Australian councils with a simple, effective and inexpensive methodology for elucidating the uneven geographies of social vulnerability, ensuring that pre-existing disadvantaged isn't compounded by SLR adaptation. Moreover, socio-spatial mapping can be used as a starting point for discussions about what desirable coastal communities will look like in future. As El-Zein (2019, 30) pertinently asks, "... how many of the chronic problems found in our cities today have been

at least partly caused by decisions made, say 70 or more years ago?” Hence, integrating robust and comprehensive planning frameworks is essential if today’s SLR planning decisions are not to negatively affect coastal societies in future by exacerbating the existing disadvantage of vulnerable residents.

## **2.6 Chapter summary**

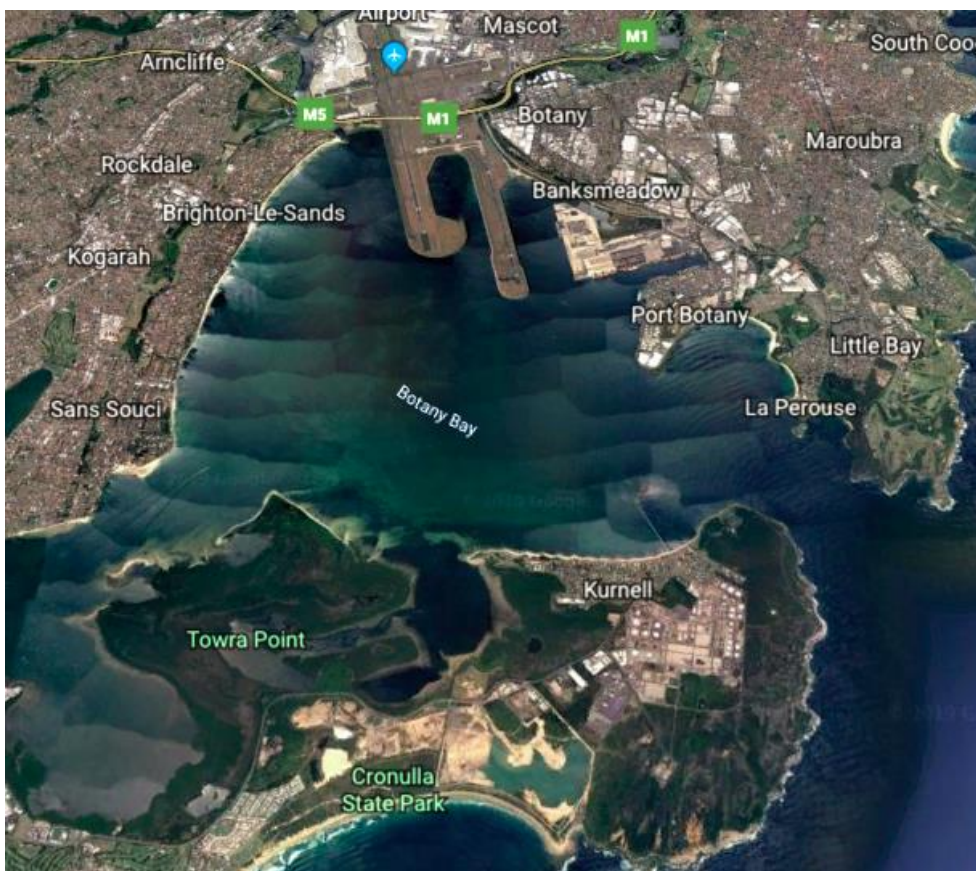
In sum, implementing a mixed-method approach provides a deeper understanding of SLR adaptation and social vulnerability within each community studied. The approach consisted of three components: document analysis of current SLRAPs; socio-spatial mapping identifying climate disadvantage; and questionnaires providing residents a forum to voice their concerns about SLR adaptation. The methodology used in this research - a novel approach in Australian SLR adaptation research - provides councils with a valuable tool for equitably confronting SLR adaptation, ensuring planning considers the needs of all residents. While the limitations of this approach are evident, the potential benefits of incorporating a new and comprehensive way of assessing SLR adaptation are plentiful.



## Chapter 3 Botany Bay

This chapter provides a case study of the Botany Bay region. The chapter consists of three sections: an assessment Bayside Council's current SLRAP; the use of socio-spatial mapping to identify climate disadvantage in the region; and questionnaire responses that give community members an opportunity to voice their concerns.

Figure 3.1 Map of Botany Bay



(Source: Google Earth)

### 3.1 Climate profile

Botany Bay is a marine estuary located in the southeast of Sydney. Flanked by two large sandstone headlands (see Figure 3.1) – Kurnell and La Perouse – the bay has a narrow opening (1.1 km) to the Tasman Sea (Frost, 2011, 17). Botany Bay is subject to vigorous

wave activity, erosion and flooding (Brakell et al., 2012; Frost, 2011), which will be exacerbated by SLR. Significant development has dramatically altered the natural physical characteristics and the interaction of coastal processes in the bay (Frost, 2011). Major developments include Sydney Airport and Port Botany, which serves as a major import point for Australia ](Kreller and Graham, 2019). Both projects required significant dredging and land reclamation (Frost, 2011).

### **3.2 Community profile**

Over 174,378 residents live in the densely populated region (ABS, 2016a) around a foreshore subject to intense industrial development. In 2016, the area previously encompassed under Botany Bay City Council and Rockdale City Council was amalgamated, forming Bayside Council. Demographically, residents of Botany Bay are younger, less affluent and more ethnically diverse compared to the national average (ABS, 2016a). These factors contributed to the Sydney Coastal Councils Group's (SCCG) determination that the region was more socially vulnerable than any other coastal council in Sydney (Preston et al., 2008b).

### **3.3 Current SLR adaptation policy**

At the time of writing, Bayside Council were yet to develop their own SLRAP, using instead the limited SLR policy of the former Botany Bay Council. This policy utilises the IPCC benchmarks of 0.9m SLR by 2100 in its adaptation strategy (City of Botany Bay, 2015). The sparse nature of the document is problematic for several reasons. Resulting from the Botany Bay Council focus, the policy neglects half the LGA, excluding the area formerly covered by Rockdale City Council. Moreover, the document provides minimal insight into

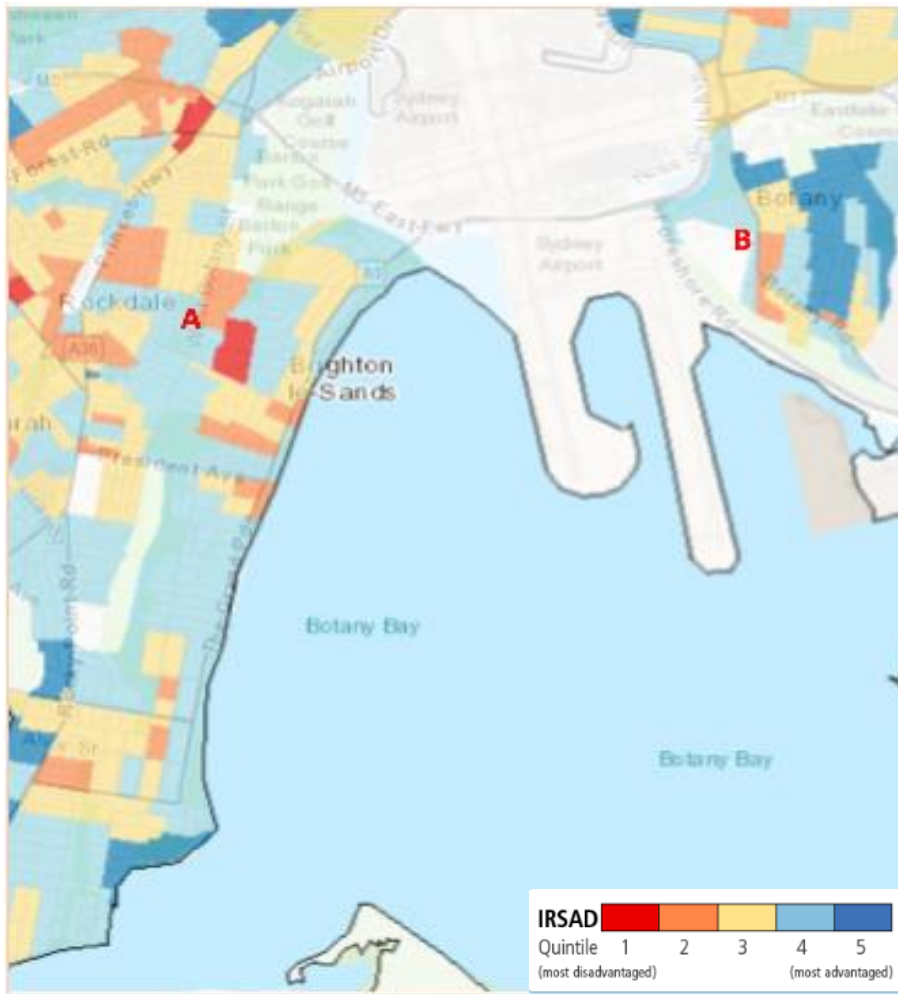
how the Council actually intends to adapt to SLR. For example, despite the council's ostensible commitment "... to working with its community to identify and respond to emerging hazards and risks associated with sea level rise" (City of Botany Bay, 2015), the policy is light on detail. The 10-page policy fails to outline how SLR and weather-related incidents will impact the community, nor how adaptation policy consultation will be undertaken. The policy draws a significant portion of its content from the SCCG analysis discussed above (Preston et al., 2008b), with the council providing negligible analysis itself. Yet despite Preston et al. (2008b) illustrating the high social vulnerability in the region, the document neglects vulnerability entirely.

A significant amount of the policy document is drawn from the SCCG analysis discussed above (Preston et al., 2008b), with negligible analysis undertaken by the council itself. While, Preston et al. (2008b) extensively discuss the high vulnerability of the Botany Bay region, the SLRAP doesn't mention vulnerability once. Finally, while Bayside Council states on its website that the draft policy was exhibited from 12 August 2015 to 11 September 2015, the policy doesn't mention whether the community was consulted on the document prior to the council's adoption (City of Botany Bay, 2015).

### **3.4 Identifying climate disadvantage**

Socio-spatial mapping is a means to identify vulnerable community members in the Botany Bay region. As seen in Figure 3.2, the Botany Bay region is socioeconomically diverse. Using socio-spatial maps, which combine both ecological exposure and social vulnerability, two areas of potential climate disadvantage can be identified: Point A, along Bay Street in Brighton-le-Sands; and Point B, in the industrial area of Botany Bay.

Figure 3.2 Botany Bay IRSAD SEIFA map

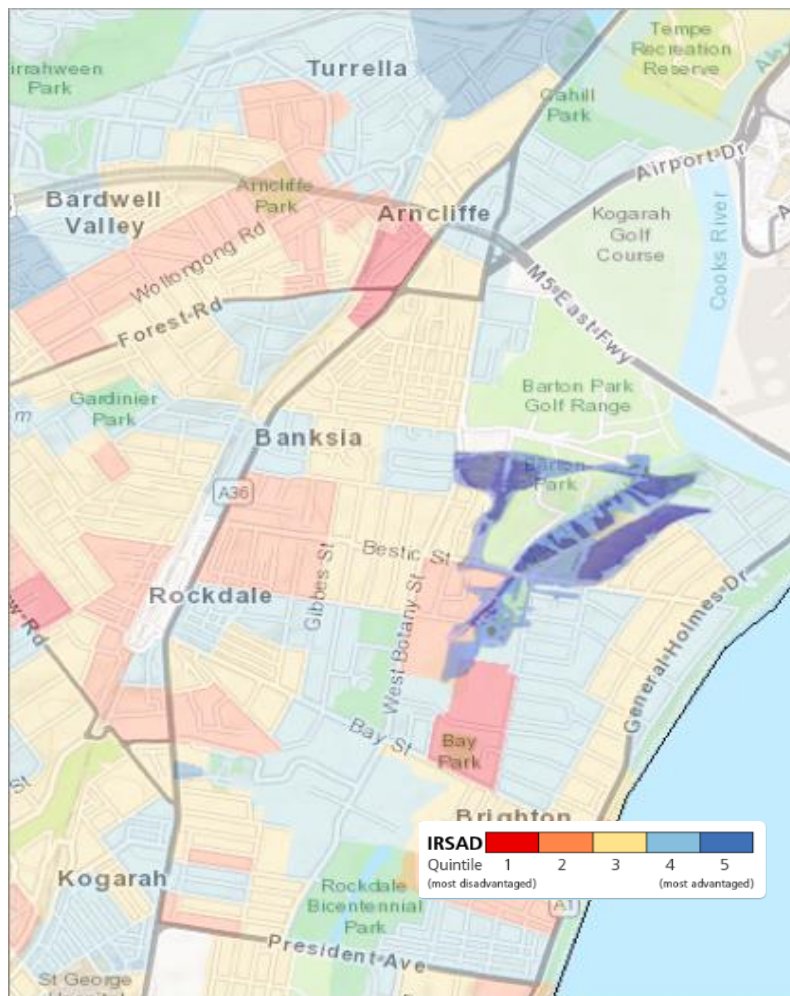


(Source: ABS, 2016)

Point A, the locality surrounding Muddy Creek in Brighton-le-Sands, faces potential climate disadvantage. Coastal Risk (2019) SLR projections indicate that residences from Bestic Street along Francis Street towards Bay Street will be threatened by coastal inundation resulting from higher sea levels (see Figure 3.3). Point A is particularly vulnerable to external stressors due to the lower adaptive capacity of residents. While residents surrounding Bay Street are among the more advantageous in Australia, the subpopulation behind Bay Park falls into the most-disadvantaged quintile (see Figure 3.3). The subpopulation's disadvantage is the product of several socioeconomic factors. The density of public housing in the area (40%), the percentage of residents who have graduated high school (35%) less

than the suburb's average (55%), and individual gross weekly incomes considerably below the area's average (\$670 against \$823) (ABS, 2016a). These factors, combined higher proportion of households where a non-English language is spoken, means residents are less capable of responding to, and recovering from, coastal inundation.

Figure 3.3 Botany Bay (A) 2100 sea-level rise projections



(Source: ABS, 2016; Coastal Risk, 2019)

Point B in Figure 3.2 - the industrial area in the suburb of Botany, adjacent to Sydney Airport - also demonstrates the potential for climate disadvantage. However, the socioeconomic variance between Point A and B highlights the necessity of incorporating social vulnerability considerations in adaptation plans, with the risk of exposure an insufficient understanding

of the full risk posed by SLR. Situated north of the Botany industrial area, the susceptible region below Mill Pond is a mix of residential housing and industrial spaces.

Figure 3.4 Botany Bay (B) 2100 sea-level rise projections



(Source: Coastal Risk, 2019; ABS, 2016)

Residents in this area are economically better off than those in Point A, but their profile is below the national average in terms of gross weekly average income (\$604) (ABS, 2016a). Besides income, the area is demographically comparable to the national average in ethnicity, high-school graduates and tenancy rates. As discussed by Lindley et al (2011), these factors contribute to a higher adaptive capacity for residents.

Although these areas are comparable in terms of exposure to coastal inundation, the differing socioeconomic compositions of the areas means Point A is more vulnerable than

Point B. Thus, adaptation plans that fail to consider social vulnerability ignore residents' capacity to recover and respond to external stressors, underestimating the risk of rising sea levels to their community. Socio-spatial maps, which incorporate both ecological exposure and social vulnerability, enable policy-makers to identify subpopulations particularly at risk from coastal inundation and extreme weather events. While socio-spatial mapping provides local councils with a valuable tool for identifying vulnerability, giving residents an opportunity to identify factors that contribute to their vulnerability is also critical.

### **3.5 Questionnaire responses**

Questionnaires were conducted across two-days - 17 July and 23 July 2019 - along Brighton-Le-Sands Beach promenade. The 16 participants were asked questions across four areas: demographics, attitudes to SLR, adaptive capacity and desires for future SLR adaptation. Respondents were comparable to the Botany Bay regional profile in terms of household incomes, home ownership and residents who had completed year 11 and year 10 equivalents. The sample was overrepresented by females, people aged between 18 and 39 and over 60, and residents with Bachelor level qualifications and above and underrepresented by males and participants aged between 40 and 59.

Table 3.1 Demographic comparison between questionnaire respondents and Botany Bay region

	Questionnaire respondents	Botany Bay region
<b>Gender</b>		
Female	61%	50%
Male	39%	50%
<b>Age</b>		
18-29	31%	23%
30-39	25%	17%
40-49	6%	14%
50-59	0%	11%
60+	25%	17%
<b>Highest Level of Education</b>		
Bachelor degree level and above	56%	27%
TAFE or other vocational certificates	6%	20%
Year 12 or equivalent	6%	20%
Year 11 or equivalent	6%	3%
Year 10 or below	19%	16%
<b>Housing status</b>		
Occupy owned home	56%	56%
Renting and other	44%	44%
<b>Annual household income</b>		
Nil to \$40,000	31%	Median household incomes were \$81,744 and \$84,522 for Rockdale and Botany, respectively.
\$40,001 to \$80,000	25%	
\$80,001 to \$150,000	38%	
Over \$150,000	6%	

(Source: ABS, 2016)



### 3.5.1 Attitudes towards sea-level rise

The initial question category gauged residents' awareness and perceptions of SLR (see Table 3.2). The results were surprising, with only a slight majority of residents (56%) aware that Botany Bay may be threatened by future SLR.

Table 3.2 Perceptions of sea-level rise (n =16)

	<b>Botany Bay (% = yes)</b>
<b>Aware community may be threatened by future sea-level rise?</b>	56%
<b>Concerned about the threat of SLR to personal well-being?</b>	31%
<b>Concerned about the threat of SLR to community well-being?</b>	31%

Additionally, slightly under one-third of residents (31%) were concerned about the threat of SLR to themselves or to the wider community. When asked to expand on these responses, residents provided a mixture of reasons. Some residents remarked that they didn't know much about SLR in their area, pointing to the lack of local government education about the issue. Others said they had failed to notice any changes in sea levels despite living in the area for over 10 years. This was in stark contrast to other residents who stated that the impact of rising sea-levels had become increasingly evident: one participant stated they had "...lived here for 28 years and had noticed significant erosion past the rock wall installation settlement" (BB2, 2019). However, most residents noted that while they were aware of and concerned about SLR at a national or global level, it wasn't something they had considered locally. "I'm more concerned about the global impact, Australia seems like it hasn't been impacted" (BB14).

### 3.5.2 Local council SLRAP

The second group of questions were aimed at understanding the effectiveness of local government SLR engagement strategies. When asked if they were familiar with the local council’s adaptation policy, residents overwhelmingly responded that they were not (see Table 3.3).

Table 3.3 Local government sea-level rise adaptation plans (n = 16)

	Botany Bay (% = Yes)
Aware of any local council sea-level rise adaptation plan?	12%
Believe views are represented by local government?	12% (76% unsure)
Do you believe residents have the opportunity to contribute their knowledge to decisions about SLR?	12% (76% unsure)
Would like greater voice in future sea-level rise adaptation plan decision-making processes?	81%

The majority of residents (76%) were unsure whether their views were represented by the local government. Residents’ uncertainty was also evident when questioned about current engagement processes, with the same proportion of respondents (76%) unsure whether residents had the ability to contribute their knowledge to SLR decisions. However, when asked whether they would like a greater voice in future SLRAP decisions, a significant majority (81%) answered that they would.

### 3.5.3 Adaptive capacity

The third set of questions aimed to gauge respondents’ adaptive capacities. Initially, participants were asked to rank the strength of their local social network between one (very weak) and five (very strong). Healthy social networks are an important element in the ability

of individuals and communities to respond to, and recover from, SLR. As Adger (2003 , 388) notes, adaptation occurs collectively, rather than individually, as the ability for societies to adapt is “bound up in their ability to act collectively.” Paavola and Adger (2006) support this argument, noting that individuals and communities with healthy social networks are more equipped at dealing with climate change and adaptation than those without them. The average response of 2.7 reflected a divergence between respondents who had lived in the community for a long time, enabling them to develop strong communal ties, and residents who had arrived more recently. Respondents were then asked how prepared their household was for an extreme weather event that may last three days or more, on a scale ranging between one (very unprepared) and five (very prepared). The average answer (3.4) demonstrated that respondents generally felt okay about their household’s ability to withstand such an event. Finally, when asked if they believed they were able to make the preparations necessary to prepare for an extreme weather event, only a small majority of residents (56%) believed they could.

#### ***3.5.4 Well-being***

Residents were then asked about well-being. Current approaches in adaptation planning to well-being are generally resource-based, creating an index that assigns losses in well-being as losses in resources. Approaching well-being from a resource-metric understanding misses the range of basic needs and functionings that enable individuals to flourish. Conversely, as Wolff and de-Shalit (2007) cogently argue, while resources play an important role in disrupting disadvantage, the tendency for disadvantages to cluster means public policy require a deeper understanding of the vulnerable capabilities that contribute to “corrosive

disadvantage”. Moreover, as Schlosberg (2012) notes, enabling community members to map their own vulnerability satisfies both the recognition and participatory capabilities.

The initial question in this group sought to assess whether residents believed resources were an adequate index for their well-being. When asked on a scale of one to five, respondents generally felt economic factors played an important role, with a mean response of 3.9.

*Table 3.4 Definitions of well-being (n=16)*

<i>How would you define well-being?</i>	<b>Botany Bay</b>
<b>Capabilities and functionings</b>	56%
<b>Resource-based</b>	38%
<b>N/A</b>	6%

Table 5.5 shows that a majority of residents (56%) spoke about well-being in terms of basic needs capabilities enabling individuals to experience life. As one resident noted, “Well-being is dependent on the person and culture, hence we need a better understanding of society to ensure well-being” (BB11). The other major theme pertained to respondents’ belief that resources were essential to their well-being, with one in four (38%) believing that resources or wealth played a significant role in their overall health.

### *3.5.5 Focus of current and future SLR adaptation*

Respondents were then asked to consider the focus of current and future government policy. First, residents were asked whether they felt government policy should concentrate on an individual's opportunities to experience life, rather than on the distribution of wealth. The justice literature demonstrates several prominent issues with policies that prioritise resources at the expense of human's ability to flourish (see Section 2.2), which Pelling (2003) argues, minimises the risk to the social status-quo. This approach manifests itself in SLR adaptation with the focus on exposure at the expense of socio-political factors that affect human vulnerability. Enabling residents to voice their beliefs about the direction of policy is the first step in creating community-based planning that invites residents to be part of each stage of planning. An overwhelming majority (83%) of respondents agreed with the statement that governments should focus on individuals' ability to experience life, with one in four (28%) pointing to the exclusion of disadvantaged residents in current policy outcomes. The same proportion (28%) said greater attention was needed to ensure all individuals had similar opportunities to experience life. Some respondents disagreed, with 17% of residents asserting that the government was already too entwined in our lives, asserting that the ability for individuals to experience life was already available to them.

Table 3.5 Community discourse surrounding policy

<i>An argument exists that governments should focus on individuals' opportunities to experience life, rather than the distribution of wealth.</i>  <i>Do you agree? (Why/why not?)</i>	<b>Botany Bay</b>
<b>(Yes) Social vulnerability</b>	28% (5)
<b>(Yes) Capabilities and functioning</b>	28% (5)
<b>(No) Small government</b>	17% (3)
<b>(Yes) Procedural and distributive justice</b>	17% (3)
<b>(Yes) Recognition</b>	5% (1)
<b>N/A</b>	5% (1)

Respondents were then asked what “fair” adaptation would look like in their community (see Table 3.4). Mostly, respondents spoke in terms of justice. Slightly under a third of respondents (31%) believed greater attention needed to be given to vulnerable residents, while one in four (25%) spoke about temporal justice, asserting that future generations needed greater consideration in planning. Other answers included ensuring future SLR adaptation decisions were socially inclusive (13%), while another respondent said recognising the damage anthropogenic climate change was inflicting on the non-human world was vital. One in five respondents (19%) were unsure.

Table 3.6 Community framing of “fair” adaptation

<i>What would “fair” adaptation look like in your community?</i>	<b>Botany Bay</b>
<b>Focusing on the socially vulnerable</b>	<b>31%</b>
<b>Focus on future generations</b>	<b>25%</b>
<b>N/A</b>	<b>19%</b>
<b>More inclusive SLRAP decision-making</b>	<b>13%</b>
<b>Education</b>	<b>6%</b>
<b>Recognition and inclusion of nonhumans</b>	<b>6%</b>

### 3.6 Research findings

1. At the time of writing, Bayside Council were yet to develop their own adaptation policy, still using the limited policy developed by Botany Bay Council in 2015.
2. Potential climate disadvantage was evident in two locations: Point A, in Brighton-le-Sands behind Bay Street; and Point B, in the industrial area of Botany Bay. The significant disadvantage of Point A – resulting from the high-density of public housing in the area - means it should be prioritised as an area of concern for Bayside Council when developing a future SLR policy. These findings were consistent with vulnerability research conducted on behalf of the SCCG by Preston et al. (2008b). The evidence of potential climate disadvantage highlights the utility of using socio-spatial mapping to identify vulnerable residents in SLR adaptation planning.
3. Questionnaire responses highlighted that only a slight majority of residents (56%) were aware that SLR and extreme weather events threatened the Botany Bay region. Additionally, less than one in three (31%) were concerned about the threat of SLR to

their personal or community's well-being. These results were at odds with research undertaken by Kreller and Graham in 2019, who found 55% of Botany Bay and Rockdale residents were concerned about the personal effects of SLR.

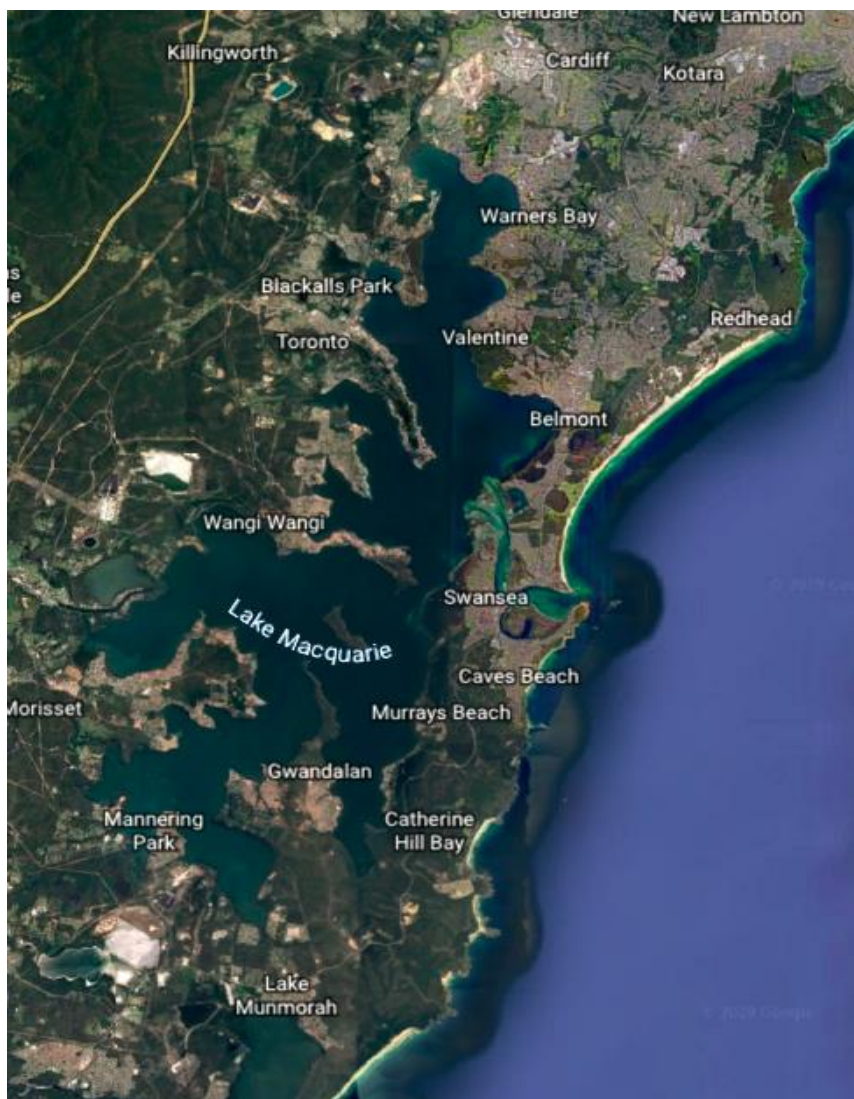
4. The negligible community awareness of Bayside Council's SLRAP, combined with the strong proportion of respondents that wanted a greater future voice in SLR adaptation decisions, highlights the inadequacy of current decision-making processes and the need for procedural reform. This was consistent with the findings of Kreller and Graham (2019, 324), who found residents believed procedural fairness had not been achieved by either Botany Bay Council or Rockdale Council.
5. When asked what "fair" SLR adaptation would look like in their community, residents overwhelmingly spoke about the need for socially inclusive policy, with several justice-based themes evident. Almost a third of residents (31%) said SLR adaptation processes needed to give more attention to disadvantaged residents, while another quarter (25%) believed future generations required greater input to decision-making processes. These findings clearly demonstrate community support for transformative SLR adaptation policies.



## Chapter 4 Lake Macquarie

This chapter is comprised of three sections: (1) using document analysis to analyse Lake Macquarie City Council's (LMCC) SLRAP; (2) using socio-spatial mapping to consider potential climate disadvantage within the LGA; and (3) questionnaire responses that engage residents' about SLR, well-being and adaptation planning.

*Figure 4.1 Map of Lake Macquarie Local Government Area*



(Source: Google Earth)

## 4.1 Climate profile

Located on the eastern coast of Australia about 100 km north of Sydney, Lake Macquarie City is the second largest metropolitan area in the Hunter region of NSW with an area of 787.4 km<sup>2</sup> (see figure 4.1). The city is situated around one of the largest saltwater lakes in the southern hemisphere. The area has experienced several climate change related disasters, most recently flooding and the storm that ran aground the Pasha Bulker cargo ship off Nobby's Beach in neighbouring Newcastle in June 2007, which has resulted in Lake Macquarie being declared one of the most vulnerable climate change areas in Australia (Brunckhorst et al., 2011).

Lake Macquarie is a large estuarine lagoon with complex hydrodynamic processes and responses. The lake's composition varies from a mix of shallow sand near-shore areas, deeper rocky foreshores and shorelines thinly mantled with muddy sands, resulting in different parts of the lake areas responding differently to inflows of stormwater (LMCC, 2015, 16). Lake Macquarie has almost 70 km of absolute waterfront residential development, including extensive residential and industrial development. Much of the development is low-lying – less than 2 m above mean sea level - contributing to the area being identified as one of Australia's most at-risk locations for inundation of property and infrastructure assets (ibid). Increasing population growth in the region will add pressure for the redevelopment and protection of foreshore private property (Umwelt, 2015b).

The lake connects to the ocean via a marine gateway known as Swansea Channel. The channel is used year-round by recreational and sporting vessels. However, the dynamic nature of the channel means it requires constant management to ensure functional and recreational needs (Haines et al., 2015). Communities on either side of the channel are

threatened by several potential issues including inflows of lake water to the sewage system, tidal backup into stormwater drains and inundation of private property (ibid).

The eastern suburbs of the city, which includes Swansea, Marks Point and Belmont, situated between the lake and the Tasman Sea, are particularly vulnerable to SLR. The large salt water lake connected with the ocean often brings King Tides, impacting low-lying settlements around the lake (Brunckhorst et al., 2011). As a result, while a range of coastal hazards poses a significant threat to the area, the key concern for Lake Macquarie is from coastal inundation as higher sea-levels encroach upon low-lying area already prone to flooding.

#### **4.2 Community profile**

Lake Macquarie is the fourth largest LGA in NSW with a population of 197,371 at the 2016 Census (ABS, 2016b). The population had a slightly higher proportion of females (51.2%), while the median age (42) was older than the national average, with people aged 65 years and over comprising 20.6% of the population compared to 15.8% nationally. Brunckhorst et al. (2011, 47) highlighted that the area's appeal as a retirement destination contributed to the older average age.

Lake Macquarie City is predominately populated by residents of lower-socioeconomic status. Both the personal and household median weekly incomes (\$609/\$1313) were less than the national average (\$662/\$1438) respectively. The lower proportion of residents (15.5%) who had completed a Bachelor level degree, compared to 23.4% nationally, can partially explain the lower incomes of residents. Ethnically, the area is predominately Anglo-

Saxon. Over four-fifths of residents (85.3%) were born in Australia, much higher than the national average (66.7%) (ABS, 2016b).

Brunckhorst et al. (2011) pointed to several of these factors when highlighting the high social vulnerability of the area, augmenting this data with survey responses from 610 residents. The authors used a “Social Vulnerability Index” to highlight several areas in the LGA as being particularly socially vulnerable to climate change: notably retirement villages in Belmont and Bonnells Bay, and relocatable home parks in the Swansea-Pelican area (Brunckhorst et al., 2011, 47). In addition, the authors highlight the lack of community understanding about the risk of climate change and managing its impacts (ibid). Research undertaken by McManus et al. (2014) pointed to the Swansea-Blacksmiths area as being particularly vulnerable to climate change, resulting from the area’s position between the lake and sea, combined with high proportion of lower-income residents.

#### **4.3 Current SLRAP**

The experience of Lake Macquarie’s residents with climate change-related disasters has resulted in the early adoption of climate change adaptation policies (McManus et al., 2014), supported by comprehensive assessments that incorporated analysis of the region’s social vulnerability. (Brunckhorst et al., 2011). Lake Macquarie City Council developed a broad Coastal Zone Management Plan (CZMP) adaptation plan in 2015, incorporating coastline erosion, estuaries and Swansea Channel, resulting in the *Four-Year Action Plan 2015-2019*. The CZMP augmented the *Lake Macquarie Waterway Floodplain Risk Management Study and Plan* commissioned by the LMCC in 2012.

The 2012 *Lake Macquarie Waterway Flood Risk Management Study* (WMA Water, 2012) assessed rising sea levels and the increased risk of flooding to the floodplain and foreshore of Lake Macquarie and the adaptation options available to LMCC. The report points to the projected growth of Lake Macquarie's population in the next 30 years as an issue for the council. The growth of Lake Macquarie's population by 60,000 to 70,000 new residents in the next 30 years will add complexity to the challenges faced by the council. Two significant challenges arising from this growth will be the increased demand for residences along the low-lying foreshore, combined with a growing elderly population - the percentage of the population aged over 55 is projected to increase from 29 percent to 39 percent by 2050 (WMA Water, 2012). These challenges reflect what Zafrin (2014) describes as a "super wicked problem": complex socio-environmental issues that are compounded by the long-term nature of climate change and uncertainty surrounding planning for adaptation.

The 2012 *Lake Macquarie Waterway Flood Risk Management Study* includes a social assessment of the potential impacts of flooding, categorising flood damages into two groups: tangible damages, which includes the direct and indirect damages; and intangible damages. Intangible damages are described as additional costs incurred by residents during and after flooding, to which monetary value can't be assigned. These include mental health impacts, risk/loss of life and injury. As noted by the author, it is important to include these considerations to understand the impacts of flooding on a community (WMA Water, 2012, 25).

Research undertaken by Brunckhorst et al. (2011) supports the inclusion of intangible costs. The authors conducted a vulnerability assessment of the Hunter and Central Coast, highlighting that several areas within Lake Macquarie were socially vulnerable to SLR and

related extreme weather events. Moreover, the percentage of human settlement vulnerable to SLR is likely to increase to 280,000 by 2070 (Brunckhorst et al., 2011, 84).

Interestingly, despite research demonstrating the social vulnerability of the region and the inclusion of intangible costs within the 2012 flood risk management study, the wider social impacts of SLR were mostly neglected in the 2015 CZMP. Indeed, while the plans' overarching goal and vision is to increase community resilience, the biophysical-focused CZMP neglects social vulnerability and mental health factors. Research undertaken by Collins (2016) demonstrated that the focus on risk-management was prominent across CCAPs nationally.

The CZMP *Four-Year Action Plan 2015-2019* states its vision and goal is focused on increasing the resilience of the community and the environment. The vision of the plan, which reflects "community aspirations", is "A resilient living coast and estuary provides for a liveable city and quality lifestyle. Caring for the environment equates to caring for the community" (LMCC, 2015, 6). The four-part CZMP incorporates assessments of the coastline, estuaries and Swansea Channel, along with the final report. Each report includes extensive community consultation and utilises a risk-management assessment. Vulnerability is only mentioned in reference to ecological systems and infrastructure.

Part A of the CZMP assesses the threat of SLR and coastal erosion to Lake Macquarie's coastlines and coastline communities. The plan assesses the available options for adapting to coastal erosion and outlines seven themes, which concentrate on managing risks, ensuring ongoing community usage and providing strong coastal governance and communication (Umwelt, 2015a, iii). Lake Macquarie's estuary system is assessed in Part B of the CZMP. Again, a limited risk-management approach is adopted by the report to assess

the threat of rising sea levels to the lake’s estuaries and foreshore (Umwelt, 2015b). The plan initially assesses the geomorphology of the estuary and rehabilitation works, suggesting various mechanisms to increase the resilience of the ecological system, while ensuring continued community access to activities on the lake and foreshore. Part C provides a framework for managing risks arising from coastal and estuarine hazards, including the impact on “existing and future development, ecological and community assets in and around Swansea Channel” (Haines, 2011, 3).

*Table 4.1 SLR adaptation criteria for Swansea Channel*

Capital cost and recurrent cost
Environmental or social impact
Community acceptability
Ability for decision to be reversed or adapted
Effectiveness over time
Legal/approval risk
Technical viability

*(Source: Haines et al., 2015)*

Each component of the plan considers the range of adaptation options available to LMCC: how criteria options are assessed, and the points where intervention becomes necessary. For example, in the assessment of coastal management, the plan outlines management options for existing and future developments: Protect, Accommodate and Retreat (PAR) for existing development; and, Avoid, Accommodate and Accept (AAA) for future development (Umwelt, 2015b, 84). These options are assisted by adaptation pathways – where different adaptation options are enacted by increasing conditions - and are discussed for both existing and future development (see Figure 4.2).

Each adaptation option was then assessed according to the criteria listed in Table 4.1, along with threshold “triggers”, to prioritise the importance of each option. High priority actions considered by the report included conducting an assessment of existing lake foreshore erosion treatment sites (on public land) to determine their current conditions and performance (Umwelt, 2015b, 72), and developing coastal monitoring systems to provide regular updates about the rate of changes to beaches (Umwelt, 2015a).

Figure 4.2 Adaptive change management processes

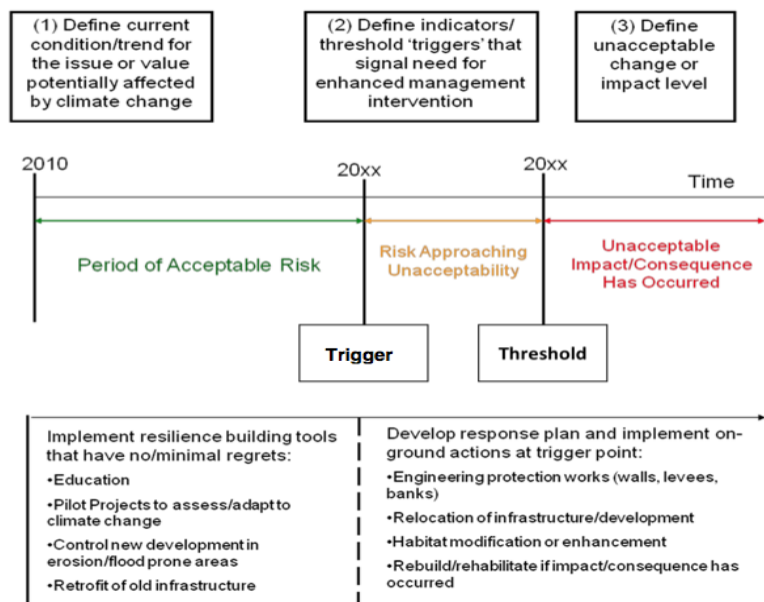


Figure 2-1 Continuum Model for Climate Change Adaptation Action (adapted from Fisk & Kay, 2010)

(Source: Haines et al., 2015, 27)

Each report included an extensive consultation process. The draft was exhibited in accordance with the public consultation requirements in the NSW *Coastal Protection Act* (1979), which required the consideration of submissions received and revision where possible (Umwelt, 2015b). As outlined in the final report, consultation was designed to “collect information about coastal values relating to the coastline and coastal access” (LMCC, 2015, 26). Each stage of the plan involved distributing leaflets to inform residents of the process and meetings with stakeholders. In addition, community workshops, online



engagement and “pop-up” information booths were used to give the community information about the contents of the draft CZMP and gain residents’ input (ibid). The majority of community input coalesced around two themes: “Actions for a healthy coastal zone” and “actions for sustainable community access, use and value” (LMCC, 2015, 28).

The CZMP also considered the social and cultural impacts of rising sea levels in each section. For example, Part A considered how adaptation coastal recession will affect surf life-saving clubs, 4WD access to beaches and other beach activities. As Plan A outlines, creating the right framework for ongoing adaption is the “first step towards resilient coastal ecosystems and resilient communities who benefit from healthy coastal systems” (Umwelt, 2015a, 176). Moreover, the importance and long-standing history of Aboriginal cultural heritage in the area is recognised in the final report, noting the connection between threats to the ecological features of the coast zone and Aboriginal cultural sites (LMCC, 2015, 21).

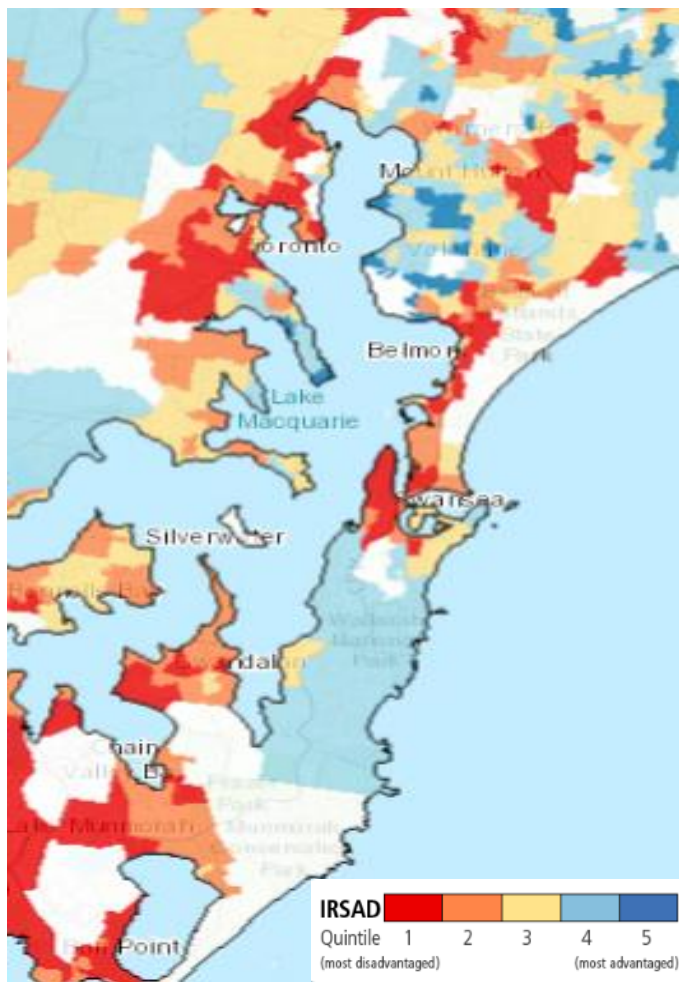
However, despite the CZMP canvassing a broad range of potential SLR impacts, its narrow risk-based scope fails to recognise social vulnerability as a factor contributing to the risks residents face. While the plan does consider some social aspects - such as activities that utilise the beach - deeper socioeconomic currents that can cause and enhance vulnerability to SLR are ignored. The challenge inherent to this limited-scope becomes apparent in Section 4.4, which highlights how current existing socioeconomic disadvantage in Lake Macquarie has the potential to be compounded by SLR. Indeed, evidence of climate disadvantage within Lake Macquarie reflects recent adaptation literature that demonstrates how human vulnerability means the risk of SLR varies between individuals, subsequently underlining the need to prioritise social vulnerability in adaptation planning.

#### 4.4 Climate disadvantage

The potential for climate disadvantage exists in multiple locations in Lake Macquarie.

Compelling examples of how disadvantage and vulnerability to sea-level rise can co-exist can be observed in two areas of Lake Macquarie LGA (see Figure 4.3): Point A, the area surrounding Swansea Channel including the suburbs of Swansea, Blacksmiths and Little-Pelican; and Point B, the area surrounding Fennell Bay in the north-west of the lake.

*Figure 4.3 Lake Macquarie IRSAD map*



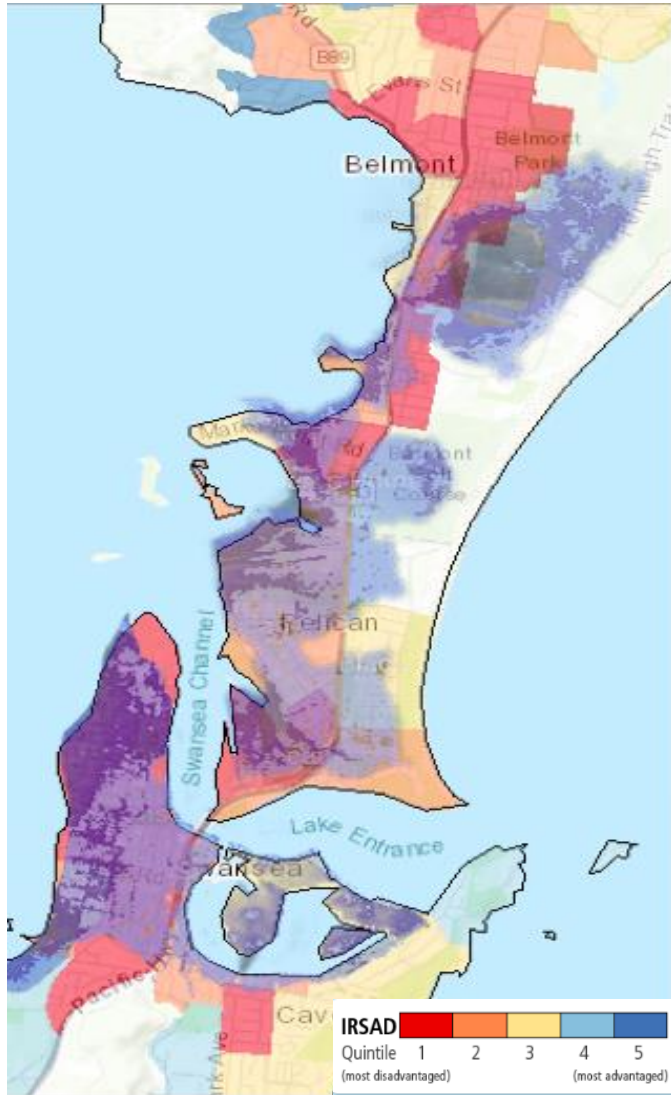
*(Source: ABS, 2016)*

As discussed above, several areas within Lake Macquarie LGA demonstrate high social vulnerability, resulting from lower average incomes and an older population (ABS, 2016).

While some areas of relative advantage, such as Valentine and Eleebana in the north, exist

thanks to resident families from higher income brackets (McManus et al., 2014), former and current coal-mining areas in the east and west are notably disadvantaged (see Figure 4.3), falling into the most disadvantaged quintile in Australia (ABS, 2016).

Figure 4.4 Lake Macquarie (A) 2100 sea-level rise projections



(Source: ABS, 2016; Coastal Risk, 2019)

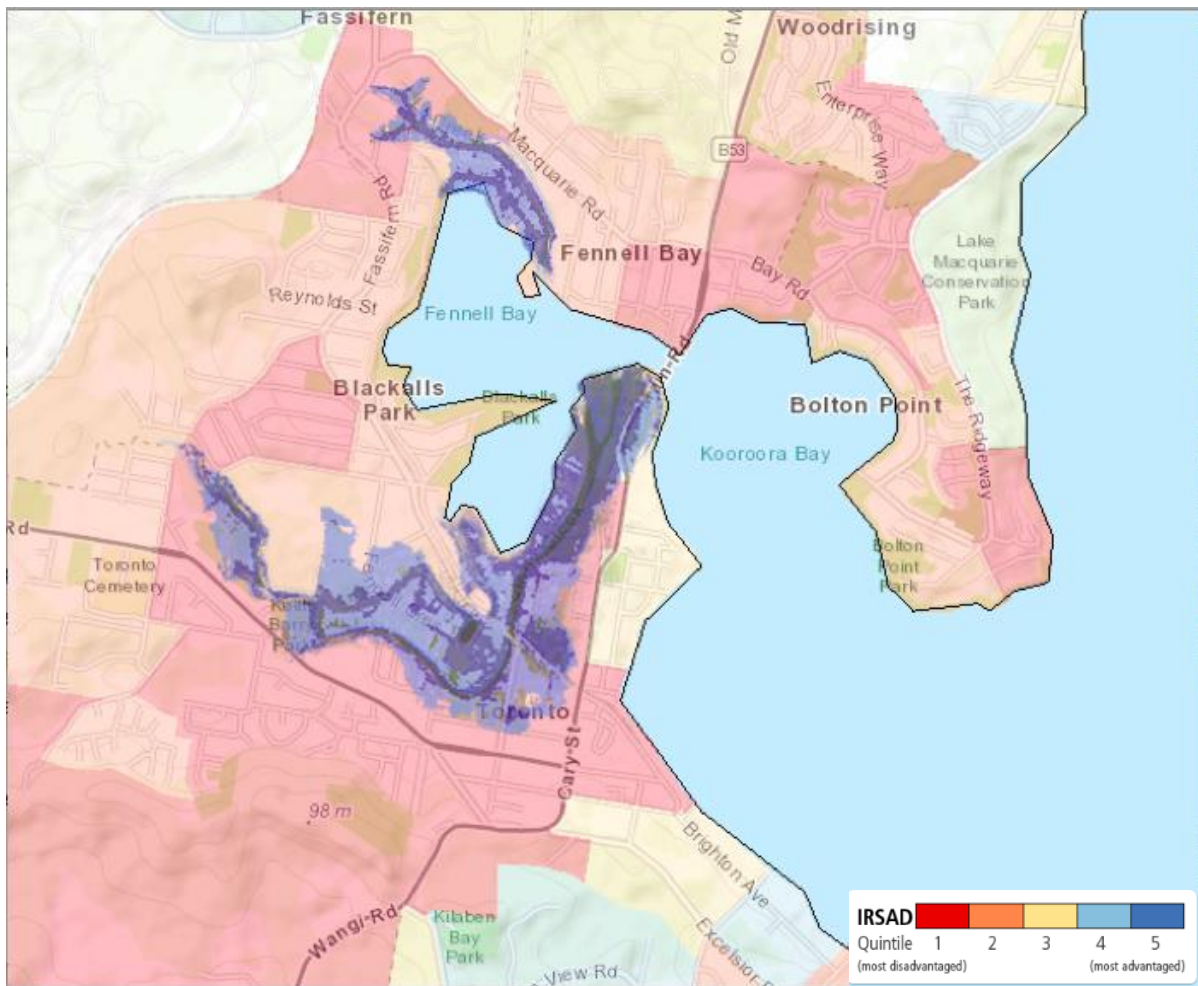
Combining SEIFA (2016) socioeconomic data with Coastal Risk (2019) SLR ecological exposure projections, clearly demonstrates the potential for climate disadvantage in two areas of Lake Macquarie. Point A (see Figure 4.4) represents the area that surrounds Swansea Channel, including the suburbs of Swansea, Little-Pelican and Blacksmiths. The purple areas reflect high disadvantage combined with projections that these suburbs will be

submerged during the highest tides anticipated to occur by 2100. The simultaneous threats of high exposure and high social vulnerability in these areas clearly demonstrates the potential for climate disadvantage. The area's high social vulnerability is the result of two key factors: over a third of the sub-population is aged over 65 (more than double the national average), while these suburbs report a median weekly income of \$462 – \$200 under the national median. As discussed in Section 4.4, older sub-populations are particularly vulnerable to extreme weather events, with the shock from external stressors potentially contributing indirectly to mortality. The proportion of vulnerable residents spread across Swansea and Little Pelican highlights that this area warrants prioritisation in LMCC's SLR adaptation planning.

The close relationship between vulnerability and exposure also exists in Point B in the west of Lake Macquarie. Coastal inundation, resulting from higher sea levels, threatens the area surrounding Fennell Bay. The lower socioeconomic suburbs Toronto and Blackalls Park are situated next to two creeks, LT Creek and Stony Creek, which will become more likely to flood the adjacent areas as sea levels rise (see Figure 4.5).

Lower-income residents are also more likely to live in the Fennell Bay area, a result of the area's proximity to coal mines (McManus, 2014; ABS, 2016). The factors contributing to this area's vulnerability were similar to Point A, with the average age of the sub-population significantly higher than both the NSW and Australian averages; and the highest level of educational attainment either being Certificate level III or Year 10 (ABS, 2016). However, in Toronto the proportion of unemployed residents was another contributing factor to social vulnerability, combined with over a quarter of families being supported by a single parent (ibid).

Figure 4.5 Lake Macquarie (B) 2100 sea-level rise projections



(Source: ABS, 2016; Coastal Risk, 2019)

Socio-spatial mapping – combining ecological exposure and social vulnerability maps – demonstrates that climate disadvantage threatens several areas of Lake Macquarie. While the flood risk plan and CZMP implemented by the LMCC covers a broad range of potential impacts, the failure to consider resident vulnerability and the social impacts of SLR means the council currently underestimates the risk of SLR to the community.

While socio-spatial mapping provides a valuable tool for identifying groups of vulnerable residents, SEIFA (2016) disadvantage maps pertain solely to resource-metric and biophysical understandings of individual well-being. Community surveys can give residents a voice, enabling insight into individuals who are potentially impacted by SLR but unable or unwilling

to express their concerns within traditional decision-making processes. Also, by giving individuals an opportunity to identify the factors that contribute to their own vulnerability, adaptation planning moves away from elitist, top-down approaches towards a bottom-up, community-based process. This change helps ensure that decision-making is transparent and legitimate, contributing to holistic social vulnerability frameworks that complement current risk-management assessments.

#### **4.5 Questionnaire results**

Questionnaire responses were obtained by approaching residents in Lake Macquarie over two days at two locations: Toronto foreshore on July 27 and Warners Bay foreshore on July 28. In total, 18 respondents participated over the two days (see Table 4.2). Respondents were comparable to socioeconomic data for the whole LMCC LGA in terms of participants aged 18-29 and over 60; and home ownership. However, the sample was overrepresented by females, participants with who attained Bachelor degrees and higher, and participants aged 30-49. Underrepresented in the survey were males, participants aged 50-59, and residents whose highest educational attainment was year 12 and below.

Table 4.2 Demographic comparison between questionnaire respondents and Lake Macquarie City Council LGA

	Questionnaire respondents	Lake Macquarie region
<b>Gender</b>		
Female	61%	51%
Male	39%	49%
<b>Age</b>		
18-29	22%	17%
30-39	22%	10%
40-49	33%	12%
50-59	0%	14%
60+	22%	29%
<b>Education</b>		
Bachelor degree level and above	61%	14%
TAFE or other vocational certificate	22%	31%
Year 12 or equivalent	0%	11%
Year 11 or equivalent	0%	4%
Year 10 or below	17%	16%
<b>Housing status</b>		
Occupy owned home	78%	73%
Renting and other	22%	27%
<b>Annual household income*</b> <i>(one respondent declined to answer)</i>		
Nil to \$40,000	11%	The median annual household income was \$64,272 for Lake Macquarie
\$40,001 to \$80,000	22%	
\$80,001 to \$150,000	33%	
Over \$150,000	22%	

(Source: ABS, 2016)

#### 4.5.1 Attitudes towards sea-level rise

Overall, participants in Lake Macquarie were more aware about the threat of SLR and concerned about the threat of SLR to their personal and community well-being than residents in Botany Bay, but less than respondents in Collaroy-Narrabeen. Graham and Barnett's (2017) finding that decision-makers struggled to engage with communities who weren't aware about the threat of SLR underlines the importance of understanding community members' awareness and concern about SLR.

Table 4.3 Perceptions of sea-level rise (n =18)

	<b>Lake Macquarie (% = yes)</b>
<b>Aware community may be threatened by future sea-level rise</b>	78% (14)
<b>Concerned about threat of SLR to personal well-being</b>	67% (12)
<b>Concerned about threat of SLR to community well-being</b>	78% (14)

A large majority (78%) was aware that Lake Macquarie was threatened by future SLR, with the same percentage concerned about the threat of SLR to their community's well-being. A slightly smaller proportion, but still a significant majority, was concerned about the threat of SLR to their personal well-being. While some respondents (LM4) said that the lake hadn't risen much in the 10 years they had lived in the area, other residents said the impact was already clear, "Beach erosion is evident already, the entire beach at Blacksmiths has gone" (LM3, 2019). While concerned, other residents felt the consequences would be faced by younger generations, "It won't happen overnight" (LM8).



#### ***4.5.2 Local council SLRAP***

The next set of questions gauged whether LMCC had been effective in consulting the public about SLR and council's plans for adaptation. Despite the extensive consultation undertaken by LMCC, only slightly over a tenth (11%) of respondents were aware that the council had an SLR adaptation plan - a figure consistent with the findings at Botany Bay and Collaroy-Narrabeen. However, less than half of the residents surveyed believed their views were represented by the local government. Despite the minimal knowledge of the SLRAP, a strong majority believed residents had the opportunity to contribute their knowledge to decisions about SLR if they desired. However, one respondent added that they felt consultation was just a "box-ticking process" and had no relevance to the outcome (LM5). In stark contrast to Botany Bay, however, less than half (44%) of residents wanted a greater voice in future SLR decision-making processes. The inadequate LMCC SLRAP consultation is consistent with Zafrin et al.'s (2014) research, which found that Queensland coastal management decision-making processes had limited engagement, resulting in a lack of public awareness. Moreover, while the LMCC went through several levels of engaging the community, this consultation process still falls within the "tokenism" category of Arnstein's (1969) typology of participation.

Table 4.4 Local government sea-level rise adaptation plans (n = 18)

	Lake Macquarie (% = Yes)
<b>Aware of any local council sea-level rise adaptation plan</b>	11%
<b>Believe views are represented by local government</b>	22%
<b>Do you believe residents have the opportunity to contribute their knowledge to decisions about SLR?</b>	68%
<b>Would like greater voice in future sea-level rise adaptation plan decision-making processes</b>	44%

#### 4.5.3 Adaptive capacity

Questions aimed at gauging the adaptive capacity of respondents elucidated that the majority of residents were well prepared for an extreme weather event. When asked to rate the strength of their social network on a scale of one to five, on average residents felt their social networks were relatively weak, with a mean score of 2.4 – lower than both Collaroy-Narrabeen and Botany Bay. Residents’ social networks are an important asset in responding to extreme weather events, providing a response network, social support and improving local knowledge bases (Lindley et al., 2011, 8). Despite this, residents felt they were sufficiently prepared for an extreme weather event, with an average with a score of 3.9 suggesting that the region’s history of extreme weather events may have prepared residents.

#### 4.5.4 Well-being

When asked about their well-being and what contributed to it, respondents in Lake Macquarie generally felt economic factors contributed much more to their overall health than respondents in either Botany Bay or Collaroy-Narrabeen. As outlined in Chapter 1, the metric by which well-being is measured and conceptualised has significant ramifications for

how governments implement policy. Currently, well-being assessments use an index of the material resources an individual has available to them, with losses in well-being measured through losses in resources (Lindley et al., 2011).

*Table 4.5 Definitions of well-being (n=18)*

<i>How would you define well-being?</i>	<b>Lake Macquarie</b>
<b>Capabilities and functionings</b>	62%
<b>Resource-based</b>	27%
<b>Subjective welfare</b>	11%

However, applying different metrics – such as subjective welfare or basic needs capabilities – serves to emphasise factors currently unconsidered by SLRAPs, such as stress or neighbourhood characteristics (ibid). The initial question in the survey sought to gauge whether residents believed resources were a good indicator for their overall well-being. On a scale of one to five, an average score of 4.6 overwhelmingly indicated respondents believed economic factors were essential to their well-being. Conversely, when asked to expand on this answer, providing an opportunity for respondents to define well-being, a majority (61%) spoke in terms of capabilities and functionings, discussing the need for mental, spiritual and emotional health in enabling the pursuit of opportunities. Over a quarter of respondents (27%) mentioned the necessity for resources and financial security in ensuring their well-being, indicating that only some residents feel current approaches are sufficient. The remainder (11%) said the maintenance of happiness was fundamental to their well-being.

#### 4.5.5 Focus of current and future SLR adaptation

Finally, respondents were asked what they considered important for current and future adaptation policy. As evident below (see Table 4.5), when asked about the focus of government policy, residents' discourse centred on several themes of justice.

Table 4.6 Community beliefs about policy (n=18)

<i>An argument exists that governments should focus on individuals' opportunities to experience life, rather than the distribution of wealth.</i> <i>Do you agree? (Why/why not?)</i>	<b>Lake Macquarie</b>
<b>(Yes) Socially vulnerable require greater attention</b>	28%
<b>(Yes) Greater government focus on individual's basic needs, capabilities and functionings</b>	28%
<b>(No) Small government preferable</b>	17%
<b>(Yes) Policy outcomes need more inclusion of procedural and distributive justice</b>	17%
<b>(Yes) Recognition of diversity within communities</b>	5%
<b>N/A</b>	5%

More than a quarter (28%) of respondents in Lake Macquarie believed governments should give greater attention to existing disadvantage within the community, while the same proportion spoke about the need for governments to reconfigure policy to support the ability of individuals to achieve and pursue opportunities. Less than a fifth (17%) of residents felt governments were already too involved in their daily lives. The same percentage of respondents wanted greater emphasis to be given to procedural and distributive factors, ensuring that government decision-making processes and outcomes were socially inclusive. One respondent spoke about the need for governments to think more collectively: “[There’s a] trend towards individualistic focus; [the] mentality has become destructive, ‘all about me’” (LM6).

Finally, respondents were asked about what they thought fair adaptation would look like in their community. While answers varied significantly, more than a quarter of respondents asserted that a greater focus on socially vulnerable residents was necessary for SLR adaptation policy to be “fair”, Lake Macquarie respondents’ had the highest positive response rate to this question of any case study.

*Table 4.7 Community framing of “fair” adaptation (n=18)*

<i>What would fair adaptation look like in your community?</i>	<b>Lake Macquarie</b>
<b>Focusing on the socially vulnerable</b>	28%
<b>Concentrating on community-level mitigation</b>	22%
<b>Resilience</b>	11%
<b>Education</b>	11%
<b>More inclusive decision-making</b>	11%
<b>Economic and environmental transformation</b>	11%
<b>N/A</b>	6%

Slightly less than a quarter (22%) believed adaptation should involve greater incentives to mitigate emissions, with respondents’ asserting that local governments should promote the adoption of renewable energy by local residents. Questions of justice were also evident in the same proportion of respondents’ answers (22%), with participants believing that fair adaptation required decision-making to be more inclusive, while others spoke temporally – of the need to ensure future generations were able to enjoy the same environment as they do. Slightly over a tenth of residents (11%) said risk-based adaptation measures – such as dredging the Swansea Channel and foreshore rehabilitation - were essential for community well-being. In total, half of the respondents (49%) believed fair adaptation required

integrating transformational policy. As one respondent said, “fair” adaptation for her involved “Greater focus on wheelchair access, consideration of the less fortunate, more community-based facilities and increased public transport” (LM5).

#### **4.6 Research findings**

The Lake Macquarie research revealed four findings:

1. Two areas within Lake Macquarie face significant climate disadvantage. These areas, which fall into the most disadvantaged quintile in Australia, will increasingly face the significant threat of inundation as sea levels rise. The SLR socio-spatial mapping was consistent with the climate change vulnerability assessment conducted by Brunckhorst et al. (2011). The existence of climate disadvantage demonstrates that current risk-management approaches are insufficient, requiring complementary social vulnerability frameworks to ensure vulnerable residents are identified and included in planning decisions. As will be discussed later, the variation between climate disadvantage across case studies supports the notion that “place-based” approaches are most suitable for SLR adaptation. Moreover, the multiples layers of disadvantage revealed in this research, and residents’ responses, support Preston et al.’s (2011) argument that adaptation planning needs to be integrated with other social, urban and regional planning, disaster mitigation and sustainable development efforts, to increase adaptive capacity. The exclusion of social vulnerability concerns reflected McManus et al.’s (2014) finding that poorer and disadvantaged groups in Lake Macquarie had less influence over climate change policies.

2. The LMCC CZMP emphasised increasing the resilience of the community and ecological systems. This finding supported Collins’ (2016) claim that bio-physical impacts are prioritised

over socio-political inclusiveness in local councils' CCAPs. Despite earlier assessments demonstrating the social vulnerability of several parts of Lake Macquarie (Brunckhorst et al., 2011), and the inclusion of the intangible costs of flooding in the 2011 LMCC Flooding risk-assessment, the only social aspects considered within the 2015 CZMP risk-management assessment were activities directly associated with the beach, lake and foreshore. While the inclusion of these factors are important for understanding the potential impact of SLR, the emphasis on increasing community and ecological resilience in the *CZMP Four-Year Plan 2015-2019* are at odds with the community's desire for greater attention to be given to addressing existing and future vulnerability.

3. Despite an ostensibly extensive consultation process, only 11% of local residents were aware of LMCC's SLRAP, pointing to a failure of the adaptation engagement strategy. The lack of community SLRAP awareness was consistent with the results of both the Botany Bay and Collaroy-Narrabeen surveys. These findings suggest that alternative methods should be implemented to ensure community members are involved in planning processes. The integration of community members from the initial drafting of adaptation policy and throughout its implementation (see Schlosberg et al., 2017) may be a more authentic and efficient method of ensuring the entirety of residents' voices are included in decision-making.

4. As noted in (1), a disconnect between community desires for SLRAP and the risk-based focus of LMCC SLRAP exists on two levels:

- i. Almost half the respondents spoke about SLR adaptation in terms of justice, noting that current policy structures fail to sufficiently include vulnerable residents. Moreover, community discourse was focused on procedural and temporal elements of justice, with a

view to ensuring that future SLR adaptation decisions are socially inclusive and that consideration of future generations is incorporated into planning. Responses reflected community desire for transformational SLR adaptation policy, opposed to LMCC's CZMP focus on increasing resilience. Respondents' broader view of adaptation also recognised the need for SLRAP to address underlying social, political and economic issues to ensure SLR doesn't compound disadvantage. The discrepancy between respondents' language and the focus of the LMCC SLRAP supports Schlosberg et al.'s (2017) finding that a discursive disconnect exists between community groups and local governments.

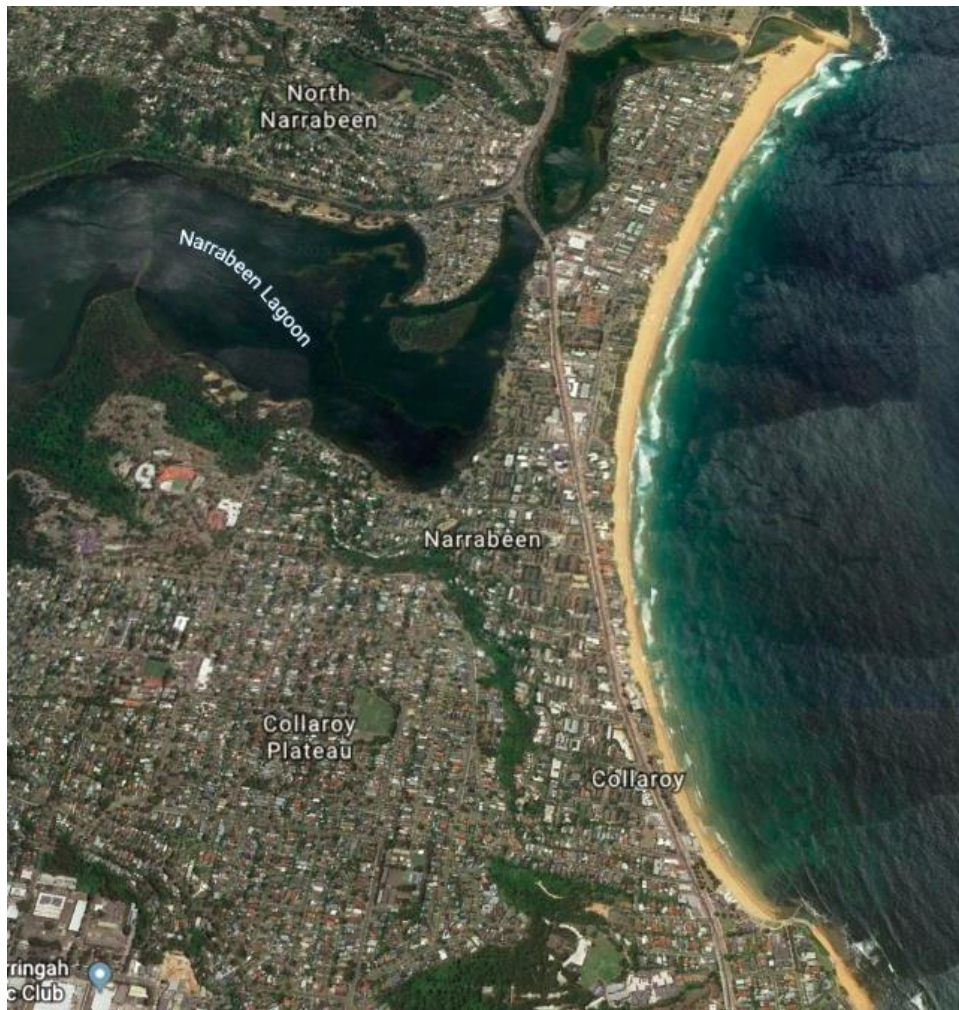
ii. The dangers of SLR to well-being are predominately framed in resource-based terms by the LMCC (with the exception of a section in the 2011 Flood risk-management plan). Conversely, a strong majority of residents defined well-being in terms of capabilities and functionings. The difference in perspective highlights that Lake Macquarie residents desire adaptation plans that conceive well-being more holistically than resource-based metrics.



## Chapter 5 Collaroy-Narrabeen

This chapter analyses SLR adaptation in Collaroy-Narrabeen in three sections: (1) an assessment of Collaroy-Narrabeen's current SLRAP; (2) socio-spatial mapping to identify potential climate disadvantage; and (3) questionnaires enabling residents to frame their concerns about SLR, well-being and SLR adaptation planning.

*Figure 5.1 Map of Collaroy-Narrabeen and surrounding area*



*(Source: Google Earth)*

## **5.1 Climate overview**

Situated on the eastern coast of Sydney, Narrabeen and Collaroy are neighbouring suburbs. Both suburbs are wedged between Narrabeen Lagoon and Collaroy-Narrabeen Beach, which extends for 3.6 km (See Figure 4.1).

Collaroy-Narrabeen has an ongoing history of coastal storms resulting in the damage from beach erosion to beachfront developments. Extreme storms have increased in frequency over the past 100 years (Royal Haskoning DHV, 2016, 8), causing significant damage to both private and public assets. The 2016 east-coast-low “super-storm”, which damaged several beachfront properties, emphasised the threat that extreme weather events associated with SLR poses to the region. Climate models predict that the frequency of storms in Sydney are projected to increase by 13% by 2030 and 48% by 2070 (AECOM, 2010). Hennecke (2004) projected that a sea-level rise of 20 cm by 2050 could result in coastal erosion of up to 22 metres along Collaroy-Narrabeen beach, rising to 110 metres given a 1- 50-year storm surge, with associated economic losses of \$230 million.

## **5.2 Community profile**

In 2018 Collaroy-Narrabeen had a combined population of 26,453 (ABS, 2016d). Both suburbs are encompassed within Northern Beaches Council but were previously within Warringah Council boundaries before the 2016 amalgamation of Warringah, Pittwater and Manly councils (Royal Haskoning DHV, 2016). The population was slightly older than the national average (37.3 years) with a median age of 40.2, and had a slightly higher proportion of females (52%) than males (48%) (ABS, 2016d). The median total income per person (\$53,506) was significantly higher than the national average (\$47,692), with the area’s

affluence also reflected in a low unemployment rate (2.9%) significantly lower than the Australian average (6.9%) (ABS, 2016d). Collaroy-Narrabeen's population is predominately Anglo-Saxon, with almost 70% of residents' having English, Australian, Irish or Scottish ancestry (ibid).

### **5.3 Current SLR adaptation plan**

Northern Beaches Council released its Coastal Zone Management Plan (CZMP) for Collaroy-Narrabeen Beach and Fisherman's Beach in December 2016. The CZMP's aim is "to find a balanced and achievable approach that protects and preserves beach environments while limiting the impact of coastal processes on public and private assets" (Royal Haskoning DHV, 2016, i). The plan identifies and prioritises four key actions:

- The protection and preservation of beach environments and beach amenity
- Manage current and projected future risks from coastal hazards
- Ensuring ongoing public access to beaches, headlands and waterways
- Protecting and promoting the culture and heritage of both beaches

(Royal Haskoning DHV, 2016)

Incorporating an adaptive risk management approach, the CZMP attempts to identify an acceptable level of risk for waterfront properties (ibid). The varying threat levels were assessed by Marsden Jacob Associates (MJA), who undertook a benefit distribution assessment (Marsden Jacob Associates, 2016). This assessment analysed the distribution of benefits and costs from coastal adaptive measures designed to protect Collaroy-Narrabeen beach from coastal erosion (ibid). In addition, the options for adapting to the threat of coastal inundation from Narrabeen lagoon were assessed by AECOM in 2010. The council

previously responsible for Collaroy-Narrabeen (Warringah) included in the vulnerability assessment conducted by SCCG (Preston et al., 2008a; Preston et al., 2008b).

The CZMP community consultation was conducted over a 33-day period. In accordance with Section 55E of the *Coastal Protection Act 1979*, the plan was exhibited publicly from 14 July 2014 to 15 August 2014; and was advertised in the Manly Daily newspaper during the exhibition period. Additionally, over 700 letters were sent to home-owners and residents adjacent to or near Collaroy-Narrabeen Beach inviting them to comment on the draft policy; and emails were sent to over 5000 residents who had signed up to the Northern Beaches Council Community engagement register (Royal Haskoning, DHV, 2016).

The policy is confined to an assessment of biophysical impacts: the risks of coastal processes and coastline hazards to the ecological and built environments along and near Collaroy-Narrabeen Beach (Collins, 2016). The private residences considered within the report are limited to beachfront properties (Royal Haskoning DHV, 2016, 54). Various adaptation measures are discussed throughout. These measures included sand dune maintenance and beach amenity, to replenish eroding coastline with sand (ibid). However, the CZMP states that while the development of properties under threat of SLR is undesirable (due to risks to the dune system) implementing necessary protection works, with the necessary risk assessments, may result in the approval of planned development (Royal Haskoning DHV, 2016). The potential for future development highlights that the council is unlikely to implement a “retreat” adaptation policy option. The plan’s focus can be categorised as adaptation as resilience in Pelling’s (2011) typology.

Using Collins' (2016) distinction between CCAPs which prioritise biophysical concerns and those prioritising socio-political concerns, Collaroy-Narrabeen clearly fits within the former, with the Collaroy-Narrabeen's CZMP predominately focusing on urban planning and infrastructure. Moreover, the plan's neglect of mental health, other social factors and marginalised groups demonstrates that the plan interprets "adaptation" as "resilience". A pertinent example of this focus is the use of vulnerability throughout the policy, confined entirely to the susceptibility of council and private assets to coastal inundation (Royal Haskoning DHV, 2016, 49). The CZMP's only consideration of social aspects consists of a limited analysis of beach-based activities including surfing, fishing, surf lifesaving clubs and swimming clubs (Royal Haskoning DHV, 2016, 23).

The minimal consideration of the impact on wider social factors that contribute to residents' adaptive capacity means the policy underestimates the full range of potential risks arising from rising sea levels. Without consideration of the wider social impacts, SLR adaptation planning may exacerbate existing disadvantage. A notable example is AECOM's recommendation of flood warnings over other options as "the early warnings of floods would be relatively inexpensive" (AECOM, 2010, 2). However, research undertaken by Samwinga et al. (2004) highlighted the contribution of social factors to the effectiveness of flood warnings, noting they were less effective in reaching some vulnerable residents, particularly recent immigrants. While the ethnic composition of Collaroy-Narrabeen is overwhelmingly Anglo-Saxon, the failure to consider such caveats risks endangering residents who already experience disadvantage.

While the majority of residents highly exposed to SLR and extreme weather events also possess high adaptive capacities, the council's approach minimises the adaptation options

available. With most of the threatened residences built onto natural sand dunes, planning only to protect these residences in the long-term is irrational and potentially costly. In addition, an exclusive focus on protecting beachfront residences augments power-political dynamics that have arisen from rising coastal property prices and from economic and population growth. Unless these power dynamics are countered, El-Zein (2019, 29) notes, “stay-and-protect” becomes the only viable option for local councils.

Despite the affluence enjoyed by beachfront residents, which contributes to their higher adaptive capacity, their high exposure to SLR seemingly vindicates Northern Beaches Council’s prioritisation of biophysical factors in their SLRAP. However, the identification of vulnerable subpopulations within the region using socio-spatial mapping demonstrates the need for inclusion of social vulnerability frameworks in adaptation planning.

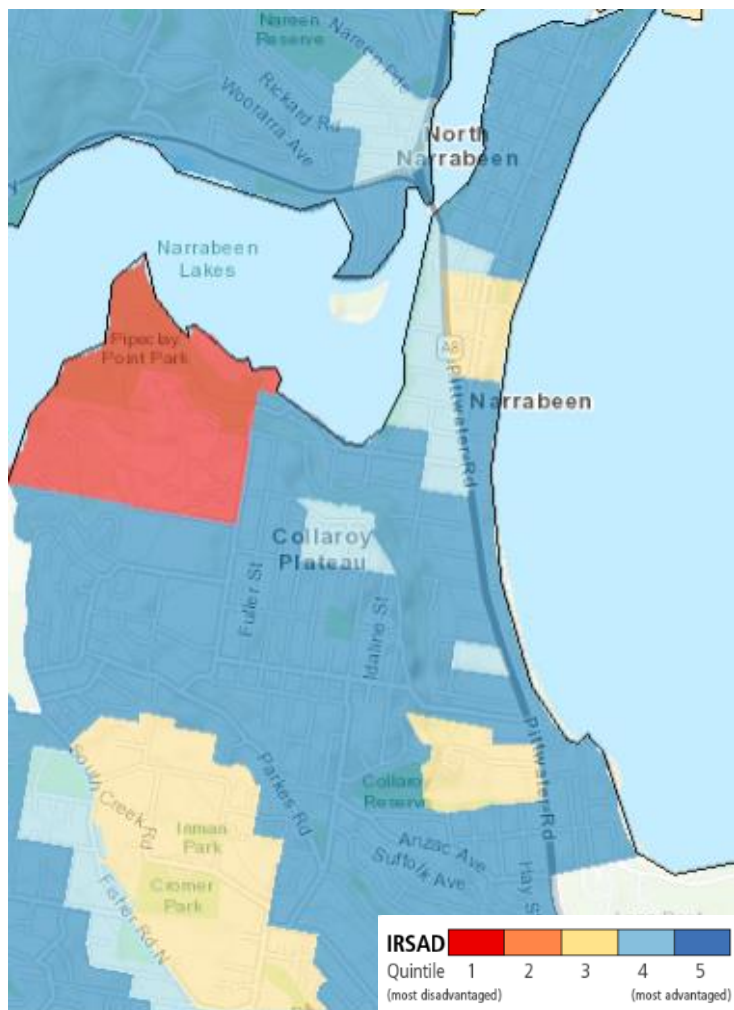
#### **5.4 Identifying climate disadvantage**

Combining ecological exposure projections with SEIFA socio-economic data demonstrates little evidence of potential climate disadvantage within Collaroy-Narrabeen, chiefly because of the area’s overall comparative affluence, with the majority of residents falling within the upper two quintiles of advantaged Australians. The area’s affluence is reflected by the much lower proportion of unemployed residents (2.9%) than the national average (6.9%); while the median household weekly income (\$2,009) is almost one-third higher than households nationally (\$1,438) (ABS, 2016d).

These findings are supported by the research undertaken by Preston et al. (2008b), who demonstrated that Warringah LGA - the area that included Collaroy-Narrabeen before amalgamation - had both a higher adaptive capacity and higher exposure to SLR compared

to other Sydney councils (Preston et al., 2008b). Thus, the relative affluence of Collaroy-Narrabeen means disadvantage is only identifiable within one area: a retirement village below Pipeclay Point Park. This subpopulation’s vulnerability demonstrates the need for nuanced local government adaptation planning that recognises the uneven geographies of social vulnerability.

Figure 5.2 Collaroy-Narrabeen IRSAD SEIFA map



(Source: ABS, 2016)

Figure 5.2 shows that a significant proportion of the region’s residents are among the upper quintile of the most-advantaged Australian citizens (ABS, 2016d). Residents who live behind Pittwater Road, and in front of Narrabeen Lakes, generally fall into the second most-

advantaged quintile (ibid). While beachfront property owners along Collaroy and Narrabeen beach face the dual threat of coastal erosion and extreme weather events, their significant endowments (i.e. accumulated assets and insurance) enhance their ability to recover and respond to external stressors.

The combination of ecological and socio-economic maps demonstrates little evidence of climate disadvantage in the area, with residents highly exposed to coastal inundation or erosion falling within the upper quintiles of advantaged residents. However, while not facing the direct threat of SLR, the vulnerability of the area below Pipeclay Point Park - falling into the most disadvantaged quintile - points to the necessity of including vulnerable groups in adaptation plans (see Figure 5.4). The vulnerable area's disadvantage results from several factors: the median age of the area (85) is significantly higher than the national average, with over half the subpopulation (51.4%) 85 years or older; and a much lower employment rate and average income (ABS, 2016d).

However, the large retirement village in this area contributed significantly to this score creating the potential for a misleading representation of vulnerability. As SEIFA doesn't account for accumulated assets (ABS, 2016d), the disadvantage indicator can be deceptive when considering concentrated sub-populations. Yet, while this sub-population may not be as disadvantaged as it first appears, the literature demonstrates that concentrated areas of elderly residents are more vulnerable to extreme weather events, particularly coastal hazards, and hence require greater consideration when planning for adaptation (Banks et al., 2014).



Figure 5.3 Collaroy-Narrabeen 2100 sea-level rise projections



(Source: ABS, 2016)

As Lindley et al. (2011, 32) note, elderly residents can be adversely impacted by the shock of an extreme-weather event and stress of recovery, with the stress exacerbating pre-existing health conditions, potentially resulting in indirect mortality. Neglecting vulnerable areas - such as the retirement village below Pipeclay Point Park - when planning for SLR adaptation creates the potential for biased and incomplete perceptions of risk (Preston et al., 2011). In sum, while Collaroy-Narrabeen represents one of the most advantaged areas in Australia,

the identification of vulnerable subpopulations with socio-spatial mapping demonstrates the need to consider socio-political factors in more nuanced SLR adaptation plans. Thus, further confirming the value of incorporating socio-spatial mapping in risk-management adaptation assessments.

### **5.5 Questionnaire results**

As discussed earlier, the benefits of holistic community engagement in informing policy development throughout the process, rather than asking residents to comment on a series of draft plans, are plentiful. In total, 18 questionnaire responses were obtained across the two days of research. The sample was overrepresented by females, residents aged 40 to 49 and over 60, residents with bachelor level qualification or above; and people who owned the house they occupied. Underrepresented were males; residents aged 18-29; and tenants.

Table 5.1 Demographic comparison between questionnaire respondents and Collaroy-Narrabeen

	Questionnaire respondents	Collaroy-Narrabeen
<b>Gender</b>		
Female	67%	48%
Male	33%	52%
<b>Age</b>		
18-29	6%	23%
30-39	11%	14%
40-49	24%	15%
50-59	11%	12%
60+	44%	25%
<b>Highest Level of Education</b>		
Bachelor degree level and above	50%	26%
TAFE or other vocational certificate	33%	27%
Year 12 or equivalent	0%	15%
Year 11 or equivalent	11%	3%
Year 10 or below	6%	9%
<b>Housing status</b>		
Occupy owned home	83%	66%
Renting and other	17%	34%
<b>Annual household income*</b>		<i>*(one resident declined to answer)</i>
Nil to \$40,000	17%	The median household income for Collaroy-Narrabeen was \$104,468
\$40,001 to \$80,000	22%	
\$80,001 to \$150,000	22%	
Over \$150,000	33%	

(Source: ABS, 2016)

### 5.5.1 Attitudes towards sea-level rise

When asked about their awareness of SLR, almost all (85.7%) respondents were aware of and concerned about the threat of SLR to their community (see Table 4.2). A slightly lower proportion was concerned about the threat of SLR to their personal well-being.

Table 5.2 Perceptions of sea-level rise (n=18)

	<b>Collaroy-Narrabeen (% = yes)</b>
<b>Aware community may be threatened by future sea-level rise</b>	78%
<b>Concerned about the threat of SLR to personal well-being</b>	78%
<b>Concerned about the threat of SLR to community well-being</b>	89%

As Hamlin et al. (2014, 117) note, community awareness and evaluation of climate change is the initial step in a process of adaptation, providing “political creature” policy-makers with incentives to enact change. Without community awareness, politicians will generally avoid acting on many issues of concern to their constituents.

When asked about their concerns, respondents reflected on the evident changes occurring along the coastline, noting that they were concerned that events like the 2016 super-storm could become more frequent and intense. As one resident remarked, “Sea-level [rise] is happening in front of our home and changing our home” (NC5).

### 5.5.2 Local council SLRAP

The following questions assessed the effectiveness of each local council’s SLR engagement strategies. Only around 10% of respondents were aware of Northern Beaches Council’s CZMP - a finding that was consistent with case studies in Botany Bay and Lake Macquarie.

Moreover, almost 90% of residents wanted a greater voice in future SLR decision-making processes.

*Table 5.3 Local government sea-level rise adaptation plans (n = 18)*

	<b>Collaroy-Narrabeen (% = Yes)</b>
<b>Aware of any local council sea-level rise adaptation plan?</b>	11%
<b>Believe views are represented by local government?</b>	11% [75% unsure]
<b>Do you believe residents have the opportunity to contribute their knowledge to decisions about SLR?</b>	38% [50% unsure]
<b>Would like greater voice in future sea-level rise adaptation plan decision-making processes?</b>	88%

### ***5.5.3 Adaptive capacity***

Collaroy-Narrabeen residents generally felt positively about both their social networks and adaptive capacity. Social networks provide an intangible support base for residents during times of crisis, enhancing their ability to recover and respond to external stressors (Lindley et al., 2011). On a scale of one to five, respondents believed their social network was quite strong, with an average score of 3.6 higher than both Botany Bay and Lake Macquarie. When asked about their ability to cope with and respond to an extreme weather event, respondents felt slightly less confident, with an average score of 3.4. This result was surprising, given the area’s high socio-economic status.

### ***5.5.4 Well-being***

One of the key conclusions reached by Lindley et al. (2011) was that CCAPs fail to adequately capture the many dimensions of well-being. The authors assert that individual well-being should instead be defined in terms of opportunities (capabilities) to achieve the valuable things a person can do or be (functionings) (Lindley et al., 2011, 95). Questions in

this category aimed to gauge which factors residents believed contributed to their well-being. On a scale of one to five, respondents were asked to rank the significance of economic resources to their overall well-being. While Collaroy-Narrabeen respondents gave an average response of 3.5, their answer rating the significance of economic resources significantly less than either Botany Bay or Collaroy-Narrabeen, When asked to define well-being, respondent’s discourse revolved around basic needs capabilities and functionings, with only two residents defining their well-being in terms of economic factors, such as income or financial security, with the remainder (88%) speaking holistically about the variety of factors that contribute to their overall health. This approach was exemplified by one resident whose definition of well-being was, “to be healthy - both physically and mentally - and be satisfied that they are able to develop themselves and to reach their full potential” (NC14).

Table 5.4 Definitions of well-being (n=18)

<i>How would you define well-being?</i>	<b>Collaroy-Narrabeen (% = Yes)</b>
<b>Capabilities and functionings</b>	89%
<b>Resource-based</b>	11%

The discursive lens of Collaroy-Narrabeen respondents, framing well-being in terms of basic needs capabilities, conflicted with the bio-physical focus of Northern Beaches Council’s CZMP.

### 5.5.5 Focus of current and future SLR adaptation

The final section of the questionnaire invited respondents to outline the factors they considered important for current and future adaptation policy. First, they were asked whether they believed incorporating a capabilities-based approach into government frameworks was desirable. Responses to this question varied, with discourse split across four themes: transformative policy; practical pragmatism; community capabilities; and subjective welfare. One in four respondents answered transformatively, seeking to ensure that all residents were able to access equal opportunities and noting the necessity of economic and structural reform (such as improved transport links) in achieving this outcome. An equal number believed that while transformative policy was theoretically desirable, policy barriers made it practically unachievable.

Table 5.5 Community beliefs about policy (n=18)

<i>An argument exists that governments should focus on individuals' opportunities to experience life, rather than the distribution of wealth.</i> <i>Do you agree? (Why/why not?)</i>	<b>Collaroy-Narrabeen</b>
<b>(Yes) Transformative policy</b>	39%
<b>(No) Practical pragmatism</b>	39%
<b>(Yes) Community Capabilities</b>	11%
<b>(Yes) Subjective welfare</b>	11%

Next, when respondents were asked to consider what “fair” adaptation would look like in their community they discussed the wider threat of SLR, noting that the current fixation on waterfront property owners neglected other concerns. Predominantly, residents believed

adaptation should be more inclusive, ensuring disadvantaged residents had access to the same resources and decision-making processes as wealthier residents.

*Table 5.6 Community framing of “fair” adaptation (n=18)*

<i>What would “fair” adaptation look like in your community?</i>	<b>Collaroy-Narrabeen</b>
<b>Focusing on socially vulnerable</b>	39%
<b>Focusing on future generations</b>	17%
<b>More inclusive decision-making processes</b>	17%
<b>N/A</b>	11%
<b>Risk-based adaptation</b>	11%
<b>Recognition and inclusion of nonhuman environment</b>	5%

Respondents’ answers predominately involved ensuring that residents currently excluded from adaptation planning - marginalised groups, future generations and also animals - were recognised and included in future planning. As one respondent said, “[sea-level rise] affects everyone in the community, rather than just waterfront property owners” (NC6).

### **5.6 Research findings**

1. Collaroy-Narrabeen presented little evidence of potential climate disadvantage, with highly exposed residents also possessing higher adaptive capacities. However, the retirement village under Pipeclay Point Park demonstrates that uneven geographies of social vulnerability can exist even within affluent areas, supporting arguments for



the inclusion of social vulnerability frameworks to complement all risk-based SLR adaptation plans.

2. Respondents were both more aware and more concerned about the threat of SLR to their personal and community well-being than those in either Botany Bay or Lake Macquarie, suggesting that previous experiences with extreme weather-related events may be effective in raising awareness about the threat of climate change and SLR.
3. Only 11% of respondents were aware of Northern Beaches Council's SLR adaptation policy for Collaroy-Narrabeen. This low level of awareness was consistent across all three case studies.
4. More than 80% of respondents wanted a greater voice in future SLR adaptation decision-making processes. Findings three and four suggest that the council's current engagement strategies are inadequate.
5. Community discourse, which concentrated on inclusive adaptation policy, conflicted with the risk-oriented Collaroy-Narrabeen CZMP. Questionnaire responses demonstrated a disconnect between residents who conceive SLR adaptation in terms of vulnerability and transformational policy, and Northern Beaches Council's CZMP, which focuses on increasing ecological and biophysical resilience. The discursive disconnect between community and government was also prevalent in respondents' definitions of well-being. Residents' conception of well-being in terms of basic needs capabilities was significantly removed from resource-metric government perspectives.

## **Chapter 6 Discussion**

The final chapter of this thesis concentrates on the major contributions and findings of this Honours research, and also discuss the importance of these findings in the context of the literature. The limitations of the study and the implications for further research will also be examined.

The novel approach to socio-spatial mapping that combines ecological exposure and social vulnerability adopted in this research - the first time the methodology has been applied to Australian SLR research - provides definitive evidence of climate disadvantage. These findings lend credence to the inclusion of social vulnerability frameworks in existing sea level rise adaptation plans (SLRAP). Additionally, three other findings from the research will be discussed: (1) the biophysical, risk-based focus of each SLRAP; (2) the failure of local council SLR engagement strategies; and (3) the disconnect between risk-focused governments and communities concerned with social vulnerability. Evidence that simultaneous layers of exposure and vulnerability exist in Australia strongly suggests that current risk-based approaches to climate adaptation planning fail to fully address the threat of sea level rise (SLR). When combined with questionnaire responses, this original Honours research demonstrates the utility of incorporating social vulnerability frameworks and socio-spatial mapping in SLR adaptation planning and policy, helping to ensure existing disadvantage isn't compounded by rising sea levels.

## **6.1 Major contribution & finding: climate disadvantage**

The significant contribution to the literature from this research is the identification of simultaneous layers of ecological exposure and social vulnerability – i.e. climate disadvantage - within Lake Macquarie and Botany Bay. Within the Australian literature, this research is the first to use socio-spatial mapping to simultaneously consider climate change exposure and disadvantage arising from SLR, demonstrating that the existing disadvantage of vulnerable coastal communities and individuals' risks being compounded without structural amendments to current adaptation planning processes. Evidence of climate disadvantage is important for three reasons: (1) current local governments' adaptation planning tends to conceptualise the threat of SLR entirely in terms of exposure and risk, thereby ignoring the threat that SLR poses to vulnerable community members; (2) this novel approach to socio-spatial mapping provides evidence that incorporating social vulnerability into existing adaptation planning frameworks can be simple, effective and inexpensive; and (3) the variations of potential climate disadvantage exhibited between different locations support arguments for "place-based" approaches to adaptation.

The initial point captured by evidence of climate disadvantage implies that current risk-based approaches to SLR adaptation are not fit for purpose. Current risk-management approaches, as utilised by the relevant council in each case study, underestimate or ignore the complex and multifaceted dangers that rising sea levels pose to vulnerable communities. Research undertaken by Preston et al. (2011) demonstrated that a critical weakness in Australian Climate Change Adaptations Plans (CCAPs) was the failure to consider non-climatic factors. As the authors assert, failing to consider climate change in the context of the socioeconomic drivers "creates the potential for biased and incomplete

perceptions of risk” (Preston et al., 2011, 407). Lindley et al. (2011) note that socio-spatial vulnerability indexes are vital for recognising that uneven geographies of vulnerability exist within and across society. Instead, current risk-based approaches respond homogeneously to the threat of SLR to communities, failing to recognise that underlying social, economic and political currents can positively or negatively enhance the ability of residents to prepare, recover and respond to external stressors. By including socio-economic data, these maps would enable governments to identify sections of the community that may be especially vulnerable to rising sea levels and extreme weather events.

Second, this research’s novel approach within the context of Australian SLR literature, integrating ecological SLR projections with socio-economic mapping, offers local government a simple and effective methodology for incorporating social vulnerability into their SLR adaptation frameworks. While socio-spatial mapping has been used extensively in literature overseas, predominantly within the disaster-management and hazards literature, its use in both academic and grey Australian literature remains sparse. Most relevantly in the context of this research, the Australian literatures shows no use of socio-spatial mapping in considerations of SLR’s threat across geographic areas. The creation of maps using existing data demonstrates that not only do local councils’ SLRAPs inadequately conceive the threat of SLR, but incorporating social vulnerability considerations within these plans can be easily achieved. Furthermore, the adoption of socio-spatial mapping by local coastal councils is supported by both moral and practical imperatives that will be discussed below.

As Banks et al. (2014) assert, by failing to account for social vulnerability, SLR adaptation planning may disproportionately impact disadvantaged individuals and communities over

the long-term. Morally, in a just society adaptation planners need to respond inclusively to evidence that while climate change evidently compounds disadvantage and poverty, conversely, poverty increases vulnerability to climate change. Consequently, the evidence of climate disadvantage in Lake Macquarie and Botany Bay demonstrates a need for each local council to conceive the threat of SLR more broadly. As Paavola and Adger (2006, 274) stress, putting the most vulnerable at the forefront of climate change adaptation plans is imperative to ensure existing disadvantage isn't compounded. The authors noting that the capacity of households and communities to adapt is dependent on their physical assets such as "health, education and human-created and natural capital" (ibid). Moreover, from a policy perspective, England and Knox (2016), note that narrow, risk-based economic assessments underestimate the costs of floods by failing to account for wider social factors, defining this as the "cascade effect". A failure to consider the "cascade effect" thereby threatens to exacerbate the SLR's anticipated social impacts. Using the example of Los Angeles traffic, El-Zein (2019) asks how many of the chronic problems society faces today have their roots in poor planning decisions made 50 years ago? The consequences of adaptation decisions made today will be felt by coastal societies to 2100 and beyond. Policies that ignore the interconnected impacts of rising sea-levels risk exacerbating the eventual effects, leaving communities less-equipped to deal with these issues. As Karen O'Brien (2012, 670) argues, climate change adaptation isn't about social engineering but, rather, "recognising that some fundamental shifts are necessary to enable desirable futures to emerge."

Therefore, current approaches to coastal planning would be improved by recognising that uneven geographies of social vulnerability exist within and between regions, a paradigm

shift which consequently justifies the preparation and adoption of locally specific adaptation plans. Measham et al. (2011, 890) go further arguing that climate change adaptation should be “place-based”, which refers to the “spatially distinct group of biophysical and social conditions ... which tend to focus at the local and regional scales where global and local drivers manifest themselves in particular ways.” The uneven geographical distribution of vulnerability was notable in the Botany Bay region, particularly when compared to more homogenous levels of disadvantage in Lake Macquarie and the comparative advantage observed in Collaroy-Narrabeen. Banks et al. (2014) argue that the variations in distributions of climate risk to vulnerable populations highlights that local authorities need to develop highly granular maps of vulnerability. However, while the political barriers to integrating social vulnerability into adaptation policy - lack of funding, policy framework, powers and capacity – may appear significant, this research indicates that socio-spatial mapping offers local governments a simple, effective and inexpensive tool for identifying vulnerable populations. Applying this novel methodology would help ensure that future SLRAPs identify the overlapping threat of climate vulnerability and exposure to rising sea levels and encourage more egalitarian adaptation planning.

Socio-spatial mapping illustrated significant areas of potential climate disadvantage within two of the three case studies. While the third case study - Collaroy-Narrabeen - demonstrated little evidence of potential climate disadvantage, the pocket of elderly residents in the retirement village below Pipeclay Point Park justify identifying and including vulnerable sections of the community in all future SLRAPs. Uneven geographies of social vulnerability were also apparent the Botany Bay region. Two areas were identified as potentially vulnerable to SLR - one that fell within the most disadvantaged quintile in

Australia, the other with a higher adaptive capacity. Lake Macquarie also contained simultaneous layers of social vulnerability and ecological exposure to coastal inundation. The socio-economic variation between and within case studies demonstrates that SLRAPs need to be tailored to specific localities and communities, augmenting the central role local government already plays in climate change adaptation at the community level.

## **6.2 Additional findings**

The research's major finding and contribution to the literature – revealing that several coastal areas of NSW face potential climate disadvantage - is accompanied by three additional findings that became evident in document analysis and questionnaire responses: (1) each local council's perception of adaptation as resilience; (2) the failure of current engagement strategies; and (3) themes of justice prevalent in community discourse.

### ***6.2.1 Sea-level rise adaptation plans: risk and resilience***

The initial finding of this research demonstrates that SLRAPs within NSW define adaptation as resilience, predominately focused on the resilience of infrastructure. Despite variations between each local government SLRAP considered in this research, the underlying theme and focus of all these SLRAPs was evidently the mitigation of risks to physical infrastructure. Moreover, the plans covering both Lake Macquarie and Collaroy-Narrabeen mostly ignored the wider social aspects of SLR and related weather events. The minimal substance of the SLRAP currently utilised by Bayside Council – in terms of both adaptation measures and potential social impacts - made it difficult to ascertain the goal of that council's SLR adaptation planning.

Pelling identifies three categories of adaptation: resilience, which protects the basic functioning and structure of society; transition, which protects the entirety of existing rights and responsibilities, rather than making fundamental regime changes; and the deepest form of adaptation, transformation, which addresses the underlying social, political and economic activities that reciprocate existing power imbalances (Pelling, 2011, 50).

*Table 6.1 Comparison each local council's SLRAP*

	<b>Botany Bay</b>	<b>Collaroy-Narrabeen</b>	<b>Lake Macquarie</b>
<b>Focus</b>	Risk-management	Risk-management	Risk-management
<b>Consultation</b>	N/A	Y	Y
<b>Vulnerability</b>	N/A	Ecological Biophysical	Ecological Biophysical
<b>Social aspects</b>	N/A	Y – confined to beach activities	Y – confined to beach/lake/foreshore activities
<b>Socio-political concerns (i.e. mental health)</b>	N/A	N/A	2011 Flood-risk plan

The IPCC (2008, 880) defines resilience as “The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self- organization, and the capacity to adapt to stress and change.” The most challenging aspect of reinforcing humans’ resilience is retaining the same basic social structures and ways of functioning. However, while emphasising the concept of adaptation as resilience enables flexible adaptation planning, there are several significant shortcomings in this approach. Focusing only on adaptation as resilience can easily allow unsustainable or socially unjust practises to persist, particularly in social contexts where entrenched power asymmetries exist (Pelling, 2011, 56), mitigating any risk to the societal status quo. Within urban Australian coastal communities, the value of waterfront properties means higher socio-economic residents are more likely to be exposed to the direct threat of SLR.



However, by perceiving adaptation as resilience, local councils limit risks to the status quo, prioritising the protection of wealthy property owners' assets while neglecting less visible but more vulnerable residents. Pelling's argument that conceiving adaptation as resilience enables socially unjust practises to persist is supported by Zafrin et al. (2014), who revealed that wealthier developers dominated Queensland's coastal governance decision-making processes, while environmental and community groups, who address issues of ecological and social vulnerability, felt relatively powerless.

The issue partially stems from the creation of a coastal management policy vacuum by the NSW and Federal governments. The vacuum developed from the 2011 decision by the NSW Coalition Government to slash mandated IPCC SLR benchmarks for 2050 and 2100, directing local councils to develop their own benchmarks from locally specific risk assessments and risk tolerances (El-Zein, 2019, 28). As a result, a precarious legal situation has emerged for local councils. Forced to navigate uncertain terrain, local government is legally required to implement long-term coastal planning (without a framework describing the potential long-term effects of SLR), while simultaneously protecting property rights enshrined in Australian statutes (Brooks and Fairfull, 2016). As El-Zein (2019, 29) asserts, these two perspectives come into serious conflict.

### ***6.2.2 Insufficient, Inadequate or Inauthentic: the case of NSW SLRAPs' engagement strategies***

The first assessment of SLR engagement strategies in Australia revealed that local councils are failing to reach community members. This finding was supported by two results: only 12% of respondents were aware of their local council's plan for SLR adaptation, while almost

three-quarters said they wanted a greater voice in future SLR decisions-making processes.

Two considerations emerge from these results: (1) the failure of current engagement strategies supports an argument for more inclusive forms of engagement; and (2) engagement issues in NSW SLR adaptation planning can be understood as resulting from inadequate governance for effective participation. Indeed, while the limited scope of participation within coastal governance is recognised as an issue throughout the literature, exacerbated by several barriers, the benefits of holistic participation in SLR planning processes are clear.

*Table 6.2 Comparison of community awareness of local council's SLRAP (n=52)*

<i>(% = yes)</i>	<b>Botany Bay</b>	<b>Collaroy-Narrabeen</b>	<b>Lake Macquarie</b>	<b>Average (n=52)</b>
<b>Aware of any local council sea level rise adaptation plan?</b>	12%	11%	11%	12%

The results of this Honours research are reflected in the work of Zafrin et al. (2014), who found that the scope of participation in coastal governance processes was limited, with two of the themes - inadequate consultation and lack of public awareness - also prevalent in this research. Clarke et al. (2013) support these findings, highlighting that Australian coastal governance processes broadly fail to capture coastal users' manifold voices, interests, values and discourses. As Zafrin et al. (2014, 323) remark, ensuring that the full range of community voices are considered requires incorporating genuine power sharing, comprehensive stakeholder participation and knowledge integration into coastal planning structures.

The inadequate mandate for effective participation in the NSW coastal governance framework provides a partial explanation for the failure of current engagement strategies. Within both pieces of coastal governance legislation - the *Coastal Management Act* (2016) and the *Coastal Protection Act* (1979) - the principal means of consultation was the requirement to receive comments on draft plans. Arnstein (1969, 25) labels these forms of limited participation as “window dressing”, asserting that while citizens’ concerns are heard, “under these conditions they lack the power to ensure that their views will be heeded by the powerful.”

The questionnaire responses in these case studies, finding that almost three-quarters of residents desired a greater voice in future SLR decisions, demonstrate that community members want more deliberative forms of engagement (see Table 6.3). These results were comparable with the findings of Keller and Graham (2018), who revealed half of the residents surveyed in Botany Bay and Rockdale believed SLR consultation was inadequate.

The benefits of collaborative approaches to policy are demonstrated throughout the literature. As Cuthill (2002) asserts, communities working in partnership with local governments facilitate the delivery of relevant benefits to diverse groups. Moreover, in his review of the participatory literature, Reed (2008) notes that quality participation results in empowerment, equity, trust and learning, combined with reducing the likelihood that marginalised voices are excluded from decision-making processes. Research undertaken by Schlosberg et al., (2017) support Reed’s finding. The authors showed that including residents in the planning stage of City of Sydney policy resulted in a broader approach to adaptation, with residents significantly concerned with the basic needs capabilities of vulnerable individuals and communities.

Table 6.3 Comparison of community desire for increased voice in SLRAP decision-making processes (n= 52)

(% = yes)	<b>Botany Bay</b>	<b>Collaroy-Narrabeen</b>	<b>Lake Macquarie</b>	<b>Average (n=52)</b>
<b>Would you like a greater voice in future sea level rise adaptation plan decision-making processes?</b>	81%	83%	44%	69%

Additionally, the lack of genuine community engagement with current adaptation planning strategies lends credence to arguments for integrating more holistic forms of participation in adaptation decision-making processes. The procedural issues that emerge in coastal governance processes in general are exacerbated by the complexity of climate change adaptation. While coastal governance already faces “wicked” problems, stemming from a myriad of social, economic and environmental pressures that historically coalesce in developed coastal areas, problems issues are compounded by the uncertainty surrounding climate change, resulting in “super wicked” problems (Zafrin et al., 2014). As Measham et al. (2011) assert, the move to include climate risk and principles of uncertainty in local decision-making is undermined by a lack of knowledge of both legislative directive and community best practice. Thus, the significant problems already facing coastal governments help make a case for introducing alternative governance frameworks around SLR and other climate-change adaptation planning.

Ecosystem-based management (EBM), which emerged in response to frustration with current institutional structures, has three prominent features: a landscape focus, equal planning that consults all stakeholders, and iterative adaptation. Layzer (2008) argues these features of EBM would overcome the engagement problems currently faced by

governments. Another proposed framework - Holland's (2014) capabilities approach to regulatory rulemaking (CARR) - integrates core capabilities thresholds and environmental preconditions as guidelines for developing public policy.

### ***6.2.3 Community discourse, justice and "fair" adaptation***

The final finding from this research became evident from analysing questionnaire responses, which revealed a clear disconnect between community members' transformational discourse and local councils that perceived adaptation as resilience. Community members viewed SLR adaptation in terms of justice, framing "fair" adaptation as a question of inclusive policy that recognises and addresses existing and future potential disadvantage. In all case studies, the research also found that transformational-minded community members were at odds with the resilience-focused adaptation strategies of local councils. The significant disconnect between these conceptualisations of adaptation supports Schlosberg et al.'s (2017) finding that a discursive disconnect existed between City of Sydney residents, who used transformative language to articulate their concerns for vulnerable residents, and the risk-oriented consultants who drafted the council's original set of policy suggestions. Subsequently, these authors found that including residents in the planning stages of adaptation policy resulted in greater emphasis on residents' basic needs and capabilities. These findings, combined with the questionnaire responses of this research, highlight that alternative engagement strategies are needed to ensure the gamut of residents' concerns is included in SLR adaptation policies. While some residents' language reflected the pragmatic, resilience-based discourse of government adaptation plans, the

majority of residents believed that disadvantaged and marginalised residents needed to be given greater policy consideration if adaptation policies were to be fair.

The disconnect between communities and governments identified in this research can be understood as a result of the inadequacy of current engagement strategies, with policies only requiring community comment once the document is drafted. Moreover, current engagement processes mean that only minor amendments are possible once a policy is in draft form. Instead, the literature notes that residents should be involved in all the stages of policy planning, enabling communities a greater say in decisions that directly affect them. Banks et al. (2014) suggest introducing community adaptation forums, enabling community members to share their experiences and learn from one another, while also providing a platform for stakeholder engagement. These authors also note that the community engagement they envision involves a diverse array of community organisations, and prioritises listening rather than talking (Banks et al., 2014, 39).

### **6.3 Limitations of the research**

The limitations of this Honours research resulted from the time, expertise and resources available. More time and resources would have facilitated obtaining more questionnaire responses, providing a more robust understanding of each community. Additionally, this researcher's negligible expertise in geographic information systems (GIS) meant socio-spatial maps were limited to coastal inundation and coastal erosion resulting from rising sea-levels, neglecting the significant damage potentially caused by the increased frequency and intensity of SLR-related weather events. Greater knowledge of GIS programs would have enabled integration of SLR-related extreme weather events, providing a more

comprehensive insight into the threat of SLR to vulnerable community members while also enabling comparison with other climate risks, such as heatwaves, drought, and bushfires.

#### **6.4 Implications for further research**

The identification of significant climate disadvantage in two Australian communities in this research highlights the need for further use of socio-spatial mapping to identify potentially vulnerable coastal communities and individuals. Over the next 50 years, increased urban development, ageing populations and the anticipated increase in the frequency and intensity of SLR-related weather events will compound the complexity of coastal governance. Consequently, local governments require holistic adaptation frameworks that recognise the multifaceted threat of SLR and the substantial risk faced by their constituents, but particularly vulnerable populations.

Further research into climate disadvantage, especially the utilisation of socio-spatial mapping to identify vulnerable communities, should be prioritised. While the novel approach implemented in this research provides a start, implementing more comprehensive GIS socio-spatial mapping at the local government level would ensure that all SLR threats are considered in future vulnerability assessments. Further, deploying this methodology to assess SLR risks in coastal LGAs across Australia would provide a nationwide overview of social vulnerability in an Australian equivalent to the research conducted by Lindley et al. (2011), highlighting the regions facing significant climate disadvantage and helping to enable more efficient and equitable allocation of government resources.

In addition, the inclusion and understanding of social factors that contribute to social vulnerability (factors currently invisible to risk-based metrics) ensures future adaptation

plans can appropriately conceptualise the many facets of human well-being. This paradigm shift at all levels of government would facilitate the inclusion of individuals and communities' basic needs capabilities in public policy. Finally, the ineffectiveness of current engagement strategies points to the need for further research into how governments and communities can begin to close the distance between infrastructure-focused local governments concentrating on the short term, and vulnerability- and transformational-minded citizens who conceive adaptation planning in the long term.



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## Appendices

### Appendix A: Sea level rise adaptation policies covering each case study

	<b>Release date</b>	<b>Policy</b>
<b>Botany Bay</b>	October 2015	<i>City of Botany Bay 2015 Sea Level Rise Policy</i>
<b>Lake Macquarie</b>	June 2012	<i>Lake Macquarie Waterway Flood Risk Management Study and Plan</i>
	April 2015	LMCC <i>Coastal Zone Management Plan 2015-2019</i> , four parts: A – Coastline B – Estuary C – Swansea Chanel D – Final report
<b>Collaroy-Narrabeen</b>	December 2016	<i>Coastal Zone Management Plan for Collaroy-Narrabeen Beach and Fishermans Beach</i>

### Appendix B: Questionnaire

#### 1. Attributes

i. What is your gender?

<b>Male</b>		<b>Female</b>		<b>Other</b>	
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ii. Which age group are you in?

<b>18-24</b>	
<b>25-29</b>	
<b>30-39</b>	
<b>40-49</b>	
<b>50-59</b>	

<b>60-69</b>	
<b>70-79</b>	
<b>80+</b>	

*Tick one*

iii. Which street do you live on?

--

iv. What is your ethnic background?

<b>Anglo-Saxon</b>	
<b>European</b>	
<b>Asian</b>	
<b>African</b>	
<b>Aboriginal Australian</b>	
<b>Other</b>	
<b>Don't know</b>	

v. Education

<b>Bachelor degree level and above</b>	
<b>TAFE or other vocational certificate</b>	
<b>Year 12 or equivalent</b>	
<b>Year 11 or equivalent</b>	
<b>Year 10 or below</b>	

vi. **Is English the primary language spoken in your household?**

<b>Yes</b>	
<b>No</b>	

vii. Which of the below describes your living arrangement?

<b>Occupy owned home</b>	
<b>Tenant</b>	
<b>Supportive housing</b>	
<b>Other</b>	

viii. Do you or anyone in your household have a disability?

<b>Yes</b>	
<b>No</b>	

ix. Do you have access to the internet in your household?

<b>Yes</b>	
<b>No</b>	

x. What is your gross household income annually?

<b>Nil to \$40,000</b>	
<b>\$40,001 to \$80,000</b>	
<b>\$80,001 to \$150,000</b>	
<b>Over \$150,000</b>	

## 2. Place attachment

i. How many years have you lived in the community for?

<b>0 to 1</b>	
<b>1 to 3</b>	
<b>3 to 5</b>	
<b>5 to 10</b>	
<b>Over 10</b>	

**ii.** What aspects of the community makes you enjoy living here?

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**iii.** Are you aware your community may be threatened by future sea-level rise?

<b>Yes</b>	
<b>No</b>	
<b>Unsure</b>	

**iv.** Are you concerned about the threat of sea-level rise and coastal climate hazards to you personally?

<b>Yes</b>	
<b>No</b>	
<b>Unsure</b>	

**v.** Are you concerned about the threat of sea-level rise and coastal climate hazards to your community?

<b>Yes</b>	
<b>No</b>	
<b>Unsure</b>	

**vi.** Can you explain your answer to questions (iii) and (iv)?



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### 3. Participation

i. Have you had any experience with your local government?

<b>Yes</b>	
<b>No</b>	

ii. Has this experience been positive or negative?

<b>Positive</b>	
<b>Negative</b>	
<b>Unsure</b>	

iii. Are you aware of any your local governments plan for adapting to sea-level rise?

<b>Yes</b>	
<b>No</b>	

iv. If yes, how did you become aware of these plans?

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v. Do you feel your views are represented by your local government?

<b>Yes</b>	
<b>No</b>	
<b>Unsure</b>	

**vi.** Do you feel residents should have a greater voice in adaptation plan decision-making processes?

<b>Yes</b>	
<b>No</b>	
<b>Unsure</b>	

**vii.** Do you believe residents have the opportunity to contribute their knowledge to decisions about SLR?

<b>Yes</b>	
<b>No</b>	
<b>Unsure</b>	

**viii.** Would you like to have a greater say in future sea-level rise adaptation planning decisions?

<b>Yes</b>	
<b>No</b>	
<b>Unsure</b>	

**ix.** Who do you think will be most affected by sea-level rise in your area?

<b>Everyone</b>	
<b>Low-income residents</b>	
<b>High-income residents</b>	
<b>Waterfront property owners</b>	
<b>Business</b>	
<b>Council</b>	

<b>Other</b>	
<b>Don't know</b>	

#### **4. Vulnerability & adaptive capacity**

- i. On a scale of 1-5 (1 = lowest; 5 = highest), how strong would you say your social network is?

- ii. On a scale of 1-5 (1 = lowest; 5 = highest), how prepared would you say your household is for an extreme weather event that might last 3 days?

- iii. What factors do you consider important in preparing for an extreme weather event?

- iv. Do you believe you're able in your current situation to make the preparations necessary for an extreme weather event?

<b>Yes</b>	
<b>No</b>	
<b>Unsure</b>	

**5. Well-being**

- i. How would you define well-being?

**6. “Just” Adaptation**

- i. On a scale of 1-5, how much do you feel economic factors (such as wealth and resources) contribute to your well-being?

- ii. An argument exists that governments should focus on individuals' opportunities to experience life, rather than solely in terms of wealth distribution. Do you agree?

<b>Yes</b>	
<b>No</b>	
<b>Unsure</b>	

- iii. Why/why not?

iv. What would fair adaptation look like in your community?