Fact Sheet Three: Results & Findings of the SCCG Vulnerability Assessment

As part of the Australian Government Department of Climate Change (DCC) National Climate Change Adaptation Program, the Sydney Coastal Councils Group (SCCG) have partnered with CSIRO Climate Adaptation Flagship working in collaboration with the University of the Sunshine Coast to undertake research on regional approaches to managing climate vulnerability in the Sydney region.

Methodology Approach

The first phase of the *Systems Approach to Regional Climate Change Adaptation Strategies* research project was to conduct a vulnerability assessment and mapping exercise for the SCCG Region. The vulnerability approach was used as it allows for a broad array of potential risk factors to be explored and identify the various factors and interactions that contribute to vulnerability and climate risk.

The methodology chosen enabled diverse sources of information to be readily incorporated into an assessment, even if the relationships among different variables are not well-defined. Various vulnerability indicators, for example, attempted to capture different aspects of vulnerability such as exposure to natural hazards, sensitivity of exposed systems and the capacity for households and Councils to successfully manage risk both now and in the future.

The landscape of the SCCG region varies significantly, from highly urbanised and densely populated communities, to more regional areas that are less intensively utilised, as well as areas primarily valued for their role in nature conservation. As a result, the vulnerability of people, assets, and ecosystems within the SCCG region is likely to vary significantly from point to point, as well as among different types of climate changes and impacts. Furthermore, the management of the potential risks of climate change may vary significantly, with responsibility for risk being borne in some instances by an individual, and in others by Local, State or Australian Governments or private institutions. To capture this diversity in potential climate change consequences and adaptation challenges, five areas of potential climate impacts were selected for vulnerability assessment and mapping, all of which have relevance to the Sydney region (Preston, 2008):

- **Extreme heat and human health effects**

  Which land areas are associated with a greater vulnerability to adverse health effects associated with extreme heat events?

- **Sea-level rise and coastal hazards**

  Which land areas are vulnerable to the effects of sea-level rise, storms, and storm surge impacts on property and infrastructure?

- **Extreme rainfall and stormwater management**

  Which land areas are vulnerable to significant urban stormwater runoff that must be managed?

- **Bushfire**

  Which land areas are vulnerable to significant bushfire events?

- **Natural ecosystems and assets**

  Which land areas are associated with ecological systems and natural resources that are more or less resilient to the effects of climate change?

The assessment and mapping of vulnerability to these different impacts was designed to emphasise the diversity of factors that can conspire to create vulnerability and the complexity of their interactions, consistent with the 'systems approach' advocated by the project as a whole. In fact, Smit and Wandel (2006) state that the goal of vulnerability assessment, is not to produce a score or rating of a particular community's current or future vulnerability. Rather, the aim is to attain information on the nature of vulnerability and its components and determinates.

Vulnerability was framed in a manner presented by the Intergovernmental Panel on Climate Change (IPCC, 2001): *"the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes"*

Vulnerability is comprised of three components: exposure, sensitivity and adaptive capacity. Exposure refers to the presence of a climate hazard. Sensitivity refers to the responsiveness of a system to that hazard. Adaptive capacity refers to the ability of a system to change in a way that makes it better equipped to mange its exposure and/or sensitivity to climate hazards and /or cope with adverse impacts.

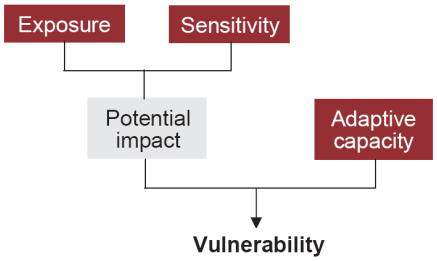

Figure 1. Components of Vulnerability (Allen Consulting, 2005)

In conducting the vulnerability assessments, simple conceptual models identifying the key processes and assumptions were developed for five potential areas (See Figure 2).

The models were used to select a broad range of regional indicators such as current regional climate gradients, projections of future climate change, topography, land use and cover, demographic information as well as indicators of council resources and performance to reflect the three components of vulnerability: exposure, sensitivity and adaptive capacity. (Refer to fact sheet two for further explanation of vulnerability and its components).

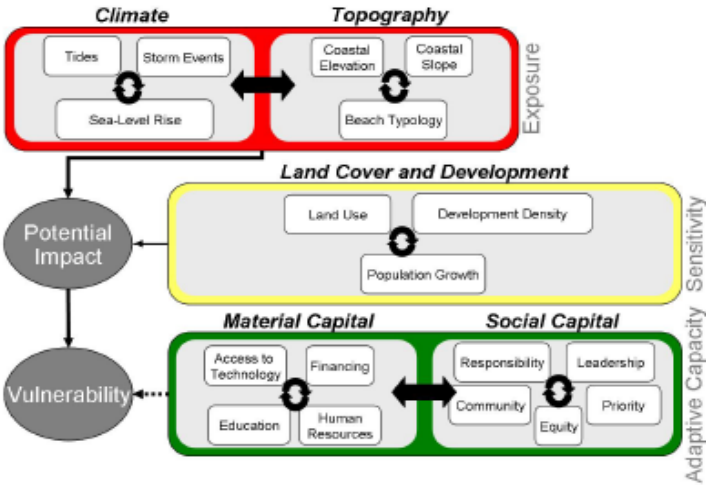

Figure2. Conceptual model of the vulnerability of coastlines to climate change.

Exposure *(red) is driven by interactions between the climate system and the landscape topography.* ***Sensitivity*** *(yellow) is a function of the assets and infrastructure on the landscape. The combination of exposure and sensitivity creates the potential for an adverse impact.* ***Adaptive capacity*** *(green) is a function of the material and social capital that can address potential impacts and ameliorate vulnerability. Critical interactions and processes are represented by arrows.*

The indicators were scored qualitatively with a raking from 1 to 5, with 1 representing a low contribution to vulnerability and 5 representing a high contribution. To prevent differential numbers of indicators for each component from biasing outcomes, indicators for each component of vulnerability were first summed and rescaled to a range from 1 to 9. In doing so no assumptions were made regarding the relative importance of individual indicators, in part due to the lack of knowledge regarding their relationships and ultimate implications for risk. The three components were summed and rescaled to estimate net vulnerability for each impact. The advantage of this approach was that is readily allowed a broad array of potential risk factors to be explored and different indicators council be added or deleted at will.

These indicators were integrated within a geographic information system (GIS) environment to generate spatial maps of the three components of vulnerability. A map of net regional relative vulnerability was produced by combining the vulnerability maps for individual climate impacts to draw generalisations about overall climate vulnerability at the regional and, subsequently, Council level (See Figure 3).

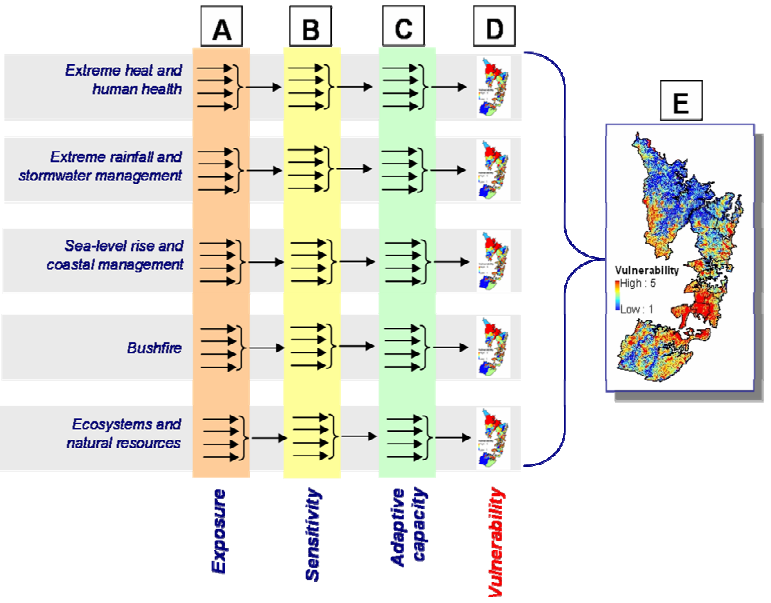

Figure 3. Conceptual model of the approach for assembling vulnerabilty maps for each of the five impact areas, and net climate change vulnerability for the region.

The net climate change relative vulnerability map resulted in a pattern that largely resembles the development patterns of metropolitan Sydney (See Figure 4.f and Figure 5). The greatest regions of vulnerability are associated with population centres and dense development: southern Hornsby Shire Council, eastern Pittwater Shire Council, Sydney Harbour to Botany Bay (particularly Rockdale and Botany Bay City Councils), and northern Sutherland Shire Council.

High values indicate a relatively high degree of relative vulnerability to future climate change while low values indicate low relative vulnerability. Areas with low relative vulnerability are not necessarily immune to adverse impacts from climate change. They simply are associated with fewer risk factors relative to areas with greater relative vulnerability (See Figure 4).

The relative vulnerability assessment represented one of the tools used to draw out information about adaptive capacity through participatory workshops and interviews with stakeholders as well as evaluation of existing management plans. The results of the climate change vulnerability assessment and mapping exercise were used as starting point for further exploration of vulnerability and adaptive capacity within the SCCG region.

In phase two of the project the vulnerability maps were presented to the SCCG Member Councils through a series of workshops in each Member Council to stimulate thought and discussion, enabling stakeholders to further decompose vulnerability and build upon the vulnerability assessment to develop a more comprehensive perspective on climate change and the opportunities and barriers to adapting to that change within the SCCG.

Refer to fact sheets four for details and findings from project phase two the regional climate change workshops undertaken for each of the Member Councils of the SCCG region.

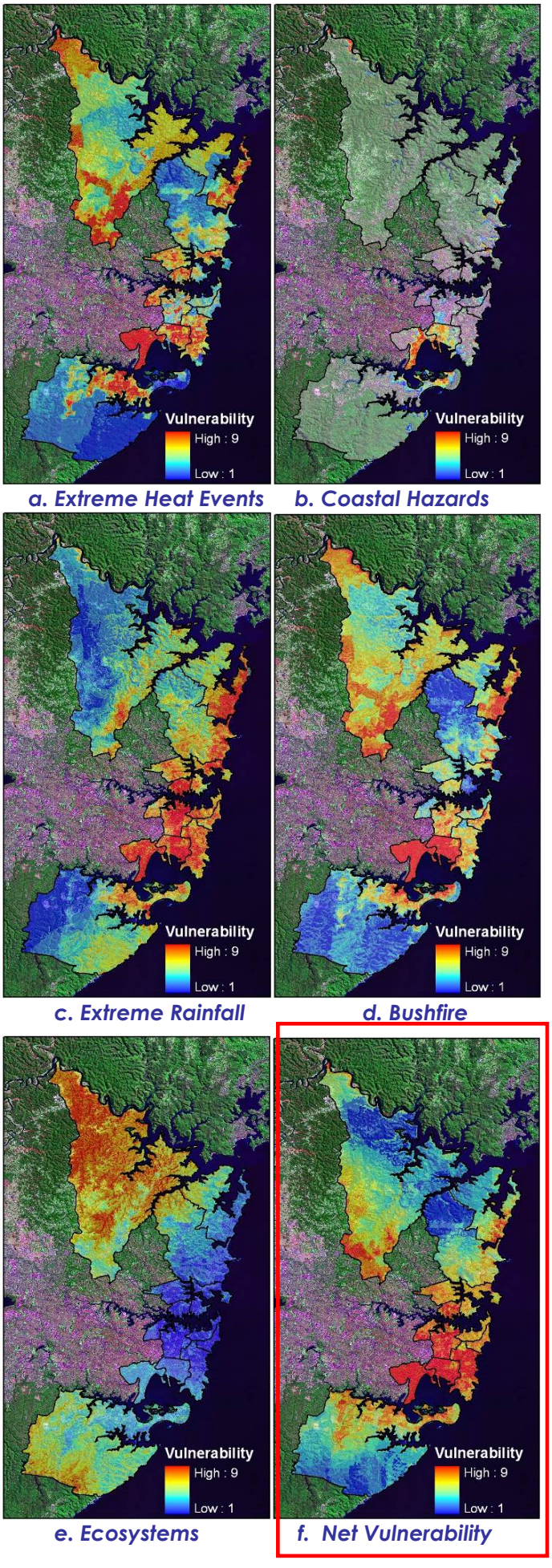

Figure 4 (a-f): Results of vulnerability assessments for the five impacts areas and net regional vulnerability based upon weighted aggregation of the five impacts (see Preston et al., 2008)

Key Results:

- Climate vulnerability is driven not only by physical changes in the climate, but also by factors such as demographics, economic drivers, landscape characteristics and infrastructure that influence the sensitivity of places and people to climate changes and their capacity to respond to reduce their risk.
- Different areas of Sydney will experience climate change in different ways depending on their geographic location, demographics, resources and tools at their disposal to manage future climate change risk.
- Despite accounting for the significant change in the climate system projected for the region in the decades ahead, the social and economic circumstances of the SCCG landscape emerge as key factors affecting future vulnerability.
- Vulnerability is closely correlated with human development patterns, indicating human activity and decision-making as core components of vulnerability.
- Almost every council has at least one area of critical vulnerability that may be a focal point for management efforts. Similarly, every Council has at least one impact to which it appears to be particularly resilient. Generally the majority of Councils appear to face multiple vulnerabilities.
- Overall, inner-city Councils between Sydney Harbor and Botany Bay had the highest levels of climate change vulnerability as they are relatively urbanised with significant exposure to the coast and some were associated with a generally low adaptive capacity compared to other areas.
- The Landscape diversity associated with large Councils creates the additional burden of having to cope with different types of vulnerability scattered over large geographic areas.
- The vulnerabilities of urban, peri-urban, and rural communities vary significantly. Urban communities are particularly vulnerable to extreme rainfall and suffer from limited ecosystem resilience; rural communities are particularly vulnerable to the effects of bushfire. Transitional communities such as suburbs appear most vulnerable to heat-related health effects.

Key Uses

- Through a series of workshops with the SCCG member councils, stakeholders were provided the opportunity to review and comment on the results. Stakeholder feedback suggested the approach taken to mapping vulnerability offered a number of advantages, particularly with respects to communicating the spatial dynamics of risk as well as the diversity of factors that contribute to vulnerability.

- The assessment indicated where some of the key challenges for each council are and where councils may select for more detailed assessments to clarify the extent to which additional management interventions are necessary.

- The vulnerability assessment is an essential first stage to better understand the impacts of climate change on the region, and to help move towards effective and adaptive management

- Combining the vulnerability assessment results with Councils own knowledge and risk management experience will improve the understanding and thinking behind the implications of climate change and what will be needed for communities to respond.

- While relative vulnerability maps may be useful for identifying and prioritising at-risk areas, they are just one of a broad range of tools that can be used to inform planning and decision-making.

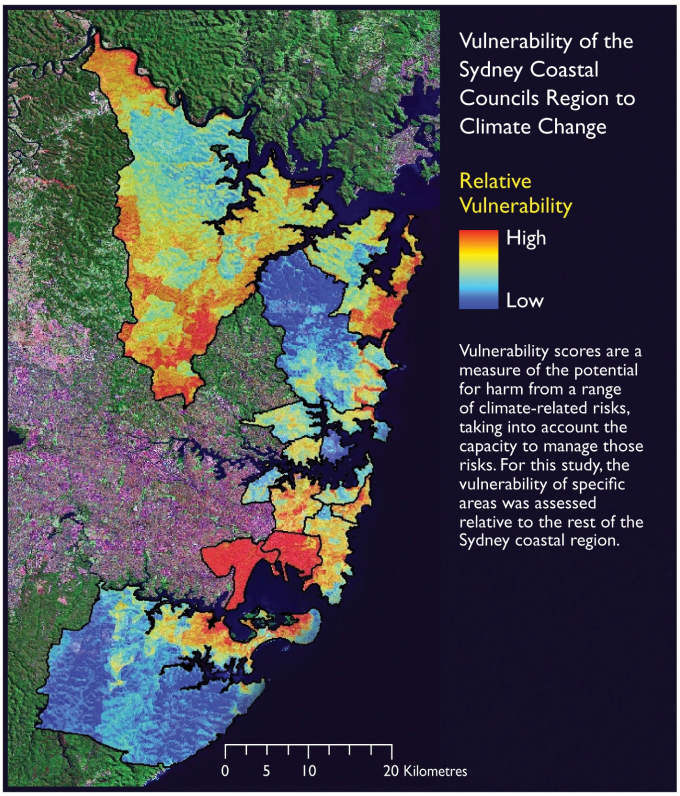

Figure 5: Net regional relative vulnerability map for the SCCG region.

Reference:

Allen Consulting (2005) Climate Change Risk and Vulnerability. Australian Greenhouse Office, Department of Environment and Water Resources, Canberra, Australia.

IPCC (International Panel on Climate Change) (2001b) Climate Change 2001: Impacts and Adaptation. Contribution of working group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK and New York , NY, USA 1000pp.

Preston, B.L., Smith, T., Brooke, C., Gorddard, R., Measham, T., Withycombe, G., McInnes, K., Abbs, D., Beveridge, B., and Morrison, C. (2008) *Mapping Climate Change Vulnerability in the Sydney Coastal Councils Group*. Prepared for the Sydney Coastal Councils Group and the Australian Government Department of Climate Change by the CSIRO Climate Adaptation Flagship, Canberra.

Preston, B.L. (2007) *Climate Change in the Sydney Metropolitan Catchments*. Prepared by CSIRO Marine and Atmospheric Research for the New South Wales Greenhouse Office, Sydney, NSW, Australia.

Smit, B. and Wandel, J. (2006) Adaptation, adaptive capacity and vulnerability. *Global Environmental Change* 16, 282-292.

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