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Invited feature

Coastal residential waterways, science and policy-making: The Australian experience

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ABSTRACT

Thousands of kilometres of coastal residential waterways have been constructed across the globe, mostly in estuaries. These have caused significant environmental impact demonstrating a need for proper management and planning informed by science. Additional potential impacts of climate change, specifically sea-level rise, make coastal residential waterway developments by their nature particularly vulnerable, with restricted options for adaptation. This paper analyses Australian policies on coastal residential waterways over the last 50 years and the extent to which science, including estuarine and climate change science, has been incorporated into policy decisions or policy formulation. This analysis is in the context of theories on the uptake of science in policy-making and against a background of Australian government and inter-governmental reports indicating the vulnerable nature of low-lying coastal development. This paper reveals that coastal residential waterways referred to as canal estates occur in all Australian mainland states but given the lack of any national coastal policy, the onus is on each individual state to formulate its own policies. These policies are on a continuum from explicit, detailed science-based policy guidelines in some states, through implicit scientific impacts informing political decisions in other states, to generic environmental assessment procedures without specific reference to canal estate development. This paper concludes that the extent to which science has been incorporated into policy-making for canal estates is variable across the Australian states and appears to be heavily influenced by politics.

1. Introduction

Residential waterways in coastal environments are found predominantly in estuaries and low-lying coastal areas around many parts of the world. A recent paper in this journal provides a definition of artificial residential waterways and estimates that almost 4000 linear km of these have been constructed globally (Waltham and Connolly, 2011). The sheer extent of these waterways points to the magnitude of their potential impact on estuarine habitats, aquatic biota and at the same time the need for proper management and planning. In mapping the global occurrence of artificial residential waterways, Waltham and Connolly (2011) refer to the construction of 'open, flow-through canal estates' which they found in all continents apart from Antarctica with the majority (77%) being in North America, 7% in each of Asia, Europe and Oceania and less than 1% in each of South America and Africa. They note that Oceania has almost 400 km of residential waterways, second only to the United States. Waltham and Connolly (2011) also refer to recent design changes, particularly in Australia, where there has been a shift from the use of canals to the creation of artificial estuarine lakes with tidal barriers.

In their study Waltham and Connolly (2011) comment on both the age and paucity of scientific literature relating to aspects such as water quality and ecological issues associated with residential waterways which, they suggest needs greater attention from estuarine scientists. They point out the vulnerability of these developments to sea-level rise, which by their very nature means that "the future climate adaptation option of allowing the coastline, and its associated habitats, to retreat is precluded" (Waltham and Connolly, 2011, p. 196).

Global awareness of potential coastal impacts from climate change, specifically sea-level rise was heightened by the release of the Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC), in particular its Working Group II,

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which provided an assessment of adaptation, impacts and vulnerability to climate change (IPCC & Parry et al., 2007). The *Coastal Systems and Low-lying Areas* chapter of the IPCC's Fifth Assessment Report (2014) not only confirms the importance of appropriate coastal adaptation responses for low-lying development, such as retreat, accommodate or protect but refers to the significance of institutional and governance structures in decision-making, noting that this is "particularly challenging when considering planned retreat" (Wong et al., 2014, p. 389).

Given the global significance of artificial residential waterways in estuaries (Waltham and Connolly, 2011), their vulnerability to sea-level rise and the importance of decision-making in any response options, it is timely to examine how science and specifically climate change science is incorporated into residential waterway policy. This paper focuses on Australian canal estates and policies for analysis in the light of IPCC concern over the extent of low-lying residential development in parts of Australia (Hennessy et al., 2007) and a national focus on coastal vulnerability associated with climate change in Australia (Harvey and Woodroffe, 2008; Department of Climate Change; [DCC], 2009; Harvey et al., 2012a; Stocker et al., 2012).

This paper first examines theoretical aspects of the environmental policy-making process in the context of Australia's federated system of governance, and challenges to scientific evidence-based policy. Second, this paper discusses definitions of coastal residential waterways and canal estates. Third, it outlines canal estate development in Australia and associated environmental issues with specific reference to recent Australian national reports on climate change and coastal vulnerability, focussing on low-lying waterfront residential development. Fourth, this paper presents a detailed analysis of various Australian state policies over the last 50 years on canal estates and the extent to which science, including estuarine and climate change science, have been incorporated into policy decisions or policy formulation. This paper concludes that there is a great variation in the use of science in decision-making about canal estates. Science application in policy appears to be on a continuum from explicit, detailed science-based policy guidelines in some states, through implicit scientific impacts informing political decisions in other states, to a minimal consideration of science in one state.

2. Science and evidence-based policy making: the Australian context

The role of science has been central in identifying the impacts that residential waterways and canal estates have on the environment, and more recently in forecasting their likely vulnerability to climate change. Science, however, is by no means the overriding factor in policy and planning: there is always a strong political influence on decision-making in any areas that are highly valuable for a range of sometimes conflicting economic, social, cultural and ecological reasons.

Many authors have commented on the environmental policy-making process in either an international context (Keeley and Scoones, 1999; Roberts, 2011; Prewitt et al., 2012) or with specific reference to Australia (Doyle and Kellow, 1995; Thomas, 2007; Crowley and Walker, 2011; Dovers, 2013). While there is general agreement that environmental policy-making is a cyclical process incorporating issue–attention cycles (Downs, 1972; Roberts, 2011) there is less agreement on the applicability of various models or theories of policy development such as the rational-comprehensive model and the incremental model (Roberts, 2011) or the mixed scanning model (sensu Etzioni, 1967). While it is beyond the scope of this paper to discuss these models in detail, the rational model appears to be idealistic, time-consuming and separates environmental issues from their social context. The incremental model is closer to what often happens in practice "based on negotiation and consensus with affected interests, rather than objective rationality" (Roberts, 2011, p. 161), whereas mixed scanning provides a combination of the two models (Etzioni, 1967). Lalor and Hickey (2013) suggest that neither a linear (i.e., rational) model of policy making nor a more complex model provide practical guidance on the utility of science in policy. In fact, Prewitt et al. (2012), in a major review of the use of science in public policy suggest there is an absence of a generally accepted model of policy-making. They illustrate the complexity of analysing the use of science in policy-making pointing out the need to simultaneously address the following phenomena:

- "Scientific findings from multiple sources and that are at times contradictory;
- A policy-making process, that is variable along many dimensions; and
- A phenomenon, "use," that changes its meaning depending on the perspective brought to it and one's location in the complex space where policy is made" (Prewitt et al., 2012, p. 39).

In a climate change study, Cash et al. (2006) also challenge the linear, rationalist model of the 'loading-dock' approach to science uptake whereby simply making science available to policy-makers is enough for them to adopt it. Rather, stakeholder engagement can enable multiple types of knowledge and ideas to be shared and co-produced across science-policy boundaries (McNie et al., 2008). If done well, this can increase the salience, credibility and legitimacy of both the knowledge and policy (Cash et al., 2006; Shaw et al., 2012).

A key feature of Cash et al.'s (2006) model is the importance of boundary spanning institutional processes: convening, or meeting face to face; translating across the 'language' and 'cultural' boundaries that characterise the science-policy divide; mediating to ensure procedural justice is done; and collaborating in the co-production of knowledge and ideas. These processes involve sophisticated communication and are required to counteract the 'loading dock' approach to linking science and policy-making Cash et al. (2006). Other authors have also called for an increased emphasis on collaboration to enhance the knowledge–governance interface in dealing with complex cross-jurisdictional issues such as climate change (Clarke et al., 2013; Lemieux et al., 2014).

What is clear in environmental policy-making is that it is virtually impossible to separate it from politics given that politicians are ultimately responsible for policy decisions. In the Australian context, environmental policy-making is further complicated by the nature of the Australian federal system of governance and a constitution where states have jurisdiction over resource development and use (Buhrs and Christoff, 2006) creating a lack of clarity on the division of responsibilities for environmental protection between the Commonwealth (Australian) and the state governments. According to Doyle and Kellow (1995) state governments initially did not accept that the Commonwealth government had any environmental responsibility within state borders but a redefined approach to federalism in Australia during the 1970s demonstrated that it did have environmental powers. More recently, the Commonwealth and state governments have adopted a co-operative approach in reaching agreement on environmental matters.

There remains a problem, however, where each state government in Australia has its own environmental legislation and environmental policy-making process, which inevitably becomes politicised through a changing mix of political parties in power at