

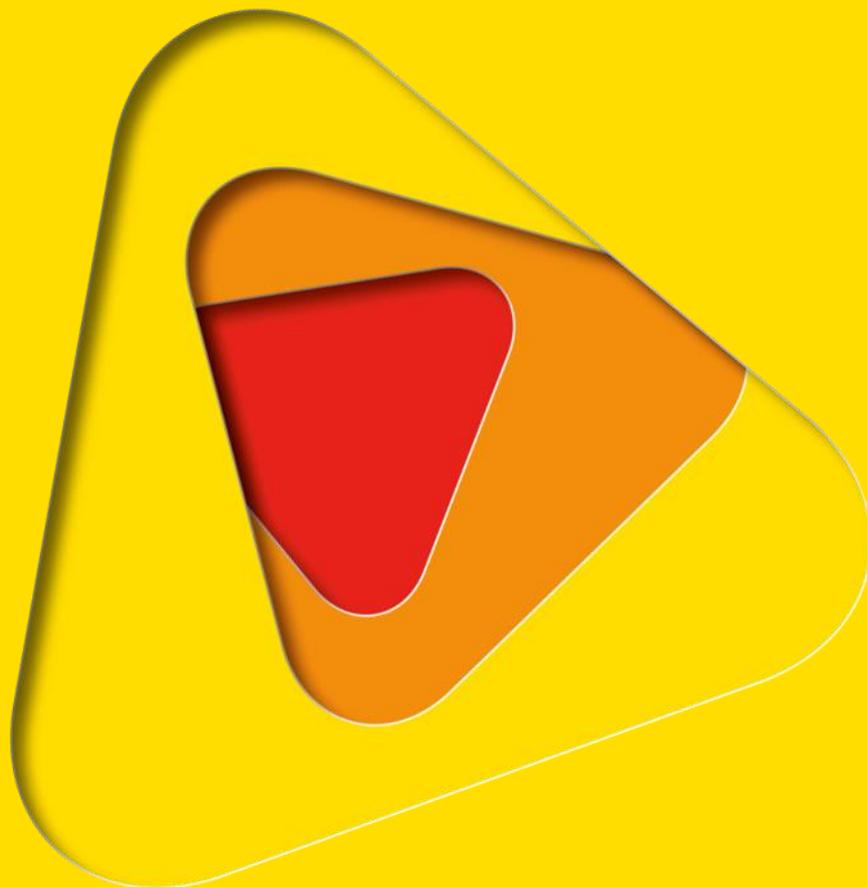


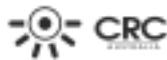
MANAGING CRITICAL INFRASTRUCTURE IN A CHANGING CLIMATE: RISK, ROLES, RESPONSIBILITIES AND POLITICS

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INTRODUCTION

Critical infrastructure underpins essential services such as power, water, health, communications systems and banking and is vital to our way of life. However, a range of risks can damage or destroy critical infrastructure and disrupt these essential services. One such risk is that posed by natural disasters, and climate change may increase the frequency and intensity of those events and risks.

In 2010, the Australian Government released its *Critical Infrastructure Resilience Strategy*, which stressed that “the best way to enhance the resilience of critical infrastructure is to partner with owners and operators to share information, raise the awareness of dependencies and vulnerabilities, and facilitate collaboration to address any impediments.” While that Strategy, and similar initiatives such as the *National Strategy for Disaster Resilience*, provides a useful framework to guide action, there are a range of peculiarities, perverse incentives and governance barriers which need to be identified and considered, if Australia’s critical infrastructure is to become more resilient to current and future risks. These impediments exist particularly in relation to the allocation of risk associated with different types of infrastructure and the ownership and management arrangements thereof; the impacts to critical infrastructure from different natural hazards; and the role and responsibilities of State and Commonwealth governments, even where they neither own nor manage the infrastructure.

This paper focuses specifically on the role and responsibility of the Commonwealth in protecting critical infrastructure assets, and explores:

- How the definition of critical infrastructure may limit our understanding of climate-related risks to, and responsibilities for, assets
- The varied ownership arrangements of critical infrastructure assets and how this complicates the allocation of risk
- The explicit and implicit roles of the Commonwealth in managing critical infrastructure, and
- Where governance arrangements may need to be strengthened or altered in order to promote infrastructure adaptation, to reduce future risks.

DEFINING CRITICAL INFRASTRUCTURE

How ‘critical infrastructure’ is defined influences the range of stakeholders that are deemed to have a role or responsibility in protecting it: what might seem trivial differences in definitions might make a big difference in policy and implementation. The Australian Government’s 2010 *Critical Infrastructure Resilience Strategy* (CIRS) defines critical infrastructure as “those physical facilities, supply chains, information technologies and communication networks which, if destroyed, degraded or rendered unavailable for an extended period, would significantly impact on the social or economic wellbeing of the nation or affect Australia’s ability to conduct national defence and ensure national security” (2010: 8). This definition includes the traditional understanding of critical infrastructure as fixed, often stand-alone physical assets such as power plants, dams and sewerage treatment sites, as well as core transportation hubs such as airports and ports. The definition also includes infrastructure associated with the provision of health care and education, such as hospitals and schools, as well as the importance of non-physical assets, such as networks or supply chains. For example, bringing food from the paddock to the plate is dependent not only on particular key facilities, but also on a complex network of producers, processors, manufacturers, distributors and retailers and the infrastructure supporting them (2010: 8). In this definition, the communication capacities and roles of web-based systems also qualify these as



infrastructure, given their increasing importance in finance, trade, health information distribution and transfer payment enablement, disruption to which may be considered ‘critical’ in social and economic impact.

However, this definition of critical infrastructure overlooks the importance of natural assets in Australia’s long term economic and social welfare. For example, water catchments are in many locations the sole source of water resources to towns and cities but until recently, maintaining the integrity of a town’s water supply system has focused on the physical assets in the water supply system, and ignored the importance of the *catchment* in providing much-needed filtering and treatment of those water supplies. The compromising of the ACT water supply (Cotter catchment) following the 2003 bushfires was unprecedented, and similarly important catchments exist elsewhere and are potentially at risk (eg Sydney, Melbourne). In terms of disruption and consequence, whether, a city’s water supply is compromised by a catchment fire or an explosion that destroys a key transmission or treatment facility is immaterial. Similarly, the Great Barrier Reef is a natural asset of intrinsic worth, but it also underpins Queensland’s economy, contributing AUD\$1b in revenue annually: significant decay or destruction of the Great Barrier Reef – or even just access to it for a period of time - would be likely to have deleterious impacts on Queensland’s and Australia’s tourism industry.

In our view, it may be better to redefine critical infrastructure, altering the wording of the CIRS to:

“those assets which, if destroyed, degraded or rendered unavailable for an extended period, would significantly impact on the social or economic wellbeing of the nation or affect Australia’s ability to conduct national defence and ensure national security”.

Regarding climate risks and the issues of significance and national interest, extending the definition of ‘infrastructure’ might therefore be warranted, and this reveals new roles and responsibilities in the protection of critical infrastructure that are currently ignored.¹

TYOLOGY OF CRITICAL INFRASTRUCTURE ASSETS

Definitions of critical infrastructure vary, and thus typologies similarly vary, as do the regulatory and institutional arrangements that govern them. For example, infrastructure sectors range from unregulated competitive markets (ports and power generation) and regulated, private sector monopolies (energy networks and water) to state-procured public goods (motorways) (PWC 2010). The private sector is deeply involved in critical infrastructure, variously as investor, owner, operator, lender, insurer and, importantly, as a major user of economic infrastructure. It therefore has a key role in addressing the risks of climate change and ensuring the resilience of economic infrastructure in Australia. The nature of climate change risks, however, is that they generate broad social and economic externalities, which the private sector may not always take fully into account. In particular, in the absence of legislative or regulatory intervention, companies may be prepared to live with a level of climate change risk that is unacceptable to society.

Given that the focus of this paper is on the role of the Commonwealth Government in critical infrastructure risks and adaptation, the typology in Table 1 categorises critical infrastructure according to the *level of government* with de facto responsibility for the asset(s), and the type of *service* the

¹ An additional element to consider – but which is beyond the scope of this paper – is the link between the vulnerability of critical infrastructure assets to natural hazards and the knock-on threat to national security that may be created as a result of domestic unrest or home-grown terrorist threats. Threats to Australia’s national defence and natural security are traditionally seen as exogenous to the state, but it is not difficult to imagine a situation whereby the devastation caused by a natural disaster is exploited by domestic terrorist organisations to wreak yet more havoc.



infrastructure provides. The inclusion of ‘natural’ infrastructure is novel, but given the significant services these assets provide, we argue they are no less important.

The relationships and interdependencies between infrastructure assets is particularly important but also complex when considering the risks that climate impacts pose to critical infrastructure services. For example: the failure of water infrastructure can have perverse impacts on electricity infrastructure through loss of cooling agent; the failure of an electricity network can have impacts on hospitals and public transport; the failure of critical transport infrastructure can impact on functioning of key ports and trade, etc. In keeping with the broadening of the scope of the term to ‘systems of assets which support the provision of important services’, the typology indicates an approach that shifts attention from the piece of infrastructure to the actual social or economic role and value.

Table 1: Local, State and Commonwealth government responsibilities for economic, social and natural infrastructure

Level of government	Economic infrastructure	Social infrastructure	Natural infrastructure (with social and/or economic significance)
Commonwealth	Aviation services (air navigation etc) Telecommunications Postal services National roads (shared) Local roads (shared) Railways (shared)	Tertiary education Public housing (shared) Health facilities (shared)	Great Barrier Reef, Kakadu National Park
State	Roads (urban, rural, local) (shared) Railways (shared) Ports and sea navigation Aviation (some regional airports) Electricity supply Dams, water and sewerage systems Public transport (train, bus) Major goods distribution hubs.	Educational institutions (primary, secondary and technical) (shared) Childcare facilities Community health services (base hospitals, small district hospitals, and nursing homes) (shared) Public housing (shared) Sport, recreation and cultural facilities Libraries Public order and safety (courts, police stations, traffic signals etc) Prisons	Major water catchments Rivers, wetlands with major filtration or supply functions
Local	Roads (local) (shared) Sewerage treatment, water and drainage supply Aviation (local airports) Electricity supply Public transport (bus)	Childcare centres Libraries Community centres and nursing homes Recreation facilities, parks and open spaces	Local/regional wetlands/ swales/bioretenion assets, protective dune systems



However, in many cases in Table 1, there is shared ownership of, and responsibility for infrastructure assets, sometimes in a legal or contractual sense with some clarity, or in an implicit sense in a realistic political context (see section 4). Whether that explicit or implicit shared ownership includes ‘ownership’ of new or exacerbated climate risk and recovery from disruption is highly variable and often ‘messy’. For example:

- Some infrastructure assets are solely government-owned assets, such as some highways, dams and some catchments,
- Some infrastructure assets are privately owned, such as some airports and ports, some electricity generation facilities,
- Some infrastructure assets are owned and operated through public-private partnership arrangements, such as a toll roads and trains, electricity distribution networks, and prisons
- Some infrastructure assets are community owned, such as irrigation systems and distributed energy systems, and
- Confusion exists with respect to the ownership versus service provision arrangements for some infrastructure assets, for example the supply and distribution of water resources from catchments.

It is this variation in ownership arrangements that makes the allocation of risk difficult to discern, especially for events that have yet to unfold. This area of complexity warrants further attention.

CRITICAL INFRASTRUCTURE AND THE ROLE OF THE COMMONWEALTH

Identifying the appropriate role for the federal government, state/territory governments and private entities in adapting critical infrastructure to account for climate change is particularly complex because the threats posed by climate change are many, varied, inter-connected and almost inevitably uncertain in place, time and scale (IPCC 2012) and are subject to the complexity outlined in the previous section. The challenge is further complicated by the shift in recent decades towards a ‘shared responsibility’ model in dealing with natural hazards, involving ever-increasing numbers of state and non-state actors with varying degrees of responsibility and capacity (McLennan and Handmer 2011). Moreover, just as climate change impacts are location-specific, so too must adaptation responses be tailored to specific infrastructure assets and account for different threats to the same asset: in other words, there is unlikely to be a single one-size-fits-all tool which will be functionally applicable across all assets (Hussey *et al.* 2012).

Some authorities argue that adaptation is essentially a local-scale endeavour and that the role of the Federal Government should be minimal (Garnaut 2008), while others assert that promoting adaptation is a responsibility of all scales of governance (Dovers & Hezri, 2010). Stakeholders represented via reports such as Webb *et al.* (2014) strongly believe that a crucial Commonwealth role is in the area of data provision/coordination and the promulgation of protocols, decision processes, etc. that *lie beyond the scope or capacity* of any other actor. Such a view is consistent with modern theories of governance in federal systems, where coordination (steering, not rowing) is an important role for national governments. Similarly, in responding to catastrophic national disasters, Eburn (2011) argues that the Commonwealth has significant interests in responding to disasters of national consequence and thus the role, powers and responsibilities of the Commonwealth should be enshrined in legislation to that effect (it is not, currently).

According to the CIRS, the role of the Australian Government lies in “understanding the vulnerabilities and dependencies in and across critical infrastructure sectors, and the risk mitigations being applied” as well as facilitating “national coordination where there are cross-jurisdictional issues, international treaty obligations, or where an incident would have national consequences or require a national response” (2010). However, in terms of public policy and responsibilities in a federal system, the term ‘critical’ is at once central and difficult to define. The CIRS uses ‘significant’ impacts on social or economic well-being,



and ‘national/international’ implications to imply a national/Commonwealth level of interest. International aspects of climate impact are clear enough, and ‘national’ may be interpreted as those matters within the Commonwealth’s (current or assumed) constitutional and legislative ambit. The matter of what is ‘significant’ enough is far more difficult to define, and may be measured, or at least debated, in terms of lives, severity or spread of non-fatal health impacts, social disruption or unrest, severity and spread of economic impact, and duration of disruption (drought versus heatwave, for example). There is little prospect of achieving quantified metrics defining a threshold of ‘national’ significance and thus Commonwealth involvement and, on the latter, the degree or largesse of that involvement. Also, there are thresholds of political imperative and moral obligation that are even more problematic (see below).

However, as a federated constitutional state, the areas in which Australia’s federal government is *legally* entitled to govern is laid down in the *Australian Constitution Act 1900* (UK) and is restricted to the ‘external affairs’ power and matters relating to taxation, health, postal and telegraphic communications, defence and counter-terrorism, insurance, trading corporations, and the payment of social security benefits (Australian Constitution s 51(xxix)). In practice, there are numerous issues and policy domains of relevance to climate change adaptation in which the Commonwealth has an interest in, or responsibility for, even in the absence of statutory powers. Successive Australian governments at both the state and federal level have designed and implemented a range of institutions to cope with those often-devastating events, including planning and development regimes, building codes, the provision of emergency services, mandatory insurance schemes and/or payments for exceptional circumstances, to name a few (see Appendix for further detail).

So the existence of numerous national strategies or policies that are climate-relevant suggests that while the degree of responsibility for the Commonwealth may be contested and vary between sectors, the fact that the Commonwealth has a role to play is not. Indeed, the Commonwealth’s role in funding relief and recovery efforts after the 2010-11 Queensland floods is a reminder of how pivotal the Commonwealth is in dealing with natural hazards; it is also a reminder of the duty the Commonwealth bears on behalf of the tax-payer to ensure relief and recovery bills are kept to a minimum (Wenger *et al.* 2013) and the on-going PC enquiry in this respect is welcome.

The following pose three bases for Commonwealth involvement, leaving aside the type and magnitude of that involvement:

Because the Commonwealth has a legal responsibility: this is clear and relatively uncontested. The responsibility for adaptation lies with owners and operators of critical infrastructure assets, and as the typology in section 3 illustrates, there are a range of assets for which the Commonwealth is solely or in large part responsible.

Because of the significance of the impact: this is much less clear and a future area of research lies in whether it is possible to identify a threshold beyond which the Commonwealth should get involved. Clearly, this would build on past experience around the declaration of natural disasters. However, there is a sizeable fiscal risk here, and the Commonwealth needs to explore the implications fully.

Because of a political or moral obligation to act: this relates to the point above, though it is far more qualitative in nature. Loss of life, long-term disruption to services etc. may involve a political imperative or moral obligation on the Commonwealth to act. Government involvement is at times described as ‘political’ in a cynical sense of gaining political advantage or avoiding electoral costs. However, human suffering provokes reactions from governments (and others) that are validly and unavoidably based on social values and perceived moral obligations. That reality cannot be ignored in public policy. The lessons of 25 years of shifts in drought policy are apposite (Botterill and Dovers 2013).



The latter two situations mean that even where there may be no formal, legal arrangements that explicitly implicate the Commonwealth, their involvement may nevertheless be warranted. Perhaps the most significant lever the Commonwealth has to limit its exposure to climate-related risk is in the reallocation of disaster relief funds, but the following section outlines a range of other actions that could be implemented.²

OPTIONS FOR COMMONWEALTH INVOLVEMENT

There is some evidence that asset owners (both public and private) here and elsewhere are beginning to take potential adaptation measures into account (Hussey et al 2013; PWC 2010). However, experience to date has highlighted a number of important challenges which the Commonwealth could usefully examine, key amongst which include:

Information gaps: The Australian Government has played a central role in the provision of information on climate change impacts and risks. This information is a public good, with wide application across society and the economy, and the important role by the Commonwealth in the provision of information about climate risks was reinforced by the recent PC report on climate adaptation and other studies (PC 2013; Webb 2013; Hussey et al. 2013; Wenger et al. 2013). However, given the broad remit of Government-led research, the information collected and provided through key initiatives tends to be generic or has a wider application, and many studies have found that the information currently available is not sufficiently detailed or tailored to their sectors and infrastructure to inform adaptation responses. Interestingly, efforts by individual companies and by industry collaborations in other countries are bridging these information gaps (PC 2010), which suggests there is growing awareness of the risk posed to private actors from climate risks. However, there is often a commercial incentive for industry to retain information and not share it in the public domain.

Short-term regulatory focus: In regulated sectors, regulators act upon the statutory duties determined by Government. Climate change adaptation is not explicitly prescribed as a statutory duty for many regulators, but is embodied within wider mandates (e.g. protection of short- and long-term consumer interest, security of supply). Regulators are adequately equipped with appropriate levers (including incentives and penalties, standards and regular pricing controls) to deliver these mandates and therefore incentivise adaptation. However, the strong emphasis on short-term value for money, especially against a backdrop of fiscal constraints, coupled with uncertainties around the severity of the long-term impacts of climate change mean that adaptation requirements are not yet being addressed on a systematic basis. Whilst in principle the regulatory framework is broadly fit for purpose in the context of climate resilience, there is a need to strengthen the focus on long-term resilience (Hussey et al. 2013). The Commonwealth could explore the potential benefits of a statutory duty on behalf of regulators to account for long term climate impacts in policy and investment decisions – much like occurred in the 1980s and 1990s in relation to health and safety concerns.

Disclosing risks and managing uncertainties: The most difficult challenge faced by many stakeholders in critical infrastructure sectors is the incorporation of uncertainties into the decision making process. There has been recent attention to processes, data needs and decision rules to insert climate risk considerations into decision making (e.g. Webb et al. 2014), though, again, confidence and consistency varies across sectors. Again, there is a critical role for the Commonwealth in providing a platform for the sharing of experiences, a role which is clearly articulated in the government's *Critical Infrastructure Resilience*

² The role of Commonwealth disaster relief funds are the subject of a Productivity Commission enquiry at the time of writing. Certainly, the need to shift the provision of DRR funds from post-disaster to prevention and mitigation measures is manifest (as evidenced by the vast majority of submissions to that enquiry).



Strategy, though whether the strategy has sufficient resources (human, financial and knowledge) supporting it remains to be seen.

A related point is that institutional investors in, and insurers of, infrastructure have a stake in timely adaptation and climate resilience. Greater disclosure of risks and actions by companies – possibly mandated by either state or commonwealth governments - could help to increase understanding within and between critical infrastructure sectors.

Balancing priorities: Even when climate change risks are considered, building in climate resilience needs to be balanced against other objectives, and with the exception of ‘no regrets’ or ‘quick win’ measures, adaptation tends to be a low priority. In competitive and unregulated sectors such as power generation and ports, adaptation investment faces competition for capital and for management time. Except for very large, long-life assets, or where the risk is particularly significant, adaptation may not always receive sufficient attention at Board level or from shareholders (PWC 2010). Grimsey and Lewis (2000: 111) identify nine risks to infrastructure projects: technical; construction; operating; revenue; financial; force majeure; regulatory/political; environmental; and project default risk due to a failure of the project from a combination of any of the above.

Some of these risks are highly relevant to climate impacts, but most refer to short term risks associated with the construction of critical infrastructure, and do not account for long term risks, the interdependencies between critical infrastructure assets, and the cumulative impacts of multiple climate impacts. And nor could they, because the framework for investment decisions does not provide incentives for such considerations, and, arguably, only governments are in a position to measure and account for those risks. However, even at procurement and construction stages, much can be done to mitigate longer term risks (e.g. consideration of physical design and location, changing or managing operational procedures, and building or retrofitting additional resilience features).

A point that has failed to garner much attention is the fact that by addressing climate risks, operators should see long-term benefits in more resilient infrastructure and enhanced security of supply and reduced costs, leading ultimately to a lower cost of capital, higher revenues (where customers are willing to pay for reliability and continuity of supply) and sustained long-term returns. It is therefore reasonable to expect long-term climate risk to be prominent in critical infrastructure design and management, and for organisations to work with other infrastructure companies, regulators and Government to address cross-sectoral risks and interdependencies. The Commonwealth has a role in – at the very least – facilitating that mainstreaming, and perhaps in some circumstances mandating it.

Interdependencies between infrastructure assets: There are strong inter-linkages within and between infrastructure sectors, as noted above. However the level of understanding of climate risks from these interdependencies is low (PWC 2012). Greater collaborative efforts between infrastructure sectors, regulators and Government are required to address these interdependencies. As suggested above, ‘working backwards’, from critical services to the asset systems that enable these, may be a useful perspective. The Australian Government’s *Trusted Information Sharing Network* (TISN) for Critical Infrastructure may be one fora where these issues could be explored.

CONCLUSION

Australia has a high level of institutional capacity and extensive experience in managing climate-related risks, but our way of life is becoming increasingly integrated, inter-dependent and complex and as with all complex systems, the more integrated it becomes the more vulnerable it can be to shocks. As well as considering specific climate-related disaster events and emergency management and community capacities to deal with these, increasing attention is being paid to the resilience of ‘critical infrastructure’



in the face of future risks. This paper has (i) provided a more comprehensive typology of the assets that contribute to essential services (ii) identified some of the complexity in the ownership arrangements of critical infrastructure assets, and thus in the allocation of risk and (iii) defined areas of potential Commonwealth action. There is yet more complexity behind this brief analysis, all of which warrants further attention.



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APPENDIX

Key statutory and institutional frameworks to address selected climate impacts

Climate threat	Policy/regulatory frameworks categorized by level of governmental responsibility			Responsible Federal authority/institution
	Local government	State/Territory Government	Federal	
Disaster management (including emergency management), which contributes overarching policy and/or legislative responses to many of the threats listed below.		<p><i>Emergencies Act 2004</i> (ACT)</p> <p><i>State Emergency and Rescue Management Act 1989</i> (NSW)</p> <p><i>Disasters Act 1982</i> (NT)</p> <p><i>Disaster and Management Act 2003</i> (QLD)</p> <p><i>Emergency Management Act 2004</i> (SA)</p> <p><i>Emergency Management Act 1986</i> (Vic)</p> <p><i>Emergency Management Act 2005</i> (WA)</p>	<p>Australian Government Critical Infrastructure Resilience Strategy</p> <p>Australian Government Disaster Response Plan</p> <p>National Catastrophic Natural Disaster Plan</p> <p>National Strategy for Disaster Resilience</p>	<p>Attorney General’s Department (Emergency Management Australia)</p> <p>National Emergency Management Committee (initiated by COAG)</p>



			National Risk Assessment Framework National Partnership Agreement on Natural Disaster Resilience	
Increased frequency and intensity of drought	Local, regional and catchment-level water-sharing plans	Statutory planning for water sharing and allocation (All) 2010-2012 Pilot of drought reform measures in Western Australia (co-funded by Commonwealth)	2004 National Water Initiative and <i>2007 Water Act</i> Funding (various): Farm Planning Program; Farm Management Deposits; Farm Family Support Program	National Water Commission (initiated by COAG) National Rural Advisory Council (NRAC)
Projected global mean sea-level rise by 2100 of 0.18 to 0.59 m Storm surge and coastal flooding	Coastal planning and development strategies	State planning and development legislation (All) <i>QLD Coastal Protection and Management Act 1995</i> Victorian Coastal Strategy 2008	<i>1999 Environmental Protection and Biodiversity Conservation Act</i> for lands under Commonwealth purview. Framework for a National Cooperative Approach to Integrated Coastal Zone Management (ICZM)	Natural Resource Management Ministerial Council



Increased severity of tropical cyclones	Land planning and development strategies	State planning and development legislation (All) State building codes	-	-
Reduced interval between fires , increased fire intensity, a decrease in fire extinguishments and faster fire spread	Land planning and development strategies	State planning and development legislation (All) State building codes Bushfire management plans (various)	<i>EPBC Act 1999</i> ³	Nothing specific to bushfires <i>per se</i> - federal engagement is covered under the National Emergency Management Committee which services relevant COAG committees
Extreme precipitation leading to increased frequency and possibly intensity of floods	Local planning and development strategies	State planning and development legislation Detailed planning provisions for floodplain management (various)	National Flood Management Guidelines Emergency Management Manuals - #19 Managing the Floodplain (1999) - #7 Land Use Planning for Natural Hazards (2002)	Nothing specific to floods <i>per se</i> - federal engagement is covered under the National Emergency Management Committee which services relevant COAG committees

³ The state and territory governments have primary responsibility for care and management of the environment. National environment law does not generally regulate fire prevention measures taken by state and territory governments, and only applies in limited circumstances. Fire prevention activities only need federal environmental approval if (i) they are likely to have a significant impact on a nationally protected matter, and (ii) they are not specifically exempted by the national environment law.



		Coastal zone management	- #20-#23 Flood Risk and Management National Water Initiative (indirectly)	
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