Marine Environmental Impact Assessment: Considering cumulative and synergistic impacts within the Australian legal framework

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Abstract

This thesis examines the shortcomings and challenges for Australian marine environmental impact assessment (EIA) legal frameworks to consider and assess cumulative and synergistic impacts, as distinct impact types, from large-scale marine use and development. The thesis aims to identify how the legal frameworks and requirements can be improved to enable better consideration and assessment of these impact types. Emphasis is given to the legal frameworks for marine environmental assessment: EIA and strategic environmental assessment (SEA). In particular, the thesis examines the different characteristics of cumulative and synergistic impacts, and how they are typically defined to be the same type of impact when considered or assessed as part of environmental assessment. Concentrating on this, if environmental assessment frameworks use definitions that do not distinguish the characteristics of these impact types, then there is a risk that detrimental synergistic impacts may be neglected. Thus, it is argued in this thesis that these impact types should be assessed and considered separately.

The thesis emphasises that consideration and assessment of cumulative and synergistic impacts should be required in EIA and SEA to enable iterative planning and decision-making frameworks. Improving EIA legal requirements for cumulative and synergistic impact consideration and assessment to better inform decision-making is a main focus. Theoretical and practical mechanisms to improve planning and decision-making are also identified to examine how the improvement of knowledge about cumulative and synergistic impacts can assist with achieving goals of marine environmental protection, and reduce uncertainty in environmental assessment and decision-making processes. The precautionary principle and the use of post-approval monitoring (PAM) are two key mechanisms that can assist with the iterative feedback of knowledge about cumulative and synergistic impacts, and the integration of EIA with SEA.

Analysis of Australian marine EIA legal frameworks to consider and assess cumulative and synergistic impacts is provided through two case studies. The first case study analyses legislation applicable to the Otways Marine Area and seeks to ascertain the extent of, and approach to, legal requirements to assess these impact types within four Australian jurisdictions (Commonwealth, Victoria, South Australia and Tasmania). The second case study analyses the consistency of approach to cumulative and synergistic impact consideration and assessment within the EIA, decision-making processes and PAM associated with Victoria's Port Phillip Bay Channel Deepening Project. These two case studies demonstrate that increased attention needs to be given to the consideration

and assessment of cumulative and synergistic impacts in EIA. A third case study was undertaken to give insight into the shortcomings and benefits of approaches to cumulative and synergistic assessment when there are legal requirements to consider these impact types in marine environmental assessment legislation. To achieve this, the final case study examined the EIA, PAM programmes, and legal frameworks for existing and approved offshore wind farms in Denmark.

The thesis concludes with recommendations for the reform of Australian marine EIA legal frameworks. The recommendations focus on improving legislative requirements for the consideration and assessment of cumulative and synergistic impacts as distinct impact types. This includes through the use of express provisions, distinct definitions and other aiding mechanisms, such as the precautionary principle, and PAM.

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Lastly, when I started this little project way back when….Andrew Roberts (my first mentor in environmental and planning law) made me promise that I would acknowledge him…. Thanks Andrew.

Certification

I, Anna Grage declare that this thesis submitted in fulfilment of the requirements for the conferral of the degree Doctor of Philosophy, from the University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. This document has not been submitted for qualifications at any other academic institution.

Anna Grage
29th August 2018

List of Abbreviations

ABAs - Approval Bilateral Agreements

Brundtland report - *Report of the World Commission on Environment and Development: Our Common Future*

CBD – *Convention on Biological Diversity 1992*

CDP – Channel Deepening Project

CEA – cumulative effects assessment

CEAA - Canadian Environmental Assessment Agency

CIA – cumulative impact assessment

COAG – Council of Australian Governments

EES – environmental effects statement

EIA – environmental impact assessment

EMP – environmental management plan

ESD – ecologically sustainable development.

EU – European Union

FAO - United Nations Food and Agriculture Organization

GBRWHA - Great Barrier Reef World Heritage Area

IGAE - Intergovernmental Agreement on the Environment (Australia, 1992)

LOSC – *United Nations Convention on the Law of the Sea 1982*

OCS – Offshore Constitutional Settlement (Australia)

OEM – Office of Environmental Monitor (Victoria)

OWF – offshore wind farm

PAM – post-approval monitoring

Ramsar Wetlands Convention - *Convention on Wetlands of International Importance Especially as Waterfowl Habitat*

Rio Declaration - *1992 Report of the United Nations Conference on Environment and Development* included the *Rio Declaration on Environment and Development*

SD – sustainable development

SEA – strategic environmental assessment

SEES – Supplementary Environmental Effects Statement

SoE – State of the Environment

SoE16 - Australia state of the environment report 2016

UNESCO – United Nations Educational, Scientific and Cultural Organization

VECs – valued ecosystem components

World Heritage Convention - *Convention Concerning the Protection of the World Cultural and Natural Heritage*

List of Foreign Terms (Danish)

Kumulative (cumulative)

Synergistike (synergistic)

Forsighighedsprincippet (precautionary principle)

(*Økologisk*) *bæredygtig udvikling* ((ecologically) sustainable development)

Overvågning (monitoring).

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CHAPTER 1 – INTRODUCTION

Chapter outline

1. Introduction

The Australian marine environment has significant intrinsic value and covers an area of 13.86 million square kilometres.[1] There is also significant recreational and economic value gained from the area; with 85 per cent of Australia's population living within 100km of the coast, a marine resources and industries sector predicted to be valued at over $105 billion by 2030, and ecosystem services currently valued at $25 billion.[2] The commercial and recreational activities associated with these values can cause pressures that result in detrimental environmental impacts.

Decisions about impacts from anthropogenic activities in Australia's marine environment, and whether they are acceptable, need to involve the assessment and consideration of complex interactions. The decision-making processes for assessing these marine environmental impacts are subject to legal requirements. Without legal requirements that specifically require the assessment and consideration of these complex interactions, there is a risk that detrimental impacts will be neglected. To address this, this thesis evaluates Australia's legal framework for requirements to consider and assess cumulative and synergistic impacts within the

[1] K Evans, N Bax and D C Smith, *Australia state of the environment 2016: marine environment*, independent report to the Australian Government Minister for the Environment and Energy (Australian Government Department of the Environment and Energy, 2017) v.
[2] Ibid.

environmental impact assessment (EIA) of large-scale marine use and development associated with anthropogenic activities.

This thesis has two aims. The first is to identify areas in which Australian legal requirements for marine environmental assessment (in particular EIA) may be inadequate for the consideration and assessment of cumulative and synergistic impacts. As part of addressing this aim, the challenges for the consideration and assessment of cumulative and synergistic impacts are identified.

The second aim is to provide recommendations for improving the current legal approach to cumulative and synergistic impact consideration and assessment within marine EIA. This aim is considered within the context of Australia's future and emerging offshore industries. It is intended that these recommendations support reform for Australian marine EIA legal frameworks through assisting to address any shortcomings identified in response to the first aim. The recommendations will provide "first step" opportunities for achieving improvements in marine environmental protection. The different types of impacts affecting the marine environment are complex, and a better understanding of these impacts, including those that are cumulative or synergistic, will assist environmental protection. One way of achieving this is through management of marine anthropogenic activities, with environmental assessment processes such as EIA.

The foundation for understanding the issues and identifying the main challenges associated with the effective consideration and assessment of cumulative and synergistic impacts is developed through academic reviews and analysis; principally environmental assessment literature and legal scholarship. For the early chapters, the literature is sourced from Australia and other countries (e.g. Canada, New Zealand, Sweden, the United Kingdom and the USA). The literature from countries other than Australia is used to guide the identifications of shortfalls in the Australian context. Case studies were undertaken to assist in identifying and understanding any shortcomings within legal frameworks. The case study analyses include a review of several Australian jurisdictions (Otways Marine Area)[3] and an example of a Victorian EIA and decision-making process (Victoria's Port Phillip Bay Channel Deepening Project).[4] An international case study focusing on the Danish and associated European Union approach to EIAs for offshore wind farms is also included.[5] The shortcomings and benefits identified within this case study are used to assist with the development of recommendations for improving the Australian legal framework.

[3] Chapter 5 Otways Marine Area
[4] Chapter 6 Victoria's Port Phillip Bay Channel Deepening Project
[5] Chapter 7 Offshore Wind Farms in Denmark: The Assessment of Cumulative and Synergistic Impacts

This chapter is divided into eight sections. Following this introduction is a review of cumulative and synergistic impacts, including discussion of the importance of environmental assessment for these impact types for the marine environment. The third section addresses Ecologically Sustainable Development (ESD) and the roles of the precautionary principle and post-approval monitoring (PAM) within environmental decision-making processes. These discussions are expanded within subsequent chapters; as are discussions about the definitions of certain terms.

The fourth and fifth sections of this chapter explain the research aims and questions of the thesis and the methodological approach. The sixth section discusses the scope and limitations of the research, and the seventh section provides an outline of the thesis structure. The eighth section outlines the original contribution and significance of the research.

2. Environmental impacts and marine environmental protection

Stressors within the marine environment, such as anthropogenic activities and environmental change,[6] are increasing.[7] Detrimental implications include a loss of biodiversity,[8] changes to ecosystem health,[9] and decline in overall health and productivity.[10] These are due to factors such

[6] Refer to glossary.

[7] See, eg, K R N Anthony et al, *A framework for understanding cumulative impacts, supporting environmental decisions and informing resilience-based management of the Great Barrier Reef World Heritage Area: Final Report to the Great Barrier Reef Marine Park Authority and Department of the Environment* (Great Barrier Reef Marine Park Authority, 2013), 15, 21 <http://www.environment.gov.au/resource/framework-understanding-cumulative-impacts-supporting-environmental-decisions-and-informing>; George Hegmann and G A (Tony) Yarranton, 'Alchemy to reason: Effective use of Cumulative Effects Assessment in resource management' (2011) 31 *Environmental Impact Assessment Review* 484, 484; Millenium Ecosystem Assessment, *Ecosystems and Human Well-Being: Biodiversity Synthesis* (World Resources Institute, 2005) 47 – 51; Alex D Rogers and Dan Laffoley, 'Editorial: Introduction to the special issue: The global state of the ocean; interactions between stresses, impacts and some potential solutions. Synthesis papers from the International Programme on the State of the Ocean 2011 and 2012 workshops' (2013) 74 (2) *Marine Pollution Bulletin* 491, 491.

[8] See, eg, B Worm et al, 'Impacts of Biodiversity Loss on Ocean Ecosystem Services' (2006) 314 *Science* 787, 787; Fanny Douvere and Charles N Ehler, 'New Perspectives on sea use management: Initial findings from European experience with marine spatial planning' (2009) 90 *Journal of Environmental Management* 77, 77.

[9] See, eg, Millenium Ecosystem Assessment, above n 7, 3- 10; Douvere and Ehler, above n 8,77.

[10] See, eg, Worm et al, above n 8, 787; Douvere and Ehler, above n 8, 77; A D Rogers and D d'A Laffoley, *International Earth System expert workshop on ocean stresses and impacts* (IPSO Oxford, 2011), 9 <http://www.stateoftheocean.org>.

as climate change, [11] overfishing,[12] habitat destruction,[13] and pollution.[14] In 2011, a widely acknowledged international group of researchers released a report entitled *International Earth System expert workshop on ocean stresses and impacts*.[15] The report concluded that - as a matter of global concern – the marine environment would suffer further 'ecosystem collapses' if appropriate actions are not taken.[16] The conclusion has since been reiterated.[17]

The combination of stressors from environmental change and anthropogenic activities is causing increased pressure in Australia's marine environment. In the Great Barrier Reef region this is occurring due to the impacts of climate change, and increased intensity of activities such as tourism, shipping, fishing and port development.[18] Other examples of marine areas affected by stressors include the north-west shelf of Australia, where there is increased pressure associated with offshore petroleum production, development and shipping.[19] In the Great Australian Bight, the increased intensity of fishing for Southern Bluefin Tuna is a further cause for concern.[20]

The need to protect the marine environment from degradation is recognised within international, regional and domestic legal frameworks. Examples from an international perspective include the *Law of the Sea Convention* (LOSC),[21] and the *Convention on Biological Diversity* (CBD).[22] At the regional level, multilateral agreements such as the *Convention for Conservation of Southern Bluefin Tuna*[23] between Japan, New Zealand and Australia provide for marine environmental

[11] See, eg, Millenium Ecosystem Assessment, above n 7, 2005, 3- 10; Douvere and Ehler, above n 8, 77; U Cubasch et al, *Introduction. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group 1 to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Stocker et al (eds) (Cambridge University Press, 2013) 136.
[12] See, eg, Benjamin S Halpern et al, 'Managing for cumulative impacts in ecosystem-based management through ocean zoning' (2008) 51 *Ocean & Coastal Management* 203, 206.
[13] See, eg, J G Hiddink et al, 'Cumulative impacts of seabed trawl disturbance on benthic biomass, production, and species richness in different habitats' (2006) 63 *Canadian Journal of Fisheries and Aquatic Sciences* 721, 721 – 722, 730 – 733; Benjamin S Halpern et al, 'A Global Map of Human Impact on Marine Ecosystems' (2008) 319 *Science* 948, 948; Riki Therivel and Bill Ross, 'Cumulative effects assessment: Does scale matter?' (2007) 27 *Environmental Impact Assessment Review* 365, 381; Paul L A Erftemeijer and Roy R Robin Lewis III, 'Environmental impacts of dredging on seagrasses: A review' (2006) 52 *Marine Pollution Bulletin* 1553, 1559.
[14] See, eg, Claudio Campagna et al, 'Gulf of Mexico Oil Blowout Increases Risks to Globally Threatened Species' (2011) 61(5) *BioScience* 393, 393; Caroline Williams, 'Combating Marine Pollution from land-based activities: Australian initiatives' (1996) 33 (1 – 3) *Ocean and Coastal Management* 87, 88 – 89.
[15] Rogers and Laffoley, above n 10.
[16] Rogers and Laffoley, above n 10, 8 – 9; See, also, Rogers and Laffoley, above n 7, 493.
[17] William J Ripple et al, ''World Scientists' Warning to Humanity: A second notice' (2017) 67 (3) *BioScience* 197, 197, 199.
[18] See, eg, Great Barrier Reef Marine Park Authority, *Great Barrier Reef Region Strategic Assessment: Strategic assessment report* (Great Barrier Reef Marine Park Authority, 2014), Chapter 5.
[19] International Risk Consultants Pty Ltd prepared for the Department of the Environment Water, Heritage and the Arts, *Petroleum and minerals industries in the North-west Marine Region: A Report to the Department of the Environment, Water, Heritage and the Arts* (2007), 8 <http://www.environment.gov.au/resource/petroleum-and-minerals-industries-north-west-marine-region>.
[20] Australian Fisheries Management Authority, *Southern Bluefin Tuna Fishery (SBTF) at a glance* (2014) <http://www.afma.gov.au/managing-our-fisheries/fisheries-a-to-z-index/southern-bluefin-tuna/at-a-glance/.
[21] *United Nations Convention on the Law of the Sea,* opened for signature 10 December 1982, 183 UNTS 3 (entered into force 16 November 1994) Part XII.
[22] *Convention on Biological Diversity,* opened for signature 5 June 1992, 1760 UNTS 79 (entered into force 29 December 1993) Art 2.
[23] *Convention for the Conservation of Southern Bluefin Tuna*, opened for signature 10 May 1993, [1994] ATS 16 (entered into force 20 May 1994).

protection through, for example, collaborative scientific research,[24] and the imposition of catch limits.[25] Frameworks such as those within the European Union (EU) Environmental Directives suite provide the foundation and direction for marine environmental protection goals to be legislated by EU member countries.[26] At a domestic level the legal framework varies between jurisdictions and can include legislation that, using Australia as an example, seeks to provide protection within the context of the sustainable management of impacts from activities,[27] or is specifically directed at marine environmental protection.[28]

The challenges posed for the effectiveness of these frameworks include the complexities associated with poor knowledge about the marine environment.[29] This also includes the integration of scientific assessment, which seeks to address these knowledge gaps, with decision-making processes (and associated legal frameworks).[30] An example of this is the tendency for decision-makers, and those undertaking environmental assessments, to avoid the assessment of complex interactions. Legislative requirements for the assessment of cumulative and synergistic impacts will assist in improving the decision-making approach because it will be based on a more comprehensive understanding of the environmental consequences of planned activities.

2.1 Cumulative and synergistic impacts

There are various types of impacts that are addressed by different regulatory frameworks for marine environmental protection. The report from the *International Earth System expert workshop on ocean stresses and impacts* identified negative cumulative and synergistic impacts

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[24] See, eg, *Convention for the Conservation of Southern Bluefin Tuna*, opened for signature 10 May 1993, [1994] ATS 16 (entered into force 20 May 1994), Article 9.
[25] See, eg, *Convention for the Conservation of Southern Bluefin Tuna*, opened for signature 10 May 1993, [1994] ATS 16 (entered into force 20 May 1994), Article 8.
[26] See, eg, *Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive) (Text with EEA relevance),* [2008] OJ L 164/19.
[27] See, eg, *Offshore Petroleum and Greenhouse Gas Storage Act 2010* (Vic), s 61, as an example of industry specific application, and the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) as an example of general application.
[28] See, eg, *Great Barrier Reef Marine Park Act 1975* (Cth).
[29] See, eg, State of the Environment 2011 Committee, *Australia state of the environment 2011. Independent report to the Australian Government Minister for Sustainability, Environment, Water, Population and Communities* (DSEWPaC, 2011) 373, 435; Natalie C Ban, Hussein M Alidina, and Jeff A Ardron, 'Cumulative impact mapping: Advances, relevance and limitations to marine management and conservation, using Canada's Pacific Waters as a case study' (2010) 34 *Marine Policy* 876, 876; Stelios Katsnevakis et al, 'Ecosystem-based marine spatial management: Review of concepts, policies, tools, and critical issues' (2011) 54 *Ocean and Coastal Management* 807, 809; Lourdes M Cooper, 'CEA in policies and plans: UK case studies' (2011) 31 *Environmental Impact Assessment Review* 465, 466.
[30] See, eg, Monique Dubé and Kelly Munkittrick, 'Integration of Effects-Based and Stressor-Based Approaches into a Holistic Framework for Cumulative Effects Assessment in Aquatic Ecosystems' (2001) 7(2*) Human and Ecological Risk Assessment: An International Journal,* 247, 250 – 253.

as some of the impact types that cause significant environmental concern.[31] It is stated that the:

> …examination of synergistic threats leads to the conclusion that we have underestimated the overall risks and that the whole of marine degradation is greater than the sum of its parts, and that degradation is now happening at a faster rate than predicted.[32]

In the Australian context, the connection between increasing pressures within the marine environment and cumulative impacts was articulated in the 2011 State of the Environment Report (2011).[33] These issues have been evident for several decades, with concerns about the degradation of Australia's marine environment raised in earlier parliamentary reports, such as the 1991 *The Injured Coastline: Protection of the Coastal Environment*.[34]

Cumulative and synergistic impacts within the marine environment result from environmental change and anthropogenic activities.[35] Whilst discussed later in depth in Chapter 2, 'cumulative' impacts can be defined here as the same or different type of impacts accumulating across time and space, with the accumulation occurring in a linear nature.[36] In contrast, although sometimes defined as a type of 'cumulative' impact,[37] 'synergistic' impacts refer to those impacts that accumulate in a nonlinear nature and result in a magnitude that is greater than the sum of the contributing impacts.[38] These too can occur across time and space. The definition of synergistic impacts is also discussed in more depth within Chapter 2; as are the potential problems with the

[31] Rogers and Laffoley, above n 10, 5.
[32] Ibid; Also see a similar comment in Elizabeth R Selig et al, 'Global Priorities for Marine Biodiversity Conservation' (2014) 9(1) *PloS One*: e82898, 9 <http://doi:10.1371/journal.pone.0082898>.
[33] State of the Environment 2011 Committee, above n 29, 373.
[34] House of Representatives Standing Committee on Environment, Recreation, and the Arts, Parliament of the Commonwealth of Australia, *The Injured Coastline: Protection of the Coastal Environment* (1991) xiii, 47.
[35] See, eg, Anthony et al, above n 7,18; Great Barrier Reef Marine Park Authority, above n 18, 10-3; Clive Wilkinson and Bernard Salvat, 'Coastal resource degradation in the tropics: Does the tragedy of the commons apply for coral reefs, mangrove forests and seagrass beds' (2012) 64 *Marine Pollution Bulletin* 1096, 1097; Andrew J Wright and Line A Kyhn, 'Practical management of cumulative anthropogenic impacts with working marine examples' (2014) 29 (2) *Conservation Biology* 333, 334.
[36] See, eg, L M Cooper and W R Sheate, 'Cumulative Effects Assessment; A review of UK Environmental Impact Statements' (2002) 22 *Environmental Impact Assessment Review* 415, 416, 422 - 423; Halpern et al, above n 12, 205; Samuli Korpinen, Manuel Meidinger and Maria Laamanen, 'Cumulative impacts on seabed habitats: An indicator for assessments of good environmental status' (2013) 74 *Marine Pollution Bulletin* 311,313; Great Barrier Reef Marine Park Authority, above n 18, XIII; Ban, Alidina and Ardron, above n 29, 883; Murray Raff, 'Ten Principles of Environmental Impact Assessment' (1997) 14 *Environmental and Planning Law Journal* 207, 210.
[37] See, eg, Ban, Alidina and Ardron, above n 29, 883; Greig et al (2003) in Peter N Duinker and Lorne A Greig, 'The impotence of cumulative effects assessment in Canada: Ailments and Ideas for Redeployment' (2006) 37(2) *Environmental Management* 153, 157; Nicole E Seitz, Cherie J Westbrook and Bram F Noble, 'Bringing Science into river systems cumulative effects assessment practice' (2011) 31 *Environmental Impact Assessment Review* 172, 173; Jill A E Harriman and Bram F Noble, 'Characterizing Project and Strategic Approaches to Regional Cumulative Effects Assessment in Canada' (2008) 10(1) *Journal of Environmental Assessment Policy and Management* 25, 26.
[38] See, eg, Raff, above n 36, 210; C L Folt et al, 'Synergism and antagonism among multiple stressors' (1999) 44(3)(2) *Limnology and Oceanography* 864,864; John D Court, Colin J Wright and Alasdair C Guthrie, *Assessment of cumulative impacts and strategic assessment in environmental impact assessment: prepared for the Commonwealth Environment Protection Agency*, (Commonwealth of Australia, 1994) Appendix I.3; Great Barrier Reef Marine Park Authority, above n 18, 10-3; Ban, Alidina and Ardron, above n 29, 883; Harry Spaling and Barry Smit, 'Cumulative Environmental Change: Conceptual Frameworks, Evaluation Approaches, and Institutional Perspectives' (1993) 17(5) *Environmental Management* 587, 592; the definition is also supported within a different context in Daniel Simberloff and Betsy Von Holle, 'Positive Interactions of nonindigenous species: invasional meltdown?' (1999) 1 *Biological Invasions* 21, 22.

approach to include synergistic impacts within the definition of cumulative impacts.[39] Both these definitions are intended to have general application and are derived by a synthesis of multiple definitions found within the literature. The literature is sourced from several jurisdictions (e.g. Australia, Canada, the United Kingdom and the USA).

The conservation, protection and sustainability needs of marine areas is prioritised within environmental science and management.[40] To achieve these goals, awareness of the cumulative and synergistic nature of anthropogenic activities, in combination with a changing marine environment, is required. As described by Harriman and Noble, assessing cumulative impacts is about improving knowledge of 'environmental effects and pathways', so as to understand and therefore minimise the causes of 'cumulative environmental change.'[41] In this respect, cumulative impact assessment is important for achieving marine environmental protection goals,[42] and in comparison with other environmental management tools can enable a better understanding of the health status of the marine environment.[43] Such assessments can also be used within environmental decision-making processes to better understand the requirements for conservation and protection of environmental values.[44]

Synergistic effects caused by human impacts are substantially altering marine ecosystems,[45] and as such it is important to further assess these types of interactions between the different anthropogenic activities and environmental change, as well their outcomes.[46] An understanding of cumulative and synergistic impacts will assist in providing strategies to alleviate detrimental impacts in a way that responds to the individual nature and therefore differing requirements of a

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[39] It is also noted here that although there are other terms that can be used in reference to these impact types (e.g. 'combined effects' or 'interactive'), because these terms have the potential for a greater variety of alternative meanings, and do not appear to be the most commonly used terms within the literature, unless otherwise specifically mentioned these terms are not the focus of this thesis.

[40] See, eg, Rhian E Jenkins, Raymond D H Brown, Michael R Phillips, 'Harbour porpoise (Phocoena phocoena) conservation management: A dimensional approach' (2009) 33 *Marine Policy* 744, 744; Richard Curtin and Raúl Prellezo, 'Understanding marine ecosystem based management: A literature review', (2010) 34 *Marine Policy* 821, 821; Robert O'Boyle and Glen Jamieson, 'Observations on the implementation of ecosystem-based management: Experiences on Canada's east and west coasts' (2006) 79 *Fisheries Research* 1,1; Benjamin S Halpern et al (2008) cited in Dana Clark et al, 'Validation and limitations of a cumulative impact model for an estuary' (2016) 120 *Ocean & Coastal Management* 88, 88; Halpern et al, above n 12, 205; Wright and Kyhn, above n 35, 334; Jesper H Anderson et al, 'Baltic Sea biodiversity status vs. cumulative human pressures' (2015) 161 *Estuarine, Coastal and Shelf Science* 88, 91 - 92.

[41] Harriman and Noble, above n 37, 27.

[42] See, eg, Ban, Alidina and Ardron, above n 29, 876; Randall Bess and Ramana Rallapudi, 'Spatial conflicts in New Zealand Fisheries: The rights of fishers and protection of the marine environment' (2007) 31 *Marine Policy* 719, 726; B S Halpern and R Fujita, 'Assumptions, challenges and future directions in cumulative impact analysis' (2013) *Ecosphere* 4(10): 131, 1 <http//:dx.doi.org/10.1890/ES-13-00181.1>; Danielle Marcotte, Samuel K Hung and Sébastien Caquard, 'Mapping cumulative impacts on Hong Kong's pink dolphin population' (2015) 109 *Ocean & Coastal Management* 51, 53.

[43] See, eg, Selig et al, above n 32, 9; Paul M Gilliland and Dan Laffoley, 'Key elements and steps in the process of development ecosystem-based marine spatial planning' (2008) 32 *Marine Policy* 32 (2008) 787, 788.

[44] See, eg, Anthony et al, above n 7, 8; Melissa M Foley et al, 'Guiding ecological principles for marine spatial planning' (2010) 34 *Marine Policy* 955, 963.

[45] See, eg, Jeremy B C Jackson, 'Ecological extinction and evolution in the brave new ocean' (2008) 105 suppl. 1 *PNAS* 11458, 11458 <http//:www.pnas.org/cgi/doi/10/1073/pnas.0802812105>.

[46] See, eg, Jackson, above n 45, 11464.

habitat, ecosystem, or species.[47] Further, it is an effective approach to mitigate or alleviate individual stressors.[48]

Knowledge about the ways in which cumulative and synergistic impacts from environmental change and anthropogenic activities affect the marine environment is therefore an important part of understanding environmental vulnerability and resilience.[49] A flow-on effect is that knowledge about the maintenance of ecosystem resilience will help enable the achievement of sustainability goals.[50] Two examples of the way the management of cumulative or synergistic impacts will help improve resilience are the capacity to reduce impacts through the identification of all contributing factors, and the removal of one or more detrimental impacts to slow a potential environmental effect.[51] There are a number of different approaches that will facilitate an increase in knowledge about cumulative and synergistic impacts. One approach is through the incorporation of cumulative and synergistic impact assessment into environmental assessment and associated decision-making processes.

2.2 The environmental assessment of cumulative and synergistic impacts

Legal frameworks for marine environmental protection can be utilised to increase knowledge about the marine environment and offer direction as to how to improve the integration of scientific assessment into statutory decision-making processes. This part discusses the use of environmental assessment,[52] as associated with environmental law frameworks and scientific assessment, to assess cumulative and synergistic impacts. It is important to note that not all environmental assessments are required to include the assessment of cumulative and/or synergistic impacts.

[47] See, eg, Laura J Falkenberg, Sean D Connell and Bayden D Russell, 'Disrupting the effects of synergies between stressors: improved water quality dampens the effects of future CO_2 on a marine habitat' (2013) 50 *Journal of Applied Ecology* 51, 52, 56; Selig et al, above n 32, 9.
[48] See, eg, Falkenberg, Connell and Russell, above n 47, 52 – 53, 55, 56; Selig et al, above n 32, 9.
[49] See, eg, Carl Folke et al, 'Regime Shifts, Resilience, and Biodiversity in Ecosystem Management' (2004) 35 *Annual Review of Ecology, Evolution and Systematics* 557, 573; Also see the discussion surrounding Folke et al in Curtin and Prellezo, above n 40, 822; Great Barrier Reef Marine Park Authority, above n 18,10-6; Sarah J Burthe et al, 'Assessing the vulnerability of the marine bird community in the western North Sea to climate change and other anthropogenic impacts' (2014) 507 *Marine Ecology Progress Series* 277, 291; Jo Foden, Stuart I Rogers and Andrew P Jones, 'Recovery of UK seabed habitats from benthic fishing and aggregate extraction – towards a cumulative impact assessment' (2010) 411 *Marine Ecology Progress Series* 259, 260.
[50] See, eg, Great Barrier Reef Marine Park Authority, above n 18, 10-3: Anthony et al, above n 7, 16 – 17; Falkenberg, Connell and Russell, above n 47, 56; Folke et al, above n 49, 575;
[51] Great Barrier Reef Marine Park Authority, above n 18, 10-3.
[52] 'Environmental assessment' is a general term used to refer to the process of assessment using scientific tools and methods for the purpose of measuring and predicting the impact of stressors on the natural environment. See, eg, Keijiang Zhang, Yuansheng Pei and Changjing Lin, 'An investigation of correlations between different environmental assessments and risk assessment' (2010) 2 *Procedia Environmental Sciences 643*, 643.

The assessment of cumulative and synergistic impacts can occur as part of environmental assessment processes;[53] with strategic environmental assessment (SEA)[54] and EIA[55] being two of the commonly used processes. Within the context of this thesis, and from a marine planning perspective, SEA is defined to encompass the assessment of broad scale planning frameworks determining the appropriate locations of different uses in response to the potential environmental outcomes within an environmental area or region.[56] It also relates to the policy and programmes developed to implement the strategies.[57] In contrast, EIA refers to the assessment and prediction of environmental impacts that occur due to the proposed development of an individual project, as well as the activities associated with a particular use.[58]

Environmental assessments can occur through domestic legal frameworks or requirements at the international or regional level. For example, at the international level, Article 206 of the LOSC,[59] imposes an obligation on State parties to assess the 'potential effects of activities' if the impact on the marine environment has the potential to be significant.[60] The CBD provides for similar obligations if the impacts on biological diversity are considered 'significant' and 'adverse'.[61] The *Convention on Environmental Impact Assessment in a Transboundary Context* also provides reference to the need to consider 'significant adverse transboundary impact(s)' within the preparation of an EIA.[62] As examples at a regional level, the EU Directives provide separate frameworks for SEA[63] and EIA.[64] In Australia, as an example, the *Environment*

[53] Within this thesis reference to the term 'environmental assessment' encompasses both 'strategic environmental assessment' and 'environmental impact assessment'. Refer to glossary.
[54] See, eg, Simon Marsden, 'Strategic environmental assessment in Australian land-use planning' (2013) *Environmental and Planning Law Journal* 422, 422; Simon Marsden, 'Strategic environmental assessment of Australian offshore oil and gas development: Ecologically sustainable development or deregulation?' (2016) 32 *Environmental and Planning Law Journal* 21, 21; Anna McLauchlan and Elsa João, 'The inherent tensions arising from attempting to carry out strategic environmental assessments on all policies, plans and programmes' (2012) 36 *Environmental Impact Assessment Review* 23, 23; Jill Gunn and Bram F Noble, 'Conceptual and methodological challenges to integrating SEA and cumulative effects assessment' (2011) 31 *Environmental Impact Assessment Review* 154, 154.
[55] See, eg, Marsden, above n 54, 422; McLauchlan and João, above n 54, 23; Hegmann and Yarranton, above n 7, 484.
[56] See, eg, Marsden, above n 54, 422; McLauchlan and João, above n 54, 23; Gunn and Noble, above n 54, 154.
[57] See, eg, Marsden, above n 54, 422; McLauchlan and João, above n 54, 23; Gunn and Noble, above n 54, 154.
[58] See, eg, Marsden, above n 54, 422; McLauchlan and João, above n 54, 23; Hegmann and Yarranton, above n 7, 484.
[59] *United Nations Convention on the Law of the Sea*, opened for signature 10 December 1982, 183 UNTS 3 (entered into force 16 November 1994).
[60] Refer to the glossary for an explanation about the use of the term 'significant' as a term to describe the measurement of an impact.
[61] *Convention on Biological Diversity*, opened for signature 5 June 1992, 1760 UNTS 79 (entered into force 29 December 1993) Art 14.
[62] *Convention on Environmental Impact Assessment in a Transboundary Context*, opened for signature 25 February 1991, 1989 UNTS 309 (entered into force 10 September 1997) Art 2, 3.
[63] *Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment*, [2001] OJ L 197/30.
[64] *Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification)*, [2012] OJ L 26/1; *Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment*, [2014] OJ L 124/1.

Protection and Biodiversity Conservation Act 1999 (Cth) includes requirements to undertake both SEA and EIA.[65]

Early legal approaches requiring cumulative effects assessment appeared within environmental assessment legislation during the late 1970s in the United States,[66] early 1980s in Canada,[67] and early 1990s in New Zealand.[68] Attention in Europe was demonstrated in the 1980s when the requirement to consider cumulative impacts was included in *EC Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment and the subsequent amending Directives 97/11/EC, 2003/35/EC & 2009/31/EC*.[69] Since that time, the United States, Canada and the European Union have developed guidelines with relatively common approaches for the assessment of cumulative impacts. [70]

In Australia, legal requirements for the use of cumulative impact assessment have been slow to develop.[71] Australian jurisdictions include legislative frameworks that identify cumulative impact assessment as a beneficial tool for gaining a better understanding of environmental impacts.[72] This occurs through a combination of legislation and policy.[73] Further, the assessment of cumulative impacts is also being incorporated (with or without specific legislative

[65] See, eg, ch 4 – Environmental assessments and approvals, and pt 10 Strategic Environmental Assessments.
[66] Robert (Bob) Connelly, 'Canadian and international EIA frameworks as they apply to cumulative effects' (2011) 31 *Environmental Impact Assessment Review* 453, 453.
[67] Ibid; Duinker (1994) in Peter N Duinker and Lorne A Greig, 'The impotence of cumulative effects assessment in Canada: Ailments and Ideas for Redeployment' (2006) 37(2) *Environmental Management* 153, 154.
[68] John Court, Colin Wright and Alasdair Guthrie, 'Environmental Assessment and Sustainability: Are We Ready for the Challenge?' (1996) 3 *Australian Journal of Environmental Management* 42, 46.
[69] *EC Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment and the subsequent amending Directives 97/11/EC, 2003/35/EC & 2009/31/EC,* [2009] OJ L 140/114. It is noted that this has since been superseded by *Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification),* [2012] OJ L 26/1 and *Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment*, [2014] OJ L 124/1. Also see the discussion in Connelly, above n 66, 453.
[70] See, eg, G C Hegmann et al, *Cumulative Effects Assessment Practitioners* Guide (AXYS Environmental Consulting Ltd, CEA Working Group for the Canadian Environmental Assessment Agency, 1999); Canadian Environmental Assessment Agency, *Cumulative Effects Assessment Practitioners' Guide* (2014) <http//:www.ceaa-acee.gc.ca/default.asp?lang=En&n=43952694-1&offset=6&toc=hide>; European Commission, *Guidelines for the Assessment of Indirect And Cumulative Impacts And Impact Interactions* (Office for Official Publications of the European Communities, 1999); Council on Environmental Quality, *Considering Cumulative Effects Under the National Environmental Policy Act* (1997) <http//:www.ceq.hss.doe.gov/publications/cumulative_effects.html>; Council on Environmental Quality, *Guidance on the Consideration of Past Actions in Cumulative Effects Analysis* (2005) <http//:www.ceq.hss.doe.gov/nepa/regs/Guidance_on_CE.pdf>; also see discussion in Connelly, above n 66, 454.
[71] Court, Wright and Guthrie, above n 68, 49.
[72] See, eg, *Environmental Planning and Assessment Act 1979* (NSW), s 115J (4); *Environmental Planning and Assessment Regulation 2000* (NSW), cl 228(2)(o).
[73] See, eg, *Environment Protection and Biodiversity Conservation Act 1999* (Cth), Part 10 Strategic Environmental Assessments; in association with Australian Government, Department of Sustainability, Environment, Water, Population and Communities, *A guide to undertaking strategic assessments: Environment Protection and Biodiversity Conservation Act 1999* (2013), 7 <http//:www.environment.gov.au/resource/guide-undertaking-strategic-assessments>.

requirements to do so) at both the SEA[74] and EIA[75] level.

Despite the apparent increasing assessment of cumulative and synergistic impacts, there is limited knowledge about these impact types.[76] Whilst there has been ongoing development of the assessment methods,[77] the approaches taken within environmental assessment have been critiqued by academics for inconsistencies and inadequate direction as to the assessment parameters and method.[78] In addition, some commentators have questioned whether there is sufficient capacity to achieve effective change without also improving decision-making frameworks.[79]

The Australian environmental assessment legal frameworks have been critiqued for inadequate requirements associated with the consideration of cumulative impacts.[80] As an example, the 1996 critique by Court, Wright and Guthrie stated that the only legislation they were aware of to require the consideration of cumulative impacts, the *Environmental Planning and Assessment Act 1979* (NSW), focused solely on additive and linear[81] impacts and did not acknowledge the

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[74] An SEA example includes the consideration given within the 2014 *Great Barrier Reef Region Strategic Assessment: Strategic assessment report*: Great Barrier Reef Marine Park Authority, above n 18, Chapter 6.8.
[75] An EIA example is the cumulative impact assessment undertaken as part of the overall assessment for the expansion of the Port of Abbot Point coal export facility: Eco Logical Australia Pty Ltd and Open Lines Consulting Pty Ltd, *Abbot Point Cumulative Impact Assessment* (2013) <http//:www.nqbp.com.au>. This document notes that the CIA is a voluntary initiative (refer to Executive Summary).
[76] See, eg, State of the Environment 2011 Committee, above n 29, 435; Ban, Alidina, and Ardron, above n 29, 876; Stelios Katsnevakis et al, above n 29, 809; Cooper, above n 29, 466; Katrina Pavlickova and Monika Vyskupova, 'A method proposal for cumulative environmental impact assessment based on the landscape vulnerability evaluation' (2015) 50 *Environmental Impact Assessment Review* 74, 75.
[77] See, eg, Ban, Alidina and Ardron, above n 29, 876, 885; Halpern and Fujita, above n 42, 1 -11; Halpern and Fujita (2013) cited in Kostantinos A Stamoulis and Jade M S Delevaux, 'Data requirements and tools to operationalize marine spatial planning in the United States' (2015) 116 *Ocean & Coastal Management* 214, 218; Halpern and Fujita (2013) cited in Linda Harris et al, 'Quantifying cumulative threats to sandy beach ecosystems: A tool to guide ecosystem-based management beyond coastal reserves' (2015) 110 *Ocean & Coastal Management* 12, 19; L W Canter and S F Atkinson, 'Multiple uses of indicators and indices in cumulative effects assessment and management' (2011) 31 *Environmental Impact Assessment Review* 491, 491; Peter N Duinker and Lorne A Greig, 'The impotence of cumulative effects assessment in Canada: Ailments and Ideas for Redeployment' (2006) 37(2) *Environmental Management* 153, 153 – 155.
[78] See, eg, Gunn and Noble, above n 54, 157 - 159; Duinker and Greig, above n 77, 156; Courtney Fidler and Bram Noble, 'Advancing strategic environmental assessment in the offshore oil and gas sector: Lessons from Norway, Canada, and the United Kingdom' (2012) 34 *Environmental Impact Assessment Review* 12, 16,19; Peter N Duinker et al, 'Scientific dimensions of cumulative effects assessment: toward improvements in guidance for practice' (2013) 21 *Environmental Review* 40, 42 – 45, 49 - 50.
[79] See, eg, Hegmann and Yarranton, above n 7, 486 - 490; Duinker and Greig, above n 77, 154; Spaling and Smit, above n 38, 589.
[80] See, eg, Hon Justice Brian J Preston, 'Adapting to the impacts of climate change: The limits and opportunities of law in conserving biodiversity' (2013) 30 *Environmental and Planning Law Journal* 375, 383; Court, Wright and Guthrie, above n 68, 44; Peter Wulf, 'Offshore Petroleum and the *Environment Protection and Biodiversity Conservation Act 1999* (Cth): Consideration of all adverse impacts' (2005) 22 *Environmental and Planning Law Journal* 296, 309 – 316; Andrew Macintosh and Debra Wilkinson, 'EPBC Act – The case for reform' (2005) 10(1) *The Australasian Journal of Natural Resources Law and Policy*139,164,171; Andrew Macintosh, 'Why the Environment Protection and Biodiversity Conservation Act's referral, assessment and approval process is failing to achieve its environmental objectives' (2004) 21 *Environmental and Planning Law Journal* 288, 299,305 – 307, 310.
[81]Within the context of 'cumulative impacts', 'linear' demonstrates that the quantified impact can be graphically represented in a straight line that shows the value increasing in increments that are directly proportional to the value added. See, eg, Halpern et al, above n 12, 207.

nonlinear[82] effects associated with synergistic impacts.[83] However, despite this statement, there is scant commentary on the level of consideration given to synergistic impacts as a distinct impact type to that of cumulative impacts.[84]

There have been Australian examples of both SEA[85] and EIA[86] that include cumulative impact assessment. The preferred future direction for cumulative impact assessment, however, has been demonstrated within environmental law reviews undertaken in Australian jurisdictions (e.g. Victoria and the Commonwealth) as an increased focus of cumulative impact consideration within SEA frameworks.[87] This preference reflects criticism regarding the absence of requirement to consider such impact types within Australian legislation. The criticism is found in commentary on historical[88] and current[89] legal frameworks. Whilst not necessarily focusing on a preference for further attention in SEA, the issue of whether cumulative impacts should be considered has also received attention within judicial decisions.[90] The influence of some of these judicial decisions is discussed in Chapter 4.

A preliminary 20 year (1995 – 2014, inclusive) analysis of Australian legal journal literature, conducted for this thesis, demonstrates that commentary on cumulative and synergistic impact assessment has tended to focus on cumulative rather than synergistic impacts (as a different impact type), and on the terrestrial environment more than the marine environment.[91] The lesser

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[82] For the purpose of this thesis, the term 'nonlinear' is the opposite of the term 'linear' and when impacts are defined as 'nonlinear' in nature, the quantified impact can be graphically represented in a curved or non-straight line. For example, the curve may represent an exponential increase in value.
[83] Court, Wright and Guthrie, above n 68, 49.
[84] For examples refer to Chapter 2 for a detailed discussion of academic literature.
[85] Great Barrier Reef Marine Park Authority, above n 18.
[86] Eco Logical Australia Pty Ltd and Open Lines Consulting Pty Ltd, above n 75.
[87] Allan Hawke, *The Australian Environment Act - Report of the Independent Review of the Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth of Australia, 2009) 80, 83, 116, 148, 156, 215; Department of Sustainability, Environment, Water, Population and Communities, *Australian Government Response to the Report of the Independent Review of the Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth of Australia, 2011) 15 - 17,19, 23, 25; Environment and Natural Resources Committee, Parliament of Victoria, *Inquiry into the Environmental Effects Statement Process in Victoria* (2011), 235.
[88] Court, Wright and Guthrie, above n 68, 44; Simon Marsden, 'Applying EIA to legislative proposals: practical solutions to advance ESD in Commonwealth and State policy-making' (1997) 14 *Environmental and Planning Law Journal* 159,161 – 162; Ralf Buckley, 'Strategic Environmental Assessment' (1997) 14 *Environmental and Planning Law Journal* 174,175,178.
[89] See, eg, Preston, above n 80, 383; Marsden, above n 54, 422; Wayne Gumley, 'An update on the EPBC Act Reviews' (2009) 3 *National Environmental Law Review* 39, 41 – 42, 44; Isabelle Connolly and Martin Falding, 'Biocertification of local environmental plans – promise and reality' (2009) 26 *Environmental and Planning Law Journal* 128, 130 – 131; David Robinson, 'Strategic planning for biodiversity in New South Wales' (2009) 26 *Environmental and Planning Law Journal* 213, 227; Macintosh and Wilkinson, above n 80, 164, 171; Andrew Macintosh, 'The Environment Protection and Biodiversity Conservation Act 1999 (Cth) – An evaluation of its cost effectiveness' (2009) 26 *Environmental and Planning Law Journal* 337, 350; Australian Panel of Experts on Environmental Law, *Marine and Coastal Issues* (Technical Paper 4, 2017) 26.
[90] See, eg, *Brown v Forestry Tasmania, Commonwealth of Australia, Commonwealth of Australia and State of Tasmania (No 4)* (2006) 157 FCR 1, 2, 22 [146]; *Tarkine National Coalition Incorporated v Minister for the Environment* [2014] FCA 468, 270 – 272 [106–115]; *Queensland Conservation Council Inc v Minister for the Environment and Heritage* [2003] FCA 1463, [38 – 41]; *Minister for the Environment and Heritage v Queensland Conservation Council Inc* (2004) 139 FCR 24, 35 – 40 [43 – 62] (Nathan Dam Case).
[91] For the purpose of this analysis six Australian based legal journals (including publication name changes) with the

focus on the marine environment is demonstrated in Figure 1-1 for cumulative impacts, and Figure 1-2 for synergistic impacts. The greater focus on cumulative impacts compared with synergistic impacts can be seen when Figure 1-1 and Figure 1-2 are compared.

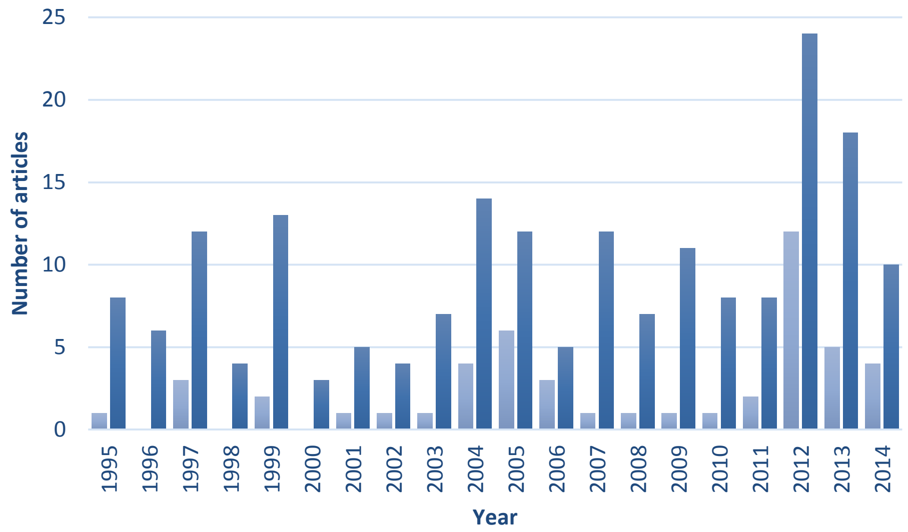

Figure 1-1: Comparison of 'cumulative' impacts (environmental assessment context) and 'cumulative' impacts (environmental assessment context) - marine environment.
Light blue colour **= 'cumulative' environmental assessment context - marine environment,** ***dark blue colour*** **= 'cumulative' environmental assessment context.**

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capacity to include discussion on marine environmental assessment law were examined: *Environmental and Planning Law Journal*; *The Australasian Journal of Natural Resources Law and Policy*; *Australian Environmental Law News*, *National Environmental Law Review* and *Australian Environmental Law Digest*; *Maritime Studies* and *Australian Journal of Maritime and Ocean Affairs*; and *Macquarie Journal of International and Comparative Environmental Law*. The journals were analysed across the time frames 1995 to 2014, except the *Macquarie Journal of International and Comparative Environmental Law* which commenced publication in 2004 and ceased publication in 2013. The electronic databases used to search these journals included Westlaw, Informit (Australian Public Affairs Full Text (APA-FT), Business Collection, AGIS plus), HeinOnline and ProQuest.

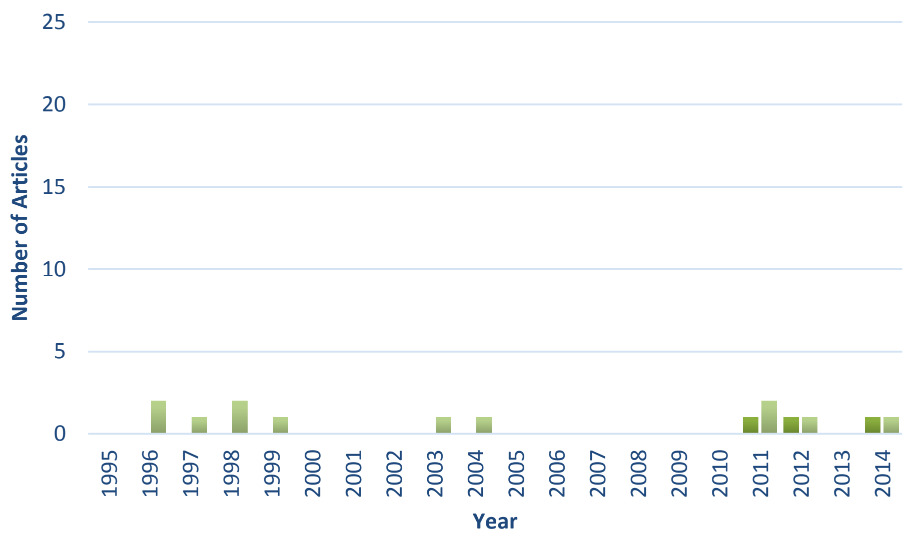

Figure 1-2: Comparison of 'synergistic' impacts (environmental assessment context) compared to 'synergistic' impacts (environmental assessment context) - marine environment. ***Dark green colour*** **= 'synergistic' environmental assessment context - marine environment,** ***light green colour*** **= 'synergistic' environmental assessment context.**

The results of this preliminary analysis show that a relatively small number of the Australian legal journal articles focused on cumulative and synergistic impacts in the marine environment (Figures 1-1 and 1-2). This indicates that the issues surrounding these impact types are not often discussed. This observation raises the question as to whether there is a need for further research into how marine environmental cumulative and synergistic impacts are addressed by Australian legal frameworks.

Legislation for marine environmental assessment can, but may not necessarily, expressly require the consideration and assessment of cumulative and synergistic impacts. When requirements are not expressed, the requirement for consideration and assessment of these impact types can be associated with implied or general provisions. If assessments of the environmental consequences of cumulative and synergistic impacts are incorporated within marine environmental assessment legislation – through express or implied requirements - an understanding of the existing and potential ability to require their consideration and assessment is necessary. This understanding is beneficial because of the role legal requirements play in identifying these impact types, whilst enabling decision-making processes that can facilitate the reduction of potential environmental detriment. Further, analysis of the benefits and shortcomings of legislative provisions may also result in opportunities to research and develop alternative approaches. This would help improve opportunities for marine environmental protection and achieving ESD principles.

3. Ecologically Sustainable Development (ESD): The role of the precautionary principle and post-approval monitoring

'Sustainable development' is an objective of international, regional and domestic legal frameworks for protecting the marine environment. At the international level 'sustainable development' gained significance as a goal after the release of the 1987 *Report of the World Commission on Environment and Development: Our Common Future* (the Brundtland report).[92] The Brundtland report identified that, as a central element of sustainable development, environmental conservation and protection must be addressed in order for development to continue in a manner that allows the ongoing use of resources in the future.[93] Concern for increasing and cumulative impacts from use and development pressures on the oceans was discussed as an imperative for attention.[94]

As part of the Brundtland report's conclusions, Annex 1 provided a 'Summary of Proposed Legal Principles' to facilitate the commencement of 'a universal Declaration and later a Convention on environmental protection and sustainable development'.[95] These principles included references to responsibilities of States in relation to generational equity, conservation, environmental protection, sustainable use and development, environmental monitoring, environmental assessment, and the need for a precautionary approach.[96] The *1992 Report of the United Nations Conference on Environment and Development* included the *Rio Declaration on Environment and Development* (Rio Declaration) and further development of these principles.[97] For the purpose of this thesis, Principle 4 and Principle 15 of the Rio Declaration are highlighted.

Principle 4 states that:

> In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it.[98]

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[92] World Commission on Environment and Development (WCED), *Report of the World Commission on Environment and Development: Our Common Future* (1987), Chapter 2, Chapter 6 <http//:www.un-documents.net/our-common-future.pdf>.
[93] Ibid.
[94] Ibid, Chapter 10(I).
[95] Ibid, Chapter 12, [86].
[96] Ibid, Annex 1.
[97] United Nations General Assembly, *Report of the United Nations Conference on Environment and Development: Annex 1 Rio Declaration on Environment and Development* UN Doc A:CONF.151:26(Vol.1) (3 – 14 June 1992) <http//:www.un.org/documents/ga/conf151/aconf15126-1annex1.htm>.
[98] Ibid Principle 4.

Principle 15 states that:

> In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.[99]

The precautionary principle (Principle 15) is a theoretical mechanism which, through emergence in policy and legislation, has increased in application. The extent of requirement varies between jurisdictions. Within the Australian context, the principles of sustainable development were adopted as part of ESD via the 1992 *Intergovernmental Agreement on the Environment* (IGAE);[100] with environmental protection being integral to the Principles of Environmental Policy,[101] and a modified version of the precautionary principle included at Section 3.5.1 to state:

> Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:
> 1. Careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and
> 2. An assessment of the risk-weighted consequences of various options.[102]

Since the IGAE was signed, the ESD principles have been adopted in environmental assessment legislation and decision-making at all levels of government in Australia.[103] It has been argued that the assessment of cumulative and synergistic impacts is important for achieving a precautionary approach and, therefore, an effective application of the precautionary principle in environmental assessment decision-making.[104] In this respect, when decisions are made to support anthropogenic activities in the marine environment, the evaluation of cumulative and synergistic impacts and subsequent knowledge gain can aid in assisting the management of uncertainty[105] and the avoidance, or mitigation, of detrimental impacts. It has been argued that the lack of knowledge about such impact types in conjunction with their complexity is in itself a reason for applying the precautionary principle.[106]

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[99] Ibid Principle 15.
[100] Council of Australian Governments, *Intergovernmental Agreement on the Environment*, 1 May 1992, <http//:www.environment.gov.au/about-us/publications/intergovernmental-agreement>.
[101] Ibid Section 3.
[102] Ibid Section 3.5.1
[103] See, eg, *Environment Protection and Biodiversity Conservation Act 1999* (Cth), section 3A; *Fisheries Management Act 2007* (SA), section 7; State Government Victoria, *Stonnington Planning Scheme: Victorian Planning Provisions* (2014) Clause 12 State Planning Policy Framework.
[104] See, eg, Court, Wright and Guthrie, above n 68, 44; D Santillo et al, 'The Precautionary Principle: Protecting Against Failures of Scientific Method and Risk Assessment' (1998) 36(12) *Marine Pollution Bulletin* 939, 942.
[105] See, eg, Joel A Tickner and Ken Geiser, 'The precautionary principle stimulus for solutions – and alternatives – based environmental policy' (2004) 24 *Environmental Impact Assessment Review* 801, 807; David Kriebel et al, 'The Precautionary Principle in Environmental Science' (2001) 109 (9) *Environmental Health Perspectives* 871, 874.
[106] See, eg, Rozalyn Daniell, 'To what extent do land use planning controls and policy in South Australia facilitate sustainable development' (1998) (1)(2) *Australian Environmental Law News* 50, 51; Derek V Ellis, 'The precautionary principle and environmental monitoring', (2003) 46 *Marine Pollution Bulletin* 933, 933; Charmain

One mechanism to improve the ability to effectively implement the precautionary principle is to monitor the outcomes of marine use and development that has been subjected to an SEA or EIA. PAM can provide feedback information about previous decisions to enable a better indication of whether sufficient precaution has been taken when a future decision to approve a use or development has been made.[107] In facilitating an iterative cycle, PAM provides for increased knowledge about the environmental effects of cumulative and synergistic impacts,[108] particularly when comparing the actual versus predicted impacts.[109] The use of SEA, EIA, the precautionary principle and PAM can assist decision-makers with cumulative and synergistic impact considerations. However, specific legal requirements for the assessment of these impact types are important to ensure consistency and clarity in approach.

4. Research Questions

The aims of this thesis are discussed at the beginning of this chapter. The aims provide the basis for two principal research questions:

1. *Do the requirements of Australian legal frameworks (at both state and federal levels), for the environmental impact assessment of large-scale marine use and development, effectively address the cumulative and synergistic impacts associated with anthropogenic activities and environmental change in the marine environment?*

2. *How can Australian legal frameworks be modified to provide for better consideration and assessment of cumulative and synergistic impacts within the environmental impact assessment of an emerging or future industry, for example, the use and development of offshore wind energy farms?*

The sub-questions supporting Principal Research Question 1 are summarised in Table 1-1.

Barton, 'The Status of the Precautionary Principle in Australia: its emergence in legislation and as a common law doctrine' (1998) 22 *Harvard Environmental Law Review* 509, 513; Kriebel et al, above n 105, 873.

[107] See, eg, Ellis, above n 106, 933; A K M R Ahammed and B M Nixon, 'Environmental impact monitoring in the EIA process of South Australia', (2006) 26 *Environmental Impact Assessment Review* 426, 429; Duinker and Greig, above n 77, 159.

[108] See, eg, Therivel and Ross, above n 13, 367.

[109] See, eg, L W Canter (1996) cited in Lourdes M Cooper and William R Sheate, 'Integrating cumulative effects assessment into UK strategic planning: implications of the European Union SEA Directive' (2004) 22(5) *Impact Assessment and Project Appraisal* 5, 15; L W Canter, *Environmental Impact Assessment* (McGraw – Hill Book Co, 1996) 48; Therivel and Ross, above n 13, 367 & 380.

Table 1-1: Sub-questions supporting Principal Research Question 1

Chapter	Sub-questions
Chapter 2 – Cumulative and synergistic impacts: definitions, anthropogenic activities and environmental change	What are the challenges for defining cumulative and synergistic impacts? How can cumulative and synergistic impacts from anthropogenic activities and environmental change affect the marine environment?
Chapter 3 – Cumulative and synergistic impacts: environmental assessment, the precautionary principle and post-approval monitoring	Are cumulative and synergistic impacts better addressed within environmental assessment frameworks associated with SEA or EIA? What are the roles and challenges for the application of the precautionary principle and post-approval monitoring within environmental assessment decision-making processes that can include cumulative and synergistic impacts?
Chapter 4 – Cumulative and Synergistic Impacts in Australia: The Assessment Framework, and the Precautionary Principle	How can Australian marine environmental assessment legal frameworks address, incorporate or require the consideration and assessment of cumulative and synergistic impacts to enable decision-making processes to assist marine environmental protection?
Chapter 5 – Otways Marine Area	Focusing on a case study that encompasses the Otways Marine Area, what requirements are there to consider cumulative and synergistic impacts within the legislation for the environmental assessment of large-scale marine use and development? What is the approach of legal provisions that expressly require the consideration of cumulative and/or synergistic impacts, and what are the

	potential limitations and implications when express requirements are absent?
Chapter 6 – Victoria's Port Phillip Bay Channel Deepening Project	Focusing on Victoria's Channel Deepening Project, as a case study, what can be demonstrated about the consistency of approach between the EIA of, and decision-making about, cumulative and synergistic impacts?

The sub-questions supporting Principal Research Question 2 are summarised in Table 1-2.

Table 1-2: Sub-questions supporting Principal Research Question 2

Chapter	**Sub-questions**
Chapter 7 – Offshore wind farms in Denmark: The assessment of cumulative and synergistic impacts.	Focusing on EIA and environmental monitoring for selected offshore wind farms in Denmark (as a case study), as well as the associated legal frameworks, what are the benefits and shortcomings of the approach to assessing cumulative and synergistic impacts?
Chapter 8 – Conclusion and recommendations	Based on the challenges identified in the literature reviewed, and the benefits and shortcomings identified within the case studies, what recommendations can be made to improve the approach to considering and assessing cumulative and synergistic impacts within the Australian marine EIA legal framework?

To achieve the aims, and address the questions for each chapter, literature from the disciplines of environmental assessment, science and law are reviewed to identify the challenges associated with effectively assessing cumulative and synergistic impacts within environmental decision-making processes. Australian case studies are used to assist with the identification of shortcomings within the Australian legal framework context for requiring the assessment of cumulative and synergistic impacts. The case studies include analysis of marine environmental assessment legislation relating to the Otways Marine Area,[110] and a case study analysis of the legal, EIA, decision-making and PAM frameworks and assessments associated with Victoria's Port Phillip Bay Channel Deepening Project (CDP).[111]

The Otways Marine Area was selected as a case study because it extends across four jurisdictions. This enabled analysis into the extent of, and approach to, express and implied requirements for the consideration and assessment of cumulative and synergistic impacts for a broad cross-section of Australian legislation. The CDP was selected on the basis that the primary environmental assessment legislation[112] did not expressly require the consideration or assessment of cumulative or synergistic impacts. The analysis sought to see how the lack of express requirement influenced decision-making and discussion about these impact types.

Current stressors for the Australian marine environment are predicted to increase in intensity with additional pressure from existing anthropogenic activities,[113] as well as future and emerging activities (e.g. offshore hydrocarbon and marine renewable energy). Offshore wind farms are identified as a future renewable energy industry for Australian marine waters; with Australian Government research funding directed towards its development.[114] There is no industry-specific environmental assessment framework within Australia.[115] Assessments are currently dependent on general environmental assessment legal frameworks.[116] For the purpose of the second element of the research aim, the thesis focuses on marine renewable energy production from offshore wind farms. Other marine renewable energy sources, such as wave and tidal energy, have been excluded from the analyses due to the relatively slow progress in

110 Refer to Chapter 5.
111 Refer to Chapter 6.
112 As selected from the legislation assessed in Chapter 5: Otway Marine Area case study, refer to the *Environmental Effects Act 1978* (Vic).
113 See, eg, State of the Environment 2011 Committee, above n 29, 373, 424.
114 See, eg, Clean Energy Finance Corporation, 'Statement from the CEFC on receipt of updated Investment Mandate', (Statement, 23/12/15) <http://www.cleanenergyfinancecorp.com.au/media/releases-and-announcements/files/statement-from-the-cefc-on-receipt-of-the-updated-investment-mandate.aspx>.
115 In contrast to, for example, offshore petroleum or fisheries. Refer to Chapter 5 and Appendix 5-1 for examples of the legislative frameworks applicable to these industries.
116 See, eg, *Environmental Protection Biodiversity Conservation Act 1999* (Cth). This act is applicable to renewable energy facilities, with relevant sections for such proposals including, for example: sections 18, 18A, 20, 20A, 23, 24A, 26, & 27A. For an example of state based legislation see the *Environmental Effects Act 1978* (Vic), and *Environmental Protection Act 1986* (WA), Part IV.

successful development and operation as an energy supply.[117]

Addressing the second aim, selected examples of the EIA reports and monitoring of cumulative and synergistic impacts within offshore wind farm construction and operation in Denmark are analysed. Denmark was selected because of the country's established programme for the development of offshore wind farms. The case study includes a focus on the applicable Danish legal framework and associated EU Environmental Directives.[118] Insights from this case study can assist in providing recommendations for reforming Australian legislation for marine environmental assessment, in particular EIA.[119] It is anticipated that these recommendations would improve requirements for the consideration and assessment of cumulative and synergistic impacts. The recommendations are discussed in the concluding chapter.[120]

5. Methodological approach

To answer the research questions a combination of qualitative and quantitative analysis was used. A mix of qualitative and quantitative methods was used when it was apparent that the level of understanding for a case study analysis would be benefited by a multi-faceted approach. The literature review chapters provide a qualitative review of literature and legislation in the areas of environmental assessment, science and law. The case study chapters apply contextual analysis to determine the extent of reference and/or consideration given to cumulative and synergistic impacts within legislation and/or EIA reports and associated decision-making processes and documents.

The literature reviewed for **Chapter 2** focused on discussion about definitions for cumulative and synergistic impacts, as well as examples of cumulative and synergistic impacts from both anthropogenic activities and environmental change. Examples of definitions from within the environmental assessment legal frameworks for Canada, the European Union, New Zealand, and the United States are reviewed.

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[117] See, eg, Robert L Evans, *Fueling our Future: An introduction to Sustainable Energy,* (Cambridge University Press, 2007) 106 – 107, 110; European Ocean Energy Association, *Industry Vision Paper 2013* (European Ocean Energy, 2013), 5 <http://www.oceanenergy-europe.eu/images/Publications/European_Ocean_Energy_Industry_Vision_Paper_2013.pdf>; this conclusion is also supported by the author's perceptions of progress gained during attendance at the Ocean Energy Europe Conference (Paris, October 2014).
[118] Refer to Chapter 7.
[119] In narrowing the focus to EIAs, it should be noted that whilst the thesis discussion involves SEAs given the apparent preference and trajectory for improving cumulative and synergistic impact consideration requirements within SEA frameworks, the thesis focus is to recommend improvements within the legal framework for EIA to facilitate a concurrent evolution of approach.
[120] Chapter 8.

Chapter 3 focused on cumulative and synergistic impacts within environmental assessment, in particular SEA and EIA. Within the context of environmental decision-making, the literature discussion about the relationship between cumulative and synergistic impacts and the application of the precautionary principle, as well as the role of PAM are examined.

Chapter 4 narrows the context by reviewing literature and government reports that are focused on cumulative and synergistic impacts within Australia's marine environment. The literature also addressed the fragmentation of legal frameworks, ESD, the precautionary principle and PAM. Examples of legislation from Australian marine environmental assessment legal frameworks are reviewed to provide context. The legislation reviewed focused on environmental assessment, individual sector management and marine environmental protection.

For the case studies within **Chapters 5 - 7**, the sources examined include publicly available information and comprise European Union Directives, Danish legislation, Australian legislation (Acts and Regulations), parliamentary reports, government and agency publications (including policy), and EIA and environmental monitoring reports.

The Acts and Regulations[121] selected for the **Chapter 5** Otways Marine Area[122] case study analysis were chosen based on the high probability of certain types of the occurrence of large-scale marine use and development.[123] The legislation selected was applicable to the marine environment and either directly focused on environmental assessment, or contained environmental assessment provisions as part of industry-specific or environmental protection frameworks. Both quantitative and qualitative methods were applied for the analysis. The quantitative analysis method was based on the selection of value-neutral terminology alongside a series of presence/absence[124] queries. The terms associated with the presence/absence queries vary in focus on matters such as the extent of cumulative and/or synergistic impact assessment requirement, definitions, and alternative terminology use. The quantitative analyses are refined through the application of contextual analysis, and terms are discounted in situations where the subject matter is irrelevant to the thesis topic. Recent law reform reports commissioned by the Commonwealth and Victorian governments, focusing on the review of environmental assessment legislation,[125] are also reviewed for cumulative and synergistic impact assessment

[121] Victorian, Tasmanian, South Australian and the Commonwealth legislation only.
[122] Refer to Chapter 5 for a detailed description of this area.
[123] For example, fisheries, offshore petroleum, mining, and shipping.
[124] For example, a question might seek to determine whether cumulative impacts are required to be considered by a certain piece of legislation. The answer based on a presence or absence query is 'YES' or 'NO'. The answers are then quantified.
[125] Hawke, above n 87; Environment and Natural Resources Committee, Parliament of Victoria, *Inquiry into the Environmental Effects Statement Process in Victoria* (2011).

discussion. The law reform reports apply to general environmental assessment legislation and processes and are applicable to the Otways Marine Area.

Within **Chapter 6**, the document selection associated with the analysis of Victoria's Port Phillip Bay Channel Deepening Project includes publicly available documents applicable to the legal framework, the Supplementary Environmental Effects Statement (SEES),[126] decision-making and post-approval monitoring. Public submissions are not included in the analysis unless referred to within government or project proponent documentation. The documents are qualitatively analysed for the extent of consideration given to cumulative and synergistic impacts. The extent of prediction, and the approach to risk assessment, of cumulative and synergistic impacts, as detailed in the SEES, are critically analysed from a non-scientific perspective.

In **Chapter 7**, qualitative assessments were undertaken between the EIAs for the Danish offshore wind farm developments known as Anholt and Kriegers Flak. These wind farms were selected on the basis that EIA documents were publicly available[127] and relatively recent[128] within the Danish context. A contextual qualitative analysis of the environmental monitoring programme documentation associated with the Horns Rev I and Nysted[129] offshore wind farms (Denmark) was also undertaken. Danish legislation and the associated EU Environmental Directives were analysed based upon relevance to the environmental assessment of offshore wind farm use and development and marine environmental protection.

Given the nature of and constraints surrounding document selection, conclusions based on the methods detailed above cannot be considered as providing definitive answers for any jurisdictions. The data and analysis do, however, provide informative value. Applying this information, **Chapter 8** provides recommendations to aid the development of any future Australian legal framework for marine EIA frameworks; with offshore wind farms used as an example.

[126] Port of Melbourne Corporation, *Main Volume Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007a); Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b).
[127] English publications only. It is noted that not all documents relevant to the EIAs or environmental monitoring programmes were publicly available in English.
[128] Anholt (2010) and Kriegers Flak (2015).
[129] The Nysted area is also known as Rødsand.

6. Scope and Limitations

There are a number of limitations surrounding the design and content of this thesis. The thesis is not intended to be all encompassing of the issues surrounding the assessment of cumulative and synergistic impacts, but instead focuses on elements that assist in achieving the thesis aims. The scope and limitations are discussed as follows.

Cumulative and synergistic impacts occurring within the marine environment can be assessed using different environmental assessment tools, for example, mapping models[130] and mathematical models.[131] This thesis does not assess the effectiveness of these tools, but instead is focused on selected legal frameworks. Within this assessment, it is acknowledged that cumulative and synergistic impacts can have positive outcomes for the environment.[132] Unless discussed otherwise, however, the assumption for these references to impact/s on the environment is that of a detrimental type. Further, when the term 'environment' is used, reference is only intended to include the natural/ ecological environment and does not, unless otherwise stated, refer to the built, social or economic aspects.

The primary focus for cumulative and synergistic requirement and consideration analysis relates to legislation. Whilst there is discussion about policy frameworks and documents within the chapters, unless otherwise referenced, for the purpose of this thesis discussion any reference to a legal framework does not include policy. The reason for this centres on the constraints of time and focus for the research undertaken. It is also the author's opinion that the discretion, associated with the application of environmental policy, can result in poorer environmental outcomes when related statutory requirements are inadequate. [133]

Within the context of environmental assessment, whilst there is discussion on both SEA and EIA (as well as analysis of the legislation focusing on both), the intent of this thesis is to focus on large-scale projects for use and development within the marine environment and the associated capacity of EIA. The reasons for the continual inclusion of SEA within the discussion include the author's conclusion that the success of both EIA and SEA are interdependent. Further, the need for focus on improving consideration requirements within EIA is at risk of neglect and needs further attention to counteract an apparent shift toward increasing

[130] See, eg, Ban, Alidina and Ardron, above n 29, 876; Marcotte, Hung and Caquard, above n 42, 51 - 63.
[131] See, eg, Elizabeth A Masden et al, 'Cumulative impact assessments and bird/ wind farm interactions: Developing a conceptual framework' (2010) 30 *Environmental Impact Assessment Review* 1, 5.
[132] See, eg, there is the potential for beneficial synergistic impacts on 'fish community structure'. Such impacts can increase with the larger scale wind farms providing artificial reef environments and altering 'biological interactions' within an area: Dan Wilhelmsson, Torleif Malm and Marcus C Öhman, 'The influence of offshore windpower on demersal fish' (2006) 63 *ICES Journal of Marine Science* 775, 782.
[133] Based on professional experience in the areas of urban and environmental planning and law.

consideration requirements within Australian legal frameworks for SEA.[134]

It is acknowledged that different discourses surrounding marine environmental protection will attribute different meanings to the terms ‘protection’, ‘conservation’ and ‘sustainability’. This thesis does not focus on the distinction between the different approaches. For the purposes of this thesis, unless otherwise discussed in context, reference to marine environmental protection is intended to be general as a means of supporting marine environmental health, and includes all facets of conservation, targeted protection (e.g. areas and species), and sustainable resource management.

All documents assessed within the case studies are either currently, or have been, publicly available documents. However, given the complexity of translation for Danish language documents,[135] only publicly available Danish legislation was translated from Danish to English. Other appropriate publicly available Danish documents were reviewed if an English version was available.

In general, where search terms are used for document analysis, the focus is on cumulative and synergistic impacts and close linguistic associations. The variations are discussed in detail in each chapter, and the search term methods used often included an abbreviated form, for example, ‘cumulat*’ or ‘synerg*’ (alongside contextual analysis). The term ‘synergetic’, as a potential variation of ‘synergistic’, was not an appropriate result due to the positive connotations of this term.

The recommendations focus is constrained to the example of offshore wind farms. Although the recommendations provided could be translated to other existing marine environmental assessment legal frameworks, given the complexities surrounding the multiplicity of approaches to EIA within the varying legislative requirements, including industry-specific legislation (e.g. offshore petroleum or fisheries), a narrower approach was chosen.

Finally, the evaluations and conclusions made in this thesis are not exhaustive in terms of all general environmental assessment or industry-specific environmental assessment related legislation in Australia. The thesis instead seeks to cover sufficient breadth to identify some of the existing problems and inform potential solutions.

[134] See Chapters 3 and 4 for further detailed discussion on the literature surrounding these matters.
[135] Unless the document has been published in English, all Danish translations are undertaken by the author of this thesis. The author therefore takes all responsibility for errors.

7. Thesis Structure

The purpose of **Chapter 2** is to identify and discuss cumulative and synergistic impacts; including the varying approaches to their definitions, and the differences between these impact types. Examples of the ways in which cumulative and synergistic impacts can affect the marine environment are also discussed.

Chapter 3 concentrates on the literature addressing cumulative and synergistic impacts within the field of environmental assessment. Beyond the challenges associated with the definitions, this section focuses on the benefits and limitations of considering such impacts within SEA and EIA. Further, within the context of environmental decision-making, the relationship between cumulative and synergistic impacts and the application of the precautionary principle is addressed, including the issues surrounding the reversal of the 'burden of proof'. The role of PAM in the effective consideration and assessment of cumulative and synergistic impacts is also discussed.

Chapter 4 focuses on why cumulative and synergistic impacts are perceived as a problem for the Australian marine environment. The approach to environmental assessment for large-scale marine use and development within Australian legal frameworks is then examined. The focus is on the different jurisdictions having responsibility for Australia's marine environment, and the potential within the applicable regulatory frameworks to enable the assessment of cumulative and synergistic impacts in the marine environment both before and after the approval of a project. The role of ESD and the precautionary principle for assisting cumulative and synergistic impact assessment is examined. The discussion also includes examples of the ways in which the consideration and assessment of cumulative and synergistic impacts can be required within legislation for environmental assessment, individual sector environmental management and environmental protection. Examples of the influence Australian judicial decisions have had on the application of legislative requirements for cumulative and synergistic impact consideration and assessment are also reviewed.

Chapter 5 analyses the approach to cumulative and synergistic impact requirements within legislation addressing marine EIA. Within this case study, the analysis focuses on the review of four of the eight Australian jurisdictions with relevance to the marine environment: the Commonwealth Government, South Australia, Tasmania and Victoria. A case study area related to these four jurisdictions, the Otways Marine Area, has been selected as a means of identifying legislation that provides for the environmental assessment of the use and development of anthropogenic activities. The legislation applicable to these activities has been analysed to determine the extent of inclusion and requirement for the consideration and assessment of cumulative and synergistic impacts.

Within **Chapter 6**, the SEES and associated decision-making process arising from Victoria's Port Phillip Bay Channel Deepening Project (CDP) provides an example of the application of environmental assessment legislation from an Australian jurisdiction; the *Environmental Effects Act 1978* (Vic). The analysis reviews the relationship between the Victorian legal requirements for EIA and the approach taken toward the consideration and assessment of cumulative and synergistic impacts within publicly available documents associated with the decision-making process approving the CDP.

The discussion in **Chapter 7** begins with a brief review of the potential cumulative and synergistic impacts associated with offshore wind farms. Analysis of the Danish Offshore Wind Farm EIA reports, monitoring and legislative approach is then undertaken. The EIA reports for Danish offshore wind farms reviewed include the Anholt offshore wind farm and Kriegers Flak offshore wind farm. The environmental monitoring programme analysed is that associated with the Horns Rev I and Nysted (Rødsand) offshore wind farms. The benefits and shortcomings are identified for all offshore wind farms reviewed; with a similar approach taken for the analysis of Danish legislation and EU Environmental Directives to enable comparative discussion.

Chapter 8 concludes the thesis and in doing so provides for a number of recommendations for inclusion in any future Australian EIA framework using a legal framework for offshore wind farm use and development. The recommendations are intended to improve the legal requirements for the consideration and assessment of cumulative and synergistic impacts within Australian EIA processes. The recommendations focus on the issues, challenges, shortcomings and potentially beneficial approaches discussed in the earlier chapters (Chapters 2 – 7).

8. Thesis contribution and significance

The research undertaken for this thesis addresses areas previously under developed within the academic literature. The thesis draws attention to the distinction between cumulative and synergistic impacts and aims to evolve the definition discussion about these terms by arguing that cumulative and synergistic impacts must be considered and treated separately within legal frameworks and requirements for environmental assessment.

The thesis emphasises the risk that cumulative and synergistic impact consideration within marine environmental assessment, including within Australia, might be neglected within EIA. The potential for improving cumulative and synergistic impact consideration and assessment within marine EIA legal frameworks, to enable a more effective iterative strategic planning (e.g. SEA) and statutory decision-making approach, is also emphasised whilst acknowledging the important roles of the precautionary principle and PAM.

The case studies in Chapters 5 and 6 of this thesis are original research. This is achieved within the context of cumulative and synergistic impact consideration and assessment within Australian marine environmental assessment legal frameworks. The analysis within Chapter 7, focusing on offshore wind farm examples in Denmark, is original, and identifies some of the shortcomings and benefits of the EIA, monitoring and associated legal framework approach to cumulative and synergistic impact assessment. Providing a comparative framework, the analysis of Chapter 7 is used to inform recommendations (discussed in Chapter 8) for the modification and improvement of the current Australian legal framework approach.

Within the context of assessing cumulative and synergistic impacts, Chapter 8 includes recommendations to modify the Australian marine environmental legal frameworks for the EIA of cumulative and synergistic impacts within future and emerging industries (e.g. offshore wind farms).

CHAPTER 2 – CUMULATIVE AND SYNERGISTIC IMPACTS: DEFINITIONS, ANTHROPOGENIC IMPACTS AND ENVIRONMENTAL CHANGE

'It is when hidden decisions are made explicit that the arguments begin. The problem for the years ahead is to work out an acceptable theory of weighting. Synergistic effects, nonlinear variation, and difficulties in discounting the future make the intellectual problem difficult, but not (in principle) insoluble.'[1]

Chapter outline

1. Introduction

Cumulative and synergistic impacts, caused by anthropogenic activities and environmental change in the marine environment, can be addressed in the processes undertaken for environmental assessment. From a legal and scientific perspective, however, it has been a challenge to define these impact types in a manner that enables a clear understanding of the requirements for environmental assessment. This chapter aims to provide an understanding of the challenges of defining cumulative and synergistic impacts within an environmental assessment context and examines how definitional variations can affect legal requirements for

[1] G Hardin, 'The Tragedy of the Commons' (1968) 162 *Science* 1243, 1244.

the consideration and assessment of these different types of environmental impacts. The chapter also identifies examples of the ways in which cumulative and synergistic impacts affect the marine environment.

Sections 2 and 3 of this chapter analyse the definitions of cumulative and synergistic impacts; highlighting the variations in approach. The definition analysis focuses on a general environmental assessment context and legal frameworks. The discussion demonstrates a tendency of some commentators to include ‘synergistic impacts’ as a subset of ‘cumulative impacts’. Section 4 further examines this approach, and presents the argument that these impact types should be defined and assessed separately within scientific analyses, and associated legal requirements, for environmental assessment. The basis for this argument is that the characteristics of cumulative and synergistic impacts are different, and therefore, distinct differentiation in legal requirements and scientific method is needed to ensure that both impact types are independently assessed. Separate consideration and assessment would enable increased knowledge about cumulative and synergistic impacts and the identification of ways to avoid or mitigate the detriment caused in marine environments.

The inconsistency between definitions is demonstrated, in section 5, as having occurred since environmental assessments became entrenched as an environmental management approach in the 1970s. The implications of inadequate definitions, and the need to achieve adequate definitions for cumulative and synergistic impacts, is also discussed as a challenge for legal frameworks. Section 6 identifies examples of the types of cumulative and synergistic impacts that can occur in the marine environment. The examples focus on anthropogenic activities and environmental change. This includes the way in which changes that occur within the natural environment have the capacity to combine with impacts from anthropogenic activities and intensify detrimental environmental outcomes.

2. Cumulative impacts

This section defines ‘cumulative’ impacts, and includes common definition elements as found within literature discussions. A discussion of cumulative impact definition examples as provided within the marine environmental assessment legal frameworks for Australia, Canada, the European Union, England, New Zealand and the United States is provided.

2.1 Defining cumulative impacts

The definition of 'cumulative impact' is typically discussed in the context of the methodology and regulatory requirements for cumulative impact assessment (CIA) or cumulative effects assessment (CEA).[2] As stated in Chapter 1, cumulative impacts can be defined as the same or different type of impacts accumulating across time and space, with the accumulation occurring in a linear nature.[3] These impact types can include stressors caused by anthropogenic activities and environmental change.[4] Discussing 'linear' within the context of cumulative impacts, Halpern et al demonstrate that when impacts accumulate in a linear nature, the quantified impact can be graphically represented in a straight line that shows the value increasing in increments that are directly proportional to the value added.[5]

Since the mid-1980s, literature discussing the definition of 'cumulative impact' has identified that there is an inconsistent approach to the term and uncertainty about the requirements and best methods for CIA. There are several definitional elements that are commonly associated with 'cumulative impacts'. These include that the temporal element refers to impacts that accumulate and combine (interact) with past, present and future actions, and that the impacts assessed occur within a defined geographical area (spatial).[6] Other elements evident within the

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[2] See, eg, Barbara L Bedford and Eric M Preston, 'Developing the Scientific Basis for Assessing Cumulative Effects of Wetland Loss and Degradation on Landscape Functions: Status, Perspectives, and Prospects' (1988) 12 (5) *Environmental Management* 751, 752; Lennart Folkeson, Hans Antonson, and J O Helldin, 'Planners' views on cumulative effects. A focus-group study concerning transport infrastructure planning in Sweden' (2013) 30 *Land Use Policy* 243, 243; Cheryl K Contant and Lyna L Wiggins, 'Defining and analyzing cumulative environmental impacts' (1991) 11 *Environmental Impact Assessment Review* 297, 298; Peter N Duinker et al, 'Scientific dimensions of cumulative effects assessment: toward improvements in guidance for practice' (2013) 21 *Environmental Reviews* 40, 40; Anastássios Perdicoúlis and Jake Piper, 'Network and system diagrams revisited: Satisfying CEA requirements for causality analysis' (2008) 28 *Environmental Impact Assessment Review* 455, 456; Daniel M Franks, David Brereton and Chris J Moran, 'Managing the cumulative impacts of coal mining on regional communities and environments in Australia' (2010) 28 (4) *Impact Assessment and Project Appraisal* 299, 299 – 300; Jennifer Dixon and Burrell E Montz, 'From Concept to Practice: Implementing Cumulative Impact Assessment in New Zealand' (1995) 19 (3) *Environmental Management* 445, 445.

[3] See, eg, L M Cooper and W R Sheate, 'Cumulative Effects Assessment: A review of UK Environmental Impact Statements' (2002) 22 *Environmental Impact Assessment Review* 415, 416, 422 - 423; Benjamin S Halpern et al, 'Managing for cumulative impacts in ecosystem-based management through ocean zoning' (2008) 51 *Ocean and Coastal Management* 203, 205; Samuli Korpinen, Manuel Meidinger and Maria Laamanen, 'Cumulative impacts on seabed habitats: An indicator for assessments of good environmental status' (2013) 74 *Marine Pollution Bulletin* 311,313; Great Barrier Reef Marine Park Authority, *Great Barrier Reef Region Strategic Assessment: Strategic assessment report* (Great Barrier Reef Marine Park Authority, 2014) XIII; Natalie C Ban, Hussein M Alidina and Jeff A Ardron, 'Cumulative impact mapping: Advances, relevance and limitations to marine management and conservation, using Canada's Pacific Waters as a case study' (2010) 34 *Marine Policy* 876, 883; Murray Raff, 'Ten Principles of Environmental Impact Assessment' (1997) 14 *Environmental and Planning Law Journal* 207, 210; Harry Spaling and Barry Smit, 'Cumulative Environmental Change: Conceptual Frameworks, Evaluation Approaches, and Institutional Perspectives' (1993) 17 (5) *Environmental Management* 587, 589.

[4] Refer to Section 5 of this chapter for examples.

[5] Halpern et al, above n 3, 207. Refer to glossary.

[6] See, eg, Contant and Wiggins, above n 2, 302; Contant (1984) in Contant and Wiggins, above n 2, 302; Halpern et al, above n 3, 205; Raff, above n 3, 210; William Sheate et al, *The Relationship between the EIA and SEA Directives: Final Report to the European Commission* (Imperial College London Consultants Ltd, 2005) xiii; Madelaine Porter, Daniel M Franks, and Jo-Anne Everingham, 'Cultivating collaboration: Lessons from initiatives to understand and manage cumulative impacts in Australian resource regions' (2013) 38 *Resources Policy* 657, 657 – 656; Franks, Brereton and Moran, above n 2, 300.

definitions include a focus on impact accumulation that results in a substantive impact;[7] time and/or space crowding caused by repetitive detrimental impacts with insufficient recovery between disturbances (perturbations); [8] 'nibbling';[9] changes that occur within a natural system that may or may not be known or predictable;[10] synergistic reactions;[11] and that cumulative impacts can be direct or indirect.[12]

The association of the words 'impact' and/ or 'effect' can also have a bearing on the definition of cumulative impacts, and the variation in approach to the use of these terms in the literature is, therefore, important to discuss. This variation is driven by the context of usage, with distinctions between impacts and effects. The approach of some commentators suggests that the terms 'cumulative impacts' and 'cumulative effects' are interchangeable.[13] In contrast, others draw a distinction between the two; identifying that the term 'effect' relates to the changes that actually occur within the environment, whereas 'impact' is the resulting outcome caused by these changes.[14] As an example Bedford and Preston (whose work focused on the USA and Canada) discussed concern about interchanging of the terms 'effects' and 'impacts', particularly alongside the double meaning applied to 'impact' (both cause and effect).[15] The inconsistent approach to defining these terms was thought, 'to impede progress in relating science to regulatory needs'.[16] Preston and Bedford discuss that the term cumulative 'impact' has also been referred to as a 'social or political' 'value judgement', whereas the term cumulative

[7] Raff, above n 3, 210; Contant (1984) in Contant and Wiggins, above n 2, 302.
[8] See, eg, Beanlands et al (eds), The Canadian Environmental Assessment Research Council (CEARC) and the United States National Research Council (NRC), *Cumulative Environmental Effects: A Binational Perspective,* (CEARC, NRC, 1986) 161; Beanlands et al (1986) cited in Contant and Wiggins, above n 2, 301.
[9] See, eg, John Court, Colin Wright and Alasdair Guthrie, 'Environmental Assessment and Sustainability: Are We Ready for the Challenge?' (1996) 3 *Australian Journal of Environmental Management* 42, 50; Contant and Wiggins, above n 2, 302; Folkeson, Antonson, and Helldin, above n 2, 243; Beanlands et al (eds), above n 8, 161; Gordon A Robilliard, 'Commentary I' cited in Beanlands et al (eds), above n 8, 108; Robilliard cited in E B Peterson et al (Canadian Environmental Assessment Research Council), *Cumulative Effects Assessment in Canada: An Agenda for Action and Research,* (Ministry of Supply and Services Canada, 1987) 49; Peterson et al (1987) cited in John Glasson, Riki Therivel and Andrew Chadwick, *Introduction to Environmental Impact Assessment,* (Routledge, 3rd ed, 2005) 325. Refer to glossary.
[10] See, eg, Contant and Wiggins, above n 2, 302;
[11] See, eg, Contant and Wiggins, above n 2, 302; Bedford and Preston, above n 2, 758.
[12] See, eg, Beanlands et al (eds), above n 8, 161; Beanlands et al (1986) cited in Contant and Wiggins, above n 2, 302; Thomas G Dickert and Andrea E Tuttle, 'Cumulative Impact Assessment in Environmental Planning: A Coastal Wetland Watershed Example' (1985) 5 *Environmental Impact Assessment Review* 37, 39.
[13] See, eg, Larry Canter and Bill Ross, 'State of practice of cumulative effects assessment and management: the good, the bad and the ugly' (2010) 28(4) *Impact Assessment and Project Appraisal* 261, 262; John D Court, Collin J Wright and Alasdair C Guthrie, *Assessment of cumulative impacts and strategic assessment in environmental impact assessment (prepared for the Commonwealth Environment Protection Agency),* (Commonwealth of Australia, 1994) Appendix I.3; Folkeson, Antonson, and Helldin, above n 2, 243; Spaling and Smit, above n 3, 587, 589, 591.
[14] See, eg, Antoinette Wärnbäck & Tuija Hilding-Rydevik, 'Cumulative effects in Swedish EIA practice – difficulties and obstacles', (2009) 29 *Environmental Impact Assessment Review* 107, 108; Elizabeth A Masden et al, 'Cumulative impact assessments in bird/wind farm interactions: Developing a conceptual framework' (2010) 30 *Environmental Impact Assessment Review* 1, 3; Spaling and Smit, above n 3, 587, 589, 591; Eric M Preston and Barbara L Bedford, 'Evaluating Cumulative Effects on Wetland Functions. A Conceptual Overview and Generic Framework' (1988) 12 (5) *Environmental Management* 565, 568.
[15] Bedford and Preston, above n 2, 758.
[16] Ibid.

‘effect’ directly relates to the ‘scientific and technical component’.[17] The Preston and Bedford approach, as well as the approach within the United States and Canada, and that of other commentators,[18] was considered by Court, Wright and Guthrie.[19] The approaches were addressed within a discussion that extended the issue to the Australian context. Comparing the Australian legal approach from the 1990s, and the dictionary definition, Court, Wright and Guthrie reasoned that a determination as to whether these terms should be distinguished or interchangeable was difficult to conclude.[20] For the purpose of this thesis, the interchangeable use of the terms ‘impact’ and ‘effect’ in association with the terms ‘cumulative’ (and ‘synergistic’) is considered appropriate. This is because both terms can be used to describe the causes and consequences of stressors within an environment.

The discourse demonstrates that there are different elements that need to be considered when defining cumulative impacts for the purpose of scientific analysis in environmental assessment. It also demonstrates variations in approach and concerns about inconsistency because of these variations. Given the potential for legal requirements to affect the conduct of environmental assessment and scientific analysis, the approach within marine environmental assessment legal frameworks should also be considered.

2.2 Definitions within the legal context

Comparison of the approach to defining cumulative impacts taken by several jurisdictions[21] relevant to marine environmental impact assessment, indicates that an attempt to achieve consistency has already occurred. On face value, it appears that Canada, New Zealand and the United States have sought clarity with the provision of definitions for cumulative impacts within their legislative and policy frameworks. For example, in the United States, a definition of cumulative impacts is provided in the *National Environmental Policy Act (NEPA) Regulations 1978* (Council on Environmental Quality).[22] With some similarities, in Canada, the federal

[17] Preston and Bedford, above n 14, 568.
[18] Court, Wright and Guthrie, above n 13, Appendix I.3 – I.4; see, eg, Preston and Bedford (1988) cited in Court, Wright and Guthrie, above n 13, Appendix I.3 – I.4; Stakhiv (1988) cited in Court, Wright and Guthrie, above n 13, Appendix I.3 – I.4; Hubbard (1990) cited in Court, Wright and Guthrie, above n 13, Appendix I.3 – I.4.
[19] Court, Wright and Guthrie, above n 13, Appendix I.3 – I.4.
[20] Ibid. The legal approaches discussed included environmental assessment legislation from Victoria and New South Wales. The Macquarie Dictionary (no edition or date identified) was also referred to.
[21] Jurisdictions compared include New Zealand, the United States, Canada, Australia, England and the related directives for EIA from the European Union. The assessment only relates to federal government requirements (June 2016).
[22] CEQ, Regulations for implementing NEPA [40 CFR Parts 1500 – 15081]. Washington DC: Council on Environmental Quality; 1978, Reg. 1508.7. The definition being:‘*...impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time*’

Canadian Environmental Assessment Act 2012 provides a definition within their requirement to consider cumulative environmental effects.[23] In New Zealand, whilst the wording is different, the intent could be considered similar to the United States and Canadian requirements, with Section 3(d) of the *Resource Management Act 1991* (NZ) providing an explanation of cumulative effects within the definition of effect; that being:

> …which arises over time or in combination with other effects –
> regardless of the scale, intensity, duration, or frequency of the effect, and also includes-
> (e) any potential effect of high probability; and
> (f) any potential effect of low probability which has a high potential impact.[24]

The European Union (EU) mandates the consideration of cumulative impacts in a number of the EU Directives that relate to environmental assessment and marine environmental management. *Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification))* (EIA Directive)[25] and the amending *Directive 2014/52/EU on the assessment of the effects of certain public and private projects on the environment*[26] requires CIA as part of environmental impact assessment (EIA).[27] Implementation of the requirements is achieved through applicable European Union member states' legislation. The EIA Directive does not, however, provide a clear definition of cumulative impacts. Similarly, the EU's *Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment* (SEA Directive)[28] makes reference to the consideration of cumulative impacts, but does not provide a definition.

Article 6(3) of the European Union's *Council Directive 92/43EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora* does not directly reference the term 'cumulative', yet it appears to contribute to a possible definition of this term. This occurs by providing for the assessment of cumulative impacts through its requirement that plans and projects

> …not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall

<https://ceq.doe.gov/nepa/regs/ceq/1508.htm#1508.1 >

[23] The definition being: '...any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out...' Section 19(1)(a) *Canadian Environmental Assessment Act 2012*.

[24] *Resource Management Act 1991* (NZ) section 3(d).

[25] *Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification),* [2012] OJ L 26/1.

[26] *Directive 2014/52/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification),* [2014] OJ L 124/1.

[27] See, eg, *Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification),* [2012] OJ L 26/1, Schedule IV; *Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment*, [2001] OJ L 197/30, Schedule I.

[28] *Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment*, [2001] OJ L 197/30

> be subject to appropriate assessment of its implications for the site...[29]

This example definition is unclear and creates ambiguity. The EIA Directive example also creates ambiguity because there is no definition of the term. In both instances, the absence of a definition could result in a compromised assessment of cumulative impacts.

Definitions can also be found within policy documentation. These definitions are not legally binding, but are intended to provide guidance. For example, even though there is no clear definition of 'cumulative impacts' within the European Union legal framework, a non-binding definition has been provided within the *Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions.*[30] These guidelines comment on the absence of a common definition, and as such provide direction on the consideration of cumulative and synergistic impacts.[31]

As an example of implementation of the EU EIA Directive, the particular requirements for impact assessments for certain activities within the United Kingdom's marine environment are regulated by the *Infrastructure Planning (Environmental Impact Assessment) Regulations 2009*[32] and *Marine Works (Environmental Impact Assessment) Regulations 2007*.[33] These regulations, whilst requiring the consideration of cumulative effects,[34] do not provide a definition. This lack of definition could contribute to inadequate assessment practice.

In Australia, at the federal government level, there is no legislative based definition of cumulative impacts in marine environmental assessment legislation.[35] This absence is further discussed in Chapter 5 through a case study analysis of legislation relevant to the 'Otways Marine Area'. The case study provides a review of the extent of assessment requirements and definitions for cumulative and synergistic impacts as provided within the Commonwealth, South Australian, Tasmanian and Victorian jurisdictions. Definitions provided by Australian governments have, however, been included within policy at both the State and Federal

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[29] *Council Directive 92/43EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora*, [1992] OJ L 206/7; this is also discussed in Simon Marsden, *Strategic Environmental Assessment in International and European Law: A Practitioner's Guide* (Earthscan, 2008) 245.

[30] Hyder, *Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions* (European Communities, 1999), ii – iii <https:www.ec.europa.eu/environment/archives/eia/eia-studies-and-reports/pdf/guidel.pdf>. Definition provided for cumulative impact: 'Impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project.

[31] Hyder, above n 30, ii.

[32] As applicable to England, Wales and Scotland only.

[33] As applicable to England, Wales, Scotland and Northern Ireland (excepting section 34).

[34] *Marine Works (Environmental Impact Assessment) Regulations 2007* (UK), Schedule 3(3)(2); *Infrastructure Planning (Environmental Impact Assessment) Regulations 2009* (UK), Schedule 4, Part 1.

[35] Refer to Chapter 5 for a detailed analysis.

government levels.[36]

In 1994 Court, Wright and Guthrie analysed the need for the consideration of cumulative impacts within the Australian federal environmental impact regulatory framework and compared jurisdictions and the approach to considering such cumulative impacts.[37] Within Court, Wright and Guthrie's discussion, the current definitions were reviewed, including those from the United States, New Zealand, Canada and the European Community.[38] A similar comparison was undertaken in 1992 by Cocklin, Parker and Hay, for the United States, Canada and New Zealand.[39] A consistent finding of these reviews is the absence of an effective approach to addressing and evolving the definition during the last 30 years.

The ongoing literature discussion suggests that, in instances where legislation provides a definition for cumulative impacts (e.g. the United States, New Zealand and Canada), these definitions appear to have broad parameters and an inadequate explanation as to what exactly are cumulative impacts. There is also an absence of differentiation as to what they are not (e.g. synergistic impacts). The definition of synergistic impacts was briefly discussed in Chapter 1, and because of the distinct elements, the reasons for ensuring that cumulative and synergistic impacts are distinguished within environmental assessment definitions (legal or otherwise) is important to examine further.

3. Synergistic impacts

This section defines 'synergistic' impacts, and examines the discussion identifying the critical elements of this impact type when applied to environmental assessment. The marine environmental assessment legal frameworks examined for the approach to the definition of cumulative impacts (i.e. Australia, Canada, the European Union, England, New Zealand and the United States), are also examined for the approach to the definition of synergistic impacts.

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[36] See, eg, South Australian Government's definition within the context of their Marine Planning Framework. The meaning provided is relatively simple, being: 'Created by successive additions (for example: of impacts)' in Natural and Cultural Heritage, Department for Environment and Heritage, *Marine Planning Network for South Australia,* (Government of South Australia, 2006) 21; Also see Commonwealth Government, *Australia's Oceans Policy: Specific Sectoral Measures - Caring, understanding, using wisely (Volume 2)* (Environment Australia,1998) 46 where the definition is 'Cumulative Impact: The combined impacts of successive or coincident influences or effects on environmental or other attributes'.

[37] Court, Wright and Guthrie, above n 13, 5.10 - 5.14.

[38] Ibid.

[39] Chris Cocklin, Sharon Parker and John Hay, 'Notes on Cumulative Environmental Change I: Concepts and Issues' (1992) 35 *Journal of Environmental Management* 31, 32-33.

3.1 Defining synergistic impacts

Synergistic impacts refer to those impacts that interact and accumulate in a nonlinear[40] nature, resulting in a magnitude that is greater than the sum of the contributing impacts.[41] Synergistic impacts can also occur across time and space.[42] Whilst isolated impacts may not in themselves be considered problematic, when combined, the synergy may produce differing impacts or a different magnitude of impact.[43] A simple definition is provided by Wärnbäck and Hilding-Rydevik through their statement of 'the fact that one plus one can, in some cases, be more than two'.[44]

With more detail, Breitburg and Riedel explain synergistic impacts as follows:

> When multiple stressors affect an individual, population or ecosystem, the effects can be greater than, less than, or qualitatively different from the sum of the effects that would be predicted if each stressor occurred in isolation. Effects of multiple stressors that are greater than additive, or synergistic, occur because a change caused at the physiological or ecological level by one stressor increases the severity or occurrence of effects of a second stressor.[45]

This definition is supported by Halpern and Fujita.[46] The definition for 'synergistic' impact, however, can vary. MacDonald, for example, identified that for synergistic impacts to occur, the resultant effect *must* be more than the total effect if the combined impacts were additive.[47] Other examples of this approach can also be seen within government guidelines,[48] legislative

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[40] The term 'nonlinear' is the opposite of the term 'linear' and when impacts are defined as 'nonlinear' in nature, the quantified impact can be graphically represented in a curved or non-straight line. Refer to glossary.

[41] See, eg, Raff, above n 3, 210; C L Folt et al, 'Synergism and antagonism among multiple stressors' (1999) 44(3)(2) *Limnology and Oceanography* 864,864; Court, Wright, Guthrie, above n 13, Appendix I.3; Great Barrier Reef Marine Park Authority, above n 3, 10-3; Ban, Alidina and Ardron, above n 3, 883; Spaling and Smit, above n 3, 587, 592; the definition is also supported within a different context in Daniel Simberloff and Betsy Von Holle, 'Positive Interactions of nonindigenous species: invasional meltdown?' (1999) 1 *Biological Invasions* 21, 22.

[42] See, eg, Katarina Pavlickova and Monika Vsykupova, 'A method proposal for cumulative environmental impact assessment based on landscape vulnerability evaluation' (2015) 50 *Environmental Impact Assessment Review* 74, 74; Contant and Wiggins, above n 2, 302; Glasson, Therivel and Chadwick, above n 138, 325; Garry K Meffe, C Ronald Carroll and contributors, *Principles of Conservation Biology,* (Sinaur Associates Inc., 2nd ed, 1997) 680; Spaling and Smit, above n 3, 592; Simberloff and Von Holle, above n 41, 22; Raff, above n 3, 210; Sheate et al, above n 6, xiii.

[43] See, eg, Pavlickova and Vsykupova, above n 42, 74; Contant and Wiggins, above n 2, 302; Glasson, Therivel and Chadwick, above n 138, 325; Meffe, Carroll and contributors, above n 42, 680; Spaling and Smit, above n 3, 592; Simberloff and Von Holle, above n 41, 22; Raff, above n 3, 210; Sheate et al, above n 6, xiii.

[44] Wärnbäck and Hilding-Rydevik, above n 14, 110.

[45] Denise L Breitburg and Gerhardt F Riedel, 'Multiple Stressors in Marine Systems' in Elliot A Norse and Larry B Crowder (eds), *Marine Conservation Biology – The Science of Maintaining the Sea's Biodiversity* (Island Press, 2005) 167, 168.

[46] Breitburg et al (1998) cited in Benjamin S Halpern and Rod Fujita, 'Assumptions, challenges and future directions in cumulative impact analysis' (2013) 4 (10) 131 *Ecosphere* 1, 5.

[47] Lee H MacDonald, 'Evaluating and Managing Cumulative Effects: Process and Constraints' (2000) 26 (3) *Environmental Management* 299, 299.

[48] See, eg, Office of the Deputy Prime Minister, *A Practical Guide to the Strategic Environmental Assessment Directive: Practical Guidance on applying European Directive 2001/42/EC "on the assessment of the effects of certain plans and programmes on the environment"* (Scottish Executive, Welsh Assembly Government, Department of the Environment, Northern Ireland, 2005) Appendix A: 78.

framework reviews,[49] and from other commentators. For example, Folt et al define these impacts as 'stressors in combination are synergistic…when their combined effects are greater….than, respectively, the effect of the single worst stressor.'[50] The Folt et al definition has been reiterated within both marine biology and environmental assessment focused papers by a number of commentators.[51] Rogers and Laffoley have provided a similar definition, to that of Folt et al, with the additional comment that synergies can be positive or negative in outcome.[52]

In the 2005 *Final Report to the European Commission* on the *Relationship between the EIA and SEA Directives*, 'synergistic effects' were defined as '*cumulative effects that result when the interaction of a number of impacts is greater than or different from the sum of the individual impacts*.'[53] Examples provided to aid the definition include:

- the combined impact of construction noise from various development is greater than the sum of the individual noise impacts.
- when a different type of impact occurs from the original impacts, such as when the combination of particular weather conditions and certain pollutants (NO_x) produces smog.[54]

That this definition includes reference to cumulative impacts, could be seen as providing inadequate distinction between the two impact types. That the definition of the term synergistic can be inadequate, is also identified within the literature.[55] Folt et al expressed concern about an absence of clear definition because it is important to distinguish between the different causes and levels of severity associated with the effects.[56]

Reiterating an earlier example, Glasson, Therivel and Chadwi used the '*widely quoted*' definition by the '*Canadian Environmental Assessment Research Council (CEARC) (Peterson*

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49 Court, Wright, Guthrie, above n 13, Appendix I.3.
50 Folt et al, above n 41, 865.
51 See, eg, V Stelzenmüller et al, 'Quantifying cumulative impacts of human pressures on the marine environment: a geospatial modelling framework' (2010) 398 *Marine Ecology Progress Series* 19, 20; Jo Foden, Stuart I Rogers and Andrew P Jones, 'Human pressures on UK seabed habitats: a cumulative impact assessment' (2011) 428 *Marine Ecology Progress Series* 33, 34 – 35; J E Johnson et al, 'Quantitative methods for analysing cumulative effects on fish migration success: a review' (2012) 81 *Journal of Fish Biology* 600, 601; Linda Harris et al, 'Quantifying cumulative threats to sandy beach ecosystems: A tool to guide ecosystem-based management beyond coastal reserves' (2015) 110 *Ocean & Coastal Management* 12, 22; Marisa I Batista et al, 'Assessment of cumulative human pressures on a coastal area: Integrating information for MPA planning and management' (2014) 102 *Ocean & Coastal Management* 248, 248 – 249.
52 Alex D Rogers and Dan Laffoley, 'Editorial - Introduction to the special issue: The global state of the ocean; interactions between stresses, impacts and some potential solutions. Synthesis papers from the International Programme on the State of the Ocean 2011 and 2012 workshops' (2013) 74 *Marine Pollution Bulletin* 491, 493.
53 Sheate et al, above n 6, xiii.
54 Ibid.
55 See, eg, Folt et al, above n 41, 865.
56 Folt et al, above n 41, 865.

et al, 1987)'.[57] Summarising the CEARC definition,[58] they provide that the definition of cumulative impact includes reference to:

> …Synergisms – where different types of perturbation occurring in the same area may interact to produce qualitatively and quantitatively different responses by the receiving ecological communities;… [59]

A similar approach was taken in the early 1990s by Cocklin, Parker and Hay where within the categorisation of cumulative effects, synergistic effects were also referred to as 'compounding effects'. [60] As more recent examples, MacDonald identified that cumulative impacts can be 'additive or synergistic',[61] and Lawrence discussed that 'compounding and synergistic effects' often form part of significant impact determination within CEA.[62] Similarly, Crain, Kroeker and Halpern stated that, 'a synergism occurs when the cumulative effect of both stressors reduces a response more than the sum of the individual stressor effects'.[63] As further recent examples, Korpinen, Meidinger and Laamanen followed Crain, Kroeker and Halpern, and Foden, Rogers and Jones and included synergistic impacts within cumulative,[64] as do Pavlickova and Vyskupova.[65] It is noted that the term 'nonlinear' (without express reference to 'synergistic') has also been encompassed under the 'cumulative' term.[66]

Dickert and Tuttle noted that an interaction can be synergistic or additive.[67] This approach is also supported within more recent literature.[68] It is also noted that the terms 'interactive', 'interaction' and 'multiplicative' are still used to capture synergistic impacts independently of 'additive' cumulative impacts.[69]

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[57] Glasson, Therivel and Chadwick, above n 138, 325; Also see, eg, Cocklin, Parker and Hay, above n 37, 35; Folkeson, Antonson, and Helldin, above n 2, 243.
[58] E B Peterson et al (Canadian Environmental Assessment Research Council), *Cumulative Effects Assessment in Canada: An Agenda for Action and Research,* (Ministry of Supply and Services Canada, 1987) 7.
[59] Glasson, Therivel and Chadwick, above n 138, 325.
[60] Cocklin, Parker and Hay, above n 37, 35, 37.
[61] MacDonald, above n 47, 299.
[62] David P Lawrence, 'Impact significance determination – Pushing the boundaries' (2007) 27 *Environmental Impact Assessment Review* 770, 778.
[63] Caitlin Mullan Crain, Kristy Kroeker and Benjamin S Halpern, 'Interactive and cumulative effects of multiple stressors in marine systems' (2008) 11 *Ecology Letters* 1304, 1308.
[64] Korpinen, Meidinger and Laamanen, above n 3, 313.
[65] Pavlickova and Vsykupova, above n 42, 74.
[66] See, eg, Falko T Buschke and Bram Vanschoenwinkel, 'Mechanisms for the inclusion of cumulative impacts in conservation decision-making are sensitive to vulnerability and irreplaceability in a stochastically simulated landscape' (2014) 22 *Journal for Nature Conservation* 265, 265.
[67] Dickert and Tuttle, above n 12, 39.
[68] See, eg, Crain, Kroeker and Halpern, above n 63, 1305.
[69] See, eg, Halpern et al, above n 3, 204; Xiongzhi Xue, Huasheng Hong and Anthony T Charles, 'Cumulative environmental impacts and integrated coastal management: the case of Xiamen, China' (2004) 71 *Journal of Environmental Management* 271, 273; Crain, Kroeker and Halpern, above n 63, 1304; Alejandro H Buschmann et al, 'Salmon aquaculture and coastal ecosystem health in Chile: Analysis of regulations, environmental impacts and bioremediation systems' (2009) 52 *Ocean and Coastal Management* 243, 244; Porter, Franks, and Everingham, above n 6, 657; Franks, Brereton and Moran, above n 2, 300.

Buckley typified cumulative impacts in a way that includes 'interaction', but with a broad enough scope to incorporate synergistic impacts. This definition includes:

- …Interactive impacts from nearby developments of different types;
- Interactions between impacts from diffuse and point sources;
- Net impacts of multiple developments on particular environmental parameters (eg water quality)
- Joint effects of multiple stressors on plant and animal populations (eg, through habitat clearance)....[70]

In a simpler form, the *Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions* provide the following definition of 'impact interactions': 'The reactions between impacts whether between the impacts of just one project or between the impacts of other projects in the areas (sic).'[71] In this instance, however, there is also a separate definition provided for cumulative impacts whereby there is specific reference to the additive nature of the impact type.[72] In addition to the examples whereby synergistic impacts are integrated within the 'cumulative' definition, the identification of these impact types in a way that clearly identifies their nature as distinct to that of cumulative impacts is also evident within the literature.[73] The next section examines the approach to defining synergistic impacts, but with a focus on legislation.

3.2 Definitions within the legal context

The legislative impact assessment requirements discussed for cumulative impacts (refer to section 2.2) were also reviewed for examples of requirements applicable to synergistic impacts. The distinction of synergistic impacts from cumulative impacts was found within the European Union's SEA Directive.[74] There is, however, no definition provided within this example. The absence of definition within the EU Directives, in general, has been associated with inconsistent approaches to assessment methodology.[75]

There is no direct reference to the consideration of synergistic impacts in United States, Canada

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[70] Ralf Buckley 'Notes, Commentary and Reviews - Cumulative Environmental Impacts: Problems, Policy and Planning Law' (1994) 11 *Environmental and Planning Law Journal* 344, 344 – 345.
[71] Hyder, above n 30, ii.
[72] Ibid.
[73] See, eg, Carle Folke et al, 'Regime Shifts, Resilience, and Biodiversity in Ecosystem Management' (2004) 35 *Annual Review of Ecology, Evolution and Systematics* 557, 575; Stelzenmüller et al, above n 51, 20.
[74] See, eg, *Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment*, [2001] OJ L 197/30, Annex 1.
[75] R Aschemann (2005), S Heiland et al (2006) and S Siedentop (2005) cited in Ulrike Weiland, 'Strategic Environmental Assessment in Germany – Practice and open questions' (2010) 30 *Environmental Impact Assessment Review* 211, 212.

and New Zealand legislation.[76] In Australia, as with cumulative impacts, the legal requirement for the consideration of synergistic impacts is limited.[77] Further, whilst there are examples of discussions within legislative reviews that include a synergistic impact definition,[78] they do not address the absence of express requirements to assess these impact types within Australian environmental assessment legislation.

The inadequate differentiation within the legislation discussed above suggests that in the non-European Union instances, the premise to consider synergistic impacts is derived from a common approach to include synergistic impacts within the cumulative impact definition and assessment methodology. This approach of cross referencing and incorporation is apparent in each of the cumulative impact and synergistic impact definition discussions. The next section, therefore, addresses the need for a more distinct approach.

4. Defining 'cumulative' and 'synergistic' separately

The ambiguity associated with the definitions of these terms, when the impact types are clearly distinct, emphasises the need to ensure they are defined and used separately. This section considers the reasons why it is important to define, consider and assess cumulative impacts and synergistic impacts separately. Recommendations that aim to improve the current definition approaches are also provided.

The inadequate differentiation between the definitions of cumulative and synergistic impacts identified in the above discussion about legal definitions, is also evident within the academic literature. [79] The definition examples of cumulative impacts indicate that some commentators are more explicit about identifying a distinction from synergistic impacts (even if they are

[76] CEQ, Regulations for implementing NEPA [40 CFR Parts 1500 – 15081]. Washington DC: Council on Environmental Quality, 1978; *Canadian Environmental Assessment Act 2012*; *Resource Management Act 1991* (NZ).
[77] See Chapter 5 for further analysis.
[78] See, eg, Australian Government Department of the Environment Water Heritage and the Arts, above n 159, [4.242], [8.68]; Court, Wright, Guthrie, above n 13, 4.4.
[79] See, eg, Ban, Alidina, Ardron, above n 3, 883; Greig et al (2003) in Peter N Duinker and Lorne A Greig, 'The impotence of cumulative effects assessment in Canada: Ailments and Ideas for Redeployment' (2006) 37(2) *Environmental Management* 153, 157; Seitz, Westbrook and Noble, above n 140, 173; Jill A E Harriman and Bram F Noble, 'Characterizing Project and Strategic Approaches to Regional Cumulative Effects Assessment in Canada' (2008) 10 (1) *Journal of Environmental Assessment Policy and Management* 25, 26; Glasson, Therivel and Chadwick, above n 138, 325; Foden, Rogers and Jones, above n 51, 34; Caitlin M Crain et al, 'Understanding and Managing Human Threats to the Coastal Marine Environment', (2009) 1162 *The Year in Ecology and Conservation Biology 2009: Ann. N.Y. Acad. Sci* 39, 52; Peter N Duinker and Lorne A Greig, 'Forum: The Impotence of Cumulative Effects Assessment in Canada: Ailments and Ideas for Redeployment' (2006) 37(2) *Environmental Management* 153, 157; Gunn and Noble, above n 139, 155 -156; Danielle Marcotte, Samuel K Hung, Sébastien Caquard, 'Mapping cumulative impacts on Hong Kong's pink dolphin population' (2015) 109 *Ocean & Coastal Management* 51, 53, 56.

considered under the same term).[80] Other commentators have preferred definitions that, whilst acknowledging that there are other categories, tend to focus on the 'past, present and future actions' elements.[81] The definition of cumulative impacts, however, applies to accumulation in an additive (linear) nature. In comparison, synergistic impacts, whilst also capable of accumulating across space and time, result in outcomes that are nonlinear. This difference requires separate consideration. Further, incorporation of one impact type within the meaning of the other compounds the concerns raised around the absence of a clear definition for cumulative impacts. These issues are also emphasised when terms that are applicable to both cumulative and synergistic, such as interactive, continue to be used with differential meaning.

The complexities of achieving a clear definition for synergistic impacts can also be seen in instances where commentators use definitions for CEA methods that are general in terms of typology. These can be potentially perceived as causing uncertainty as to the type of interaction being discussed. One such example provided by Pavlickova and Vyskupova includes the all-encompassing reference to 'impacts which can supposedly multiply and worsen their effects more than they could individually.'[82]

Based on the potential prevalence for synergistic impacts and the defined difference between cumulative and synergistic impacts, it is important to focus on the concerns raised by Folt et al. Specifically, it is important to distinguish between levels and severity of impacts,[83] and examine examples where synergistic impacts and cumulative impacts are already referred to and considered separately.[84] Whilst not providing a definition, an early example where a clear distinction was provided through direct reference to both terms is found in the 1995 National Research Council (United States) report *Understanding Marine Biodiversity A Research Agenda for the Nation*. The document stated that 'the cumulative or synergistic interactions between natural and human stresses' are identified as contributing causes for biodiversity changes.[85] It is noted however, that whilst other commentators, such as Sala and Knowlton, have discussed synergistic impacts and acknowledged the work within *Understanding Marine Biodiversity A Research Agenda for the Nation*, the distinction between the two impact types was not clearly

[80] See, eg, Christina Kelly et al, 'Investigating options on how to address cumulative impacts in marine spatial planning' (2014) 102 *Ocean & Coastal Management* 139, 139,145; Dickert and Tuttle, above n 12, 39; MacDonald, above n 47, 299; Folt et al, above n 41, 865; Harriman and Noble, above n 79, 26; M Wing Goodale and Anita Milman, 'Cumulative adverse effects of offshore wind energy development on wildlife' (2016) 59 (1) *Journal of Environmental Planning and Management* 1, 7-8; Heiland et al (2006) cited in Weiland, above n 75, 213.
[81] See, eg, Folkeson, Antonson, and Helldin, above n 2, 243; Franks, Brereton and Moran, above n 2, 300; Porter, Franks, and Everingham, above n 6, 657.
[82] Pavlickova and Vsykupova, above n 42, 82.
[83] Folt et al, above n 41, 865.
[84] See, eg, *Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment*, [2001] OJ L 197/30, Annex 1; National Research Council, *Understanding Marine Biodiversity A Research Agenda for the Nation* (National Academy Press, 1995) 25.
[85] National Research Council, above n 84, 25.

stated.[86] A recent example with clear distinction provided is that by Rogers and Laffoley, where it was emphasised that an approach must be found to minimise or remove the impact of anthropogenic stressors on the marine environment, and that achieving this is 'critical because many direct and indirect human stressors act in a cumulative or synergistic fashion'.[87]

The following argument concentrates on some of the potential problems within environmental assessment and legal frameworks when synergistic impacts are not identified separately from cumulative impacts. Of significance is the need to acknowledge that prediction and knowledge about the implications of stressors within an environment is important.[88] Further, with environmental impacts rarely occurring in isolation,[89] research into cumulative and synergistic impacts is necessary to provide the knowledge and ability to make more accurate predictions about human induced change within environments such as marine ecosystems.[90] Whilst it is acknowledged that synergistic impacts can flow on from cumulative impacts, the importance of recognising them separately within assessments is useful in relation to the aim of providing a more complete knowledge base. To date, studies have shown that knowledge about cumulative and synergistic impacts is limited,[91] and concern has been expressed about the potential to neglect the cumulative impact types that are not additive (or linear) alongside the difficulties associated with predicting impacts.[92] Based on this, the query is raised as to whether the absence of differentiation between cumulative and synergistic impacts might increase the risk that environmental assessments do not assess adequately these impact types; particularly when definitions within legal requirements are unclear or inconsistent.

Whilst there has been significant focus on cumulative impacts since the late 1990s, the high number of observations showing that a combination of stressors can increase as well as compound a negative effect, demonstrate that synergistic impacts are common.[93] In support of this, Halpern and Fujita commented that 'linear responses of ecosystems to stressors, and to

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86 Enric Sala and Nancy Knowlton, 'Global Marine Biodiversity Trends', (2006) 31 *Annual Review of Environment and Resources*) 93, 101, 106, 110.
87 Rogers and Laffoley, above n 52, 491.
88 Breitburg and Riedel, above n 45, 167.
89 See, eg, Crain et al, above n 79, 49.
90 See, eg, Crain et al, above n 79, 49; Johnson et al, above n 51, 601.
91 See, eg, Crain et al, above n 79, 52; Korpinen, Meidinger and Laamanen, above n 3, 313; Selina Agbayani, Candace M Picco and Hussein M Alidina, 'Cumulative impact of bottom fisheries on benthic habitats: A quantitative spatial assessment in British Columbia, Canada' (2015) 116 *Ocean and Coastal Management* 423, 432; Pavlickova and Vyskupova, above n 42, 75.
92 See, eg, Contant and Wiggins, above n 2, 298, 303; Agbayani, Picco and Alidina, above n 91, 428, 430 – 431.
93 See, eg, Benjamin S Halpern and Rod Fujita, 'Assumptions, challenges and future directions in cumulative impact analysis' (2013) 4 (10) 131 *Ecosphere* 1, 8; Crain, Kroeker and Halpern, above n 63, 1304; Norman Myers, 'Environmental Unknowns' (1995) 269 *Science* 358, 360; Sala and Knowlton, above n 86, 110; Crain et al (2008), Darling and Côté (2008), Myers (1995) and Sala and Knowlton (2006) cited in Batista et al, above n 51, 248; Crain, Kroeker and Halpern (2008), and Darling and Côté (2008) cited in Dana Clark et al, 'Validation and limitations of a cumulative impact model for an estuary' (2016) 120 *Ocean & Coastal Management* 88, 96.

cumulative stress, are the exception rather than the rule.'[94] Breitburg and Reidel stated that 'truly additive, non-interactive multiple stressor effects are rare'.[95] This was also supported by Buschke and Vanschoenwinkel, based on their interpretation of the research by Rockström et al,[96] Scheffer,[97] and Scheffer et al,[98] that the relationship between detrimental impacts on the environment and an environmental response is more likely to be synergistic than additive.[99] The unpredictable nature of these outcomes was also emphasised.[100] Based on this, Buschke and Vanschoenwinkel warned that the additional impacts from two 'identical' projects in the same area were unlikely to behave in an additive manner.[101] This observation is a concern that has been raised in earlier discourse, by Dickert and Tuttle, who commented on the potential for a response to additive stressors to become nonlinear or synergistic.[102]

Darling and Côté provided a different perspective and warned against identifying synergistic impacts as occurring more often than cumulative impacts.[103] In coming to this conclusion, however, they qualified their research by stating that it was undertaken in the context of simple situations and that the outcome of those interactions occurring within the natural environment, at an ecosystem level, is harder to predict.[104] It is also noted that their discussion does not suggest that there was more potential for significant detriment to occur simply because an impact interaction is additive rather than synergistic. Nor was there the suggestion that synergistic impacts should be given less attention as a type of impact separate from that of a cumulative impact.[105] Based on this, it could be said that discussions, such as that of Darling and Côté, suggest that the use of cumulative or additive impacts as a primary all-encompassing term should be done with caution. It does not suggest that synergistic impacts are indistinct from cumulative impacts, or that they should not be considered.

This interpretation of Darling and Côté's perspective is supported by Halpern and Fujita's synthesis of Darling and Côté's research. They concluded that there is a paucity of information

[94] Halpern and Fujita, above n 93, 8.
[95] Breitburg and Riedel, above n 45, 168.
[96] Johan Rockström et al, 'A safe operating space for humanity' (2009) 461 *Nature* 472, 472.
[97] M Scheffer (2009) cited in Buschke and Vanschoenwinkel, above n 66, 265.
[98] Marten Scheffer et al, 'Catastrophic shifts in ecosystems' (2001) 413 *Nature* 591, 595; Marten Scheffer et al, 'Anticipating Critical Transitions' (2012) 338 *Science* 344, 346.
[99] Buschke and Vanschoenwinkel, above n 66, 265.
[100] See, eg, Buschke and Vanschoenwinkel, above n 66, 265; Scheffer et al (2001), above n 98, 591; Marten Scheffer et al (2012), above n 98, 344; Scheffer (2009) cited in Buschke and Vanschoenwinkel, above n 66, 265; Rockström et al, above n 96, 472.
[101] Buschke and Vanschoenwinkel, above n 66, 265.
[102] Dickert and Tuttle, above n 12, 39.
[103] Emily S Darling and Isabelle M Côté, 'Quantifying the evidence for ecological synergies' (2008) 11 *Ecology Letters* 1278, 1283 – 1284.
[104] Darling and Côté, above n 103, 1284.
[105] Ibid.

about how synergistic impacts occur.[106] Further, Halpern and Fujita have commented that an increase in information about ecosystem response to stressors, including the thresholds[107] for nonlinear outcomes, would 'greatly improve' the accuracy of impact predictions.[108] The consequence of this lack of knowledge was also identified as a limitation for ensuring effective regulation and policy approaches to cumulative and synergistic impact assessment.[109]

Duinker and Greig commented that the approach to identifying types of cumulative effects, inclusive of synergistic and others, lends itself to the limitation of focusing on 'a special class of effect, when the critically important point is quite simply the need to assess the aggregate stresses'.[110] The argument focused on the tendency for confusion when definitions differ.[111] This argument emphasises the point that whilst definitions may be of use when devising methodology, it is the presence of consistent definitions within legal requirements that is important for effective cumulative and synergistic impact consideration and assessment.

Significant to this, there is concern about the neglect of stressor interactions when research and policy focus too much on significant single stressors. [112] The effect of such neglect could compromise the usefulness of scientific results.[113] It could be argued that the scientific basis for differentiation is important to the successful application of a legal environmental assessment framework. The basis for this is a potential risk of synergistic interactions being neglected if prescriptive language within legislative frameworks, or guiding language within policy documents, only use the term 'cumulative', and an ordinary meaning that concentrates on the 'addition'[114] of change across 'time and space' is applied within the context of legal interpretation. Bayden et al provide an example that emphasises that the application of effective policy on the amelioration of synergistic impacts within a local marine environment helps to decrease the impact of global pressures.[115] This in turn was suggested to provide local communities with an ability to respond to matters that can otherwise seem beyond their control, for example, climate change effects.[116]

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[106] Halpern and Fujita, above n 93, 5.
[107] Refer to glossary.
[108] Halpern and Fujita, above n 93, 8.
[109] Ibid.
[110] Duinker and Greig, above n 79, 157.
[111] Ibid.
[112] See, eg, Breitburg and Riedel, above n 45, 167.
[113] See, eg, Breitburg and Riedel, above n 45, 167.
[114] See, eg, Angus Stevenson (ed), *Oxford Dictionary of English* (Oxford University Press, 3rd ed, 2014) <http://www.oxfordreferenc.com.ezproxy.uow.edu.au/view/10.1093/...ef/9780199571123.001.0001/m_en_gb019790?rskey=niUP60&result=1> Cumulative: *adjective* 'increasing or increased in quantity, degree or force by successive additions'.
[115] Bayden D Russell et al, 'Synergistic effects of climate change and local stressors: CO_2 and nutrient –driven change in subtidal rocky habitats' (2009) 15 (9) *Global Change Biology*, 2153, 2159.
[116] Russell et al, above n 115, 2159.

The arguments provided for differentiating cumulative and synergistic impacts do not necessarily require a change in methodological or linguistic approach to using these terms. Instead, it should be acknowledged is that there is a need to define these terms separately within legislative and assessment frameworks. To do so will ensure appropriate use of assessment methodology. As an early example, Dixon and Montz discussed the implementation of New Zealand's legal requirements for CEA in the early 1990s and explained the distinction between additive (cumulative) and synergistic impacts.[117] They also acknowledged the challenges faced by decision makers by the requirements of the legislation when knowledge about the natural environment is limited, and that the nature of cumulative impacts and assessment methods are also complex.[118] More recently, Kelly et al stated that in developing and applying the Shetland Islands' Marine Spatial Plan, the Ecosystem-based Risk Assessment used applied to direct impacts only and assumed that the cumulative impacts were 'additive'.[119] The limitations of the model were identified by acknowledging that not all impacts would be direct and not all cumulative impacts would be 'additive'.[120] Contributing to this discussion, Clark et al suggested that the lack of knowledge about synergistic impacts means that 'the additive model remains the default option'.[121] These concerns suggest that in identifying synergistic impacts separately, there is a need to further develop assessment methods.

There are examples of reference to both cumulative and synergistic impacts within frameworks such as that of the EU Directives for environmental assessment.[122] Definitions for these terms, however, are only found in policy (e.g. *Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions*[123]) and application is not mandatory. This raises another issue, as the absence of distinct definitions could result in both insufficient clarity within the legal framework and limited capacity to develop appropriate guidance documents for the framework's application. An example of this is demonstrated within the case study analysis of Victoria's Port Phillip Bay Channel Deepening Project.[124]

Clarity in the definitions for cumulative and synergistic impacts can assist in the understanding of how they might best be considered separately within a legal framework. Considering the views that have been presented it is recommended that with differentiation any definition of

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[117] Dixon and Montz, above n 2, 445 - 446, 450, 453 – 454.
[118] Ibid, 445 – 456.
[119] Kelly et al, above n 80, 145.
[120] Ibid.
[121] Dana Clark et al, 'Validation and limitations of a cumulative impact model for an estuary' (2016) 120 *Ocean & Coastal Management* 88, 96.
[122] See, eg, *Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment*, [2001] OJ L 197/30, Annex 1.
[123] Hyder, above n 30, ii – iii.
[124] Refer to Chapter 6.

'cumulative' impacts should avoid encompassing interactions of a synergistic nature and instead focus on the characteristics associated with accumulation across space and time in a linear manner. The need for strong definitions are highlighted when the combination of impacts from both anthropogenic activities and environmental change also needs to occur; particularly within highly interactive and changeable environments such as the marine environment. Examples of these impact types within the marine environment are discussed below (section 6).

The argument for clear definitions is not just limited to the distinction between these impact types. Problems can also arise because inconsistent and inadequate approaches to defining and considering cumulative and synergistic impacts separately has the potential to undermine the efficacy of environmental assessment when inadequate legal requirements affect application within environmental assessment. These challenges have been perpetuated through the historical use and application of these terms, and they have significant implications for effective approaches to cumulative and synergistic impacts within environmental assessment.

5. The challenges associated with inadequate definitions in legal frameworks

This section further examines the concerns about inconsistencies between, and the inadequacies of, the cumulative and synergistic definitions. That the discussion focuses more on cumulative impacts is a reflection of the absence of similar discussion in the literature about synergistic impacts. The implications of these challenges for the effective application of legal frameworks is also examined.

5.1 The definition of cumulative impacts: An inconsistent and inadequate evolution

In the late 1980s Bedford and Preston emphasised that all environmental effects are cumulative in nature when connected temporally or spatially, and 'they can accumulate by 'additive', 'synergistic' or 'interactive' means''.[125] The use of the term 'nibbling', as an additional element of the definition, is discredited by Bedford and Preston on the basis that it should only be used as a synonym for 'additive'.[126] More recently this distinction has been supported by the Canadian Environmental Assessment Agency (CEAA), which discussed the term and provided

[125] Bedford and Preston, above n 2, 758.
[126] Ibid; Paul G Risser, 'General Concepts for Measuring Cumulative Impacts on Wetland Ecosystems' (1988) 12 (5) *Environmental Management* 585, 587 – 588; Risser (1988) cited in Bedford and Preston, above n 2, 758; Preston and Bedford, above n 14, 568; Preston and Bedford (1988) cited in Bedford and Preston, above n 2, 758.

an explanation of how cumulative effects occur.[127] It is noted, however, that this distinction was not made clear within the CEAA definition.[128]

In the mid-1980s, Dickert and Tuttle proposed a different definition from that of Bedford and Preston. They argued that 'interaction' is not a separate category and that the 'interaction' occurs in either an 'additive' or 'synergistic' manner, either directly or indirectly.[129] In 1991 Contant and Wiggins reviewed the definitions of Bedford and Preston, Dickert and Tuttle, as well as several other commentators from the 1980s, and in consolidating the approaches they identified cumulative impacts as including a number of the elements detailed above.[130] They endorsed the consolidated definition for cumulative impacts, previously provided by Contant. That being: 'Cumulative impacts are the result of additive and aggregative actions producing impacts that accumulate incrementally or synergistically over time and space.'[131]

The concern about the lack of clarity in definition has been an ongoing issue, with Contant and Wiggins having identified this in the mid-1980s. They noted problems when there is an absence of clear and consistent definition.[132] Further to the issues raised in the mid-1980s, Contant and Wiggins have commented that the concerns continued to be problematic several years later (i.e. 1991).[133] Within the literature, the weight of discussion and concern about an absence of common definition continued through the 1990s.[134] As an example of the contribution to the discussion at this time, Cocklin, Parker and Hay commented that the 'lack of development in the field of CEA was at first reflected in the absence of useful definitions and concepts'.[135]

The significant discussion within the field about the concerns caused by the variations in definition of cumulative impacts, as well as its application in environmental assessment, is also apparent within the literature published since 2000. This discourse includes commentators such as Thomas and Elliot, who showed that whilst the literature discussions about what is an acceptable approach have tended toward an absence of common definition (e.g. should the

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[127] Government of Canada, Canadian Environmental Assessment Agency *Cumulative Effects Assessment Practitioners' Guide,* 2.2.2 <https://www.ceaa-acee.gc.ca/default.asp?landg=EN&n=43952694-1&offset=6&toc=hide>.
[128] Government of Canada, Canadian Environmental Assessment Agency *Cumulative Effects Assessment Practitioners' Guide,* 2.2.2 <https://www.ceaa-acee.gc.ca/default.asp?landg=EN&n=43952694-1&offset=6&toc=hide>.
[129] Dickert and Tuttle, above n 12, 39.
[130] Contant and Wiggins, above n 2, 301 – 302; As examples of the 'other commentators' see Beanlands et al (1986) cited in Contant and Wiggins, above n 2, 301; Sonntag et al (1987) cited in Contant and Wiggins, above n 2, 301; Baskerville (1986) cited in Contant and Wiggins, above n 2, 301.
[131] Contant (1984) in Contant and Wiggins, above n 2, 302.
[132] Contant and Wiggins, above n 2, 298.
[133] Ibid.
[134] See, eg, Spaling and Smit, above n 3, 588; Cocklin, Parker and Hay, above n 37, 34.
[135] Cocklin, Parker and Hay, above n 37, 34.

definition and therefore its application include synergistic impacts?[136]), there appears to be a common conclusion that 'dynamic change' and 'holism' are integral elements.[137] A number of other commentators, such as Cooper and Sheate, and Glasson, Therivel and Chadwick, have provided similar comment.[138]

More recently, the discussion has been approached by Gunn and Noble, who concluded, after interviewing experts from within the fields of CEA and strategic environmental assessment (SEA), that the absence of definitional consensus is 'one of the most basic challenges'. [139] In an article by Seitz, Westbrook and Noble, the point previously raised by Cormier and Suter that inconsistency increased the complexity of methodological application unnecessarily, is made.[140] Seitz, Westbrook and Noble concluded their discussion by declaring that the variations are antagonistic to effective CEA.[141]

In 2013, Duinker et al reviewed the definition of 'cumulative effects' within CEA focused literature and made a number of key observations about CEA practitioners and CEA commentators.[142] These observations focused on situations where environmental assessment practitioners have a poor understanding of what is required to be assessed when the term 'cumulative impacts' is used. [143] The concern about the level of understanding was discussed alongside reliance upon legislation and guidelines for definitions, even when those definitions may be inadequate.[144] Of the journal articles discussing the cumulative impact definition, Duinker et al found that there was a tendency by authors to repeat definitions previously proposed. [145] Duinker et al suggested that this may be because either the earlier definitions are adequate or that there is a resistance toward a discourse that seeks to evolve the definitions.[146] Commenting further, Duinker et al suggest that reluctance to improve these definitions through

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[136] Ian Thomas and Mandy Elliot, *Environmental Impact Assessment in Australia: theory and practice* (The Federation Press, 4th ed, 2005) 47- 49; Erikson (1994) cited in Thomas and Elliot at 47- 48; R Buckley, 'Cumulative environmental impacts' in Alan J Porter and John J Fittipaldi (eds), *Environmental Methods Review: Retooling Impact Assessment for the New Century*, (The Press Club, 1998) 95, 97; R Buckley (1998) cited in Thomas and Elliot at 47- 48, ; E Vlachos (1985) cited in Thomas and Elliot at 47- 49.
[137] Thomas and Elliot, above n 136, 47- 49; Erikson (1994) cited in Thomas and Elliot, above n 136, 47- 48; Buckley, above n 136, 95; Buckley (1998) cited Thomas and Elliot, above n 136, 47- 48; E Vlachos (1985) cited in Thomas and Elliot, above n 136, 47- 49.
[138] Cooper and Sheate, above n 3, 416, 422 - 423; John Glasson, Riki Therivel and Andrew Chadwick, *Introduction to Environmental Impact Assessment,* (Routledge, 3rd ed, 2005) 325 - 326.
[139] Jill Gunn and Bram F Noble, 'Conceptual and methodological challenges to integrating SEA and cumulative effects assessment' (2011) 31 *Environmental Impact Assessment Review* 154, 156.
[140] Nicole E Seitz, Cherie J Westbrook and Bram F Noble, 'Bringing science into river systems cumulative effects assessment practice' (2011) 31 *Environmental Impact Assessment Review* 172, 174; Susan M Cormier and Glenn W Suter II, 'A Framework for Fully Integrating Environmental Assessment' (2008) 42 *Environmental Management* 543, 543 -556. It is noted that Cormier and Suter did not specifically refer to CIA but environmental assessment in general.
[141] Seitz, Westbrook and Noble, above n 140, 174.
[142] Duinker et al, above n 2, 42.
[143] Ibid.
[144] Ibid.
[145] Ibid.
[146] Ibid.

change and debate is of concern due to the likelihood that earlier definitions are inadequate.[147] Other observations included when alternative definitions are offered, the contribution to the discourse should be considered valuable; and that concern that there is no 'universal' definition despite wide agreement. Hence, Duinker concluded that the comment by Gunn and Noble (discussed above) surrounding the challenge of achieving this[148] was still valid.[149] Based on these observations, Duinker et al argued that continuing to rely on short definitions did not assist with defining the objectives being sought within CIA.[150] Instead, a 'detailed conceptual analysis' was considered more appropriate.[151]

Providing more detail in definitions was also seen as a necessary evolution for effective CIA. Duinker et al identified that single sentence definitions are inadequate direction for assessment and recommended that consideration be given to what it is that causes effects to be cumulative.[152] This notion is important to clarify, because a lack of clarity surrounding a cumulative impact definition can have implications for the effective application of legal frameworks, and legislation will often rely on simple definitions. Further, although there is an absence of similar literature discussion on synergistic impacts, it is also important to consider the challenges that relate to synergistic impacts. The next section considers whether the concerns raised within the environmental assessment focused discussion are also apparent within legislative frameworks, and if so, what may be the implications.

5.2 The implications of inadequate definitions: Legal frameworks

When definitions associated with legal requirements are ambiguous, the effective application of those requirements can be more difficult to achieve. The discussion within the literature also provides examples, since the 1980s, of the challenges caused by inadequate definitions within legal frameworks.

In 1994 a report on CIA within SEA[153] and EIA[154] was prepared for Australia's Commonwealth Environment Protection Agency by Court, Wright and Guthrie.[155] The report focused on the reasons for poor implementation of CIA as a tool for achieving ecologically sustainable

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147 Ibid.
148 Gunn and Noble, above n 139, 156.
149 Duinker et al, above n 2, 42.
150 Ibid.
151 Ibid.
152 Ibid, 49.
153 Refer to glossary.
154 Refer to glossary.
155 Court, Wright and Guthrie, above n 13, 4.4.

development within Australia, and demonstrated that the wide ambit of definition, and lack of consensus surrounding a consistent definition, were the main factors for poor implementation.[156] Fallon and Krikowen also discussed the inadequate definition for 'cumulative' impact in Australian policy and law. The focus of this discussion was the absence of definition provided for the term, despite its use in the *Protocol on Environmental Protection to the Antarctic Treaty, 1991* (Madrid Protocol), and Australian legislation such as the *Antarctic Treaty (Environment Protection) Act 1980* (Cth).[157] The concerns raised about the absence of definition included a lack of clarity about whether additional activities (e.g. external factors) could be assessed as a cumulative impact, and inadequate direction as to how these types of impacts should be assessed.[158] Fallon and Krikowen stop short of providing specific recommendations as to what should be an appropriate definition.

The absence of clear definition for 'cumulative' impacts was identified within the interim report of the independent review of the Commonwealth Government's *Environment Protection Biodiversity Conservation Act 1999.*[159] That this was evident in the public submissions, submitted for the purpose of the review, was also commented on as a concern.[160] The concerns raised within the interim report were not, however, reiterated in the final *Report of the Independent Review of the Environment Protection and Biodiversity Conservation Act 1999* (EPBC Review).[161]

It is evident from these examples that there is concern about the extent of variation within the definitions. The lack of clarity and inconsistencies cause problems in the application of legislation. These concerns are also relevant to Duinker's observations (see above) about continued reliance, by those assessing environmental impacts, on inadequate definitions provided within legal frameworks.

The commentary within the literature has followed the variations between definitions found in the regulatory frameworks of different jurisdictions.[162] As a topic, however, this seems to have had less attention; possibly due to an expectation that different jurisdictions will have different

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[156] Ibid.
[157] Liza D Fallon and Lorne K Kriwoken, 'Environmental Impact Assessment under the Protocol on Environment Protection to the Antarctic Treaty and Australian Legislation' (2005) 2 *Macquarie Journal of International and Comparative Environmental Law* 67, 69, 80, 82, 96, 97, 101.
[158] Fallon and Krikowen, above n 157, 82, 96; T J Ensminger, L N McCold and J W Webb (1999) cited in Fallon and Krikowen, above n 157, 101.
[159] Australian Government Department of the Environment Water Heritage and the Arts, *Independent Review of the Environment Protection and Biodiversity Conservation Act 1999 (Cth): Interim Report* (Commonwealth of Australia, 2009), [4.241] <https:www.environment.gov.au/epbc/review>.
[160] Australian Government Department of the Environment Water Heritage and the Arts, above n 159, [4.241].
[161] Allan Hawke, *The Australian Environment Act - Report of the Independent Review of the Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth of Australia, 2009).
[162] See, eg, Cocklin, Parker and Hay, above n 37, 34; Court, Wright and Guthrie, above n 13, 5.10 - 5.14.

needs. Instead, the discussion emphasises the lack of clarity within individual regulatory frameworks. As an example, Cooper and Sheate identified that a number of different definitions were used for different project assessments undertaken in accordance with UK legislative procedures for EIA.[163] The concern about this was that processes used to achieve outcomes were inconsistent in the use of definitions, even though the processes were regulated by the same legislative framework.[164] An argument for overcoming inconsistencies within regulatory frameworks is that the different needs of different jurisdictions should be reviewed and compared against the examples provided within other jurisdictions.[165] It is also important to consider the likelihood that approaches differ because of different legal jurisdiction requirements and definitions, as well as differing political, social, economic and environmental needs and ideals.

The examples discussed above emphasise the need for clarity within legal framework definitions for cumulative impacts. As discussed in section 2.2, the effective assessment of these impact types can be compromised when definitions are ambiguous. The judicial interpretation of any legal requirements or definitions may improve clarity, yet to enable effective and consistent implementation of any such interpretation, it is recommended that legislative requirements be amended to reflect the standard and ensure consistent application.

Although not discussed in the literature, the same concerns could be applied to the need for clarity when defining synergistic impacts. Given the complexity of impact interactions resulting in cumulative and synergistic impacts, poor assessments can result from inadequate direction as to what it is that needs to be assessed. Further, there is a risk that synergistic impacts will be neglected when these impact types are not defined separately. The way in which cumulative and synergistic impacts affect the marine environment is addressed in the next section.

6. Cumulative and synergistic impacts within the marine environment

The sources of cumulative and synergistic impacts, as discussed in Chapter 1, can be related to both anthropogenic activities and environmental change.[166] This section addresses the second

[163] Cooper and Sheate, above n 3, 416.
[164] Ibid, 433; this was also discussed by Gunn and Noble, above n 139, 156.
[165] For an example of this approach, see, eg, Australian Government Department of the Environment Water Heritage and the Arts, above n 159, [2.78].
[166] See, eg, K R N Anthony et al, *A framework for understanding cumulative impacts, supporting environmental decisions and informing resilience-based management of the Great Barrier Reef World Heritage Area: Final Report to the Great Barrier Reef Marine Park Authority and Department of the Environment* (Great Barrier Reef Marine Park Authority, 2013), 18 <http://www.environment.gov.au/resource/framework-understanding-cumulative-impacts-supporting-environmental-decisions-and-informing>; Great Barrier Reef Marine Park Authority, above n 3, 10-3;

aim of this chapter and examines the importance of identifying and increasing knowledge about cumulative and synergistic impacts within the marine environment. The need to consider the influence of environmental change[167] as well as anthropogenic activities[168] when assessing cumulative and synergistic impacts is also discussed. Examples are presented of cumulative and synergistic impacts caused by anthropogenic activities. These examples are derived from various scientific literature sources (summarised in Table 2-1). Finally, to demonstrate the impact of environmental change, and as an example of a stressor within the marine environment, the cumulative and synergistic impacts associated with climate change are discussed.

Identifying and assessing cumulative and synergistic impacts separately may increase understanding of the number and diversity of potential interactions occurring within the marine environment between a proposed or existing anthropogenic activity, other nearby activities in the marine environment, and environmental change.[169] When anthropogenic activities cause cumulative and synergistic interactions, the impacts can cause changes within the marine environment's natural systems and level of biodiversity.[170] As mentioned in Chapter 1, examples of anthropogenic activities include fishing, development (such as, offshore energy infrastructure), and navigation. Examples of detrimental changes that can occur within the marine environment as a result of these human influences include: a reduction in biological diversity; habitat destruction, alteration and/or fragmentation; changes to food sources; an increase in nutrient loads leading to eutrophication; changes to resource provisions; and the establishment of invasive species.[171] These changes can be due to over utilisation of the marine environment's natural resources and the intentional and unintentional input of pollution.[172] Aside from being caused by direct impacts, environmental change can also occur as a result of natural variability (e.g. seasonal and/or salinity variations),[173] anthropogenic activity impacts

Clive Wilkinson and Bernard Salvat, 'Coastal resource degradation in the tropics: Does the tragedy of the commons apply for coral reefs, mangrove forests and seagrass beds' (2012) 64 *Marine Pollution Bulletin* 1096, 1097; Monique G Dubé, Cumulative effect assessment in Canada: a regional framework for aquatic ecosystems, Environmental Impact Assessment Review 23 (2003) 723 – 745, 724.

167 Refer to glossary.

168 Refer to glossary.

169 See, eg, Harriman and Noble, above n 79, 27; Jeremy B C Jackson, 'Ecological extinction and evolution in the brave new ocean' (2008) 105 (Suppl. 1) *Proceedings of the National Academy of Sciences* 11458, 11464 <http//:www.pnas.org/cgi/doi/10/1073/pnas.0802812105>.

170 See, eg, Sala and Knowlton, above n 86, 101, 110; Eric Goberville et al, 'Climate-driven changes in coastal marine systems of western Europe' (2010) 408 *Marine Ecology Progress Series* 129, 129 – 130.

171 See, eg, Halpern et al, above n 3, 203; Lotze and Milewski (2002) cited in Heike K Lotze and Boris Worm, 'Complex interactions of Climatic and Ecological Controls of macroalgal recruitment' (2002) 47(6) *Limnology and Oceanography* 1734, 1734; Sala and Knowlton, above n 86, 110.

172 Darling and Côté, above n 103, 1278.

173 See, eg, Thomas H Suchanek, 'Oil Impacts on Marine Invertebrate Populations and Communities' (1993) 33 (6) *American Zoologist* 510, 516.

that have less of a nexus, such as indirect impacts (e.g. climate change),[174] and changes to species abundance (e.g. species migration).[175]

Negative cumulative and synergistic impacts occurring within oceans have been attributed as responsible for large-scale marine environmental change and ecosystem failures.[176] Research has demonstrated that the ocean areas where cumulative impacts are predicted to be concentrated include the continental shelf and slope,[177] with the effects in coastal and coral reef areas considered greater than in other ocean areas.[178] Knowledge about cumulative and synergistic impacts has the potential to assist with marine environmental protection.[179] Whereby an increased understanding can facilitate management strategies that respond to the needs of a particular habitat, species or ecosystem, at the same time as providing guidance for mitigating or removing stressors impacts.[180]

The causes of cumulative and synergistic impacts are not only direct, but can also be indirect.[181] Darling and Côté point out that whilst it can be relatively easy to predict 'additive' cumulative impacts, there is significant uncertainty surrounding synergistic impacts.[182] This makes it more difficult to predict environmental change.[183] Pavlickova and Vyskupova also raise concern about accurately predicting cumulative impacts because of 'the uncertainty of their future evolution.'[184]

Ecosystems have complex structures and scale, and are fundamentally adaptive and resilient.[185] This knowledge is essential to acknowledge within environmental assessment. Therefore,

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174 See, eg, T P Hughes et al, 'Climate Change, Human Impacts, and the Resilience of Coral Reefs' (2003) 301 *Science* 929, 930.

175 See, eg, National Research Council, above n 84, 25, 59; Amélie Lescoröl et al, 'Seeing the ocean through the eyes of seabirds: A new path for marine conservation?' (2016) 68 *Marine Policy* 212, 213; Paul Adam, 'Ecological Communities – The context for biodiversity conservation or a source of confusion?' (2009) 13 (1) *The Australasian Journal of Natural Resources Law and Policy* 7, 17.

176 See, eg, National Research Council, above n 84, 25, 34; A D Rogers and D d'A Laffoley, *International Earth System expert workshop on ocean stresses and impacts* (IPSO Oxford, 2011) 8 – 9; Jackson, above n 169, 11458. It is noted that the attribution to ecosystem failure is a 'possibility' as opposed to a known fact.

177 Benjamin S Halpern et al, 'A Global Map of Human Impact on Marine Ecosystems', (2008) 319 *Science* 948, 949.

178 Jackson, above n 169, 11458.

179 See, eg, Rhian E Jenkins, Raymond D H Brown, Michael R Phillips, 'Harbour porpoise (Phocoena phocoena) conservation management: A dimensional approach' (2009) 33 *Marine Policy* 744, 744; Richard Curtin and Raúl Prellezo, 'Understanding marine ecosystem based management: A literature review', (2010) 34 *Marine Policy* 821, 821; Robert O'Boyle and Glen Jamieson, 'Observations on the implementation of ecosystem-based management: Experiences on Canada's east and west coasts' (2006) 79 Fisheries Research 1,1.

180 See, eg, Laura J Falkenberg, Sean D Connell and Bayden D Russell, 'Disrupting the effects of synergies between stressors: improved water quality dampens the effects of future CO_2 on a marine habitat' (2013) 50 *Journal of Applied Ecology* 51, 52; Elizabeth R Selig et al, 'Global Priorities for Marine Biodiversity Conservation' (2014) 9(1) *PloS One*: e82898, 9 <http://doi:10.1371/journal.pone.0082898>.

181 See, eg, Franks, Brereton and Moran, above n 2, 300; Harriman and Noble, above n 79, 35; Dickert and Tuttle, above n 12, 39.

182 Darling and Côté, above n 103, 1284.

183 Ibid.

184 Pavlickova and Vyskupova, above n 42, 75.

185 See, eg, Folke et al, above n 73, 558 - 559.

improving the understanding of cumulative and synergistic interactions can increase knowledge about adaptive capacity and resilience.[186] This knowledge could be used to assist the maintenance of resilience and improve marine environmental protection.[187] This is particularly important for understanding nonlinear responses within the natural environment.[188]

The concern and need for further knowledge development is evident in the literature. For example, Rockström et al discuss that there are 'Earth-system processes and associated thresholds which, if crossed, could generate unacceptable environmental change'.[189] The related Earth-system processes and thresholds for the marine environment include climate change, ocean acidification, pollution, loss of biodiversity, and changes to the phosphorous and nitrogen cycles.[190] Further, when biodiversity and the phosphorous and nitrogen cycles are detrimentally impacted the health and resilience of marine ecosystems can be diminished.[191] These factors affect an ecosystem's ability to recover when environmental changes occur, such as ocean acidity and climate change.[192]

The management of cumulative change within environments is important for understanding resilience and avoiding 'state shifts' within ecosystems.[193] When non-significant disturbances occur within environments, 'repeated recovery can give a false impression of resilience, masking the fact that the system may actually be approaching a tipping point for a systemic shift'.[194] Foden, Rogers and Jones emphasise the importance of assuming that synergistic impacts will lower resilience to future impacts when undertaking environmental assessment.[195] Therefore, it is important to consider cumulative and synergistic impacts before their magnitude becomes 'significant'[196] or before the tipping point is reached. In addition, although the complexities of ecosystem thresholds and limited knowledge about cumulative and synergistic impacts are acknowledged, the practical application of CIA modelling is still considered inadequate to account for both of these impact types.[197] Developing modelling in combination with threshold identification is critical for the marine environmental management of cumulative

[186] See, eg, Folke et al, above n 73, 573; Also see the discussion surrounding Folke et al in Curtin and Prellezo, above n 179, 822; Great Barrier Reef Marine Park Authority, above n 3, 10-6; Ban, Alidina and Ardron, above n 3, 883.
[187] See, eg, Great Barrier Reef Marine Park Authority, above n 3, 10-3: Anthony et al, above n 166, 16 – 17; Falkenberg, Connell and Russell, above n 180, 56; Folke et al, above n 73, 575; Jo Foden, Stuart I Rogers and Andrew P Jones, 'Recovery of UK seabed habitats from benthic fishing and aggregate extraction – towards a cumulative impact assessment' (2010) 411 *Marine Ecology Progress Series* 259, 260.
[188] See, eg, Cocklin, Parker and Hay, above n 37, 36.
[189] Rockström et al, above n 96, 472.
[190] Ibid.
[191] Ibid, 474.
[192] See, eg, Rockström et al, above n 96, 474.
[193] Scheffer et al (2001), above n 98, 595, 596.
[194] Scheffer et al (2012), above n 98, 345.
[195] Foden, Rogers and Jones, above n 187, 263.
[196] Refer to Chapters 4 and 5 for more discussion on the distinction between significant and 'indirect'.
[197] See, eg, Clark et al, above n 121, 96; Batista et al, above n 51, 248; Halpern and Fujita, above n 93, 5, 8.

impacts.[198]

In the previous sections the discussion highlighted that, in considering environmental impacts, knowing about cumulative and synergistic impact interactions enables better identification of detrimental impacts and the possibility of removing one stressor and increasing the potential for positive ecosystem responses. This is particularly important in instances where the ecosystem has not already been altered beyond a point of return.[199] This knowledge would also provide a better understanding of ways in which to avoid tipping points (regime shifts).[200]An example of this that acknowledges the importance of identifying these impact types separately is demonstrated within the report *A Marine Nation: National Framework for Marine Research and Innovation*. This policy document emphasises that the pressures on Australia's marine environment, from both cumulative and synergistic impacts, can cause marine environmental protection thresholds to be breached if there is a lack of understanding about the interaction between use and development pressures, and the changes they cause within ecosystems.[201]

It is noted here that the cumulative impact definition elements identified by Contant and Wiggins (discussed above in section 2.1) and the response of natural systems are also relevant to synergistic impacts.[202] Contant and Wiggins emphasised scientists' concerns that within the context of the natural environment, 'additive' impacts are not the only form of cumulative impacts that occur. [203] Similarly they discuss that 'effects that exceed a system's ability to recover, are unanticipated, cause structural changes within the system, or occur interactively across several systems are included as part of this category of impacts.'[204] Further, Contant and Wiggins,[205] and Sonntag et al,[206] discussed the capacity for cumulative ('additive') and synergistic impacts to influence environmental change to the point that a threshold is breached and irreparable changes occur. These impacts have been identified as 'discontinuous'.[207]

The next part of this section provides examples of cumulative and synergistic impacts that can occur as a result of anthropogenic activities. The examples enable a better understanding, for the

[198] Jesper H Anderson et al, 'Baltic Sea biodiversity status vs. cumulative human pressures' (2015) 161 *Estuarine, Coastal and Shelf Science* 88, 90 – 91.
[199] See, eg, Great Barrier Reef Marine Park Authority, above n 3, 10-3; Crain et al, above n 79, 52 – 53.
[200] See, eg, Folke et al, above n 73, 575.
[201] Oceans Policy Science Advisory Group/Marine Science Steering Committee, *A Marine Nation: National Framework for Marine Research and Innovation* (Australian Government, 2009), 10 <https://www.imos.org.au/fileadmin/user_upload/shared/IMOS%General/documents/external_reports/opsag-marine-nation-01.pdf>
[202] Contant and Wiggins, above n 2, 302.
[203] Ibid, 303.
[204] Ibid.
[205] Ibid.
[206] Sonntag et al (1987) cited in Contant and Wiggins, above n 2, 301.
[207] Ibid; Contant and Wiggins, above n 2, 303.

purpose of discussion throughout this thesis, of the detriment that can be caused in the marine environment.

6.1 Anthropogenic activities

The potential impacts on the marine environment from different uses and associated development are numerous. Table 2-1 provides some examples of cumulative and synergistic impacts that can occur as a result of anthropogenic activities. The different activity impacts can interact to cause cumulative and/or synergistic impacts. Table 2-1 is not an exhaustive list of examples. This is because of the multitude of impacts that can influence ecosystems and species, the uncertainty about the understanding of linear and nonlinear impacts, and the potential for different outcomes within different environments and impacts.

Table 2-1: Examples of marine anthropogenic activities that cause cumulative and synergistic impacts

Activity	Example
Commercial shipping	**Hull anti-fouling** – the use of chemicals containing zinc compounds to replace Tributilytin (TBT) have been shown to cause synergistic interactions when interacting with increasing environmental levels of copper.[208] This raises concerns about the detrimental impacts on water quality and marine species from toxins.[209] **Animal collisions –** accumulation of direct impacts (boat strike) with individuals of various species leading to injury and mortality.[210] **Noise pollution**[211] - concern for marine animals with shipping noise causing disturbance, potential stress and avoidance

[208] See, eg, Vivien W W Bao et al, 'Synergistic toxic effects of zinc pyrithione and copper to three marine species: implications on setting appropriate water quality criteria' (2008) 57 *Marine Pollution Bulletin* 616, 616.
[209] See, eg, Bao et al, above n 208, 616.
[210] See, eg, Benjamin S Halpern et al, Supporting Online Material for 'A Global Map of Human Impact on Marine Ecosystems' (2008) 319 *Science*, SOM 7 <https://www.sciencemag.org/cgi/comtent/full/319/5865/948/DC1>.
[211] See, eg, Halpern et al, above n 210, 7; Matthew K Pine, Andrew G Jeffs and Craig A Radford, 'The cumulative effect on sound levels from multiple underwater anthropogenic sound sources in shallow coastal waters' (2014) 51 *Journal of Applied Ecology* 23, 26.

	behaviour.[212] These impacts can be both cumulative and synergistic. **Habitat damage** - arising from ship sinkings and groundings,[213] and oil spills from shipping accidents.[214] **Pollution discharge** – for example, waste and CO_2 emissions from bunker fuels (oil spills and anti-fouling paints can also be included here). [215] Impacts from pollution discharge are typically concentrated within ports and high-traffic shipping lanes.[216] **Dredging** – cumulative impacts from the repeated dredging of shipping channels and berths can detrimentally impact on benthic habitats, such as seagrass beds, and the associated benthic species.[217]
Invasive species	Non-native species can be relocated to foreign environments via ships' ballast water (and its subsequent release), vessel biofouling, or marine debris.[218] The chance of successful invasion by these species can increase where human activities cause environmental change (e.g. climate change, dredging, and infrastructure installation).[219] The long term modification of a

[212] L S Weilgart, 'The impacts of anthropogenic ocean noise on cetaceans and implications for management' (2007) 85 (11) *Canadian Journal of Zoology* 1091, 1105 – 1106; Andrew J Wright and Line A Kyhn, 'Practical management of cumulative anthropogenic impacts with working marine examples' (2014) 29 (2) *Conservation Biology* 333, 334 – 335.
[213] See, eg, Halpern et al, above n 210, 7.
[214] See, eg, F Sánchez et al, 'Monitoring the *Prestige* oil spill impacts on some key species of the Northern Iberian Shelf' (2006) 53 *Marine Pollution Bulletin* 332, 333, 340.
[215] See, eg, Xiongzhi, Huasheng and Charles, above n 69, 277; Halpern et al, above n 210, 10.
[216] See, eg, Xiongzhi, Huasheng and Charles, above n 69, 277; Halpern et al, above n 210, 10.
[217] See, eg, Xiongzhi, Huasheng, and Charles, above n 69, 276; Paul L A Erftemeijer and Roy R Robin Lewis III, 'Environmental impacts of dredging on seagrasses: A review' (2006) 52 *Marine Pollution Bulletin* (2006) 1553, 1559; Humood A Naser, 'The role of environmental impact assessment in protecting coastal and marine environments in rapidly developing islands: The case of Bahrain, Arabian Gulf' (2015) 104 *Ocean & Coastal Management* 159, 164.
[218] See, eg, Sala and Knowlton, above n 86, 105; Halpern et al, above n 210, 8.
[219] See, eg, Sala and Knowlton, above n 86, 107; Nicholas Bax et al, 'Marine invasive alien species: A threat to global biodiversity' (2003) 27 *Marine Policy* 313, 316 – 317.

	habitat by invasive species is also a potential cause of environmental change.[220]
Commercial fisheries	**Overfishing**[221] and **detrimental fishing methods**[222] **-** impacts to benthic and pelagic areas from such practices can have cumulative consequences through negative impacts on biodiversity, particularly when combined with changes in natural environmental conditions. [223] The extent of cumulative impact on benthic habitat and species can vary due to fishing methods and gear types. For example, trawling has been shown to correlate with an increased cumulative impact.[224] The number of fisheries and intensity of fishing activity can also cause cumulative impacts within a region.[225] When combined with the effects of climate change on fishery populations, there is a potential for interactions with anthropogenic activities to result in synergistic impacts.[226] **Coastal structures** – the cumulative impact of such infrastructure on fish stocks can result in diminished fish recruitment and nursery habitat, particularly in relation to changes to nursery habitat.[227] **Climate change -** examples of synergistic effects that have a significant impact on biodiversity levels include the combination of fish species, such as anchovy and sardine, and climate change.[228]

[220] See, eg, Sala and Knowlton, above n 86, 109.
[221] See, eg, Halpern et al, above n 3, 206; Cathryn Clarke Murray et al, 'Advancing marine cumulative effects mapping: An update in Canada's Pacific waters' (2015) 58 *Marine Policy* 71, 76.
[222] See, eg, Halpern et al, above n 210, 3 – 4.
[223] See, eg, J G Hiddink et al, 'Cumulative impacts of seabed trawl disturbance on benthic biomass, production, and species richness in different habitats' (2006) 63 *Canadian Journal of Fisheries Aquatic Sciences* 721, 722, 730 – 733.
[224] See, eg, Agbayani, Picco and Alidina, above n 91, 428, 430 – 431.
[225] See, eg, Agbayani, Picco and Alidina, above n 91, 428.
[226] See, eg, Tony J Pitcher and William W L Cheung, 'Fisheries: Hope or despair?' (2013) 74 *Marine Pollution Bulletin* 506, 514.
[227] See, eg, Halpern et al, above n 3, 206.
[228] See, eg, Sala and Knowlton, above n 86, 108.

	Evaluation of research in areas such as the North Sea identify that significant ecosystem changes due to the impacts of overfishing and climate change impacts, are likely to be synergistic in nature.[229] Coral reef erosion is also identified as a potential synergistic impact resulting from the influence of climate change.[230]
Mariculture/aquaculture	Potential cumulative impacts include: 'benthic habitat fragmentation', alterations to essential nutrient and chemical element levels within the water; detrimental impacts from 'acoustic deterrent devices' ('noise'); and habitats perturbation.[231] Concern also exists about the impact of disease and its transmission beyond aquaculture operations into the wider marine environment.[232] The operation of multiple sites of both the same and different species within an area can also add to cumulative and synergistic pressures.[233] The use of 'acoustic deterrent devices' (noise) impacts on marine mammals and birds in ways that include causing distress, avoidance behaviour, pain and damage to hearing.[234] At a general level, it is considered that the longer the period of operation of aquaculture/ mariculture facilities, the greater the cumulative impact on the environment.[235] In addition, other impacts from activities and environmental change can influence the cumulative and synergistic impacts of these operations.[236] It is noted that additional stressors such as climate change require

[229] See, eg, Richard R Kirby, Gregory Beaugrand and John A. Lindley, 'Synergistic Effects of Climate and Fishing in a Marine Ecosystem' (2009) 12 *Ecosystems* 548, 548, 556 – 558.
[230] See, eg, Mebrahtu Ateweberhan et al, 'Climate change impacts on coral reefs: Synergies with local effects, possibilities for acclimation, and management implications' (2013) 74 *Marine Pollution Bulletin* 526, 529, 535.
[231] See, eg, Sarah C King and Ronald Pushchak, 'Incorporating cumulative effects into environmental assessments of mariculture: Limitations and failures of current siting methods' (2008) 28 (8) *Environmental Impact Assessment Review* 572, 573.
[232] See, eg, King and Pushchak, above n 231, 573.
[233] See, eg, Buschmann et al, above n 69, 244.
[234] See, eg, King and Pushchak, above n 231, 580; V J Taylor, D W Johnston and W C Verboom (1997) in King and Pushchak, above n 231, 580.
[235] See, eg, King and Pushchak, above n 231, 579.
[236] Ibid, 578.

	further consideration in the context of the cumulative and synergistic impacts caused by mariculture operations.[237]
Pollution	Pollution within the marine environment can be attributed to either land or marine sources, such as commercial fishing, tourism and shipping vessels, recreational vessels, offshore energy facilities, storm water and sewerage outfalls, and agricultural. Impacts include: • Substantial cumulative anthropogenic impacts from either land sources or atmospheric pollution. [238] • The potential for both cumulative and synergistic impacts on the health of mammals. For example, killer whales/ dolphins, due to interactions between exhaust pollution from tourist vessels and organic pollutants already within the marine environment.[239] • A decrease in marine sediment quality because of pollution accumulation. This in turn impacts on benthic species and ecosystems. [240] • Contaminated sediment dumped within the marine environment can release pollution into waters.[241] • Noise pollution from multiple underwater sources, such as shipping, have the potential to create a cumulative impact.[242] • Pollution impacts such as toxins and nutrients cause detriment to coral reef and mangrove systems.[243] However, knowledge about the synergistic effects of certain nutrients combined with pollutants is considered limited.[244]

[237] Ibid, 584.
[238] See, eg, Caroline Williams, 'Combating Marine Pollution from land-based activities: Australian initiatives' (1996) 33 (1 -3) *Ocean and Coastal Management* 87, 88 – 89.
[239] See, eg, Cara L Lacmuth et al, 'Estimation of southern killer whale exposure to exhaust emissions from whale-watching vessels and potential adverse health effects and toxicity thresholds' (2011) 62 *Marine Pollution Bulletin* 792, 794, 802.
[240] See, eg, Xiongzhi, Huasheng and Charles, above n 69, 277 – 278.
[241] Ibid, 277.
[242] See, eg, Pine, Jeffs and Radford, above n 211, 26.
[243] See, eg, Britta Schaffelke, Jane Mellors and Norman C Duke, 'Water quality in the Great Barrier Reef region: responses of mangroves, seagrass and macro algal communities' (2005) 51 *Marine Pollution Bulletin* 279, 279.
[244] See, eg, Schaffelke, Mellors and Duke, above n 243, 291.

	• As synergistic and cumulative impacts can lead to unacceptable pollution levels, the release of different pollutants into the marine environment, as well the different source points needs to be addressed.[245]
Offshore petroleum & carbon geosequestration	**Infrastructure installation** – cumulative habitat and sea floor destruction through the installation of petroleum rigs and associated structures (e.g. pipelines),[246] as well as pollution from discharges and accidents.[247] Combined with oil, the use of dispersants to combat oil spills has a synergistic impact on zooplankton (e.g. *Brachionus plicatilis*).[248] **Exploration -** can cause significant disturbance and damage with offshore drilling and seismic survey activities. [249] For example, noise from seismic surveys and shipping have shown cumulative and synergistic effects on cetaceans, particularly where these activities have occurred on multiple occasions.[250] **Oil & gas –** the impact of oil (e.g. crude and bunker), can vary because of the synergistic effects that result from environmental variability in habitats combining with different stressors.[251] The cumulative and synergistic impacts of oil can differ due to variations in sediment loads and geographical location, as well as natural environmental variability and

[245] See, eg, A Preston and P C Wood, 'Monitoring the Marine Environment' (1971) 177 *Proceedings of the Royal Society of London B: Biological Sciences* 451, 456 – 457.
[246] See, eg, Halpern et al, above n 210, 7; Riki Therivel and Bill Ross, 'Cumulative effects assessment: Does scale matter?' (2007) 27 *Environmental Impact Assessment Review* 365, 381; Peter Wulf, 'Offshore Petroleum and the Environment Protection and Biodiversity Conservation Act 1999 (Cth): Consideration of all adverse impacts', (2005) 22 *Environmental and Planning Law Journal* 296, 309 – 313.
[247]See, eg, Therivel and Ross, above n 246, 381; Patrick D O'Hara and Lora A Morandin, 'Effects of sheens associated with offshore oil and gas development on microstructure of pelagic seabirds' (2010) 60 *Marine Pollution Bulletin* 672, 672; I Schifter et al, 'Long-term effects of discharges of produced water the marine environment from petroleum-related activities at Sonda de Campeche, Gulf of Mexico' (2015) 187 *Environmental Monitoring and Assessment* 723, 743; Wulf, above n 246, 309 – 313.
[248] Roberto Rico-Martínez, Terry W Snell and Tonya L Shearer, 'Synergistic toxicity of Macondo crude oil and dispersant Corexit 9500A® to the Brachionus plicatilis species complex (Rotifera)' (2013) 173 *Environmental Pollution* 5, 7 – 8.
[249]See, eg, Therivel and Ross, above n 246, 381; Courtney Fidler and Bram Noble, 'Advancing strategic environmental assessment in the offshore oil and gas sector: Lessons from Norway, Canada, and the United Kingdom, (2012) 34 *Environmental Impact Assessment Review* 12, 16.
[250] Weilgart, above n 212, 1105 – 1106.
[251] Ocean Affairs Board National Research Council, 'Petroleum in the Marine Environment' (1975) 56 (1) *Bulletin of the Ecological Society of America,* 4, 6.

seasonal variability.[252] Variations in salinity is also said to be influential.[253]

Research shows that the use of chemicals, (such as diethyline glycol) within offshore processing has the potential to cause cumulative and synergistic impacts within the marine environment. This is particularly relevant when used within 'discharged produced waters'.[254]

Carbon geosequestration - consideration also needs to be given to the potential utilisation of petroleum reservoirs when they are no longer utilised for extraction. Technology now allows these reservoirs to be used for carbon geosequestration. The impacts associated with facilitating geosequestration are associated with pipeline installation and the potential impacts from the storage itself include carbon dioxide (CO_2) leakage into the surrounding environment or into nearby geological formations. [255] This has the potential to contaminate adjacent petroleum deposits or waters,[256] and subsequently cause cumulative or synergistic impacts.

Table 2-1 represents only a few of the known examples of cumulative and synergistic impacts. Many of these examples have not been fully investigated. When considering the examples, not only should the effect of impacts from a particular activity be addressed, but also the combined effect of impacts from multiple anthropogenic activities. For example, Marcotte, Hung and Caquard examined the multiple sources for cumulative impacts on the Indo-Pacific humpback dolphins (*Sousa chinensis*) concluding that land reclamation, dredging, vessel movement, pile driving, and boring all caused cumulative impacts.[257]

The information presented in Chapters 1 and 2 shows that there is poor knowledge about

[252] See, eg, Suchanek, above n 173, 516.
[253] Ibid.
[254] See, eg, Andrea Tornambè et al, 'Toxicity evaluation of diethylene glycol and its combined effects with produced waters of offshore gas platforms in the Adriatic Sea (Italy): Bioassays with marine/ estuarine species' (2012) 77 *Marine Environmental Research* 141, 147 – 148.
[255] See, eg, Martin Edwards, 'Interactions between petroleum operations and carbon capture and storage operations' (2009) 26 *Environmental and Planning Law Journal* 152, 152 – 153.
[256] See, eg, Edwards, above n 255, 153.
[257] Marcotte, Hung, Caquard, above n 79, 54.

cumulative and synergistic impacts occurring within the marine environment.[258] The paucity of information available about such biophysical impacts inhibits effective CIA.[259] The caution implied by this is reflected in comments about other marine activities. For example, Roberts et al recommended the need for further research into the potential cumulative and synergistic impacts on marine ecosystems that could result from interactions between brine from desalination plants, and both climate and seasonal changes.[260] Also focusing on desalination plants, a similar conclusion about the need for further research was reached by Latteman and Amy. Specifically, they highlighted the lack of attention within EIA and monitoring programmes given to cumulative and synergistic impacts within the marine environment.[261] Briffa et al recommended additional research be undertaken to determine whether there are any 'synergies' between increased ocean acidification and other marine environmental changes that could further impact on marine animal behaviours.[262]

The need to be cautious about the approach to marine research, and whether cumulative and/or synergistic impacts might occur because of the research activities, has also been discussed. Verlaan, for example, argued that caution is required when undertaking research because experiments undertaken within the marine environment will often be carried out on the assumption that the methods will not have detrimental cumulative or synergistic impacts. [263] As such experiments should be subject to rigorous and adaptive EIA and monitoring processes in order to ensure that the marine environmental protection and research objectives of the *Law of the Sea Convention* are maintained.[264] This is also an important consideration when assessing environmental change.

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[258] See, eg, Crain et al, above n 79, 49, 52; Korpinen, Meidinger and Laamanen, above n 3, 313; Jake Rice et al, *Science dimensions of an Ecosystem Approach to Management of Biotic Ocean Resources (SEAMBOR)* (Marine Board – ESF Position Paper 14, 2010) 70; Rice et al (2010) cited in Stelios Katsanevakis et al, 'Ecosystem-based marine spatial management: Review of concepts, policies, tools and critical issues' (2011) 54 *Ocean and Coastal Management* 807, 808, 809.
[259] See, eg, Court, Wright and Guthrie, above n 9, 52.
[260] See, eg, David A Roberts, Emma L Johnston, Nathan A Knott, 'Impacts of desalination plant discharges on the marine environment: A critical review of published studies' (2010) 44 *Water Research* 5117, 5126.
[261] Sabine Latteman and Gary Amy, 'Marine monitoring surveys for desalination plants – a critical review' (2013) 51 (1 – 3) *Desalination and Water Treatment* 233, 234, 242.
[262] See, eg, Mark Briffa, Kate de la Haye, Philip L Munday, 'High CO_2 and marine animal behaviour: Potential mechanisms and ecological consequences' (2012) 64 *Marine Pollution Bulletin* 1519, 1527.
[263] See, eg, Philomène A Verlaan, 'Experimental activities that intentionally perturb the marine environment: Implications for the marine environmental protection and marine scientific research provisions of the 1982 United Nations Convention on the Law of the Sea' (2007) 31 (2) *Marine Policy* 210, 212.
[264] Verlaan, above n 263, 212.

6.2 Environmental change: The example of climate change

This part of the chapter focuses on indirect marine environmental change due to anthropogenic activities. Climate change is the focus.

There are a number of natural variations within the marine environment that can combine with human activities to cause impacts in addition to the accumulation and interaction of anthropogenic activities causing impacts and effects or environmental change. These can occur between different areas and during different periods. Examples include salinity changes, the locations of upwelling (nutrient and temperature), and long-term weather patterns.[265] Whilst these changes within the marine environment have always occurred, the rate at which they occur can be hastened and magnified by human use and development.[266]

The consideration of combinations of environmental change and anthropogenic activity is particularly important in the context of synergistic impacts; as changes within a natural system have the potential to affect the accuracy of a previously predicted environmental effect[267] and the predictability of the marine environment in general (i.e. modelling may become imprecise).[268] The potential impact of climate change is one example of the cumulative and/ or synergistic impacts that are sourced from natural and human influences.[269] Within the context of cumulative impacts, climate change has been described as a 'background'[270] source of impact that should be considered within environmental assessments focusing on cumulative and synergistic impacts.[271] Masden et al, identifying what impacts should be considered within CIA so as to ensure a 'comprehensive' approach, suggested that inclusion of 'all actions, past, present and future, with future being defined as those actions in planning when considering consented projects, and reasonable projections for non-consented actions such as fishing activity or climate change' is needed.[272] Sala et al identified climate change as one of the most important 'drivers of change' for reductions in species biodiversity levels and that 'synergistic interactions' contributed to these changes.[273]

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[265] See, eg, Halpern et al, above n 3, 205; Suchanek, above n 173, 516.
[266] See, eg, Peter M Vitousek et al, 'Human Domination of Earth's Ecosystems' (1997) 277 *Science* 494, 494 - 495; Vitousek et al (1997) cited in in Heike K Lotze and Boris Worm, 'Complex interactions of Climatic and Ecological Controls of Macroalgal Recruitment' (2002) 47 (6) *Limnology and Oceanography* 1734, 1734.
[267] See, eg, Halpern et al, above n 3, 206.
[268] Ibid, 205; Russell et al, above n 115, 2158.
[269] See, eg, Thomas Wernberg et al, 'Impacts of climate change in a global hotspot for temperate marine biodiversity and ocean warming' (2011) 400 *Journal of Experimental Marine Biology and Ecology* 7, 7, 12; Halpern et al, above n 3, 209; Marine Biodiversity Decline Working Group, *A National Approach to Addressing Marine Biodiversity Decline – Report to the Natural Resource Management Ministerial Council Marine*, (Marine and Coastal Committee of the Natural Resource Management Ministerial Council, 2008), 21.
[270] See, eg, Masden et al, above n 14, 3.
[271] See, eg, Hyder, above n 30, 89 – 90; Hyder (1999) cited in Masden et al, above n 14, 3.
[272] See, eg, Masden et al, above n 14, 4.
[273] Osvaldo E Sala et al, 'Global Biodiversity Scenarios for the Year 2100' (2000) 287 *Science* 1770, 1773.

MacDonald reiterated Abel's conclusion that synergistic impacts were less likely to occur within environmental systems without alterations caused by temperature changes or chemical interactions.[274] Further, it has been noted that there is little understanding of the impacts caused by climate change and other natural changes, including the extent of expected change occurring in an area where there has been minimal anthropogenic activity.[275] Due to this, the impacts are difficult to assess.[276] For example, because of the unknown ecological variation anticipated due to climate change, and the difficulties associated with predicting synergies, there is the possibility that future impacts will be underestimated.[277]

The impacts from climate change on the marine environment include changes to sea surface temperature, changes to the concentration of ultraviolet radiation (UV) on the Earth's surface, and increased levels of CO_2 causing acidification.[278] When such changes occur they are considered to be cumulative; particularly because of the additional pressure that can be placed on areas that already have reduced resilience from previous natural or human induced impacts.[279]

The impacts of ocean acidification could bring about changes in marine ecosystems different from those predicted when caused by a single stressor alone, especially when combined with other anthropogenic impacts such as increased water temperature, invasive species, changes to the nitrogen and phosphate cycles and depletion of fish stocks.[280] Fabry et al stated that more data needs to be gathered to better understand the outcomes of these combined impacts. [281] Further, they suggested that there is a need for the development of different models for predicting ecosystem changes.[282]

As mentioned earlier in this chapter, resilience is important for determining the ability of a

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[274] Abel (1996) cited in MacDonald, above n 47, 299.
[275] Marine Biodiversity Decline Working Group, above n 269, 21.
[276] Ibid; Hyder, above n 30,89 – 90; Hyder (1999) cited in Masden et al, above n 14, 3.
[277] See, eg, Robert T Paine, Mia J Tegner and Edward A Johnson, 'Compounded Perturbations Yield Ecological Surprises' (1998) *Ecosystems* 1 (6) 535, 542 – 543; Paine (1998) cited in Russell et al, above n 115, 2158; E A Hernández-Delgado, 'The emerging threats of climate change on tropical coastal ecosystem services, public health, local economies and livelihood sustainability of small island: Cumulative impacts and synergies' (2015) 101 *Marine Pollution Bulletin* 5, 8 – 9.
[278] See, eg, Halpern et al, above n 210, 11 – 13.
[279] See, eg, Halpern et al, above n 3, 207.
[280] Schippers et al (2004) and Hutchins et al (2007) cited in Victoria J Fabry et al, 'Impacts of ocean acidification on marine fauna and ecosystem processes' (2008) 65 *ICES Journal of Marine Science* 414, 427; Peter Schippers, Miquel Lurling and Marten Scheffer, 'Increase of atmospheric CO_2 promotes phytoplankton productivity' (2004) 7 *Ecology Letters* 446, 450.
[281] Fabry et al, above n 280, 427.
[282] Fabry et al, above n 280, 427.

species or ecosystem to recover from a cumulative or synergistic impact.[283] The resilience of coral reefs to counteract the effects of negative impacts from within the natural environment has been detrimentally affected by the synergistic impacts associated with anthropogenic activities.[284] Halpern et al illustrated this by discussing comparative studies undertaken by Hughes and Connell about cyclone damage to coral reefs in Australia and Jamaica.[285] The ability of Australian coral reefs to recover was shown to be far greater than that of the Jamaican reef systems that had been subjected to greater levels of cumulative and synergistic impacts associated with overfishing and disease.[286] Also affecting coral reef ecosystems, the potential for synergistic effects associated with climate change was identified in relation to trophic webs due to sea de-oxygenation (affecting fish), coral bleaching and the impact of acidification on calcifying organisms.[287] In general, the synergistic combinations of sea-level change, extreme weather, pollution and increased ocean acidity are considered to be a significant cause for concern in terms of impact on the health and existence of coral reef systems.[288] Similarly, conclusions by Perkol-Finkel and Airoldi about studies on the resilience of macroalgal forests in the Adriatic Sea, pointed to a reduction in resilience and recovery in areas affected by extreme weather events. [289] This was particularly evident when the detrimental impact of human activities has reduced biological diversity.[290]

Studies on macroalgal blooms provide another example of the combined influence of anthropogenic activity and environmental change, causing cumulative and synergistic effects.[291] Macroalgal blooms are more likely to be impacted upon, and magnified, because of pollution with a reduction in species that feed on the macroalgae in synergy with light and temperature changes.[292]

Przeslawski, Davis and Benkendorff have emphasised the uncertainty surrounding the impact of

[283] See, eg, Halpern et al, above n 3, 207.
[284] J E Maragos, M P Crosby and J W McManus 'Coral reefs and biodiversity: A critical and threatened relationship' (1996) 9(1) *Oceanography* 83, 87 – 88 <http://dx.doi.org/10.5670k/oceanog.1996.31>; M P Crosby, G Brighouse and M Pichon, 'Priorities and strategies for addressing natural and anthropogenic threats to coral reefs in Pacific Island Nations' (2002) 45 *Ocean and Coastal Management* 121, 135.
[285] Hughes and Connell (1999) cited in Halpern et al, above n 3, 207.
[286] T P Hughes and J H Connell, 'Multiple stressors on coral reefs: A long-term perspective' (1999) 44 (3, part 2) *Limnology and Oceanography* 932, 937 – 939; Halpern et al, above n 3, 207.
[287] See, eg, Jorge Christian Alva-Basurto and Jesús Ernesto Arias-González, 'Modelling the effects of climate change on a Caribbean coral reef food web' (2014) 289 *Ecological Modelling* 1, 8 – 10.
[288] See, eg, J E N Vernon et al, 'The Coral Reef Crisis: The Critical Importance of < 350 ppm CO_2' (2009) 58 *Marine Pollution Bulletin* 1428, 1431; Peter F Sale, 'Management of coral reefs: Where have we gone wrong and what can we do about it' (2008) 56 *Marine Pollution Bulletin* 805, 807-808.
[289] Shimrit Perkol-Finkel and Laura Airoldi, 'Loss and Recovery Potential of Marine Habitats: An Experimental Study of Factors Maintaining Resilience in Subtidal Algal Forests at the Adriatic Sea', (2010) 5 (5) *PLoS One* e107911, 9 – 10, <http://doi:10.1371/journal.pone.001079>.
[290] Perkol-Finkel and Airoldi, above n 289, 9 – 10.
[291] See, eg, Heike K Lotze and Boris Worm, 'Complex interactions of Climatic and Ecological Controls of Macroalgal Recruitment' (2002) 47(6) *Limnology and Oceanography* 1734, 1734.
[292] See, eg, Lotze and Worm, above n 291, 1741.

climate change in combination with existing marine environmental stressors.[293] Their discussion on the synergistic effects that climate induced marine environmental change can have on rocky shore molluscs included a demonstration that the interactive impact could not have been arrived at had the impacts of the stressors been considered individually.[294] The discussion concluded by cautioning against avoiding the consideration of such interactions when undertaking research.[295]

Russell et al have made similar comments about the need for further research to understand cumulative and synergistic outcomes; particularly within an area specific context.[296] Russell et al also identified the importance of considering the synergy between local and global environmental stressors.[297] They demonstrated that there is a potential for the synergistic interaction between CO_2 and increased nutrient runoff to occur. This would increase the potential for altered ecosystems through events such as the replacement of kelp forests by other algae (in subtidal rocky habitats).[298] Russell et al also highlighted that there was a greater magnitude of effect from the interactions between differing CO_2 levels and nutrient levels than would have been anticipated for the effects of either the nutrient levels or CO_2 concentration occurring in isolation.[299] As a final example, Salo and Pedersen indicated that within estuarine areas where water temperature is increased, climate change in combination with lowered salinity could cause a detrimental synergistic impact that affects the growth and survival rate of seagrass species.[300]

Based on the above examples and issues raised, it is concluded that requirements for the assessment of cumulative and synergistic impacts of both anthropogenic activities and environmental change are an integral aid to achieving the objectives of effective marine protection. This is particularly because of uncertainty and the limited knowledge about the interactions between anthropogenic activities and environmental change within the marine environment, combined with the natural environment's ability to assimilate, adapt, or be resilient, to any detrimental impacts that may occur.

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293 R Przeslawski, A R Davis and K Benkendorff, 'Synergistic effects associated with climate change and the development of rocky shore molluscs' (2005) 11 (3) *Global Change Biology*, 515, 515.
294 Przeslawski, Davis and Benkendorff, above n 293, 518 – 519.
295 Ibid, 521.
296 Russell et al, above n 115, 2160.
297 Ibid, 2153, 2160.
298 Ibid, 2153, 2159.
299 Ibid, 2154, 2158.
300 Tiina Salo and Morten Foldager Pedersen, 'Synergistic effects of altered salinity and temperature on estuarine eelgrass (*Zostera marina)* seedlings and clonal shoots' (2014) 457 *Journal of Experimental Marine Biology and Ecology* 143, 147.

7. Conclusion

The examples discussed and interpreted in this chapter demonstrate that defining cumulative and synergistic impacts is challenging. There is a perception within the literature that the definitions provided for the term ‘cumulative impact’ are inadequate, inconsistent and require change. An example of this is the inclusion of synergistic impacts within the cumulative impact definition when there is evidence that these terms have distinct meanings. The insight gained from the general literature and specific legal examples from a cross-section of countries is also beneficial to understanding current Australian approaches (see, eg, Chapter 4 - Cumulative and Synergistic Impacts in Australia: the Assessment Framework, and the Precautionary Principle, and Chapter 5: The Otways Marine Area) and providing subsequent recommendations for improvement (Chapter 8 – Conclusions and Recommendations).

As is also discussed, the issues raised by these challenges can influence the application of environmental assessment legal requirements for considering cumulative and synergistic impacts. This can result in legal frameworks being inadequate due to the absence of requirements or adequate definitions (when there are requirements). The problems caused by the inadequacy includes an inability to effectively manage cumulative and synergistic impacts within the marine environment. The concerns about clarity of definition for cumulative and synergistic impacts could also result in the neglect of synergistic impacts even when cumulative impacts are assessed. Chapter 6 Victoria’s Port Phillip Bay Channel Deepening Project includes an analysis of EIA, and associated decision-making and monitoring processes. The analysis provides an example of a situation when the legislation requiring the impact assessment does not require the consideration of, or provide a definition for, cumulative and synergistic impacts.

Cumulative and synergistic impacts should be defined, considered and assessed separately to improve knowledge about impact predictions, for both impact types. It is concluded that the concerns raised and discussed in this chapter about the potential for environmental harm as caused by synergistic impacts establishes the need for synergistic impacts to be paid equivalent attention to cumulative impacts within the context of their assessment. This is emphasised by the conclusions that synergistic impacts may occur more often than acknowledged, and that cumulative impacts could be precursors to synergistic impacts.

The importance of considering both impact types is presented by commentators as being important to environmental resilience. Scientific assessment focusing on the known and potential cumulative and synergistic impacts already exists (Section 5 (including Table 2-1)). This shows that the problems within the marine environment exist because of the combined stressors of environmental change (both due to human influence and natural variation) and anthropogenic activities. The scientific based opinion that was presented provides examples of how inadequate definitions can confuse analyses and interpretation. This is not only clear in terms of identifying these impact types separately, but also emphasises the need for the consideration of all facets of environmental change when assessing the cumulative and synergistic impacts from anthropogenic activities. Based on the literature reviewed, the conclusion is made that whilst scientists are aware of the problems caused by these impact types, the extent of knowledge is poor. The research and commentary also emphasises the difficulties in predicting marine environmental impacts and change because of uncertainty.

The scientific analysis of cumulative and synergistic impacts requires a clear distinction between these impact types. The literature, however, shows that there can be an inadequate acknowledgement of the distinction in environmental assessment, CIA practice, law and policy. There is a reluctance to evolve the definition of cumulative impact within these fields/ disciplines. Attempts to evolve the definition do not identify the distinction between cumulative and synergistic impacts. Nor do these attempts address the need to consider these impact types separately. It could be suggested that this lack of definition evolution contributes to the confusion about cumulative and synergistic impacts.

In response to all of the concerns that were discussed, and to ensure that there are clear, distinct and consistent meanings for the remainder of this thesis, definitions of cumulative and synergistic impacts are provided as follows:

> **Cumulative impact:** impacts/effects that result from interactions between stressors and that are demonstrated to have linear characteristics. They result from the accumulation of impacts/effects that interact within spatial areas and/or time periods.[301]
>
> **Synergistic impact:** impacts/effects that result from interactions between stressors and that are demonstrated to have nonlinear characteristics. The resultant impact/effect is of a greater magnitude than the expected sum of the combined impacts/effects. They can occur as a result of interactions across defined spatial areas as well as defined time periods.[302]

These definitions utilise components of the various definitions discussed and reviewed as part of this chapter. In response to the opinion by Duinker et al that 'single sentence' definitions are inadequate to provide the required detail for defining cumulative impacts, it is agreed that

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[301] Refer to glossary.
[302] Refer to glossary.

definitions should provide sufficient detail to guide application. It is also agreed that these proposed definitions are short. However, as will be discussed in more detail in the recommendations for improving the capacity of Australia's marine environmental assessment legal framework for requiring these impact types (Chapter 8), short definitions are often useful in the first instance, for example, in legislation (and for the purpose of this thesis). Additional detail for definitions should then be provided within either delegated legislation or policy documents that have been designed to assist the implementation of legislation. As such, the contribution of this chapter is to discuss and interpret information presented by others. The outcome is to recognise and encourage further evolution of cumulative and synergistic impact assessment by emphasising that the approach to defining these terms must be differentiated within legal frameworks applicable to their consideration and assessment.

Finally, aside from suggesting that cumulative and synergistic impacts need to be better defined and distinguished, it is argued that this emphasis on distinction needs to be derived from legal frameworks for environmental assessment (e.g. requirements for SEA or EIA also need to include requirements to assess cumulative and synergistic impacts). This would better enable the achievement of those goals associated with environmental assessments that focus on the avoidance, mitigation or remediation of environmental degradation. However, before this can be achieved, the other challenges that constrain effective cumulative and synergistic impact assessment need to be identified. The following chapter (Chapter 3) explores the challenges that can occur because of ambiguous definitions within the context of environmental assessment. In addition, Chapter 3 further elaborates on the function of cumulative and synergistic impact assessment within decision-making processes. This includes the application of, and responsibilities, surrounding the precautionary principle and the iterative role of post-approval monitoring.

CHAPTER 3 – CUMULATIVE AND SYNERGISTIC IMPACTS: ENVIRONMENTAL ASSESSMENT, THE PRECAUTIONARY PRINCIPLE AND POST-APPROVAL MONITORING

'The established reality, however, is one of complex causation, multiple disturbances, interacting processes and populations, and both past and present human activities simultaneously affecting a number of sites in a geographic area.'[1]

Chapter outline

1. Introduction

Effective environmental management needs to include cumulative and synergistic impact consideration and assessment. Achieving this is particularly important for marine ecosystems that are not fully understood (i.e. compared to terrestrial ecosystems they are more dynamic and less studied). Environmental assessment, the precautionary principle and post-approval

[1] Barbara L Bedford and Eric M Preston, 'Developing the Scientific Basis for Assessing Cumulative Effects of Wetland Loss and Degradation on Landscape Functions: Status, Perspectives, and Prospects' (1988) 12 (5) *Environmental Management* 751, 751.

monitoring are mechanisms that can be used to increase understanding about cumulative and synergistic impacts. This chapter focuses on the capacity of the environmental assessment framework to consider cumulative and synergistic impacts, in particular, it examines the processes of strategic environmental assessment (SEA) and environmental impact assessment (EIA). The chapter has two principal aims. The first is to determine whether the assessment of cumulative and synergistic impacts is better suited to SEA or EIA, or whether they should be considered within both frameworks. In addressing this aim, challenges to effective environmental assessment are identified. The second aim is to enhance understanding of how the application of the precautionary principle and post-approval monitoring, within environmental assessment and decision-making processes, can assist with the consideration of cumulative and synergistic impacts. The discussion focus includes the challenges associated with the 'burden of proof' for applying the precautionary principle, when considering cumulative and synergistic impacts.

The discussion begins with an examination of how environmental assessment operates as a decision-making process. This is followed by a review and critique of literature that highlights the benefits and shortcomings of the frameworks used to apply SEA and EIA. The later sections of the chapter focus on the precautionary principle and post-approval monitoring (PAM) as mechanisms that can also be utilised within the environmental decision-making processes associated with SEA and EIA. There is discussion of the application of the precautionary principle and how it assists the development of knowledge about cumulative and synergistic impacts. Consideration is given to implementation challenges, such as application within the scientific assessment of environmental impacts. The importance of PAM as a means of feeding data and other information about cumulative and synergistic impacts back into the decision-making process is addressed. This creates a feedback loop that increases knowledge about these types of environmental impacts and improves baseline information for future environmental assessment.

The conclusion within Chapter 2 that synergistic impacts are often considered as a subset of cumulative impacts helps inform this chapter. The concluding argument from Chapter 2 emphasised the necessity to identify and define cumulative and synergistic impacts separately. Thus, the term 'cumulative (and synergistic)' will be used when referring to 'cumulative' impacts to emphasise the importance of maintaining the distinction between these terms. The basis for this is an acknowledgement that a substantial amount of the literature refers to 'cumulative impact' or 'cumulative effects' without necessarily expressly mentioning synergistic impacts. Yet, based upon the tendency to implicitly include synergistic impacts within the cumulative impact definition, it is appropriate to assume that there was no intention to exclude synergistic impacts. When a specific point about synergistic impacts is made, the term ‘synergistic’ will be used to ensure explicit distinction.

2. Environmental Assessment: The consideration of cumulative and synergistic impacts within strategic environmental assessment and environmental impact assessment

The first part of this section focuses on the environmental assessment of cumulative and synergistic impacts, with a brief explanation of how the assessment of these impact types can be incorporated into SEA and EIA to inform decision-making processes. The second part examines the benefits and shortcomings of the current approaches to cumulative and synergistic impact assessment beyond the challenges presented by ambiguous definitions (as discussed in Chapter 2). The discussion and critique is confined to literature that considers the question whether cumulative and synergistic impact assessment should occur within SEA or EIA. Attention is then turned to the consideration of cumulative (and synergistic) impact assessment in SEA combined with EIA. The literature reviewed focuses on the application of cumulative (and synergistic) impact assessment rather than examination of legal requirements. The objective of this critique is to further understand the challenges of applying cumulative and synergistic impact assessments as part of EIA and SEA. The benefit of evaluating these challenges is that any recommendations made about Australian legal framework approaches to the assessment of cumulative and synergistic impacts in the marine environment are better informed.

There are numerous examples in the literature about the need to consider cumulative and synergistic impacts in environmental assessments.[2] As introduced in Chapter 1, two of the commonly used processes for environmental assessment are SEA and EIA. Environmental assessments such as SEA and EIA provide information to aid decision-making processes.[3]

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[2] See, eg, Jill Gunn and Bram F Noble, ‘Conceptual and methodological challenges to integrating SEA and cumulative effects assessment’ (2011) 31 *Environmental Impact Assessment Review* 154, 154; Peter N Duinker and Lorne A Greig, ‘The Impotence of Cumulative Effects Assessment in Canada: Ailments and Ideas for Redeployment’ (2006) 37 (2) *Environmental Management* 153, 153; John Glasson, Riki Therivel and Andrew Chadwi, *Introduction to Environmental Impact Assessment,* (Routledge, 3rd ed, 2005) 325-328, 343; Ian Thomas and Mandy Elliot, *Environmental Impact Assessment in Australia: theory and practice* (The Federation Press, 4th ed, 2005) 47-51; Lourdes M Cooper and William R Sheate, ‘Cumulative Effects Assessment: A review of UK environmental impact statements’ (2002) 22 *Environmental Impact Assessment Review* 415, 416; Riki Therivel and Bill Ross, ‘Cumulative effects assessment: Does scale matter?’ (2007) 27 *Environmental Impact Assessment Review* 365, 365 – 366.

[3] See, eg, Simon Marsden, ‘An international overview of strategic environmental assessment, with reference to world heritage areas globally and in Australian coastal zones’ (2002) 4 (1) *Journal of Environmental Assessment Policy and Management,* 31, 33, 39 – 40; Anna McLauchlan and Elsa João, ‘The inherent tensions arising from attempting to carry out strategic environmental assessments on all policies, plans and programmes’ (2012) 36 *Environmental Impact Assessment Review* 23, 24; Gerry Bates, *Environmental Law in Australia,* (LexisNexis Butterworths, 7th ed, 2010) 300 – 301.

These decisions can be required by environmental assessment legislation.[4] An SEA can be used to inform government decisions about the capacity to use a region for multiple types of one use; for example, different commercial fisheries,[5] or multiple different anthropogenic activities.[6] As an example of EIA applied to decision-making, the Commonwealth Government's *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act 1999* (Cth)) stipulates that all significant impacts on a species listed for protection require approval; with the decision-making process requiring an EIA to be undertaken in certain instances.[7]

A core function of SEA is to facilitate assessment of the environmental impacts that could result from the implementation of policies, plans and programmes that affect an environmental area or region.[8] As a process for considering cumulative and synergistic impacts, the use of SEA can form part of broader strategic planning approaches and be used to inform zoning controls, policy development and environmental management plans.[9] Within SEA, consideration can be given to cumulative and synergistic impacts through either focus on an individual sector or multiple sectors within an area.[10] The SEA process should result in objectives that need consideration before making decisions about the environment.[11] SEA also provides for not just an expanded spatial and temporal assessment, but a broad based approach to understanding the way activities interact within an environment.[12]

Considering cumulative (and synergistic) impacts within SEA and EIA can assist in determining impacts that may not be obvious, or recognised, should only isolated effects from a use or development be assessed.[13] Strategic planning objectives of SEA seek to consider the potential impacts from a variety of different uses and development within a broad area.[14] The role of EIA

[4] See, eg, Australia's *Environment Protection and Biodiversity Conservation Act 1999* (Cth), Chapter 4 – Environmental assessments and approvals.
[5] See, eg, *Environment Protection and Biodiversity Conservation Act 1999* (Cth), Chapter 4, Part 10 – Strategic assessments, Division 2 – Assessment of Commonwealth – managed fisheries.
[6] Ibid.
[7] See, eg, Chapter 4, Part 8, Division 6 – Environmental Impact Statements.
[8] See, eg, Simon Marsden and John Ashe, 'Strategic Environmental Assessment in Australian States and Territories' (2006) 13 (4) *Australasian Journal of Environmental Management* 205, 205; Simon Marsden, 'Strategic environmental assessment of Australian offshore oil and gas development: Ecologically sustainable development or deregulation?' (2016) 32 *Environmental and Planning Law Journal* 21, 21; Simon Marsden, 'Strategic environmental assessment in Australian land-use planning' (2013) *Environmental and Planning Law Journal* 422, 422; McLauchlan and João, above n 3, 23; Gunn and Noble, above n 2, 154.
[9] See, eg, Benjamin S Halpern et al, 'Managing for cumulative impacts in ecosystem-based management through ocean-zoning' (2008) 51 *Ocean and Coastal Management* 203, 205; Marsden (2013), above n 8, 432; Glasson, Therivel and Chadwi, above n 2, 343; Gunn and Noble, above n 2, 155, 158 – 159; Lourdes M Cooper, 'CEA in policies and plans: UK case studies' (2011) 31 *Environmental Impact Assessment Review* 465, 466; Therivel and Ross, above n 2, 371 – 372.
[10] See, eg, Jill A E Harriman and Bram F Noble, 'Characterizing project and strategic approaches to regional effects assessment in Canada' (2008) 10 (1) *Journal of Environmental Assessment Policy and Management* 25, 38 – 41.
[11] See, eg, Harriman and Noble, above n 10, 27.
[12] Ibid, 38.
[13] Larry Canter and Bill Ross, 'State of practice of cumulative effects assessment and management: the good, the bad and the ugly' (2010) 28 (4) *Impact Assessment and Project Appraisal* 261, 262 – 263.
[14] See, eg, Harriman and Noble, above n 10, 38 - 39.

differs from SEA in that it facilitates the assessment of environmental impacts predicted to occur as a result of proposed use and/or development at a particular site.[15] The focus on individual projects and the level of construction and operational detail provided at the EIA stage can facilitate identification of the environmental impacts with more detail than at the SEA stage.[16] Further, the detailed knowledge about impacts that can be provided through EIA may be neglected within the broad based approach typified by SEA.[17]

As an example, within Australia the use of SEA and EIA can occur within legislative decision-making processes for the planning of urban or natural environments (including terrestrial or marine areas).[18] The challenges associated with addressing cumulative and synergistic impact in regulatory frameworks is discussed further in section 2.3.1 of this chapter. Chapter 4 focuses on Australia's legal frameworks for marine environmental assessment and the various approaches that there are toward addressing cumulative (and synergistic) impact assessment.

There are a number of methods used for the assessment of cumulative (and synergistic) impacts within SEA and EIA. Duinker et al, concluded on the basis of a literature review that the most commonly discussed methods are geographical information systems (GIS), alternative development scenarios, thresholds, indicators and indices, network analysis, and matrices.[19] One of the frameworks identified by Duinker et al as a common method, was that of an approach by Canter and Ross.[20]

In identifying that cumulative (and synergistic) impact assessment frameworks are in place in a significant number of countries, Canter and Ross summarised common elements.[21] These elements included the selection of Valued Ecosystem Components (VECs).[22] VECs encompass those ecosystem components determined to be of value by set criteria, for example, ecosystem

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[15] See, eg, Marsden (2013), above n 8, 422; McLauchlan and João, above n 3, 23; George Hegmann and G A (Tony) Yarranton, 'Alchemy to reason: Effective use of Cumulative Effects Assessment in resource management' (2011) 31 *Environmental Impact Assessment Review* 484, 484.
[16] See, eg, Lourdes M Cooper and William R Sheate, 'Integrating cumulative effects assessment into UK strategic planning: implications of the European Union SEA Directive' (2004) 22 (5) *Impact Assessment and Project Appraisal* 5, 6; Nicola Rivers (public hearing transcript of evidence) quoted in Environment and Natural Resources Committee, Parliament of Victoria, *Inquiry into the Environmental Effects Statement Process in Victoria September* (2011) 232 - 233; Therivel and Ross, above n 2, 384; Harriman and Noble, above n 10, 35.
[17] See, eg, Nicola Rivers (public hearing transcript of evidence) quoted in Environment and Natural Resources Committee, Parliament of Victoria, *Inquiry into the Environmental Effects Statement Process in Victoria September* (2011) 232 – 233; Environmental Defenders Office (Victoria) and Mr J Chenoweth, General Counsel, Australian Conservation Foundation (public hearing transcript of evidence) cited in Environment and Natural Resources Committee, Parliament of Victoria, *Inquiry into the Environmental Effects Statement Process in Victoria September* (2011) 232.
[18] See, eg, *Planning and Environment Act 1987* (Vic) and *Great Barrier Reef Marine Park Act 1975* (Cth).
[19] Peter N Duinker et al, 'Scientific dimensions of cumulative effects assessment: toward improvements in guidance for practice' (2013) 21 *Environmental Reviews* 40, 44 - 47.
[20] Ibid, 44 - 45.
[21] Canter and Ross, above n 13, 263.
[22] Ibid.

functions, habitats or species.[23] Direct and indirect impacts on the VECs that would be caused by the proposed development or activity should be identified early in the environmental assessment process.[24] Following this, the suggested sequential approach was:

- determination of other cumulative (and synergistic) impacts associated with relevant 'past, present and reasonably foreseeable future actions';[25]
- identification of the extent of area and time periods relevant to the project proposal and other contributing impacts;[26]
- determination of the health status of VECs and identification of the indicators for changes in this health status whilst ensuring comparisons between effects relevant to the VECs both with and without the cumulative impacts from a project proposal;[27] and
- linking the proposed project's impacts to the VECs to determine the cumulative (and synergistic) effects.[28]

Canter and Ross also discussed that when uncertainty constrains the use of particular methods of assessment, for example modelling, a different assessment method should be considered.[29] Consideration should also be given to the 'significance' of the cumulative (and synergistic) impacts identified.[30] This then enables determination of appropriate mitigation methods and/or monitoring programmes.[31]

The discussion about available methods establishes that whilst there is a place for the assessment of cumulative (and synergistic) impacts, uncertainty about impact predictions is an important factor to address. This challenge of representing uncertainty, combined with the framework and methodological approaches to assessment, warrants further examination. The following discussion focuses on the benefits and shortcomings of assessing cumulative (and synergistic) impacts within SEA and EIA.

2.1 Assessing cumulative and synergistic impacts within SEA and EIA: Which approach is better?

This section reviews scholarly and practitioner debate on whether it is most appropriate to

[23] See, eg, Gordon E Beanlands and Peter N Duinker, *An Ecological Framework for Environmental Impact Assessment in Canada* (Institute for Resource and Environmental Studies Dalhousie University and Federal Environmental Assessment Review Office, 1983) 8.
[24] Canter and Ross, above n 13, 263.
[25] Ibid.
[26] Ibid.
[27] Ibid.
[28] Ibid, 263 - 264.
[29] Ibid.
[30] Ibid, 264.
[31] Ibid.

utilise SEA or EIA for addressing cumulative (and synergistic) impacts. The critique that follows compares SEA and EIA to evaluate the benefits and shortcomings of using these processes to facilitate cumulative and synergistic impact assessment.

Despite the existence of assessment methods, concern remains about the effectiveness of environmental assessment processes such as SEA and EIA to incorporate assessment of cumulative and synergistic impacts. Spaling and Smit noted that the cumulative changes to an environment occur over extended periods of time that are not necessarily contemplated by strategic policy and planning decisions.[32] These changes come from anthropogenic activities everywhere; generally occurring because of the many seemingly innocuous and isolated decisions made in a variety of circumstances by many different people.[33] The points raised by Spaling and Smit identify that because cumulative and synergistic impacts can arise due to the accumulation or interaction from many small impacts, these impact types can be neglected by SEA and EIA processes. This is of particular concern when 'significant'[34] environmental impacts are often the only focus of SEA and EIA.[35] Further, Ross and Carter note that EIA is only utilised in 'trigger conditions', which potentially excludes the consideration of cumulative impacts until attention is drawn to the issues.[36] Writing in 2012, they also considered that the use of SEA is still uncommon in Australia.[37]

There has been significant discussion of the benefits of using an SEA over a project EIA,[38] as well as arguments seeking to establish SEA as a more appropriate mechanism for cumulative (and synergistic) impact assessment than EIAs of individual projects. One argument is that there are advantages of applying the assessment methodology within SEA because of the resultant capacity to inform concerns about environmental impacts within a wider geographical area and avoid consideration of activities in isolation.[39] In this respect, identifying the issues of concern

[32] Harry Spaling and Barry Smit, 'Cumulative Environmental Change: Conceptual Frameworks, Evaluation Approaches, and Institutional Perspectives' (1993) 17 (5) *Environmental Management* 587, 587.
[33] Spaling and Smit, above n 32, 587.
[34] Refer to the glossary for an explanation about the use of the term 'significant' as a term to describe the measurement of an impact.
[35] See, eg, Peter N Duinker and Gordon E Beanlands, 'The significance of environmental impacts: an exploration of the concept' (1986) 10 (1) *Environmental Management* 1, 1.
[36] Helen Ross and R W (Bill) Carter, 'Reflection on our system of environmental instruments' (2012) 9 (2) *Australasian Journal of Environmental Management* 75, 76.
[37] Ross and Carter, above n 36, 76.
[38] See, eg, Gunn and Noble, above n 2, 154 – 155; Cooper and Sheate, above n 16, 7; K Fuller and B Sadler (1999) cited in Cooper and Sheate, above n 16, 12; Olivia Bina, 'A critical review of the dominant lines of argumentation on the need for strategic environmental assessment' (2007) 27 *Environmental Impact Assessment Review* 585, 591; Anne Shepherd and Leonard Ortolano, 'Strategic Environmental Assessment for Sustainable Urban Development', (1996) 16 *Environmental Impact Assessment Review* 321, 322, 324.
[39] See, eg, Chris Cocklin, Sharon Parker and John Hay, 'Notes on Cumulative Environmental Change I: Concepts and Issues' (1992) 35 *Journal of Environmental Management* 31, 44; Monique Dubé and Kelly Munkittrick, 'Integration of Effects-Based and Stressor-Based Approaches into a Holistic Framework for Cumulative Effects Assessment in Aquatic Ecosystems' (2001) 7 (2) *Human and Ecological Risk Assessment: An International Journal* 247, 250;

through a cumulative (and synergistic) impact assessment at the earlier and more strategic stage of plan or programme development can assist to avoid, or facilitate the mitigation of, some of the environmental issues that may otherwise arise at the individual project assessment stage.[40] Some of the other advantages of focusing the assessment methodology within SEA include reduced complexity, and the reduced risk of a 'reactive' approach.[41]

Underlying the emphasis that SEA is a preferred approach, is that the assessment of cumulative and synergistic impacts within a broader geographical area, that encompasses more than one project, such as at a regional level, allows for a more proactive approach.[42] A proactive approach reduces the risk of failure to undertake assessment than might otherwise occur within EIA projects.[43] A principal concern with EIA is the limitation to consider cumulative or synergistic impacts from multiple activities within a region,[44] and the inadequate consideration given within the assessment of smaller projects.[45] In this sense, it is argued that the capacity of SEA to provide for the gathering of baseline environmental data[46] assists in making the regional approach a better process for identifying impacts.[47]

Other benefits of considering cumulative and synergistic impacts within SEA include that it can lead to management strategies that provide a greater control and input for future developments.[48] Benefit is also found in approaching assessment from greater spatial and temporal scales.[49] This allows for more management options than project level EIA.[50] Further, a strategic planning framework enables better indication of environmental change within an area and identification of thresholds for absorbing impacts.[51] Some commentators, however, suggest that it is difficult to gain an understanding of ecosystems within SEA when there are limitations to understanding ecosystems within EIA.[52]

Harriman and Noble, above n 10, 26; Spaling and Smit, above n 32, 589; Duinker and Greig, above n 2, 153, 155; Cooper and Sheate, above n 16, 6.

[40] See, eg, Hegmann and Yarranton, above n 15, 486.

[41] See, eg, Cocklin, Parker and Hay, above n 39, 44 – 45; Spaling and Smit, above n 32, 589.

[42] Cooper and Sheate, above n 16, 7.

[43] See, eg, Meg Keen and Marjorie Sullivan, Aiding the environment: the Australian Development Agency's experience of implementing an environmental management system, (2005) 25 *Environmental Impact Assessment Review* 628, 645.

[44] See, eg, David James, 'Environmental Impact Assessment: Improving Processes and Techniques' (1995) 2 *Australian Journal of Environmental Management* 78, 79; Cooper and Sheate, above n 16, 7; Spaling and Smit, above n 32, 589; Fuller and Sadler (1999) cited in Cooper and Sheate, above n 16, 7.

[45] See, eg, John Court, Colin Wright and Alasdair Guthrie, 'Environmental Assessment and Sustainability: Are we ready for the challenge?' (1996) 3 *Australian Journal of Environmental Management* 42, 48.

[46] Refer to Glossary.

[47] See, eg, Robert (Bob) Connelly, 'Canadian and international EIA frameworks as they apply to cumulative effects' (2011) 31 *Environmental Impact Assessment Review* 453, 455.

[48] See, eg, Therivel and Ross, above n 2, 371.

[49] Ibid.

[50] Ibid.

[51] See, eg, Court, Wright and Guthrie, above n 45, 46.

[52] See, eg, Gunn and Noble, above n 2, 157; Duinker and Greig, above n 2, 156.

For individual project EIA there is a potential of failure to consider the spatial and temporal aspects due to complexity of technical considerations and inadequacy of legal requirements.[53] This is further emphasised when it is acknowledged that not all activities and their environmental effects go through an approval process.[54] As such, SEA can assist in capturing a greater understanding of the environmental impacts that could occur throughout a region.[55] Hegmann and Yarranton, however, warned that for cumulative (and synergistic) impact assessment, greater spatial and temporal parameters provide for an increase in uncertainty of predicted outcomes.[56] This occurs because of the complexities of environmental systems, including synergistic impacts, and the overall lack of knowledge about the environment.[57]

Korpinen, Meidinger and Laamanen discuss concern that poor knowledge could result in strategically deficient decision-making.[58] This is a consequence of uncertainty. Further, concern has been raised about the application of SEA as a vehicle for cumulative impact assessment, particularly in instances when an SEA does not provide a strategic component.[59] Bidstrup and Hansen referred to this as the 'paradox of non-strategic SEA' and suggested that this occurs in instances where SEA fails to address strategic issues due to poor resourcing and knowledge access.[60]

Fidler and Noble examined the effectiveness of SEA for offshore oil and gas management in Canada, the UK and Norway and concluded that it was limited in its ability to facilitate effective cumulative (and synergistic) impact assessment.[61] They noted constraints on the implementation capabilities in terms of requirement and approach as opposed to the available science and technology.[62] Further, they suggested that, contrary to academic conclusions, some participants were unconvinced of the ability of SEA to address cumulative (and synergistic) impacts assessment.[63] Within an Australian marine context, Marsden reiterates these concerns with

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[53] See, eg, Spaling and Smit, above n 32, 589; Nicole E Seitz, Cherie J Westbrook, and Bram F Noble, 'Bringing science into river systems cumulative effects assessment practice' (2011) 31 *Environmental Impact Assessment Review* 172, 173.
[54] Spaling and Smit, above n 32, 589 – 590; Seitz, Westbrook and Noble, above n 53, 173 – 174.
[55] Cooper and Sheate, above n 16, 6.
[56] Hegmann and Yarranton, above n 15, 486.
[57] Ibid.
[58] Samuli Korpinen, Manuel Meidinger and Maria Laamanen, 'Cumulative impacts on seabed habitats: An indicator for assessments of good environmental status' (2013) 74 *Marine Pollution Bulletin* 311, 318.
[59] Morten Bidstrup and Anne Merrild Hansen, 'The paradox of strategic environmental assessment' (2014) 47 *Environmental Impact Assessment Review* 29, 29.
[60] Bidstrup and Hansen, above n 59, 34.
[61] Courtney Fidler and Bram Noble, 'Advancing strategic environmental assessment in the offshore oil and gas sector: Lessons from Norway, Canada, and the United Kingdom' (2012) 34 *Environmental Impact Assessment Review* 12, 19.
[62] Fidler and Noble, above n 61, 16, 19; B F Noble and J Harriman (2008) cited in Fidler and Noble, above n 61, 19.
[63] Fidler and Noble, above n 61, 16, 19.

reference to the development of offshore petroleum.[64]

Poor knowledge about ecosystems and the complexity of accurate assessment at a smaller project level, provides further evidence that the broader temporal and spatial scale of SEAs is a challenge for effectively addressing cumulative impacts.[65] For example, Gunn and Noble pointed out that there is limited consideration of synergistic effects in situations involving multiple projects.[66] Providing a marine environment example, Douvere and Ehler suggested that strategic planning is limited in itself in terms of influence on the spatial and temporal aspects of marine use and development.[67] Other inputs, such as fishing quotas, gear type and 'best practice environmental management' also need to be taken into account.[68]

Fidler and Noble raise further concerns about the inability of SEA to manage the operational and construction 'specifics' compared with project focused EIA. [69] This can result in an increase in uncertainty for predicting cumulative impacts.[70] Masden et al, however, raised concern about the parameters of practical assessment at the EIA level and the question of the reliance and consistency of assessment when defined by different experts.[71] Given this, when compared to EIA, it is argued that the SEA framework is better in terms of uniformity and the provision of an overarching approach.[72]

In Australia, it has been argued that it is difficult to achieve effective assessment of cumulative and synergistic impacts without addressing them within an SEA framework.[73] Court, Wright and Guthrie argued in 1994 that because of the inability of EIA to deal with cumulative impacts, the goals of Ecologically Sustainable Development (ESD) could not be met within the Australian framework. [74] They also said that to achieve these goals it was necessary to utilise a precautionary and 'integrated' approach.[75] Court, Wright and Guthrie also identified that, aside

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[64] Fidler and Noble (2012) quoted in Marsden, above n 8, 25.
[65] See, eg, Gunn and Noble, above n 2, 157; Duinker and Greig (2006) cited in Gunn and Noble, above n 2, 157; Duinker and Greig, above n 2, 158 – 159; also see reiteration of this concern by Lorne Greig and Peter Duinker, 'Strengthening impact assessment: what problems do integration and focus fix?' (2014) 32 (1) *Impact Assessment and Project Appraisal* 23, 23.
[66] Gunn and Noble, above n 2, 155 -156.
[67] F Douvere and C N Ehler, 'New perspectives on sea use management: Initial findings from European experience with marine spatial planning' (2009) 90 *Journal of Environmental Management* 77, 79.
[68] Douvere and Ehler, above n 67, 79.
[69] Fidler and Noble, above n 61, 16.
[70] Ibid.
[71] Elizabeth A Masden et al, 'Cumulative impact assessments and bird/wind farm interactions: Developing a conceptual framework' (2010) 31 *Environmental Impact Assessment Review* 1, 4.
[72] Masden et al, above n 71, 4.
[73] John D Court, Colin J Wright, Alasdair C Guthrie, *Assessment of cumulative impacts and strategic assessment in environmental impact assessment: prepared for the Commonwealth Environment Protection Agency*, (Commonwealth of Australia, 1994) 8.3; James, above n 44, 84;
[74] Court, Wright and Guthrie, above n 45, 44.
[75] Ibid.

from a few instances, development assessment frameworks lacked capacity to address such issues.[76] More recently, the academic arguments in support of SEA as a more appropriate approach have been acknowledged within Australian legal reform and regulatory process discussion.[77] As an alternative argument, it is has been suggested within the law reform discussion that SEA does not identify all issues, because it operates at a less detailed level than EIA.[78] This can be due to the uncertainties of future development within the selected spatial area (region) or time frame.[79]

At an international level, the potential for cumulative and synergistic impact consideration within SEAs has also been acknowledged by scientific expert bodies such as the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP).[80] However, studies have shown that the potential is not being utilised by countries and the consideration of such impacts is often absent.[81]

A benefit of using EIA to assess cumulative and synergistic impacts is the opportunity to avoid 'incremental' change.[82] In addition, as assessments undertaken at the project level can be more comprehensive, EIA is considered a more suitable conduit than SEA for addressing issues associated with the operational and construction details of activities.[83] In comparison, the methods associated with SEA result in a comparative lack of specific information about predicted effects.[84]

Cumulative and synergistic impacts can also be assessed within framework processes that stem from, and feedback into, EIA. For example, Ross and Carter have demonstrated the importance of frameworks providing mechanisms to improve knowledge bases. [85] Their discussion identifies that the facilitation of the monitoring process is a benefit of EIA. [86] As discussed in

[76] Ibid, 48 - 49.
[77] See, eg, Environment and Natural Resources Committee, Parliament of Victoria, *Inquiry into the Environmental Effects Statement Process in Victoria September* (2011) 214, 216, 219, 220; Environmental Protection Authority Western Australia, *Review of the Environmental Impact Assessment Process in Western Australia,* (EPA, 2009), 8, 30 <https//:www.epa.wa.gov.au/abouttheepa/eiareview/Pages/default.aspx>.
[78] See, eg, Nicola Rivers (public hearing transcript of evidence) quoted in Environment and Natural Resources Committee, Parliament of Victoria, *Inquiry into the Environmental Effects Statement Process in Victoria September* (2011) 233.
[79] See, eg, Nicola Rivers (public hearing transcript of evidence) quoted in Environment and Natural Resources Committee, Parliament of Victoria, *Inquiry into the Environmental Effects Statement Process in Victoria September* (2011) 233; Hegmann and Yarranton, above n 15, 486.
[80] GESAMP (Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection), *Assessment and Communication of Environmental Risks in Coastal Aquaculture: Reports and Studies No 76* (FAO, 2008) 23.
[81] Ibid, 6.
[82] Cooper and Sheate, above n 16, 6.
[83] See, eg, Therivel and Ross, above n 2, 384; Cooper and Sheate, above n 16, 7; Fidler and Noble, above n 61, 16.
[84] See, eg, W Baxter, W Ross and H Spaling (2000) cited in Cooper and Sheate, above n 16, 7; Fidler and Noble, above n 61, 16.
[85] Ross and Carter, above n 36, 76.
[86] Ibid.

section 3.2 of this chapter, the assessment of cumulative and synergistic impacts within monitoring programmes can increase knowledge about complex interactions and actual environmental impacts.

The constraints for cumulative and synergistic impact assessment within project-focused EIA are well identified. Therivel and Ross identified some of the potential constraints as the failure of governments and proponents to take responsibility, as well as issues around the expectations that proponents may be required to account for problems associated with other unrelated activities.[87] Other problems raised in relation to successful consideration of cumulative and synergistic impacts within EIA include that of the willingness of the proponent to undertake complex and costly assessments. As Duinker and Greig observed, there is a tendency for proponents to consider the quickest and most cost-effective method of undertaking an EIA, which in turn can lead to an aversion of such assessments.[88] Similar to Therivel and Ross' considerations, Duinker and Greig acknowledge that proponents will question having to take responsibility for the past project impacts that are caused by others, as well as those that might occur as a result of future project impacts.[89] Sinclair et al have suggested that it is the role of legislation to resolve these issues before a project commences; with legislation used to provide more clarity about the role of proponents and governments in data collection and assessment.[90] Duinker and Greig also observed that there has been a shift from an association of EIA with environmental protection when first introduced in the 1970s to one of 'sustainable development'.[91] Whether EIA can continue to be a useful process for assessing cumulative (and synergistic) impacts within a 'sustainable development' approach when there are views that the environmental assessment requirements are a constraint on successful development is an important consideration. This may be addressed by a continued emphasis on the goals of environmental protection within 'sustainable development'.

Without distinguishing the benefits of either SEA or EIA, Dubé and Munkittrick focused on the methods used to apply these processes and discuss the benefit of assessing cumulative (and synergistic) impact types within an approach oriented toward assessing the actual environmental effects and change within the environment ('effects-based' approach[92]).[93] This approach differs

[87] Therivel and Ross, above n 2, 371.
[88] Duinker and Greig, above n 2, 156.
[89] Ibid.
[90] A J Sinclair et al, 'Looking up, down and sideways: Reconceiving cumulative effects assessment as a mindset' (2017) 62 *Environmental Impact Assessment Review* 183, 186.
[91] Duinker and Greig, above n 2, 153 - 154.
[92] Refer to Glossary - n.b. in comparison to the 'stressor-based approach' the effects-based approach has more focus on the existing environmental conditions and less focus on the predicted impacts. See Dubé and Munkittrick, above n 39, 248, 251.
[93] Dubé and Munkittrick, above n 39, 251.

from the common practice of only predicting the potential impacts from an anthropogenic activity.[94] The benefit of focusing more on actual impacts in an area is that the site-specific information gathered can assist with the improved accuracy for predicted impacts and risk assessments associated with future (unknown) impacts.[95] Collecting baseline data is an integral component of effective EIA, yet Dubé and Munkittrick have identified that there is a potential limitation for assessing cumulative (and synergistic) impacts at an appropriate level within assessments.[96] This limitation is applicable to assessments on the actual environmental outcomes and effects unless specific requirements are provided for within legislative frameworks.[97] Without the required consideration of cumulative and synergistic impact assessment, the risk of poor data limits the ability to effectively determine existing conditions and predict future outcomes.[98] In contrast to undertaking new research and collecting baseline information from the environment proposed for use or development, these issues are compounded if analysis of these impact types is confined to the review of already existing literature and data.[99] The ongoing development of methods for gathering baseline data to include cumulative impacts was also emphasised by González et al.[100]

There is criticism that EIA procedures fail to consider the changing and random nature of ecosystems, and instead describe ecosystems as static.[101] This also represents a concern about baseline information analysis. As reasoned by Fairweather,[102] and reiterated by Dovers et al,[103] the minimal time frames associated with impact studies may be a cause for this misconception. Fairweather identified that one of the problems with assessing the environment from a static perspective is that it neglects 'ecologically important, but episodic phenomena'.[104] As a potential solution, Gunn and Noble suggested that the 'dynamics' of the environment must be integrated into SEA, if cumulative and synergistic impact assessments are to be effective.[105]

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[94] Ibid.
[95] Ibid.
[96] Ibid, 248 - 251.
[97] Ibid.
[98] Ibid, 250.
[99] See, eg, Dubé and Munkittrick, above n 39, 248; Adam Barker and Carys Jones, 'A critique of the performance of EIA within the offshore oil and gas sector' (2013) 43 *Environmental Impact Assessment Review* 31, 34.
[100] Ainhoa González et al, 'Current practice in biodiversity impact assessment and prospects for developing an integrated process' (2014) 32 (1) *Impact Assessment and Project Appraisal* 31, 40 - 41.
[101] See, eg, Spaling and Smit, above n 32, 592; Gordon E Beanlands and Peter N Duinker, 'Lessons from a Decade of Offshore Environmental Impact Assessment' (1984) 9 *Ocean Management* 157, 167; Peter G Fairweather, 'Where is the Science in EIA?' (1989) 20 (5) *Search* 142.
[102] Peter G Fairweather, above n 101, 142.
[103] Stephen Dovers, Tony Norton and John Handmer, 'Ecology and Policy' in J W Handmer, T W Norton and S R Dovers (eds), *Ecology, Uncertainty and Policy: Managing Ecosystems for Sustainability* (Pearson Education Ltd, 2001) 10, 12.
[104] Peter G Fairweather, above n 101, 142.
[105] Gunn and Noble, above n 2, 157.

Contant and Wiggins emphasised in 1991 that this debate was ongoing.[106] They highlighted the limitations on the ability to accurately predict impacts and the inadequate capacity within decision-making frameworks to effectively assess cumulative impacts.[107] These are points that have been shared by others. For example, Connelly has since expanded on some of these issues by identifying problems such as the high cost of collecting baseline information in terms of time and money, and the reliance upon information that is assumed and not readily identifiable.[108] The poor identification of VECs and thresholds and the complexities for EIA in dealing with wide-ranging issues including 'biodiversity loss' are also discussed by Connelly.[109] Connelly also noted that there are difficulties associated with regulatory requirements when more than one legal jurisdiction is involved.[110]

Spaling and Smit also raised concerns about the involvement of multiple jurisdictions within an EIA project area.[111] They identified that the shortcomings at the project level could result in the exclusion of decisions made within SEA frameworks or by other authorities or levels of government about other projects.[112] The potential for this is explicit when regulatory frameworks fail to require impact assessments for all projects at all levels. [113] As discussed by Therivel and Ross, however, there is benefit in incorporating cumulative and synergistic impact assessment within the EIA framework whereby the statutory decision-making frameworks are more capable of providing opportunities to halt construction or operation should an EIA be deemed inadequate.[114] In contrast, Therivel and Ross considered that SEA can be disconnected from any consent requirements that might form part of a planning approval process.[115]

Whilst the issues surrounding regulatory requirements are explored further in section 2.3.1 of this chapter, another concern about the EIA process is that of the focus on the preparation of information contained in an EIA by the proponent.[116] The preparation of the impact assessment by a proponent is criticised as creating bias toward the proponent's needs in the presentation of

[106] Cheryl K Contant and Lyna L Wiggins, 'Defining and analyzing cumulative environmental impacts' (1991) 11 *Environmental Impact Assessment Review* 297, 298.
[107] Contant and Wiggins, above n 106, 298.
[108] Connelly, above n 47, 454.
[109] Ibid.
[110] Ibid.
[111] Spaling and Smit, above n 32, 589.
[112] Ibid, 589 - 590.
[113] Ibid.
[114] Therivel and Ross, above n 2, 384.
[115] Ibid, 384.
[116] See, eg, Matthew Cashmore et al, 'The interminable issue of effectiveness: substantive purposes, outcomes and research challenges in the advancement of environmental impact assessment theory' (2004) 22 (4) *Impact Assessment and Project Appraisal* 295, 304; Gwilliam (2002, unpublished dissertation) cited in Cashmore et al, above n 116, 304; Warwick Gullett, 'Environmental Impact Assessment and the Precautionary Principle: Legislating Caution in Environmental Protection' (1998) 5 *Australian Journal of Environmental Management* 146, 150.

the information (e.g. selection of hazards of concern for assessment).[117] This can also represent a subsequent lack of independence associated with expert evidence.[118] Further, it has been commented that the risk of this bias, when there is no statutory requirement to review the information provided by a proponent, is that a decision to ignore reporting potential issues might occur. [119] The issues surrounding the legal framework and regulatory requirements for cumulative and synergistic impact assessment, as well as bias, are again indicative of a potentially weakening correlation between environmental assessment and environmental protection.

2.2 Cumulative and synergistic impact assessment within strategic environmental assessment and environmental impact assessment

Two competing opinions as to the most appropriate framework to enable effective cumulative (and synergistic) impacts assessment exist. One in which there is a preference for the inclusion of cumulative and synergistic impact assessment within SEA, and another being the alternative preference for inclusion within EIA. A further viewpoint is that there is an important role for cumulative and synergistic impact consideration at both the SEA and individual project EIA levels.[120] The application of cumulative and synergistic impact assessment within both SEA and EIA is one method of overcoming the issues raised (and discussed above) about the relationship between environmental protection and sustainable development.

There is an argument that consideration at the strategic level allows for easier application than at the EIA individual project level.[121] Harriman and Noble focused on the benefits of both. For example, that consideration at the EIA project level provides for better technical understanding, and consideration at SEA level assists with gaining an overarching understanding of environmental values and cumulative environmental change.[122] Harriman and Noble also stress that each level of assessment has the capacity for providing important information for the other,

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[117] See, eg, Cashmore et al, above n 116, 304; Gwilliam (2002, unpublished dissertation) cited in Cashmore et al, above n 116, 304; Gullett, above n 116, 150; Dr Matt Edmunds (public hearing transcript of evidence) quoted in Environment and Natural Resources Committee, Parliament of Victoria, *Inquiry into the Environmental Effects Statement Process in Victoria September* (2011) 141.
[118] See, eg, Cashmore et al, above n 116, 304; Gwilliam (2002, unpublished dissertation) cited in Cashmore et al, above n 116, 304; Dr Matt Edmunds (public hearing transcript of evidence) quoted in Environment and Natural Resources Committee, Parliament of Victoria, *Inquiry into the Environmental Effects Statement Process in Victoria September* (2011) 141.
[119] Dr Matt Edmunds (public hearing transcript of evidence) quoted in Environment and Natural Resources Committee, Parliament of Victoria, *Inquiry into the Environmental Effects Statement Process in Victoria September* (2011) 141.
[120] See, eg, Therivel and Ross, above n 2, 384; Cooper and Sheate, above n 16, 6; Duinker and Greig, above n 2, 158; Harriman and Noble, above n 10, 44- 46.
[121] See, eg, Cooper and Sheate, above n 16, 15.
[122] Harriman and Noble, above n 10, 44 - 46.

and advised against assuming that a 'one method fits all' approach is best.[123] Caution against seeking to overcome all of the problems of cumulative impact assessment at the EIA project level with an SEA focus is also emphasised.[124] Further, Harriman and Noble argued that recognising the need for cumulative (and synergistic) impact consideration at both the SEA and EIA project level allows governmental responsibility to provide information from the SEA level that both assists EIA project proponents with their own impact assessments and allows the use of information to assist in avoiding environmental degradation situations beyond remediation.[125] Research undertaken by Cooper and Sheate also supports the argument for inclusion within both frameworks. Their research, into the relationship between cumulative effects and strategic planning in the United Kingdom, indicated that the assessment of cumulative impacts at both strategic and EIA project levels was the most preferred option by research participants.[126]

Duinker and Greig discussed improvements to the approach for the assessment of cumulative and synergistic impacts in Canada.[127] Their suggestions included that there is both a need for improved technique within the EIA approach as well as a need to undertake assessments at a regional level.[128] More recently, Duinker et al explicitly acknowledged that whilst having previously argued in favour of assessing cumulative effects within SEA, they are also of the opinion that improving such assessments within EIA is equally important.[129]

Therivel and Ross identified that there is 'one significant benefit' of undertaking an assessment of cumulative (and synergistic) impacts; that being that 'they identify problems that need attention.'[130] Applicable to this, they have also concluded that there are a number of important aspects for cumulative and synergistic impact management, including the need to ensure that legal frameworks provide a strong foundation for their requirement. [131] Also identified is the need to consider and respond to any issues raised, and provide access to knowledge and previously undertaken studies between project proponents and government authorities. [132] Finally, Therivel and Ross emphasised the need to ensure consistent requirements and application, as well as impact monitoring.[133] This discussion demonstrates the need to address more than issues of assessment method development when undertaking cumulative and synergistic impacts within an assessment framework.

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[123] Ibid, 46.
[124] Ibid, 28.
[125] Ibid, 44 - 45.
[126] Cooper and Sheate, above n 16, 10.
[127] Duinker and Greig, above n 2, 158.
[128] Ibid, 158.
[129] Duinker et al, above n 19, 49.
[130] Therivel and Ross, above n 2, 376.
[131] Ibid, 372.
[132] Ibid.
[133] Ibid.

Dubé and Munkittrick have suggested that where use and development assessment occurs within strategic and statutory planning frameworks, such as SEA and EIA, the assessment should address cumulative (and synergistic) impacts within both 'effects-based'[134] and 'stressor-based'[135] approaches.[136] They discussed the need to gain an understanding of how such impacts have affected the environment prior to any new activity being considered (e.g. baseline monitoring),[137] predicting such impacts of any proposed activity (e.g. SEA or EIA),[138] and monitoring these impacts after new development has occurred (e.g. PAM).[139] An increased focus on the 'effects based' approach within monitoring as a way of improving knowledge about cumulative impacts for application within future environmental assessment is also emphasised by Lattemann and Amy.[140] The 'effects-based' and 'stressor-based' approaches emphasise the need for project level EIA, in combination with SEA, as a method for improved understanding of environmental impacts.

Dickert and Tuttle addressed the capacity of impacts, previously categorised as non-significant, to exceed a threshold and subsequently be identified as significant.[141] They explained that in maintaining cumulative and synergistic impact assessments within EIA to support SEA, there is more opportunity to manage environmental impacts within threshold limits.[142] As an Australian example, Chapple suggests that EIA should also be further developed as a context to assess cumulative impacts.[143]

The arguments presented within sections 2.1 and 2.2 emphasises hesitancy toward an approach that values considering cumulative and synergistic impacts in both frameworks to enable an iterative process. Further, no discussion about the value of considering synergistic impacts as a separate impact type within either paradigm was identified within the literature. This absence of consideration and approach is also applicable to the value of considering both cumulative and synergistic impacts within both SEA and EIA in a manner that enables integrative and proactive environmental planning.

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[134] Refer to Glossary.
[135] Refer to Glossary – in comparison to the 'effects-based approach' the stressor-based approach has less focus on the existing environmental conditions and more focus on the predicted impacts. See Dubé and Munkittrick, above n 39, 248, 251.
[136] Dubé and Munkittrick, above n 39, 256 - 257.
[137] Ibid, 250 – 251.
[138] Ibid, 248 – 250.
[139] Ibid, 254 – 256.
[140] Dubé and Munkittrick (2001) cited in Sabine Latteman and Gary Amy, 'Marine monitoring surveys for desalination plants – a critical review' (2013) 51 (1 – 3) *Desalination and Water Treatment* 233, 234 – 235.
[141] Thomas G Dickert and Andrea E Tuttle, 'Cumulative Impact Assessment in Environmental Planning: A Coastal Wetland Watershed Example' (1985) 5 *Environmental Impact Assessment Review* 37, 39.
[142] Dickert and Tuttle, above n 141, 39.
[143] Sophie Chapple, 'The *Environment Protection and Biodiversity Conservation Act 1999* Cth: one year later' (2001) 18 *Environmental and Planning Law Journal* 523, 529.

The viewpoint that provides for the assessment of cumulative and synergistic impacts within both SEA and EIA is the preferred approach presented and supported in this thesis. Whilst the remainder of the discussion in this chapter (as well as that of Chapter 4) examines assessment in both SEA and EIA, the subsequent chapters respond to concerns that there is a risk of neglect for the ongoing development of cumulative and synergistic impact assessment within EIA. The discussion in the case studies within Chapters 5, 6 and 7, whilst providing SEA focus where appropriate, are primarily focused on the approach to, and improvement of, legal frameworks surrounding cumulative and synergistic impact assessment within EIA.

2.3 Challenges for effective environmental assessment

There are challenges identified in the literature regarding the best framework approach for assessing cumulative and synergistic impacts. These need to be addressed as part of integrative and proactive environmental planning. In the 1980s, Robilliard identified that, the:

> non-institutional or technical constraints that affect cumulative impact assessments are of three types: procedural from a legal viewpoint; methodological, from a "how do we conduct the analysis" perspective; and technical, from the standpoint of what data/ problems/ analysis etc. are available and do we understand how the system(s) work.[144]

The discussion below summarises the challenges, recently highlighted by researchers, and includes those relating to legal, policy and decision-making frameworks, defining terminology, assessment methodology, collaboration and knowledge sharing. A number of these challenges are then expanded upon through a discussion of the additional commentary found within the literature. It is important to note that these challenges could be considered as applicable whether or not the SEA and EIA frameworks are integrated into regulatory frameworks.

Canter and Ross identified obstacles to successful cumulative impact assessment within the context of law and policy, science, and organisations.[145] The difficulties discussed included a need to increase knowledge about the complexities of environments as caused by impacts from multiple stressors and ensuring the legal and policy frameworks consider both VECs and cumulative impacts. [146] The need to further understanding and provide definitive requirements

[144] Gordon A Robilliard, 'Commentary 1' (Marine Systems Management Perspective) in in G E Beanlands et al (eds), The Canadian Environmental Assessment Research Council (CEARC) and The United States National Research Council (NRC), *Cumulative Environment Effects: A Binational Perspective* (CEARC, NRC, 1986) 108; also see Robilliard (1986) quoted in Preston and Bedford, 'Evaluating Cumulative Effects on Wetland Functions: A Conceptual Overview and Generic Framework' (1988) 12 (5) *Environmental Management* 565, 569.
[145] Canter and Ross, above n 13, 265.
[146] Ibid.

for both cumulative (and synergistic) impacts and the associated mitigation methods and environmental management programmes were also identified. [147] Finally, they highlighted the complexities of maintaining collaboration between all parties involved in the project development and decision-making during monitoring and adaptive management.[148] Added to this is the potential constraint of achieving cost and time effective cumulative impact management.[149] Canter and Ross stated that ‘it must be remembered that cumulative effects require cumulative mitigation and management solutions’.[150] This requires effective collaboration. They also discussed the key issues of poor performance in respect of cumulative impact assessment include lack of knowledge or attention to detail, lack of best practice, and concerns about funding adaptive management programmes when problems arise during monitoring.[151] Insufficient clarity in definition and guidance, the lack of knowledge sharing between past and future project proponents, lack of expertise capacity within decision-making authorities (and poor decision-making), were also identified as problems that need to be resolved before the effective assessment of cumulative impacts can occur.[152]

Smart, Stojanovic and Warren, have reiterated the importance of EIA as information for decision-making in relation to the efficacy of environmental assessment within Scotland’s planning process for wind farms.[153] The study demonstrated that survey respondents were concerned with the increasing requirements for complexity and information to be contained within EIAs.[154] This led to a belief that there is a potential to inhibit public scrutiny and comment.[155] However, survey respondents also perceived that cumulative impacts were not assessed effectively due to issues of inconsistency in guidance from decision-making authorities, and insufficiently detailed information from development proponents.[156] The perspectives voiced by respondents on the problems associated with cumulative impact assessment differed according to their background.[157] For example, whether they worked within the development area or as part of a decision-making authority influenced their opinions.[158] The difficulty in accessing data already compiled, and inadequate resources to undertake additional research and analysis, were also identified.[159]

[147] Ibid.
[148] Ibid.
[149] Ibid.
[150] Ibid.
[151] Ibid, 266.
[152] Ibid.
[153] Duncan Ewan Smart, Timothy A. Stojanovic and Charles R. Warren, ‘Is EIA part of the wind power planning problem?’ (2014) 49 *Environmental Impact Assessment Review* 13, 16.
[154] Smart, Stojanovic and Warren, above n 153, 16.
[155] Ibid.
[156] Ibid, 18.
[157] Ibid, 18, 21.
[158] Ibid.
[159] Ibid, 21.

In Sweden's planning processes, issues identified by research include that there was poor understanding surrounding the concept of cumulative (and synergistic) impact assessment,[160] issues of concern about the application of the 'significant' impact threshold,[161] and an absence of regulatory foundation.[162] Results from the research into Swedish and Scottish planning could be interpreted as emphasising the importance of assessing cumulative (and synergistic) impacts with an appropriate scientific method, whilst providing effective communication of results to a broad range of stakeholders involved in the decision-making process.

Three common themes are apparent in the challenges identified by the above research. The first theme relates to challenges associated with regulatory frameworks and behaviour ('attitudinal' challenges) toward assessing cumulative (and synergistic) impacts. The second theme includes challenges associated with the assessment science and the methodology. The third theme incorporates challenges associated with process, focusing on financial and time costs, and knowledge sharing. The following discussion expands upon these challenges.

2.3.1 Regulatory and attitudinal challenges

Senner has stated that there is a need for stronger legal foundations for requiring cumulative impact assessment.[163] The argument is based on a perception that an absence of legal requirement for sustainability considerations is a reason for failure to ensure effective environmental impact assessment.[164] Dixon and Montz identified the potential for existing legislative and policy frameworks to contain provisions that counteract the effective inclusion of requirements for cumulative effects assessment as a challenge.[165]

Hubbard raised the issue, in the 1990s, that where there is a fragmentation of legislative frameworks relating to EIA, poorly defined goals could be applied in different ways.[166] This is similar to more recent concern raised by Masden et al about inadequate guidance within the

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[160] Lennart Folkeson, Hans Antonson, and J O Helldin, 'Planners' views on cumulative effects. A focus-group study concerning transport infrastructure planning in Sweden' (2013) 30 *Land Use Policy* 243, 246 - 247.
[161] Folkeson, Antonson, and Helldin, above n 160, 247.
[162] Ibid.
[163] Robert Senner, 'Appraising the sustainability of project alternatives: An increasing role for cumulative effects assessment' (2011) 31 *Environmental Impact Assessment Review* 502, 503 – 504.
[164] Senner, above n 163, 503 – 504.
[165] Jennifer Dixon and Burrell E Montz, 'From Concept to Practice: Implementing Cumulative Impact Assessment in New Zealand' (1995) 19 (3) *Environmental Management* 445, 446.
[166] See, eg, Pamela Hubbard, *Cumulative effects assessment and regional planning in Southern Ontario: A manuscript prepared for the Canadian Environmental Assessment Research Council* (Canadian Environmental Assessment Research Council, 1990) 45, 47 – 49.

provision of definitions, and the perception that many EIA practitioners failed to understand, or incorporate, cumulative (and synergistic) impact assessment within their processes.[167] Masden et al identified this to be an 'obvious barrier' to its inclusion; arising because of 'the lack of clarity in discourse between the relevant parties i.e. developers, statutory bodies, non-governmental organisations (NGOs) and scientists.'[168] There is also similar commentary about the need for improved communication between government and stakeholders through concern about the absence of clear definition within the context of ensuring the intended 'scientific information' is clearly prescribed.[169] González et al identified that the fragmentation created by multiple stages of consent within a decision-making process can further complicate the understanding of cumulative impacts.[170]

Further to the concerns identified by Spaling and Smit (discussed above) about complications with spatial boundaries and multiple legal jurisdictions,[171] Connelly,[172] and Folkeson, Antonson and Helldin also addressed the matter.[173] In light of this, Folkeson, Antonson and Helldin emphasised that this appears to be an ongoing problem within different environmental assessment frameworks; demonstrating this through acknowledgment that the issues were raised by Contant and Wiggins in the 1990s,[174] and Franks, Brereton and Moran in 2010,[175] and were yet to be resolved.

Whilst Hubbard's concerns about the absence of requirement within Canada's legal frameworks for impact monitoring associated with EIA were identified in the 1990s,[176] there is a continued perception from commentators that there is inadequate PAM for cumulative (and synergistic) impact assessment.[177] This prevalent opinion across time periods and scholars suggests that there are still inadequate legal requirements in some jurisdictions. The importance of PAM for the effective assessment of cumulative and synergistic impacts is discussed further below.

The prescriptive nature of regulatory frameworks has been identified as constraining

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[167] Masden et al, above n 71, 1.
[168] Ibid.
[169] Folkeson, Antonson, and Helldin, above n 160, 244.
[170] González et al, above n 100, 38.
[171] Spaling and Smit, above n 32, 589.
[172] Connelly, above n 47, 454.
[173] Folkeson, Antonson, and Helldin, above n 160, 244.
[174] Contant and Wiggins (1991) cited in Folkeson, Antonson, and Helldin, above n 160, 244; Contant and Wiggins, above n 106, 307.
[175] David M Franks, David Brereton and Chris J Moran (2010) cited in Folkeson, Antonson, and Helldin, above n 160, 244; David M Franks, David Brereton and Chris J Moran, 'Managing the cumulative impacts of coal mining on regional communities and environments in Australia' (2010) 28 (4) *Impact Assessment and Project Appraisal* 299, 308.
[176] Hubbard, above n 166, 49.
[177] See, eg, Therivel and Ross, above n 2, 372; Dubé and Munkittrick, above n 39, 254 – 256; Duinker et al, above n 19, 50.

environmental assessment.[178] Specifically, the timeframes for assessment and associated approval processes are seen as a challenge to ensuring that there is adequate time to undertake a comprehensive assessment.[179] As an example, the timeframes for EIA preparation can be dictated by pre-determined schedules.[180] Timeframes dictating the preparation of an EIA can also be constrained by economic and social drivers, such as the need to progress through an assessment and decision-making process as quickly as possible.[181] This type of issue has been found in several countries, for example, Sweden[182] and Australia.[183]

Wärnbäck and Hilding-Rydevik identified, through research undertaken into the challenges faced for the consideration of cumulative and synergistic impacts in Sweden's EIA frameworks, that restrictive attitudes were another challenge.[184] The attitudes that became apparent during this research included the tendency to follow legal requirements with a bare minimum approach.[185] Thus, unless legislation states that cumulative or synergistic impacts must be considered then they generally are not incorporated into an EIA.[186] That these impact types are not deemed important enough to assess as part of common practice, on the part of the practitioner and the responsible government, is another example.[187] Also focusing on the application of methodology, studies on the effectiveness of EIA in the offshore oil and gas sector have concluded that, whilst cumulative and synergistic effects were mostly neglected, methodological training was not necessarily the best path for addressing the issue until a 'behavioural and attitudinal shift amongst stakeholders' could be achieved.[188]

In the 1990s Court, Wright and Guthrie reviewed some of the problems discussed by Hubbard (see discussion above) and suggested reasons for avoiding the responsibility of requiring

[178] See, eg, David A Munro, 'Environmental impact assessment as an element of environmental management' in G E Beanlands et al (eds), The Canadian Environmental Assessment Research Council (CEARC) and The United States National Research Council (NRC), *Cumulative Environment Effects: A Binational Perspective,* (CEARC, NRC, 1986) 25, 27 - 28.
[179] Munro in Beanlands et al (eds), above n 178, 25, 27 - 28.
[180] See, eg, Victorian Government Department of Sustainability and Environment, *Ministerial Guidelines for the Assessment of Environmental Effects under the Environmental Effects Act 1978* (Victorian Government, 7th ed, 2006) 22. In this example the guidelines provide that time schedules for the preparation of an EIA may be determined as part of the decision-making process.
[181] See, eg, Folkeson, Antonson, and Helldin, above n 160, 250; Hans Antonson, 'The treatment of landscape in a Swedish EIA process' (2011) 31 (3) *Environmental Impact Assessment Review* 195, 203; Antoinette Wärnbäck and Tuija Hilding-Rydevik, 'Cumulative effects in Swedish EIA practice – difficulties and obstacles' (2009) 29 *Environmental Impact Assessment Review* 107, 113; Duinker and Greig, above n 2, 156.
[182] See, eg, Folkeson, Antonson, and Helldin, above n 160, 250; Antonson, above n 181, 203; Wärnbäck and Hilding-Rydevik, above n 181, 113; Duinker and Greig, above n 2, 156.
[183] See, eg, Victorian Government Department of Sustainability and Environment, above n 180, 22.
[184] Wärnbäck and Hilding-Rydevik, above n 181, 107.
[185] Ibid, 111.
[186] Ibid.
[187] Wärnbäck and Hilding-Rydevik, above n 181, 113.
[188] Barker and Jones, above n 99, 36, 37.

cumulative and/or synergistic impact assessment.[189] These included insufficient political intention, poor cohesion in approach between and within all levels of government, the potential for an increase in costs for governments should cumulative (and synergistic) impact assessment occur within SEA instead of EIA, and the lack of expertise to undertake the assessments.[190] Given the concerns about the absence of legal requirement raised by commentators in the above discussion, it is suggested that at least some of these reasons may still be applicable within some jurisdictions. The ongoing concern about a lack of knowledge and data being available for those potentially responsible for preparing and assessing cumulative (and synergistic) impact assessments,[191] is also still apparent within the literature.[192] Folkeson, Antonson and Helldin, having reiterated the argument by Canter and Ross (see above discussion) that the skills within government and associated authorities responsible for making decisions were inadequate,[193] also reflected the ongoing nature of issues raised by Court, Wright and Guthrie.

Nilsson and Dalkmann characterised concerns about the lack of knowledge relevant to environmental assessment within a context of poor quality, high volume information. They state that: 'In other words, while there might be a wealth of *information,* however, there is often very little *knowledge.*'[194] Further, Nilsson and Dalkmann commented that uncertainty challenged the decision-making process. They contended that the more uncertainty there was, the greater the risk was that it would 'overwhelm' the decision-maker.[195]

The challenges that have been identified are indicative of environmental assessment legal frameworks that do not evolve at a pace that adequately responds to increasing environmental pressure at the same time as an increase in scientific knowledge about the cumulative and synergistic effects of this pressure. This could be related to the constraints of time, which in turn can lead to the attitudes that fail to support the intent of environmental assessment. One Australian example demonstrating this concern is found within the Victorian *Planning and Environment Act 1987* (Vic). This Act provides the opportunity for applicants to appeal to the Victorian Civil and Administrative Tribunal if there is a failure of the relevant planning

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[189] John D Court, Colin J Wright, Alasdair C Guthrie, *Assessment of cumulative impacts and strategic assessment in environmental impact assessment: prepared for the Commonwealth Environment Protection Agency* (Commonwealth of Australia, 1994) 2.8 – 2.9.
[190] Court, Wright and Guthrie, above n 189, 2.8 – 2.9.
[191] Ibid, ii.
[192] See, eg, Canter and Ross, above n 13, 266; Caitlin M Crain et al, 'Understanding and Managing Human Threats to the Coastal Marine Environment', (2009) 1162 *The Year in Ecology and Conservation Biology 2009: Ann. N.Y. Acad. Sci* 39, 52; Korpinen, Meidinger and Laamanen, above n 58, 313; Dixon and Montz, above n 165, 446; Katarina Pavlickova and Monika Vsykupova, 'A method proposal for cumulative environmental impact assessment based on landscape vulnerability evaluation' (2015) 50 *Environmental Impact Assessment Review* 74, 82; González et al, above n 100, 36.
[193] Folkeson, Antonson, and Helldin, above n 160, 245; Canter and Ross, above n 13, 266.
[194] Måns Nilsson and Holger Dalkmann, 'Decision making and strategic environmental assessment' (2001) 3(3) *Journal of Environmental Assessment Policy and Management* 305, 320.
[195] Nilsson and Dalkmann, above n 194, 323.

authority to make a decision[196] within 60 days.[197] This time limit has not changed in two decades.[198] Over these two decades there has been an increasing complexity associated with both planning application requirements for information to be submitted by a proponent, and the decision-making process.[199] The risk of this time pressure on the decision-making process is limited attention being given to all relevant information and the uncertainty applicable to existing information.[200] The potential for a less collaborative and more adversarial approach is also increased.[201]

As the regulatory and attitudinal challenges do not exist in isolation, they can have a negative effect on attempts to address the scientific and methodological challenges associated with cumulative and synergistic impact assessment. The next part of the discussion focuses on some of these scientific and methodological challenges.

2.3.2 Scientific and methodological challenges

Another challenge to achieving effective regulatory requirements for the assessment of cumulative and synergistic impacts is the difficulty of setting thresholds. Duinker et al have identified that 'defensible' thresholds must be achieved with rigorous science in a way that is supported by policy.[202] If this is not achieved, then the quality of VECs might be detrimentally impacted before a 'significant' impact is identified or observed.[203] The need to address thresholds for various VECs is also important for providing more certainty about future development,[204] particularly because of the question as to when it is appropriate to impose a prohibition and whether it is fair for future activity proponents to be denied opportunities.[205]

The establishment of a threshold, and the associated challenges, is also applicable to the identification of appropriate methods to mitigate cumulative and synergistic impacts.[206] Providing an Australian example, Haigh raised the concern that the EIA process within the

[196] *Planning and Environment Act 1987* (Vic), s79.
[197] *Planning and Environment Regulations 2015* (Vic) reg 32.
[198] *Planning and Environment Regulations 1998* (Vic) reg 30. These regulations have since been repealed.
[199] This opinion is based on Anna Grage's expertise in the Victorian and Western Australian planning systems (1998 – continuing).
[200] Ibid.
[201] Ibid.
[202] Duinker et al, above n 19, 47.
[203] Ibid.
[204] See, eg, Duinker and Greig, above n 2, 156.
[205] See, eg, Gordon A. Robilliard, above n 144, 107 – 108.
[206] See, eg, Duinker and Greig, above n 2, 157- 158; Jesper H Anderson et al, 'Baltic Sea biodiversity status vs. cumulative human pressures' (2015) 161 *Estuarine, Coastal and Shelf Science* 88, 90 – 91.

EPBC Act 1999 (Cth) for determining 'significance' risked damage to World Heritage Areas.[207] This was due to the neglect of smaller cumulative impacts that were indirect but would still compound over time;[208] thus causing a delay in 'substantive protection'.[209]

Interactions that result because of a chain of events and additional contributing factors can make the prediction of cumulative and synergistic impacts complicated.[210] Crain, Kroeker and Halpern et al discussed that these could include (amongst other things): the potential for synergy between stressors, for example, different responses to different environments and temperatures; that a species response to a stress may alter depending on the different environmental circumstances (e.g. availability of different nutrients); that different species may respond differently due to different levels of resilience (the measure of this can influence the predicted impact as well); and that the response of a community is influenced by individual species responses and species diversity.[211] Whilst Crain, Kroeker and Halpern acknowledged the difficulty of predicting such impacts, they also suggested that enough research had been undertaken to provide the knowledge and capacity to understand and anticipate such interactions.[212] These issues relate to the challenges faced within the scientific methods.

In the 1990s, Bedford and Preston raised concern about the failure to give consideration to synergistic impacts within the Canadian Council on Environmental Quality's then recommended approach, even though scientists involved in undertaking impact assessments were known to have the view that the consideration of synergistic impacts should occur alongside those that are cumulative.[213] Connected to this, Bedford and Preston also argued that the scientific method surrounding the prediction and assessment of 'synergistic' and 'interactive' impacts needed further development.[214] This concern was reflected by Dixon and Montz in the mid-1990s whereby the challenges discussed focused on the complexities of accurately predicting these impact types alongside the limited capacity of the method to address spatial and temporal factors.[215]

More recently, and in what appears to be a reflection of the extent of success in method

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[207] David J Haigh, 'Hinchinbrook – in defence of world heritage' (1999) 6 (1) *The Australasian Journal of Natural Resources Law and Policy* 47, 58, 69.
[208] Haigh, above n 207, 47, 58, 69.
[209] Ibid, 58.
[210] See, eg, Caitlin Mullan Crain, Kristy Kroeker and Benjamin S Halpern, 'Interactive and cumulative effects of multiple stressors in marine systems' (2008) 11 *Ecology Letters* 1304, 1305 - 1306; Ian Billick and Ted J Case, 'Higher Order Interactions in Ecological Communities: What are they and how can they be detected?' (1994) 75 (6) *Ecology* 1529, 1541 – 1542.
[211] Crain, Kroeker and Halpern, above n 210, 1305 – 1306.
[212] Ibid.
[213] Bedford and Preston, above n 1, 758.
[214] Ibid.
[215] Dixon and Montz, above n 165, 446.

development, Seitz, Westbrook and Noble reviewed a number of commentaries on the approach to CEA.[216] They concluded that the multiplicity of approaches and best-fit practice, resulted in an inconsistent approach for CEA, and was an obstacle to success.[217] Duinker et al also reviewed the approach to developing frameworks for assessing cumulative effects.[218] In explaining that there were a multitude of different framework approaches to assessing cumulative impacts it was also commented that the differences between approaches could complicate the process as opposed to providing clear guidance.[219] As a solution, Duinker et al recommended that frameworks continue to implement the complex assessment of cumulative (and synergistic) impacts within existing EIA frameworks (as opposed to SEA only), whilst acknowledging the need for robust scientific approaches because of this complexity.[220] Providing an additional recent example, Pavlickova and Vyskupova identified barriers to the successful assessment of cumulative (and synergistic) impacts as including limited assessment methods, and the difficulties associated with not knowing what future impacts will contribute to the impacts from a current development.[221] They also identified that cumulative (and synergistic) impacts can be more difficult to perceive and therefore measure.[222]

The examples discussed emphasise a need for the continual development of environmental assessment legal frameworks that recognise the scientific and methodological challenges, such as robust thresholds from a science and policy perspective, environmental variability and the uncertainty of prediction. The complexity of cumulative (and synergistic) impact assessment also has the potential to create several flow-on effects, including an increase in the economic demands on development proponents. This is discussed further below.

2.3.3 Challenges of economics, time, knowledge sharing and collaboration

An important question that needs addressing is that of who is to pay for the additional economic costs attributed to cumulative and synergistic impact assessment? This risk is possibly heightened if a knowledge sharing framework is in place and the first proponent ends up paying more for information gathering than subsequent proponents.[223] The costs associated with detailed monitoring programmes can also impact upon the propensity or willingness of project

[216] Seitz, Westbrook and Noble, above n 53, 174.
[217] Ibid.
[218] Duinker et al, above n 19, 42 - 45.
[219] Ibid, 45.
[220] Ibid.
[221] Pavlickova and Vsykupova, above n 192, 82.
[222] Ibid, 74.
[223] See, eg, Gordon A Robilliard, above n 144, 107 – 108.

proponents to undertake, or governments to impose conditional requirements for, such programmes.[224]

Buschke and Vanschoenwinkel raised the issue of where the cost for cumulative (and synergistic) impact assessment should be borne.[225] In doing so, they stated that the risk of economic inequity for future developers arises if limitations for future development arise due to identified cumulative impacts (for example, additional mitigation works or reduced development opportunity because of earlier activities).[226] The development of cost sharing frameworks was suggested as a method to address this, but it was acknowledged that this was limited by a lack of knowledge about the precise details and impacts of future use and development.[227] Given the challenge of attributing financial costs, they also raised the point that an outcome of undertaking cumulative (and synergistic) impact assessment in an effective manner would in itself act as a limitation on future development potential.[228] In stating this, they argued the position that within the context of sustainable development there is no inherent license to continually develop.[229]

The potential expectation that project proponents are responsible for collecting baseline data was a cost challenge identified by Dixon and Montz.[230] In discussing their opinion, Dixon and Montz stated that it was a potential constraint to expect this aspect of environmental assessment for cumulative (and synergistic) impacts to be undertaken by any stakeholder other than the government authority.[231] Although the issue was raised in the 1990s that cumulative and synergistic impacts are still not a common component of environmental assessment, this means that the challenges of any associated economic burden have still not been properly addressed. The complexities and challenge of assessing these impact types could also be seen as a reason for potential inaction to incorporate assessments within SEA and EIA. Aside from economic cost, the 'challenge' is also discussed as often being avoided due to inappropriate time frames.[232] The time frame complexities associated with individual project assessments are

[224] See, eg, Richard F Ambrose, Russell J Schmitt and Craig W Osenberg, 'Predicted and Observed Environmental Impacts: Can we Foretell Ecological Change?' in Russell J Schmitt and Craig W Osenberg (eds), *Detecting ecological impacts: concepts and applications in coastal habitats* (Academic Press, 1996) 345, 367.
[225] Falko T Buschke and Bram Vanschoenwinkel, 'Mechanisms for the inclusion of cumulative impacts in conservation decision-making are sensitive to vulnerability and irreplaceability in a stochastically simulated landscape' (2014) 22 *Journal for Nature Conservation* 265, 266.
[226] Buschke and Vanschoenwinkel, above n 225, 266.
[227] Ibid.
[228] Ibid, 268.
[229] Ibid, 268. It is noted that, that whilst referred to by Bushcke and Vanschoenwinkel, this argument appears to be counteractive to the argument put forward by Bill Willers in Bill Willers, 'Sustainable Development: A New World Deception' (1994) 8 *Conservation Biology* 1146, 1146.
[230] Dixon and Montz, above n 165, 448.
[231] Ibid, 449.
[232] See, eg, Spaling and Smit, above n 32, 589.

emphasised when long-term natural environmental processes are considered.[233]

Collaboration has been identified as an important, and sometimes lacking, element of successfully addressing cumulative (and synergistic) impact assessment effectively.[234] As an example, Duinker et al recommended collaboration between stakeholders as a critical element to effective assessment.[235] Similarly, it was discussed that collaboration should extend to knowledge sharing so as to better enable other cumulative (and synergistic) effects assessments within the same region.[236] However, collaboration has also been identified as a constraint when there are significant challenges in achieving collaboration between multiple groups of stakeholders with varying agendas.[237] This is further emphasised when, for example, the spatial boundary is difficult to establish, the time period associated with the cumulative (and synergistic) impact is not defined, or there is a requirement for multiple stakeholders to monitor impacts caused by single or multiple activities.[238]

As mentioned above, effective collaboration can be constrained by legal frameworks for environmental assessment that have failed to evolve and/or facilitate a fragmented approach to decision-making. The challenge of knowledge sharing and the equity associated with economic costs can also be considered in this context. Whilst the complexity of these issues is acknowledged, and legal framework modifications should aim to address them, due to the limitations of this thesis their continued discussion will not be a central focus. Instead the thesis will continue to address legal and scientific challenges for assessing cumulative and synergistic impacts.

3. Applying the precautionary principle and utilising post-approval monitoring

The difficulty of accurately predicting impacts, as well as a lack of knowledge, are causes of uncertainty.[239] The challenges of uncertainty, in combination with the need for effective

[233] Ibid.
[234] See, eg, Dixon and Montz, above n 165, 448,455; Madelaine Porter, Daniel M Franks and Jo-Anne Everingham, 'Cultivating collaboration: Lessons from initiatives to understand and manage cumulative impacts in Australian resource regions' (2013) 38 *Resources Policy* 657, 658; Duinker and Greig, above n 2, 159; Franks, Brereton and Moran, above n 175, 309; Duinker et al, above n 19, 50; Folkeson, Antonson, and Helldin, above n 160, 247 – 248; David P Lawrence, 'Impact significance determination – Pushing the boundaries', (2007) 27 *Environmental Impact Assessment Review* 770, 781.
[235] Duinker et al, above n 19, 50.
[236] Ibid.
[237] Porter, Franks, and Everingham, above n 234, 666 – 669.
[238] Ibid; Franks, Brereton and Moran, above n 175, 309 – 310.
[239] See, eg, Fidler and Noble, above n 61, 16; Hegmann and Yarranton, above n 15, 486; Canter and Ross, above n 13, 263 – 264; Jacqueline Peel, *The Precautionary Principle in Practice: Environmental Decision-Making and Scientific Uncertainty*, (The Federation Press, 2005) 143; Nilsson and Dalkmann, above n 194, 323.

assessment of cumulative and synergistic impacts within environmental assessment, have been identified by various scholars.[240] This section further explores the uncertainty that results from a lack of knowledge about cumulative and synergistic impacts occurring in the marine environment. The section also examines the application of the precautionary principle and implementation of PAM as mechanisms for reducing levels of uncertainty within decision-making processes that are associated with environmental assessment.

The ability to enable accurate predictions about environmental impacts is constrained by the extant knowledge about natural environmental systems and species.[241] Commentators such as Peel have emphasised that environmental impacts should be considered alongside the fact that little is known about the environment.[242] With cumulative (and synergistic) impacts identified as a reason for scientific uncertainty,[243] best practice environmental assessment methods should also recognise that impact predictions may not be the same as the eventual and actual impacts.[244] The development of scientific method has also been identified as contributing to uncertainty.[245] Comments from Duinker et al, concluded that further research was required in addition to continuing data collection and developing assessment methods to improve predictions and measurements. [246] The basis for this is to understand environmental thresholds and therefore assist in ensuring that regulatory thresholds can be correlated and used more often.[247]

Fisher provided a broader reason for uncertainty: in considering the complexity and uncertainty of scientific information about environmental impacts, the consistency of approach to impact assessment is further complicated by the uncertainties of the decision-making process itself, including the surrounding legal framework.[248] Further, Masden et al argued that the types of uncertainty that impact on the effective consideration of cumulative (and synergistic) impacts within environmental assessment can be categorised.[249] The categories suggested include: the

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[240] Refer to sections 2, 2.1 and 2.3.1.
[241] Thomas and Elliot, above n 2, 155.
[242] Peel, above n 239, 195.
[243] See, eg, Owen McIntyre and Thomas Mosedale, 'The Precautionary Principle as a norm of customary international law' (1997) 9 (2) *Journal of Environmental Law* 221, 221; Warwick Gullett, 'Environmental Protection and the "Precautionary Principle": A response to Scientific Uncertainty in Environmental Management' (1997) 14 *Environmental and Planning Law Journal* 52, 53.
[244] See, eg, Ambrose, Schmitt and Osenberg in Schmitt and Osenberg (eds), above n 224, 367; Dallas Johnson et al, 'Improving cumulative effects assessment in Alberta: Regional strategic assessment' (2011) 31 *Environmental Impact Assessment Review* 481, 482; Johnson et al (2011) cited in Ayodele Omoniyi Olagunju and Jill A E Gunn, 'Selection of valued ecosystem components in cumulative effects assessment: lessons from Canadian road construction projects' (2015) 33 (3) *Impact Assessment and Project Appraisal* 207, 207.
[245] See, eg, McIntyre and Mosedale, above n 243, 221.
[246] Duinker et al, above n 19, 49 - 50.
[247] Ibid.
[248] D E Fisher, *Australian Environmental Law: norms, principles and rules* (Thompson Reuters, 2010) 300 – 301 [12.220]. See also Fisher's discussion of *Prineas v Forestry Commission of New South Wales* (1983) 49 LGRA 402 at 417 on this page.
[249] Elizabeth A Masden et al, 'Renewable energy developments in an uncertain world: The case of offshore wind and birds in the UK' (2015) 51 *Marine Policy* 169, 170 – 171.

unpredictable nature of change occurring within environmental systems ('random' uncertainty); the type of uncertainty associated with a poor knowledge base that can be improved with further understanding ('systematic' uncertainty); the absence of clear definition for terms ('linguistic' uncertainty); inconsistency in decision-making frameworks and policy ('decision-making' uncertainty); insufficient environmental data ('knowledge' uncertainty); the uncertainty that is associated with inadequate science being improved upon and leading to changes in knowledge; and uncertainty due to inconsistencies in data collection and analysis methods.[250] Also discussing uncertainty within the context of environmental science and management, Regan, Colyvan and Burgman summarised the categories that relate to natural systems and scientific analysis as 'epistemic uncertainty'.[251] Further, Regan, Colyvan and Burgman emphasised that 'although linguistic uncertainty is common in conservation biology where policy and decision-making play important roles, it is often ignored and only epistemic uncertainty is considered.'[252]

The precautionary principle and PAM can be used to address the issues raised by uncertainty within the decision-making process and associated frameworks. Referring back to discussion in Chapter 1, the definition of the precautionary principle provided within Principle 15 of the *Rio Declaration on Environment and Development* (Rio Declaration) states that where there is a 'threat of serious or irreversible' environmental damage, then uncertainty about the actual potential for that damage to occur is not an appropriate excuse for avoiding 'cost-effective' preventative measures.[253] The precautionary principle provides for a management approach toward environmental impacts where, because of 'uncertainty', the complexity of the cause and effect relationship is not easily understood.[254] It also assists with the continual need to increase knowledge about cumulative (and synergistic) impacts themselves.[255] To aid the achievement of these goals, the application of the precautionary principle can be required within legislative

[250] Masden et al, above n 249, 170 – 171.
[251] Helen M Regan, Mark Colyvan, and Mark A Burgman, 'A taxonomy and treatment of uncertainty for ecology and conservation biology' (2002) 12(2) *Ecological Applications* 618, 618; Also see discussion about this article in The Hon Justice Brian J Preston, 'Biodiversity offsets: Adequacy and efficacy in theory and practice' (2016) 33 *Environmental and Planning Law Journal* 93, 108.
[252] Regan, Colyvan, and Burgman, above n 251, 618.
[253] United Nations General Assembly, *Report of the United Nations Conference on Environment and Development: Annex 1 Rio Declaration on Environment and Development* UN Doc A:CONF.151:26 (Vol.1) (3 – 14 June 1992), Principle 15 <http//:www.un.org/documents/ga/conf151/aconf15126-1annex1.htm>.
[254] See, eg, Jaye Ellis and Stepan Wood, 'International Environmental Law' in Benjamin J Richardson & Stepan Wood (eds) *Environmental Law for Sustainability* (Hart Publishing, 2006) 343, 361 – 362; Joel A Tickner and Ken Geiser, 'The precautionary principle stimulus for solutions – and alternatives – based environmental policy' (2004) 24 *Environmental Impact Assessment Review* 801, 807; David Kriebel et al, 'The Precautionary Principle in Environmental Science' (2001) 109 (9) *Environmental Health Perspectives* 871, 873, 874; Fisher, above n 222, 301 [12.220].
[255] See, eg, Rozalyn Daniell, 'To what extent do land use planning controls and policy in South Australia facilitate sustainable development' (1998) (1)(2) *Australian Environmental Law News* 50, 51; Derek V Ellis, 'The precautionary principle and environmental monitoring', (2003) 46 *Marine Pollution Bulletin* 933, 933; Charmain Barton, 'The Status of the Precautionary Principle in Australia: its emergence in legislation and as a common law doctrine' (1998) 22 *Harvard Environmental Law Review* 509, 513; Kriebel et al, above n 254, 873, 874.

frameworks for environmental decision-making.[256] For environmental assessment, the principle can be applied within processes for deciding whether anthropogenic activities occurring within the natural environment should be approved.[257] This consideration includes whether conditions aimed at mitigating environmental impacts after they occur should be imposed as part of any approval granted.[258] Chapter 4 further discusses the role of the precautionary principle in Australia.

The link between the precautionary principle and the assessment of cumulative (and synergistic) impacts was emphasised by Snell and Cowell through their discussion on EIA scoping.[259] They identified that there are inherent difficulties with choosing to confine assessment requirements to those 'significant' impacts to enable efficient decision-making whilst incorporating assessments of the more complex impacts (such as cumulative and synergistic impacts) that allow for greater precaution in the decision-making process.[260] Further, commentary provided by Duinker and Greig discussed that any decision made should not be done so on the premise that cumulative (and synergistic) impacts are 'insignificant' simply because conclusions that the isolated predicted effects of a project are of themselves deemed to be 'insignificant'.[261]

Post-approval monitoring is perceived as an important part of environmental management and planning processes as it provides an iterative feedback mechanism for addressing the uncertainties associated with predicted impacts,[262] as well as information on actual impacts.[263] The data collected through PAM has the potential to inform and link strategic environmental planning, including SEAs,[264] and the surrounding decision-making processes that incorporate EIAs in a cyclical manner.[265] This is achieved through the use of PAM knowledge gained from a past environmental assessment and decision-making processes to inform future environmental assessment and decision-making processes.

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[256] See, eg, Australia's *Environment Protection and Biodiversity Conservation Act 1999* (Cth), Section 391.
[257] See, eg, Peel, above n 239, 15, 155 – 159.
[258] Ibid, 158.
[259] Tim Snell and Richard Cowell, 'Scoping in environmental impact assessment: Balancing precaution and efficiency?' (2006) 26 *Environmental Impact Assessment Review* 359, 360. Refer to the glossary for a definition of 'scoping'.
[260] Ibid.
[261] Duinker and Greig, above n 2, 157.
[262] See, eg, L W Canter (1996) cited in Cooper and Sheate, above n 16, 15; L W Canter, *Environmental Impact Assessment* (McGraw – Hill Book Co, 1996) 48; Beanlands and Duinker, above n 101, 169 - 170.
[263] See, eg, R Bisset and P Tomlinson (1983) cited in A K M Rafique Ahammed and Bronte Merrick Nixon, 'Environmental impact monitoring in the EIA process of South Australia', (2006) 26 *Environmental Impact Assessment Review* 426, 428 - 429.
[264] See, eg, L W Canter (1996) cited in Cooper and Sheate, above n 16, 15; Canter, above n 262, 48; Therivel and Ross, above n 2, 367, 372 – 373.
[265] See, eg, L W Canter (1996) cited in Cooper and Sheate, above n 16, 15; Canter, above n 262, 48; Therivel and Ross, above n 2, 367, 372 – 373.

The PAM of an anthropogenic activity's impact on the environment can occur after a decision to approve a particular use and/or development has been granted,[266] and can assist remedial action to be taken should the impacts be considered detrimental and unacceptable.[267] PAM can be required directly by legislation frameworks,[268] through incorporation within the conditions imposed on an approved project (after EIA),[269] as an integral part of an SEA,[270] and through general management regimes.[271] As an example of the use of conditions of approval, Gullett discussed the question of whether activities occurring beyond the activity proposed should be assessed as a cumulative impact within the context of Talbot J's decision in *Port Stephens Pearls Pty Ltd v Minister for Infrastructure and Planning* [2005] NSWLEC 426 (the *Port Stephens* case).[272] Addressing this, Gullett provided the example of Talbot J's approach to the management of cumulative impacts through approval conditions that required monitoring; thus providing information that can determine whether any cumulative impacts found to have occurred need to be addressed through future actions or decision-making processes.[273]

The commentary within the literature about the function of the precautionary principle and PAM in improving knowledge about cumulative (and synergistic) impacts raises key issues. These include the potential for a reduction in uncertainty in scientific environmental assessment, as well as the uncertainty that is associated with environmental decision-making processes, and the facilitation of iterative feedback. These issues are discussed further in section 3.1. The literature reviewed identifies that the application of the precautionary principle should occur for cumulative and synergistic impacts that do not automatically fall into the 'significant' impact category. The discussion, however, is centred on anthropogenic activities and it is suggested that environment change, whilst adding to the complexity of uncertainty, also needs to be addressed.

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[266] See, eg, International Association for Impact Assessment in cooperation with Institute of Environmental Assessment, UK, *Principles of Environmental Impact Assessment Best Practice,* (1999), 4 <http//:www.iaia.org/publicdocuments/special-publications/Principles%20of%201A_web.pdf>; International Association for Impact Assessment in cooperation with Institute of Environmental Assessment (1999) cited in Thomas and Elliot, above n 2, 18 – 19.

[267] See, eg, International Association for Impact Assessment in cooperation with Institute of Environmental Assessment, UK, above n 266, 4; International Association for Impact Assessment in cooperation with Institute of Environmental Assessment (1999) cited in Thomas and Elliot, above n 2, 18 – 19.

[268] See, eg, Australia's *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth), Regulation 14(6).

[269] See, eg, conditions of approval requiring monitoring of the Victoria's Port Phillip Bay Channel Deepening Project as discussed in Office of the Environmental Monitor, *Annual Review No. 3 – January 2011, Reporting period: 8 February 2008 to 31 December 2010* (Victorian Government - Office of the Environmental Monitor, 2011) iii.

[270] See, eg, Great Barrier Reef Marine Park Authority, *Great Barrier Reef Region Strategic Assessment: Strategic assessment report* (Great Barrier Reef Marine Park Authority, 2014), 6 - 66, 6 - 71 – 6 – 72.

[271] See, eg, Therivel and Ross, above n 2, 367, 372 – 373.

[272] *Port Stephens Pearls Pty Ltd v Minister for Infrastructure and Planning* [2005] NSWLEC 426, [56]; *Port Stephens Pearls Pty Ltd v Minister for Infrastructure and Planning* [2005] NSWLEC 426 cited in Warwick Gullett, 'Contesting the merits of aquaculture development: Port Stephens Pearls Pty Ltd v Minister for Infrastructure and Planning [2005] NSWLEC 426' (2006) 11 (1) *The Australasian Journal of Natural Resources Law and Policy* 109, 113 - 114. The case is also discussed within Chapter 4, section 2.2.

[273] *Port Stephens Pearls Pty Ltd v Minister for Infrastructure and Planning* [2005] NSWLEC 426, [56]; *Port Stephens Pearls Pty Ltd v Minister for Infrastructure and Planning* [2005] NSWLEC 426 cited in Gullett, above n 272, 113 - 115.

This should occur when applying the precautionary principle and utilising PAM, and might assist in increasing attention given to 'non-significant' impacts.

3.1 The precautionary principle and cumulative and synergistic impacts: methods and challenges for environmental assessment

This part of the discussion reviews literature commentary on the relationship between the precautionary principle and methods for scientific assessment of cumulative and synergistic impacts. The reversal of the burden of proof when applying the precautionary principle to scientific environmental assessment is also addressed. The discussion concludes with a focus on challenges faced with the application of the precautionary principle within the context of cumulative and synergistic impact assessment.

Criticism discussing the relationship between EIA and the precautionary principle has raised issues about the adequacy of cumulative (and synergistic) impact assessment. As an example, Gullett has stated that because precautionary considerations in EIA processes are insufficient, there is an inadequate application of the precautionary principle.[274] To overcome this, Gullett suggested that more attention needed to be paid to the uncertainties that present within an EIA process; thus including cumulative impact consideration.[275] Similar arguments have been made with specific reference to synergistic impacts.[276]

Consistent application of the precautionary principle was emphasised in recommendations by the *International earth system expert workshop on ocean stresses and impacts*. These recommendations concentrated on the relationship between the responsibility for applying the precautionary principle and the protection of the world's oceans by stating the need for:

> Proper and universal implementation of the precautionary principle by reversing the burden of proof so activities proceed only if they are shown not to harm the ocean singly or in combination with other activities.[277]

This recommendation also emphasises a need to consider impact interactions beyond linear cause and effect relationships by including those that are cumulative and/or synergistic.

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[274] Gullett, above n 116, 148.
[275] Ibid, 149.
[276] See, eg, Daniell, above n 255, 51.
[277] A D Rogers and D d'A Laffoley, *International Earth System expert workshop on ocean stresses and impacts* (IPSO Oxford, 2011) 8. This recommendation is also discussed in the State of the Environment 2011 Committee, *Australia State of the Environment 2011. Independent report to the Australian Government Minister for Sustainability, Environment, Water, Population and Communities* (DSEWPaC, 2011) 418.

At both the SEA and EIA levels, management decisions about cumulative (and synergistic) impacts can be made from a precautionary perspective. As an example at the EIA project level, Therivel and Ross identified the capacity to include conditions relating to net gain (offsets) as part of any approval.[278] Canter and Ross identified two pro-active approaches that can be taken within the decision-making process in response to the issues raised within cumulative (and synergistic) impact assessments.[279] These included offsetting areas for future utilisation, or 'over-mitigating' the impacts associated with a use or development so as to 'make room' for future anthropogenic activities.[280] Counter to these suggestions, concern about the effective use of offsets, however, arises in instances where the offsets stipulated in a decision-making process are indirect (e.g. financial compensation) instead of direct (e.g. environmental restoration).[281]

An example at the strategic planning level is determining that, in future, particular activities should be avoided within a particular area.[282] In support of SEA as a process capable of identifying concerns earlier than EIA, Chaker et al discussed that from the perspective of both the 'Precautionary and Preventative Action Principles', SEA is designed to account for the more complex impacts (i.e. cumulative and synergistic).[283] Preceding the comments from Chaker et al, however, Court, Wright and Guthrie raised the concern that EIA was not suitable for applying the precautionary principle.[284] This concern can be linked to the issue raised by Cocklin, Parker and Hay (also in the 1990s), that EIA is generally more 'reactive' by design than SEA.[285] However, it is suggested that the need to apply the precautionary principle within EIA decision-making and cumulative and synergistic assessment should not be avoided due to the valuable contribution that can be made to the continual improvement of knowledge and environmental protection.[286] Due to the long-term time frames associated with developing policy for strategic planning after an SEA has been conducted, there can be a tendency for strategic planning to be reactive in nature. When EIA is utilised to its potential it can help to mitigate known environmental issues and avoid further cumulative (and synergistic) interactions.

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[278] Therivel and Ross, above n 2, 368.
[279] Canter and Ross, above n 13, 263.
[280] Ibid.
[281] See, eg, Preston, above n 251, 96 – 97.
[282] See, eg, Therivel and Ross, above n 2, 368 – 369.
[283] A Chaker et al, 'A review of strategic environmental assessment in 12 selected countries', (2006) 26 *Environmental Impact Assessment Review* 15, 51.
[284] Court, Wright and Guthrie, above n 45, 44, 56.
[285] Cocklin, Parker and Hay, above n 39, 45.
[286] This opinion is based on Anna Grage's expertise in the Victorian and Western Australian planning systems (1998 – continuing).

3.1.1 Assessment methods and the application of the precautionary principle

Cumulative impact mapping is a tool capable of identifying the potential for cumulative (and synergistic) stressors within a given area, and can be used alongside the precautionary principle to assist assessment in SEA and EIA.[287] However, it is acknowledged that, due to the complexities, there are restrictions to the consideration of synergistic impacts with this approach.[288] Other methodological approaches, such as integrated and ecosystem based management for environmental areas (e.g. marine), are also identified as appropriate for incorporation of both cumulative impact assessment and the precautionary principle.[289]

There is a focus within the environmental assessment methods literature on the importance of applying the precautionary principle when addressing complex outcomes, such as those caused by cumulative (and synergistic) impacts that are difficult to manage through risk assessment methods.[290] Iverson and Perrings argued that in incorporating uncertainty, and therefore the precautionary principle, into policy, it is not always appropriate to rely upon risk assessments when the lack of scientific knowledge prohibits 'probabilities to be plausibly specified'.[291]

The environment can respond differently to stressors depending upon the specific attributes of a habitat or ecosystem. This results in situations whereby the same stressor can have different impacts in different areas, and is another factor needing consideration.[292] Franks, Brereton and Moran have emphasised the need to consider site-specific impacts and effects when the potential for a complex chain of events causing cumulative (and synergistic) impacts is taken into account.[293] A number of variables need to be considered. Specifically, the need for baseline studies to be undertaken within a particular environment instead of relying upon desktop studies,[294] the capacity for baseline environmental conditions to change due to environmental

[287] Natalie C Ban, Hussein M Alidina, Jeff A Ardron, 'Cumulative impact mapping: Advances, relevance and limitations to marine management and conservation, using Canada's Pacific waters as a case study' (2010) 34 *Marine Policy* 876, 876, 881, 885; Halpern et al, above n 9, 208; Danielle Marcotte, Samuel K Hung, Sébastien Caquard, 'Mapping cumulative impacts on Hong Kong's pink dolphin population' (2015) 109 *Ocean & Coastal Management* 51, 51 - 63.
[288] See, eg, Ban, Alidina and Ardron, above n 287, 883; Marcotte, Hung and Caquard, above n 287, 56.
[289] See, eg, Richard Curtin and Raúl Prellezo, 'Understanding marine ecosystem based management: A literature review' (2010) 34 (6) *Marine Policy* 821, 826.
[290] See, eg, D Santillo et al, 'The Precautionary Principle: Protecting Against Failures of Scientific Method and Risk Assessment' (1998) 36 (12) *Marine Pollution Bulletin* 939, 942; Allan Randall, 'Coal Seam Gas – Toward a risk management framework for a novel intervention' (2012) 29 *Environmental and Planning Law Journal* 152, 157, 159; Peel, above n 239, 151; Terrence Iverson and Charles Perrings, 'Precaution and proportionality in the management of global environmental change' (2012) 22 *Global Environmental Change* 161, 165; Gullett, above n 243, 53 - 55.
[291] Iverson and Perrings, above n 290, 165.
[292] Franks, Brereton and Moran, above n 175, 300.
[293] Ibid.
[294] See, eg, Barker and Jones, above n 99, 34.

impacts,[295] and predicted site-specific impacts on the environment not necessarily being the same as actual impacts, [296] have also been identified. These approaches further emphasise the importance of applying the precautionary principle to decision-making processes involving cumulative and synergistic impacts, and environmental assessment. Further to comments raised by Duinker and Greig discussed above[297] about the relationship between uncertainty and the need to identify environmental thresholds, but addressing site-specific characteristics, Duinker et al have raised the question of whether a stronger application of the precautionary principle should occur.[298] This is noted in instances where it is assumed that all cumulative impacts are significant when an environment's response threshold is unknown (i.e. worst case scenario).[299]

Evidence of time lags for cumulative (and synergistic) impacts is also relevant to the effective application of the precautionary principle.[300] In this context, uncertainty about the potential impacts could increase the greater the region and longer the time frame contemplated by the cumulative (and synergistic) impact assessment. [301]

This discussion demonstrates that although there are a number of methods for assessing cumulative and synergistic impacts, the application of the precautionary principle is beneficial for addressing the complexities associated with these methods. In addition to the uncertainty created by factors influencing these methods, the responsibility for applying the precautionary principle is an additional complex component. This responsibility is addressed below within the context of a discussion on the 'burden of proof'.

3.1.2 The challenges for attributing the 'burden of proof' when associated with scientific assessment

As recommended by the *International earth system expert workshop on ocean stresses and impacts* there is a need to reverse the burden of proof.[302] The 'burden of proof' is a legal concept that refers to the attribution of responsibility for establishing sufficient facts to support a legal

[295] See, eg, Jon Day, 'The need and practice of monitoring, evaluating and adapting marine planning and management – lessons from the Great Barrier Reef' (2008) 32 *Marine Policy* 823, 827; It is noted that whilst Day references Daniel Pauly et al, 'Fishing down marine food webs' (1998) 279 *Science* 860 – 863 for a discussion on this, as well as a particular quote, the reference appears to be incorrect.
[296] See, eg, Ambrose, Schmitt and Osenberg in Schmitt and Osenberg (eds), above n 224, 367; L W Canter (1996) cited in Cooper and Sheate, above n 16, 15; Canter, above n 262, 48; Therivel and Ross, above n 2, 367 & 380.
[297] See above n 206.
[298] Duinker et al, above n 19, 50.
[299] Ibid.
[300] Iverson and Perrings, above n 290, 161.
[301] Hegmann and Yarranton, above n 15, 486.
[302] Rogers and d'A Laffoley, above n 277, 8.

claim in contention.[303] Ordinarily, in law, this responsibility resides with the party initiating proceedings, and the evidence must be provided to satisfy any required minimum legal standard.[304] When the precautionary principle is applied within decision-making processes that include environmental assessment, the 'burden of proof' is generally shifted to that of the party seeking to undertake the use and/or development (i.e. the entity that is potentially responsible for any environmental damage).[305]

Barriers to the successful application of the precautionary principle can also be related to interpretation of statistical analyses used within scientific method. As an example of the complexities surrounding the uncertainty and assessment of environmental impacts occurring across time, and their potential to become 'significant' in nature, Dahlstrom Davidson and Hewitt discuss fundamental risks with scientific statistical analysis that could result in the failure to identify actual impacts, even where they exist.[306] These include the potential for the conclusion of a 'null hypothesis' to determine that there would be 'no effect' and a subsequent understanding by decision-makers that there may be no impacts in situations when there are.[307] Kriebel et al have also addressed this issue, explaining that due to standard methods there is the potential for 'failing to detect something that actually does exist' to the extent that 'Twenty percent of the time, a real phenomenon will be missed because the data were not strong enough to convincingly demonstrate its existence'.[308] As also stated by Kriebel et al, with statistical tests for avoiding a false finding (limited to 5%) there is more caution in statistical analysis attributed to 'falsely detecting something than about failing to detect something'.[309] These issues compound the implications for applying the precautionary principle in relation to understanding and managing the uncertainty associated with cumulative (and synergistic) impacts within the environment.[310]

The question is raised as to the burden of proof attribution when environmental impact predictions are found to be incorrect.[311] In the discussion by Dahlstrom Davidson and Hewitt, the conclusion highlighted that a lack of knowledge about an impact should not automatically

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303 Peel, above n 239, 141.
304 Ibid.
305 See, eg, Barton, above n 255, 509; Peel, above n 239, 141; Kriebel et al, above n 254, 871; Tickner and Geiser, above n 254, 803; Lawrence, above n 234, 783.
306 Alisha Dahlstrom Davidson and Chad L Hewitt, 'How often are invasion-induced ecological impacts missed?' (2014) 16 *Biological Invasions* 1165, 1166, 1170.
307 Randall M Peterman, 'The importance of reporting statistical power: the forest decline and acidic deposition example' (1990) 71 (5) *Ecology* 2074, 2074; Randall M Peterman (1990) cited in Dahlstrom Davidson and Hewitt, above n 306, 1166; Dahlstrom Davidson and Hewitt, above n 306, 1170.
308 Kriebel et al, above n 254, 873.
309 Ibid; also see the discussion in Alisha D Davidson, Chad L Hewitt and Donna R Kashian, 'Understanding Acceptable Level of Risk: Incorporating the Economic Cost of Under-Managing Invasive Species' (2015) *PloS ONE* 10(11) 3/12 <http://e0141958.doi:10.1371/journal.pone.0141958>.
310 See, eg, Kriebel et al, above n 254, 873 – 874; Peel, above n 239, 41.
311 See, eg, Santillo et al, above n 290, 948.

equate to an approach whereby potential impacts are not acknowledged and the need for mitigating actions are set aside.[312] Further, Dahlstrom Davidson, Campbell and Hewitt discussed the advantages of an increased need to apply the precautionary principle as a response to uncertainty.[313] This occurs within the context of impact measurement errors, by suggesting that when the precautionary principle is applied and the burden of proof is shifted, the approach of 'guilty until proven innocent' has the capacity to reduce the extent of measurement errors.[314] In the alternative, however, there is the perception that a lack of precaution reflective of 'innocent until proven guilty' is more common within scientific decision-making,[315] and more likely to result in a tendency to identify that there is 'no impact' when errors present uncertainty.[316]

As statistical analysis forms part of many scientific environmental assessments, the potential issues associated with scientific methods of assessment in general are further compounded by the lack of knowledge about cumulative (and synergistic) impacts (as discussed above). The potential conclusion that because there is no apparent evidence for a negative environmental impact and there is unlikely to be any detriment,[317] emphasises the uncertainty. Again, as also suggested in Chapter 1, a critical concern here is that reversal in the 'burden of proof' (i.e. attributing responsibility to a project proponent), could result in the project proponent failing to appropriately identify the potential for isolated, cumulative or synergistic impacts. Thus, this would result in poor approaches to impact avoidance or mitigation if a project is given an environmental approval. This is also pertinent to the concerns raised above about actual impacts differing to predicted impacts, and is further emphasised by the fact that cumulative (and synergistic) impacts may not become readily apparent until relatively long periods of time have passed (e.g. after a development is completed and a use commenced).[318] Further, without the information available, assessment methods such as risk assessment become limited in their capacity to effectively predict outcomes.[319]

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[312] Dahlstrom Davidson and Hewitt, above n 306, 1171.
[313] Alisha Dahlstrom Davidson, Marnie L Campbell and Chad L Hewitt, 'The role of uncertainty and subjective influences on consequence assessment by aquatic biosecurity experts' (2013) 127 *Journal of Environmental Management* 103, 104.
[314] Dahlstrom Davidson, Campbell and Hewitt, above n 313, 104.
[315] Bruce D Mapstone (1995) cited in Dahlstrom Davidson, Campbell and Hewitt, above n 313, 104; Bruce D Mapstone, 'Scalable decision rules for environmental impact studies: effect size, Type 1 and Type II errors' (1995) 5(2) *Ecological Applications* 401, 403.
[316] Dahlstrom Davidson, Campbell and Hewitt, above n 313, 104.
[317] See, eg, Santillo et al, above n 290, 948; David Vanderzwaag, 'The Precautionary Principle and Marine Environmental Protection: Slippery Shores, Rough Seas, and Rising Normative Tides' (2010) 33(2) *Ocean Development and International Law* 165, 169; Barton, above n 255, 510 - 511; Kriebel et al, above n 254, 873; Tickner and Geiser, above n 254, 803.
[318] Gullett, above n 243, 53.
[319] Henn Ojaveer et al, 'Classification of Non-Indigenous Species Based on their Impacts: Considerations for Application in Marine Management' (2015) *PloS Biol* 13(4) 5/13 <http://e1002130.doi:10.1371/journal.pbio.1002130>.

In response to the concerns about reversing the 'burden of proof', Gullett and Peel observed that reversal is inherently complicated and does not necessarily ensure an effective application of the precautionary principle in all environmental assessment situations, particularly considering that it is not always possible to prove 'no detriment'.[320] The suggested solution is a need for flexibility, in terms of the extent of the burden imposed within the decision-making process.[321] It is assumed that this shift would result in the burden shifting in part to the decision-maker and, as a caution, it is the author's opinion that any approach taken needs to ensure that the burden of proof does not shift entirely. There are several reasons for ensuring a shared burden of proof. First, the discussions by Gullett and Peel do not address the complexities associated with random uncertainty or environmental change. Second, the discussion highlights concern that the less scientific and statistical analysis expertise a decision-maker has, the greater the risk of inaccurate interpretation. Finally, the need for corporate and community sectors to uphold responsibility toward environmental protection and conservation should be acknowledged. This is particularly applicable for EIA where there is a need to avoid environmental harm and subsequently demonstrate that cumulative and/or synergistic impacts can either be alleviated or avoided. Nevertheless, this can hold wherever the burden of proof lies. The arguments raised from both perspectives reflect earlier concerns expressed about the inconsistency in approach of the precautionary principle as well as for the legal requirements, methods and approaches relevant to cumulative and synergistic impact considerations.

Iverson and Perrings have also suggested the basis for a motivation (e.g. within policy) to 'learn' more about environmental problems that give rise to scientific uncertainty, and that the reasons for learning are often associated with where the 'burden of proof' lies for applying the precautionary principle.[322] As a qualifier to this argument, it is also suggested that when environmental impacts that have not been seen before start to emerge, the 'burden of proof' is more likely to be attributed to those raising the initial concern.[323] Central to concerns such as these, Gullett has warned against the failure to provide direction as to how the precautionary principle should be applied within a legislative framework, as opposed to merely incorporating it within environmental legislative objectives.[324]

As mentioned earlier in section 2.3.3, there are concerns about the need for successful collaboration when managing cumulative (and synergistic) impacts. When these concerns are connected to the challenges associated with the 'burden of proof' as it applies within

[320] Peel, above n 239, 155 – 156; Gullett, above n 116, 152.
[321] Peel, above n 239, 155 – 156; Gullett, above n 116, 152.
[322] Iverson and Perrings, above n 290, 165.
[323] Ibid.
[324] Gullett, above n 116, 155.

environmental assessments, it is the author's opinion that they could be seen as an added limitation to the successful application of the precautionary principle. This is particularly likely in situations where knowledge sharing is constrained. Further to this, Lawrence has commented that cumulative (and synergistic) impacts, when considered alongside social and economic issues, can also increase uncertainty about environmental outcomes and decision-making processes.[325] This creates further emphasis on the need for uncertainty management, and in particular a strong application of the precautionary principle[326] when knowledge about cumulative (and synergistic) impacts is limited.

As the precautionary principle is a theoretical mechanism, its effective application cannot be achieved in isolation and depends upon the integrated use of practical mechanisms. Post-approval monitoring is a mechanism that can be applied, in conjunction with the precautionary principle, to aid the reduction of uncertainty and improve understanding of cumulative and synergistic impacts. As discussed further in Chapter 4, the precautionary principle has also been expressed in policy and legislation.

3.2 The role of post-approval monitoring in the consideration of cumulative and synergistic impacts

Post-approval monitoring can be utilised to improve knowledge about cumulative and synergistic impacts,[327] and assist in reducing uncertainty. It is also a process that can be utilised in both the application of the precautionary principle and the provision of feedback as to the efficacy of the principle's use.[328] Further, as environmental assessments need to be designed to test predictions with appropriate monitoring regimes, PAM provides the data needed to address the concerns about predictions not necessarily equating to the actual impacts.[329]

The importance of PAM for cumulative and synergistic impact assessment within both SEA and EIA processes is supported by commentators.[330] As suggested in the 1990s by Hauke von Seht,

[325] Lawrence, above n 234, 781.
[326] See, eg, Lawrence, above n 234, 781; Gullett, above n 116, 149, 154, 155.
[327] See, eg, Therivel and Ross, above n 2, 367;
[328] See, eg, Ellis, above n 255, 933; A K M Rafique Ahammed and Bronte Merrick Nixon, 'Environmental impact monitoring in the EIA process of South Australia', (2006) 26 *Environmental Impact Assessment Review* 426, 428 - 429; Duinker and Greig, above n 2, 159; L M Cooper, *Guidelines for Cumulative Effects Assessment in SEA of Plans*, (EMPG Occasional Paper 04/LMC/CEA, Imperial College London, 2004) 37.
[329] See, eg, Ambrose, Schmitt and Osenberg in Schmitt and Osenberg (eds), above n 224, 367; L W Canter (1996) cited in Cooper and Sheate, above n 16, 15; Canter, above n 262, 48; Therivel and Ross, above n 2, 367 & 380; Cooper, above n 328, 37.
[330] See, eg, Folkeson, Antonson, and Helldin, above n 160, 244; Cooper, above n 328, 12, 37; Duinker and Greig, above n 2, 159; Duinker et al, above n 19, 50; Monique G Dubé, 'Cumulative effect assessment in Canada: a regional framework for aquatic ecosystems' (2003) 23 *Environmental Impact Assessment Review* 723, 741; Monique Dubé et

both these levels of environmental assessment should be undertaken in a way that ensures an interdependent approach.[331] Duinker and Greig have since provided an opinion that there is no point in undertaking an assessment of cumulative and synergistic impacts at the earlier stages unless activities are monitored and any unacceptable impacts are mitigated.[332] An increased effort in the undertaking of PAM has been reiterated by Duinker et al,[333] and Dubé, and Dubé et al, who have all emphasised the need for stronger links between the assessment of cumulative (and synergistic) impacts and monitoring.[334]

Discussing the role of PAM further, Therivel and Ross identified that decision-making at both the SEA and EIA levels provides an opportunity for the management of cumulative (and synergistic) impacts.[335] The results of monitoring can then contribute to other future management actions such as avoidance, mitigation and offsets within the individual project decision-making framework, and the development of adaptive controls that relate to zoning and management plans and policies at the strategic level.[336] Where detrimental impacts have been identified as occurring from existing activities, there is the opportunity to use the data in conjunction with original baseline information to require the undertaking of measures to mitigate continuing environmental impacts. [337] This data can also be used for similar activities.[338]

The monitoring of environmental impacts, such as those from offshore oil and gas facilities or associated gas leaks and oil spills, needs to account for the potential cumulative impacts that become evident over long time periods.[339] Monitoring over time is critical to understand the environmental effects of cumulative impacts.[340] Seitz, Westbrook and Noble, agree with this approach but note additional concern as to the potential barriers that might be caused when considering appropriate responsibility for undertaking the monitoring. [341] The need to undertake baseline studies is also important for understanding these impacts and understanding the thresholds of a particular environment.[342] Dubé and Munkittrick discussed that the design of a framework for assessing cumulative and synergistic impacts within PAM, should account for

al, 'Development of a new approach to cumulative effects assessment: a northern river ecosystem example' (2006) 113 *Environmental Monitoring and Assessment* 87, 112; Cooper, above n 265, 12, 37.
331 Hauke von Seht, 'Requirements of a comprehensive strategic environmental assessment system' (1999) 45 *Landscape and Urban Planning* 1, 3.
332 Duinker and Greig, above n 2, 159.
333 Duinker et al, above n 19, 50.
334 Dubé, above n 330, 741; Dubé et al, above n 330, 112.
335 Therivel and Ross, above n 2, 367.
336 Ibid.
337 Ibid, 379 - 380.
338 Ibid.
339 Beanlands and Duinker, above n 101, 169, 171.
340 Contant and Wiggins, above n 106, 304.
341 Seitz, Westbrook and Noble, above n 53, 178.
342 Contant and Wiggins, above n 106, 304.

outcomes to be referenced to the original baseline data, environmental values and thresholds as part of an 'effects-based approach'.[343]

Spaling and Zwier, contributed to the Dubé and Munkittrick discussion with recommendations focusing on the need to provide information about the ability of the receiving environment's thresholds and ability to withstand impacts.[344] Gunn and Noble reiterated the position that any PAM should focus on identified VECs and threshold criteria.[345] Furthermore, they identified that the information gathered as to environmental change needs to be utilised in a manner that allows for swift adaptive management actions.[346]

There is a need to ensure that the decision-making framework is designed to provide for further assessment and conditional requirements of any negative outcomes.[347] This is particularly relevant for both the prediction of impacts from anthropogenic activities ('stressor-based approach'[348]) and 'effects-based' approaches.[349] The discussion emphasises that decision-making frameworks should be designed in a way that provides for the iterative flow of information about cumulative (and synergistic) impacts.[350]

It is noted that frameworks can be adapted to help overcome the issues of concern about the environmental assessment of cumulative and synergistic impacts, including improving the knowledge gained from PAM and feedback of knowledge about resulting environmental changes into decision-making systems.[351] With knowledge about cumulative (and synergistic) impacts considered important within the context of achieving goals for environmental sustainability,[352] and based on the above discussion, it can be concluded that a best practice

[343] Dubé and Munkittrick, above n 39, 250 – 252.
[344] Harry Spaling and Janelle Zwier, 'Managing regional cumulative effects of oil sands development in Alberta, Canada' (2000) 2 (4) *Journal of Environmental Assessment Policy and Management* 501, 523.
[345] Jill Harriman Gunn and Bram F Noble, 'A conceptual basis and methodological framework for regional strategic environmental assessment (R-SEA)' (2009) 27 (4) *Impact Assessment and Project Appraisal* 258, 263, 267.
[346] Jill Harriman Gunn and Bram F Noble, 'Integrating cumulative effects in regional strategic environmental assessment frameworks: lessons from practice' (2009) 11 (3) *Journal of Environmental Assessment Policy and Management* 267, 277; Gunn and Noble, above n 345, 263, 267.
[347] Dubé and Munkittrick, above n 39, 254 - 256
[348] Refer to Glossary – n.b. in comparison to the 'effects-based approach' the stressor-based approach has less focus on the existing environmental conditions and more focus on the predicted impacts. (See Dubé and Munkittrick, above n 39, 248, 251).
[349] Dubé and Munkittrick, above n 39, 254 - 256
[350] Ibid, 256.
[351] See, eg, Duinker and Greig, above n 2, 158 – 159.
[352] See, eg, Canter and Ross, above n 13, 262; Great Barrier Reef Marine Park Authority, above n 270, 10-3; K R N Anthony et al, *A framework for understanding cumulative impacts, supporting environmental decisions and informing resilience-based management of the Great Barrier Reef World Heritage Area: Final Report to the Great Barrier Reef Marine Park Authority and Department of the Environment* (Great Barrier Reef Marine Park Authority, 2013), 16 – 17 <http://www.environment.gov.au/resource/framework-understanding-cumulative-impacts-supporting-environmental-decisions-and-informing>; Laura J Falkenberg, Sean D Connell and Bayden D Russell, 'Disrupting the effects of synergies between stressors: improved water quality dampens the effects of future CO_2 on a marine habitat' (2013) 50 *Journal of Applied Ecology* 51, 56; Carl Folke et al, 'Regime Shifts, Resilience, and Biodiversity

approach should undertake such assessments within both SEA and EIA in a manner that provides for an iterative approach and enables congruence between the information provided at each phase. To achieve effective monitoring and balance between corporate and public interests, however, Seitz, Westbrook and Noble, recommended that proponents undertake the monitoring at direction of government guidelines (minimum standards), whilst governments need to effectively use and share the data.[353] A similar position was taken by Spaling and Zwier, and although in agreement that the proponent should be responsible for undertaking the monitoring programmes, Spaling and Zwier further identified that there may be commercial confidentiality issues causing constraints for knowledge sharing.[354]

It is important to note, however, that some commentators are concerned about the extent to which effective monitoring is undertaken.[355] As Peel has discussed, it is difficult to address scientific uncertainty when the information available from PAM about impacts is limited. [356] In providing feedback into the statutory decision making process, knowledge gained from environmental monitoring and associated impact assessments can assist in identifying the potential for uncertainty and therefore makes a stronger case for the application of the precautionary principle.[357] This includes questions relating to the potential for cumulative (and synergistic) effects.[358]

4. Conclusion

This chapter provides an overview of the challenges for effective cumulative and synergistic impact assessment. This is approached through a focus on SEA and EIA as processes for environmental assessment, the precautionary principle's application in decision-making processes, and the fundamental role that PAM has as an iterative feedback mechanism between SEA and EIA.

The literature demonstrates opposing paradigm preferences for the assessment of cumulative and synergistic impacts within SEA and EIA. That these impact types are assessed within EIA is important, however, and a third viewpoint recommends the assessment of cumulative (and

in Ecosystem Management' (2004) 35 *Annual Review of Ecology, Evolution and Systematics* 557, 575; Therivel and Ross, above n 2, 367, 372.
[353] Seitz, Westbrook and Noble, above n 53, 178.
[354] Spaling and Zwier, above n 344, 523.
[355] See, eg, Christopher Wood, *Environmental Impact Assessment: A Comparative Review*, (Pearson Education Limited, 2nd ed, 2003) 241; Beanlands and Duinker, above n 101, 169; Barker and Jones, above n 99, 36; Rafique Ahammed and Merrick Nixon, above n 328, 443.
[356] Peel, above n 239, 197.
[357] Ibid, 51 - 52, 54.
[358] Ibid, 52.

synergistic) impacts should occur within both SEA and EIA. To achieve this there should be ongoing development of assessment methods within both frameworks, and any approach that facilitates the separation of strategic and statutory planning functions should be avoided.

The discussions demonstrate that several factors are important for the effective consideration of cumulative (and synergistic) impacts within environmental assessment frameworks. It is clear that there are challenges for both SEA and EIA. These include: time periods and regional considerations; the potential for a fragmented approach to decision-making (for 'significant' impacts or otherwise); the need to consider cumulative (and synergistic) impacts in relation to VECs and associated environmental thresholds; the limitations of scientific assessment methods; inadequacies with regulatory frameworks; and the issues surrounding responsibility, collaboration and knowledge sharing.

Also identified is that the application of the precautionary principle, and the need to facilitate PAM, are important mechanisms to assist with addressing the need for increased knowledge and the reduction of uncertainty that surrounds cumulative and synergistic impact assessments. This should occur within both scientific method and environmental decision-making processes. Whilst there are methods for assessing cumulative and synergistic impacts that can assist with the application of the precautionary principle, these methods can be constrained by challenges such as responsibility and collaboration. The complexities are also emphasised when there is a lack of minimum standard for proof and the potential for failings of scientific method (e.g. the limitations of statistical analysis). In particular, the impetus for reversing the 'burden of proof' to be attributed to that of a use and/or development proponent undertaking environmental assessments, is challenged by the need for further consideration to be given to flexibility in application and responsibility.

In response to the concerns about correct scientific and statistical interpretation and the need for flexibility and appropriate allocation of responsibility in establishing the 'proof', a stronger emphasis on sharing the 'burden of proof' is required. This would enable accountability measures to apply to both the proponent and decision-maker. The flexibility would also need to acknowledge the extent of involvement in an environmental assessment and decision-making process. This can be seen, for example, where governments have the highest level of responsibility for preparing SEAs, and both government and the private sector have a high level of involvement in EIAs and the associated decision-making.

The discussion and opinions reveal that there is a positive role for PAM in improving the efficacy of predictions about cumulative and synergistic impacts, as well as identifying environmental issues that need mitigation or remediation. However, it is clear that PAM is not without challenges. Commentators have emphasised issues of: poor regulatory requirement; the constraints of monitoring for long periods of time; the need to respond to environmental issues with appropriate speed; and issues of responsibility and knowledge sharing. It has also been demonstrated that the consideration of cumulative and synergistic impacts within EIA remains critical to improving knowledge and feedback, and that any future framework approaches to their consideration should not be narrowed to SEA. In this context, if an iterative cycle is achieved then the capacity to understand cumulative and synergistic impacts from a scientific perspective can increase, as can the capacity to better inform regulatory frameworks and environmental decision-making.

The importance of identifying and consolidating the issues and challenges raised within the literature and consolidated in this chapter enables clearer understanding of the original research discussed within the later chapters of this thesis. When there is insufficient consideration given to cumulative and synergistic impacts, and a subsequent impediment to improving knowledge and the opportunity to uphold marine environmental protection, questions should be asked as to how consideration and assessment can be increased within legal and policy frameworks. When answering these questions, it is also necessary to address the application of the precautionary principle and utilisation of PAM. In addition, it is suggested that with the role of policy often being to support the implementation of legislation, the consistent implementation of policy containing reference to cumulative and synergistic impacts is particularly important if legislation does not contain specific requirements.

To assist in addressing the issues raised, Chapter 4 provides examples within the Australian context, of decision-making frameworks requiring cumulative and synergistic impact assessment. Narrowing the focus to legal frameworks, Chapters 5 and 6 of this thesis provide Australian case studies demonstrating examples of the extent of legal requirement and application for cumulative and synergistic impact consideration and assessment. Chapter 7 focuses on an example case study for legal frameworks within the European Union and Denmark with analysis of legal requirements for cumulative and synergistic impact consideration and assessment, as well as the application of the precautionary principle and undertaking of PAM. The benefits and shortcomings of matters identified in this chapter can be used to inform recommendations for improvements, if found to be necessary, to the requirements for considering and assessing cumulative and synergistic impacts within Australia’s environmental assessment legal frameworks.

CHAPTER 4 – CUMULATIVE AND SYNERGISTIC IMPACTS IN AUSTRALIA: THE ASSESSMENT FRAMEWORK, AND THE PRECAUTIONARY PRINCIPLE

> *'…the cumulative impact of independent actions by different persons, all of which are below the significant impact threshold, are primarily to be addressed through State planning and land management legislation, and recovery plans. Such actions will not require approval under this Act…'*[1]

Chapter outline

[1] Explanatory Memorandum, Environment Protection and Biodiversity Conservation Bill 1998 (Cth), [51], 30 [61], 33 [79].

1. Introduction

Large-scale marine use and development within Australian waters has the potential to cause detriment to the environment because of cumulative and synergistic environmental impacts. The anthropogenic activities contributing to these impacts include commercial fishing, navigation, tourism, aquaculture, and offshore petroleum. As introduced in Chapter 1, the intensity of these types of use and development within Australian waters is increasing. This requires greater attention to be paid to cumulative and synergistic impact assessment as an aid to achieving marine environmental protection and meet the needs for sustainable ecosystems.

The aim of this chapter is to identify the ways in which Australian marine environmental assessment legal frameworks can address, incorporate or require the consideration and assessment of cumulative and synergistic impacts to enable decision-making processes that assist marine environmental protection. The legal frameworks discussed include the Commonwealth,[2] State and Northern Territory jurisdictions. The identification of how Australian policy and legal frameworks can facilitate the application of ecologically sustainable development (ESD)[3] and the precautionary principle[4] is part of this. The aims are achieved through a discussion that identifies scientific concerns raised about cumulative and synergistic impacts occurring in Australia's marine environment, as well as an overview of the ways in which cumulative and synergistic impacts can be required to be considered and assessed within Australian marine environmental assessment law. Specific examples are used to provide more detailed examination of issues raised about environmental assessment and protection, legal frameworks and environmental degradation from cumulative and synergistic impacts.

The chapter examines the potential of the Australian legal frameworks for the environmental assessment of large-scale marine use and development to require the assessment of cumulative and synergistic impacts. This begins by providing an overview of the relationship between the consideration and assessment of cumulative and synergistic impacts and Australian maritime areas. The overview is followed by a brief discussion of the general issues identified for cumulative and synergistic impacts within Australia's marine environment, and as a specific example, a discussion about the Great Barrier Reef region.

The second section of the chapter focuses on the relationship between cumulative and

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[2] The Commonwealth Government of Australia can also be referred to as the Federal Government.
[3] Refer to Glossary.
[4] Refer to Glossary.

synergistic impact assessment and ESD within the Australian context. The link between considering cumulative and synergistic impacts and the application of the precautionary principle within Australia's environmental legal frameworks is also discussed.

The third section focuses on the Australian legal frameworks for assessing cumulative and synergistic impacts. This includes discussion about the potential for the legal frameworks to include environmental assessment and post-approval monitoring (PAM) of cumulative and synergistic impacts. A review of examples of judicial decisions that have influenced legislation and the way in which cumulative and synergistic impacts have been considered and assessed within environmental law and decision-making processes is also provided. The selected cases are from Commonwealth and State jurisdictions.

The final section focuses on the challenges of regulatory fragmentation that arise due to inconsistency and poor integration between legislation and approaches for strategic environmental assessment (SEA) and environmental impact assessment (EIA). Specific examples of legislation, SEA and EIA applicable to the Great Barrier Reef region are used to examine these issues. .

Within this chapter, when the terms 'cumulative' and 'synergistic' are used independently, the term 'cumulative' does not include reference to 'synergistic' impacts. However, as with the approach in Chapter 3, the term 'cumulative (and synergistic)' is used when it is anticipated that the literature references assumed synergistic impacts to be included as a type of cumulative impact. This assumption does not apply to legislation or case law. The legislation, case law, associated guidelines, bilateral agreements and literature reviewed within this chapter are current as of April 2015.[5] This provides an overall framework analysis that supports the more detailed legislative analysis provided in the Chapter 5 Otways Marine Area case study.[6]

1.1 Cumulative and synergistic impact assessment and Australia's maritime zones

The Australian legislative framework for marine environmental assessment is dependent upon jurisdiction. This results in multiple legal frameworks forming the governance structure for

[5] At the time of thesis submission there were no significant changes to the legislation reviewed that are anticipated to affect the analysis in this chapter. Currency updates (August 2018) for significant legislative changes have been provided in the footnotes.
[6] The legislation for the Otways Marine Area case study was based on June 2015 currency.

Australia's marine waters.[7] The legal frameworks consist of multiple jurisdictions with the Commonwealth Government, and State and Territory governments having the power to legislate for the marine environment.[8] Regulation of the marine environment is also determined via Australia's *Offshore Constitutional Settlement* (OCS).[9] The OCS is an agreement between the Commonwealth and State governments that focuses on governance arrangements for offshore areas,[10] and is supplementary to legislation. For offshore areas adjacent to Australian States, the legal responsibility for marine waters within 12 nautical miles (nm) is generally divided between the relevant State governments and the Commonwealth Government. Australia's jurisdictional area beyond 12nm is the responsibility of the Commonwealth Government.[11] The division of powers is defined within legislation and the OCS.[12] The legislation provides that, generally, the States and the Northern Territory will assume responsibility for the area between the coast and the 3nm mark, and that the Commonwealth Government assumes responsibility for the area between 3nm and 12nm.[13]

The OCS details a number of circumstances in which the responsibility of the State governments or Commonwealth government is subject to altered arrangements, including aspects of joint management and common regimes.[14] The altered arrangements apply to 'fisheries',[15] offshore petroleum and minerals,[16] 'historic shipwrecks',[17] the Great Barrier Reef

[7] Australian marine waters include internal waters and maritime zones (for example, the territorial sea, contiguous zone, exclusive economic zone and continental shelf boundaries as defined in accordance with the *United Nations Convention on the Law of the Sea*, opened for signature 10 December 1982, 183 UNTS 3 (entered into force 16 November 1994) Art 3, 8 – 11, 33, 57 and Part VI).
[8] It is noted here that legislation passed by Territory governments can be disallowed by the Commonwealth government. It is also acknowledged that Section 109 of the *Commonwealth of Australia Constitution Act* provides that where there is inconsistency between a state and federal law, the federal law will prevail. Also see, Warwick Gullett and Gregory Rose, 'Australia's marine jurisdiction under international and domestic law' in Warwick Gullett, Clive Schofield and Joanna Vince (eds), *Marine Resources Management* (LexisNexis Butterworths, 2011) 25, 32, 35 - 39.
[9] Attorney General's Department, *Offshore Constitutional Settlement: A milestone in co-operative federalism* (Australian Government Publishing Service, 1980); Also see, eg, Donald R Rothwell and Stuart B Kaye, 'A legal framework for Integrated Oceans and Coastal Management' (2001) 18 (3) *Environmental and Planning Law Journal* 278, 280 – 281.
[10] Attorney General's Department, *Offshore Constitutional Settlement: A milestone in co-operative federalism* (Australian Government Publishing Service, 1980) 1.
[11] *Seas and Submerged Lands Act 1973* (Cth).
[12] Ibid; *Coastal Waters (State Powers) Act 1980* (Cth); *Coastal Waters (Northern Territory Powers) Act 1980* (Cth); *Coastal Waters (State Title) Act 1980* (Cth); *Coastal Waters (Northern Territory Title) Act 1980* (Cth); Attorney General's Department, *Offshore Constitutional Settlement: A milestone in co-operative federalism* (Australian Government Publishing Service, 1980).
[13] *Seas and Submerged Lands Act 1973* (Cth) Schedule – Parts II, V and VI of the United Nations Convention on the Law of the Sea, pt 2 art 3; *Coastal Waters (State Powers) Act 1980* (Cth) ss 4 - 5; *Coastal Waters (Northern Territory Powers) Act 1980* (Cth) ss 4 - 5; *Coastal Waters (State Title) Act 1980* (Cth) ss 4 - 5; *Coastal Waters (Northern Territory Title) Act 1980* (Cth), ss 4 - 5.
[14] Attorney General's Department, *Offshore Constitutional Settlement: A milestone in co-operative federalism* (Australian Government Publishing Service, 1980) 7 – 16.
[15] Ibid, 10 – 11.
[16] Ibid, 7 – 8.
[17] Ibid, 11.

Marine Park,[18] marine parks of international significance,[19] ‘crimes at sea’,[20] ‘shipping and navigation,[21] and ‘ship-sourced marine pollution’.[22]

In addition to the Federal[23] and State/ Territory tiers of government, local governments provide for a third tier of regulation. The relationship with marine activities is, however, limited as local government jurisdiction often extends no further than the low water mark.[24] Further, because of the need to maintain an appropriate research scope, an examination of the application of local government regulation of land based activities that can impact on the marine environment is not considered appropriate for this thesis. For these reasons, local government will not be discussed as a part of this thesis.

1.2 Cumulative and synergistic impacts in Australia's marine environment

Environmental degradation caused by cumulative (and synergistic) impacts in Australian marine and coastal environments has been identified as a problem since at least the early 1990s. In 1991, the Australian Federal Government report, *The Injured Coastline: Protection of the Coastal Environment*, discussed a lack of consideration given to the cumulative impacts of use and development within Australia's coastal environment.[25] The report stated that the ‘absence of a broad regional or national perspective’, and the failure of planning systems to consider such impacts, were fundamental reasons for the problem.[26] In 1994 the Commonwealth Environment Protection Agency commissioned a report on the *Assessment of cumulative impacts and strategic assessment in environmental impact assessment*.[27] This report identified that, within Australia, EIA processes did not provide for the assessment of cumulative impacts to the extent required for achieving ESD,[28] and that more attention should be given to ESD and cumulative (and synergistic) impact types within the context of SEA.[29]

[18] Ibid.
[19] Ibid, 12.
[20] Ibid, 13 – 14.
[21] Ibid, 14 – 15.
[22] Ibid, 16.
[23] The Federal Government is also known as the Commonwealth Government. Within an Australian context, the term federal is often used to describe the level of government.
[24] See, eg, *Local Government Act 1989* (Vic), s 3(3A).
[25] House of Representatives Standing Committee on Environment, Recreation, and the Arts, Parliament of the Commonwealth of Australia, *The Injured Coastline: Protection of the Coastal Environment* (1991) 46 - 47.
[26] Ibid, 47.
[27] John D Court, Colin J Wright, Alasdair C Guthrie, *Assessment of cumulative impacts and strategic assessment in environmental impact assessment: prepared for the Commonwealth Environment Protection Agency*, (Commonwealth of Australia, 1994).
[28] Ibid, i.
[29] Ibid, ii.

In 1998, *Australia's Oceans Policy* further recognised the need to identify strategies for the minimisation of impacts from sectoral activities as part of its effort to conserve marine biological diversity.[30] The strategies included the identification of, and measures for protection from, cumulative impacts.[31]

National State of the Environment (SoE) reporting has occurred every five years since 1996,[32] with each report containing an assessment of the health status and challenges for atmospheric, terrestrial and aquatic (marine and freshwater) environments.[33] The commentary in the 1996 SoE report identified that inadequate consideration was given to cumulative impacts within decision-making processes that affect environmental planning and management.[34] The focus on cumulative impacts was limited, however, to the impact of threatening processes on birds,[35] the coastal environment raised within discussion on a Moreton Bay development case study,[36] and concern about the adequacy of response to the destruction of habitat from coastal development.[37] With reference to synergistic impacts, the 1996 SoE report acknowledged these impact types as a stressor for biodiversity due to both the interaction of activities[38] and pollution.[39]

Reflecting the 1996 SoE report, the 2001 SoE report acknowledged that cumulative impacts posed a challenge because of the many decisions made about the use of Australia's natural resources,[40] as well as concern about poor community understanding.[41] Further, the report identified concerns in relation to cumulative impacts within the marine environment for the Great Barrier Reef,[42] and fisheries.[43] The 1996 SoE report acknowledgement of the synergistic

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[30] Commonwealth of Australia, *Australia's Oceans Policy: caring, understanding, using wisely (Volume 1)*, (Environment Australia, 1998) 22, 37; Commonwealth of Australia, *Australia's Oceans Policy: Specific Sectoral Measures - Caring, understanding, using wisely (Volume 2)*, (Environment Australia, 1998) 9.
[31] Commonwealth of Australia (Vol 2), above n 30, 9.
[32] SoE reporting is required every five years by the Commonwealth Government's *Environment Protection and Biodiversity Conservation Act 1999*, s 516B.
[33] See, eg, Australian Government (Department of the Environment), *State of the Environment (SoE) reporting*, <http://www.environment.gov.au/science/soe>.
[34] State of the Environment Advisory Council, *Australia State of the Environment 1996* (Commonwealth of Australia, 1996) Chapter 4-53 <http://www.environment.gov.au/soe/1996/publications/report/index.html>.
[35] Ibid, Chapter 4-32.
[36] Ibid, Chapter 8 -9.
[37] Ibid, Chapter 8 -50.
[38] Ibid, Chapter 4 -10.
[39] Ibid, Chapter 4 -21.
[40] Australian State of the Environment Committee 2001, *Australian State of the Environment Report 2001: Independent Report to the Commonwealth Minister for the Environment and Heritage*, (CSIRO Publishing on behalf of the Department of the Environment and Heritage, 2001) 15.
[41] Australian State of the Environment Committee 2001, *Coasts and Oceans, Australian State of the Environment Report 2001 (Theme Report)*, (CSIRO Publishing on behalf of the Department of the Environment and Heritage, 2001) 51.
[42] Australian State of the Environment Committee 2001, above n 41, 26; J Williams et al, *Biodiversity, Australian State of the Environment Report 2001 (Theme Report)*, (CSIRO Publishing on behalf of the Department of the Environment and Heritage, 2001) 67.
[43] Australian State of the Environment Committee 2001, above n 41, 74.

stressors caused by pollution was repeated in the 2001 SoE report.[44]

The 2006 SoE report observed the continuing 'cumulative decline' in the 'environmental quality' of Australia's coasts and oceans. [45] The report also identified that, ultimately, the cumulative effect of changes within the marine environment may not be known prior to degradation, because of inadequate knowledge about marine species and ecosystems. [46] This is particularly pertinent within ocean areas. [47]

Poor knowledge of the environment was reiterated in the 2011 SoE report,[48] along with concern about the cumulative effect of multiple and increasing impacts within the marine environment.[49] Knowledge deficiencies are being compounded by assessments that still do not address cumulative impacts, especially to integrate approaches towards fisheries management across Australia.[50] The report also identified that SEAs could be utilised more effectively to facilitate better understanding of the cumulative impacts from commercial fishing within regions;[51] particularly as the understanding gained from the individual fisheries assessments provided for limited information.[52] Concerns about the poor consideration of cumulative impacts within individual project assessments were identified in relation to numerous sectors, such as, port development,[53] offshore petroleum,[54] aquaculture,[55] tourism,[56] and mining.[57] Reduced resilience and a greater rate of climate change, due to the cumulative impacts of anthropogenic activities, is also highlighted.[58]

Other nationally focused reports that have addressed cumulative impacts in the environment include the 2008 *A National Approach to Addressing Marine Biodiversity Decline – Report to*

[44] J Williams et al, above n 42, 102.
[45] Beeton RJS (Bob) et al, Australian State of the Environment Committee, *Australian State of the Environment Report 2006: Independent Report to the Commonwealth Minister for the Environment and Heritage* (Department of the Environment and Heritage, 2006) 49.
[46] Ibid, 49.
[47] Ibid, 49.
[48] State of the Environment 2011 Committee, *Australia State of the Environment 2011, Independent report to the Australian Government Minister for Sustainability, Environment, Water, Population and Communities*, (DSEWPaC 2011) 373.
[49] Ibid, 373, 414.
[50] Ibid, 418.
[51] Ibid, 424, 435.
[52] Ibid, 424, 435, 446.
[53] Ibid, 445.
[54] Ibid.
[55] Ibid, 447.
[56] Ibid, 448.
[57] Ibid, 448, 449.
[58] Ibid, 110.

the Natural Resource Management Ministerial Council.[59] There are concerns about cumulative (and synergistic) impacts leading to biodiversity decline within Australian waters, with concerns identified concern about the limited knowledge surrounding these impact types.[60] The report also highlighted that because of these impact types, marine resource management in Australia needed to address environmental change.[61]

The Consultation Draft for *Australia's Biodiversity Conservation Strategy 2010 – 2020* also acknowledged the effect of cumulative impacts on the environment. The draft strategy discussed that an environmental management approach that neglects cumulative impacts will not provide for the best environmental outcome, as it is 'the cumulative impact of many local or regional decisions that will determine whether the decline in Australia's natural biodiversity is halted and reversed.'[62] It is noted that the final version, *Australia's Biodiversity Conservation Strategy 2010* – 2030, did not include this quote, but it did identify cumulative impacts as needing attention.[63]

Scientific research on cumulative and synergistic impacts from anthropogenic activities and environmental change in Australia's marine environment has occurred. For example, research by Wernberg et al demonstrated the need to consider the synergistic interaction of environmental change, such as climate change, with anthropogenic stressors.[64] They identified the potential for synergistic impacts on marine biodiversity in Australia's southern waters,[65] and the need for consideration of these impact types if future environmental impacts are to be better understood.[66] The cumulative and synergistic interactions between ocean acidification (due to climate change) and the impacts of fisheries have also been studied within the Australian context.[67] Griffith, Fulton and Richardson used predictive modelling to determine that such impacts had the potential to cause detrimental change within Australia's south-eastern

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[59] Marine Biodiversity Decline Working Group, *A National Approach to Addressing Marine Biodiversity Decline – Report to the Natural Resource Management Ministerial Council Marine*, (Marine and Coastal Committee of the Natural Resource Management Ministerial Council, 2008).
[60] Ibid, 21.
[61] Ibid, 35.
[62] National Biodiversity Strategy Review Task Group, *Australia's Biodiversity Conservation Strategy 2010 – 2020, Consultation Draft* (Australian Government (Department of the Environment Water Heritage and the Arts, 2009), 14 <http://www.environment.gov.au/system/files/pages/50e1085f-1ef9-4b25-8275-08808133c346/files/biodiversity-conservation-strategy2010-2020.pdf> .
[63] Natural Resource Management Ministerial Council 2010, *Australia's Biodiversity Conservation Strategy 2010 – 2030* (Australian Government (Department of Sustainability, Environment, Water, Population and Communities, 2010) 23, 27 <http://www.environment.gov.au/system/files/pages/58321950-f8b6-4ef3-bb68-6f892420d601/files/biodiversity-conservation-strategy-2010.pdf>.
[64] See, eg, Thomas Wernberg et al, 'Impacts of climate change in a global hotspot for temperate marine biodiversity and ocean warming' (2011) 400 *Journal of Experimental Marine Biology and Ecology* 7, 13.
[65] Wernberg et al, above n 64, 7, 13.
[66] Ibid, 12.
[67] Gary P Griffith, Elizabeth A Fulton and Anthony J Richardson, 'Effects of fishing and acidification-related benthic mortality on the southeast Australian marine ecosystem' (2011) 17 *Global Change Biology* 3058, 3059.

marine environment food webs.[68] Scientific research undertaken within the Great Barrier Reef region also provide for an important example. This area is significant to Australians, but also has international protection status. Further details about the approach to cumulative and synergistic impact assessment for the Great Barrier Reef region are provided below.

1.2.1 The Great Barrier Reef region

The Great Barrier Reef region provides an example of the concerns raised about anthropogenic impacts and environmental change within Australian waters. The region comprises marine areas protected under Commonwealth and Queensland Government legislation,[69] with 348 000 km^2 listed as World Heritage Area.[70] The threat of additional coastal and port development combined with the existing impacts including tourism, fishing (commercial and recreational), recreational boating, commercial shipping, and land sourced pollution has gained significant attention at an international level.[71] The following example discussion focuses on some of the cumulative and synergistic impacts for the Great Barrier Reef region, as well as analysis of World Heritage Committee concerns and Australian Government responses to them. The purpose of this discussion is to illustrate shortcomings and benefits of the approach to cumulative and synergistic impact consideration and assessment for a marine area where significant attention has been given to balancing the environmental assessment of use and development with marine environmental protection.

Knowledge about cumulative and synergistic impacts within the Great Barrier Reef region is limited.[72] Studies have shown that cumulative and synergistic impacts can be detrimental to coral reefs and mangroves due to the interaction of toxins, sediment, nutrients and temperature increases causing significant[73] negative impacts.[74] Combinations of terrestrial pollutants within

[68] Ibid, 3065 – 3073.
[69] See, eg, *Great Barrier Reef Marine Park Act 1975* (Cth); *Marine Parks Act 2004* (Qld).
[70] See, eg, Great Barrier Reef Marine Park Authority, *Great Barrier Reef Outlook Report 2014,* (Great Barrier Reef Marine Park Authority, 2014), 7.
[71] World Heritage Committee, Fanny Douvere (UNESCO World Heritage Centre) and Tim Badman (IUCN), *Mission Report Great Barrier Reef (Australia) (154),* United Nations Education Scientific and Cultural Organization, Convention concerning the Protection of the World Cultural and Natural Heritage, World Heritage Committee (24th June – 6th July 2012) 4; Great Barrier Reef Marine Park Authority, above n 70, 173, 176 - 180.
[72] See, eg, Britta Schaffelke, Jane Mellors and Norman C Duke, 'Water quality in the Great Barrier Reef region: responses of mangroves, seagrass and macro algal communities' (2005) 51 *Marine Pollution Bulletin* 279, 291.
[73] Refer to the glossary for an explanation about the use of the term 'significant' as a term to describe the measurement of an impact.
[74] See, eg, Schaffelke, Mellors and Duke, above n 72, 291; J E Brodie et al, 'Terrestrial pollutant runoff to the Great Barrier Reef: An update of issues, priorities and management responses' (2012) 65 *Marine Pollution Bulletin* 81, 88; Scott A Wooldridge, 'Water quality and coral bleaching thresholds: Formalising the linkage for the inshore reefs of the Great Barrier Reef, Australia' (2009) 58 *Marine Pollution Bulletin* 745, 745, 749; Scott A Wooldridge and Terence J Done. 'Improved water quality can ameliorate effects of climate change on corals' (2009) 19 (6) *Ecological Applications* 1492, 1492, 1496; Scott Andrew Wooldridge et al, 'Safeguarding coastal coral communities on the central Great Barrier Reef (Australia) against climate change: realizable local and global actions' (2012) 112 *Climatic Change* 945, 948; Stephen E Lewis et al, 'Assessing the additive risks of PSII herbicide exposure to the

the ocean environment have been shown to act synergistically.[75] The potential for these interactions to detrimentally impact on the health of crustose coralline algae has also been demonstrated, and is an area needing further research.[76] Adding to this, research undertaken into the interaction of pCO_2[77] and increased temperatures shows a synergistic effect in terms of the increasing extent of feeding by sea urchins (*Echinothrix diadema*) on crustose coralline algae (*Hydrolithon onkodes*).[78]

Studies by Grech et al, identified knowledge limitations about cumulative impacts as well as the potential for synergistic interactions to occur.[79] Their research focused on the impacts on coastal seagrasses within the Great Barrier Reef region from anthropogenic activities.[80] Along the Queensland coastline, potential management 'hotspots', including Gladstone, Abbot Point and Townsville were identified as places where coastal seagrasses are at risk of detrimental impact.[81] The threats for these 'hotspots' were identified through a combination of impacts from land sourced pollution/runoff, coastal and marine development, dredging, recreational boating, commercial boating and shipping, marine oil spills, and impacts from fishing.[82]

The World Heritage Committee (UNESCO) has raised concerns about the ongoing protection and health status of the Great Barrier Reef World Heritage Area (GBRWHA) at each annual meeting since 2011.[83] The concerns focused on the potential for detriment to the area's natural

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Great Barrier Reef' (2012) 65 *Marine Pollution Bulletin* 280, 288, 290; Andrew P Negri et al, 'Herbicides increase the vulnerability of corals to rising sea surface temperature' (2011) 56 (2) *Limnology and Oceanography* 471, 477 - 483; Andrew D Olds et al, 'Synergistic effects of reserves and connectivity on ecological resilience' (2012) 49 *Journal of Applied Ecology* 1195, 1199 – 1201.

[75] Lindsay Harrington et al, 'Synergistic effects of diuron and sedimentation on photosynthesis and survival of crustose coralline algae' (2005) 51 *Marine Pollution Bulletin* 415, 424, 425.

[76] Ibid, 424, 425.

[77] pCO_2 is the partial pressure of CO_2. See, eg, Maggie D Johnson and Robert C Carpenter, 'Ocean acidification and warming decrease calcification in the crustose coralline alga *Hydrolithon onkodes* and increased susceptibility to grazing', (2012) 434 – 435 *Journal of Experimental Marine Biology and Ecology* 94, 94.

[78] Johnson and Carpenter, above n 77, 98.

[79] A Grech, R Coles, and H Marsh, 'A broad scale assessment of the risk to coastal seagrasses from cumulative threats', (2011) 35 *Marine Policy* 560, 564; Caitlin Mullan Crain, Kristy Kroeker and Benjamin S Halpern, 'Interactive and cumulative effects of multiple stressors in marine systems' (2008) 11 *Ecology Letters* 1304, 1308.

[80] Grech, Coles, and Marsh, above n 79, 563, 565.

[81] Ibid, 564 – 565.

[82] Ibid, 564 – 565.

[83] United Nations Education Scientific and Cultural Organization, World Heritage Committee, *Decision 35 COM 7B.10*, 35th Session, Convention concerning the Protection of the World Cultural and Natural Heritage, World Heritage Committee (19 – 29th June 2011); United Nations Education Scientific and Cultural Organization, World Heritage Committee, *Decision 36 COM 7B.8*, 36th Session, Convention concerning the Protection of the World Cultural and Natural Heritage, World Heritage Committee (24th June – 6th July 2012); United Nations Education Scientific and Cultural Organization, World Heritage Committee, *Decision 37 COM 7B.10*, 37th Session, Convention concerning the Protection of the World Cultural and Natural Heritage, World Heritage Committee (16th - 27th June 2013); United Nations Education Scientific and Cultural Organization, World Heritage Committee, *Decision 38 COM 7B.63*, 38th Session, Convention concerning the Protection of the World Cultural and Natural Heritage, World Heritage Committee (15th - 25th June 2014). Similar concern about the ongoing detriment from cumulative impacts was also expressed within the United Nations Education Scientific and Cultural Organization, World Heritage Committee, *Decision 39 COM 7B.7*, 39th Session, Convention concerning the Protection of the World Cultural and Natural Heritage, World Heritage Committee (28th June – 8th July 2015).

values because of cumulative impacts from Queensland port development activities for the facilitation of liquefied natural gas (LNG) export.[84] As a result of a reactive monitoring mission conducted by the World Heritage Centre and IUCN in 2012, a series of recommendations were made to the Australian Government for improving marine environmental protection in the area.[85] These recommendations included prohibition on new port development within the GBRWHA to avoid cumulative impacts, [86] the provision of a strategic assessment framework that addresses cumulative impacts (amongst other matters) to aid environmental resilience,[87] and the assessment of cumulative impacts for decisions made under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (*EPBC Act 1999* (Cth)).[88] The recommendations also focused on the application of the precautionary principle for new developments permitted within the GBRWHA that 'create individual, cumulative or combined impacts' until the completion of a 'Strategic Assessment' and a 'plan for … long-term sustainable development'.[89] In general, this report raised concerns about cumulative and synergistic impacts within the GBRWHA, and the lack of knowledge surrounding these impact types.[90]

Whilst applicable to the entire Great Barrier Reef region, the *Great Barrier Reef Region Strategic Assessment: Strategic Assessment Report* (*GBRR Strategic Assessment Report*) is a strategic plan that responded to the concerns and recommendations raised for the GBRWHA.[91] For the whole region, concern about cumulative and synergistic impacts was identified within the report.[92] Within the *GBRR Strategic Assessment Report*, cumulative and synergistic impacts are discussed in the context of being a general threat to the health of the reef,[93] as well as in the context of specific examples,[94] assessment methods,[95] and knowledge limitations.[96] The importance of understanding and addressing cumulative impacts is also acknowledged as critical for improving resilience of the reef region, particularly when anthropogenic activities are considered in combination with environmental change (e.g. climate change).[97]

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[84] See, eg, World Heritage Committee, *Decision 36 COM 7B.8*, above n 83, 5; World Heritage Committee, *Decision 37 COM 7B.10*, above n 83, 3, 6; World Heritage Committee, *Decision 38 COM 7B.63*, above n 83, 3, 8.
[85] World Heritage Committee, Douvere and Badman, above n 71.
[86] Ibid, R2.
[87] Ibid, R5.
[88] Ibid, R7.
[89] Ibid, R8.
[90] Ibid, 33.
[91] Great Barrier Reef Marine Park Authority, *Great Barrier Reef Region Strategic Assessment: Strategic Assessment Report* (Great Barrier Reef Marine Park Authority, 2014).
[92] Ibid, 13-31 – 13-33.
[93] Ibid, 5-37, 6-67 – 69.
[94] Ibid, 5-21, 5-44, 7-42, 9-10.
[95] Ibid, 2-7, 4-41, 6-4, 6-55 – 6-67, 13-20 – 13-21.
[96] Ibid, 5-35, 5-49, 6-31, 6-69 – 6-73.
[97] Ibid, 10-4, 10-6, 10-7 11-4.

The *Great Barrier Reef Region Strategic Assessment Program Report* (*GBRR Program Report*) was released in conjunction with the *GBRR Strategic Assessment Report* in 2014. The *GBRR Program Report* outlines a 25 year management plan.[98] In addition to reiterating concerns raised within the *GBRR Strategic Assessment Report* about cumulative impacts,[99] the *GBRR Program Report* detailed management actions for minimising cumulative impacts;[100] including development of 'cumulative impact assessment guidelines'.[101]

The *2014 Great Barrier Reef Outlook Report* provides for a five year review of the management and health status of the marine environment in the Great Barrier Reef. The report followed the release of the *GBRR Strategic Assessment Report* and *GBRR Program Report*.[102] The *2014 Great Barrier Reef Outlook Report* reiterated that the 'independent assessment of management effectiveness for the 2009 outlook report' rated the management of cumulative impacts as poor.[103] The 'understanding' of cumulative and synergistic impacts was deemed to have improved,[104] yet management effectiveness was shown to be in need of further improvement for most activities occurring within the region.[105] In general, the report raised the ongoing concern about poor knowledge[106] and detriment to the environment from cumulative (and synergistic) impacts.[107] In addition, advisory reports, such as *A framework for understanding cumulative impacts, supporting environmental decisions and informing resilience-based management of the Great Barrier Reef World Heritage Area: Final Report to the Great Barrier Reef Marine Park Authority and Department of the Environment*, have been published to inform decision-makers about cumulative impacts and methods for their assessment.[108]

The *Reef 2050 Long-Term Sustainability Plan*, released in 2015, has also been developed as a strategy and 'adaptive management' tool in response to recommendations from the World Heritage Committee.[109] The plan identified that cumulative impacts from the pressures of

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98 Great Barrier Reef Marine Park Authority, *Great Barrier Reef Region Strategic Assessment: Program report* (Great Barrier Reef Marine Park Authority, 2014) iii.
99 Ibid, 10 - 12.
100 See, eg, Great Barrier Reef Marine Park Authority, above n 98, iii, 15, 18, 21 – 23, 27 – 31, 37, 41 – 44, 47, 57 – 58, 61 – 62, 65 – 66, 70 – 71, 75, 77, 79, 81, 83, 88, 90 – 92, 96.
101 Ibid, 30.
102 Great Barrier Reef Marine Park Authority, above n 70, 3.
103 Ibid, 260.
104 Ibid, 194, 260.
105 Ibid, 194.
106 Ibid, 264.
107 Ibid, 266.
108 See, eg, K R N Anthony et al, *A framework for understanding cumulative impacts, supporting environmental decisions and informing resilience-based management of the Great Barrier Reef World Heritage Area: Final Report to the Great Barrier Reef Marine Park Authority and Department of the Environment* (Great Barrier Reef Marine Park Authority, 2013), 11 – 16 <http://www.environment.gov.au/resource/framework-understanding-cumulative-impacts-supporting-environmental-decisions-and-informing>.
109 Commonwealth Government, *Reef 2050 Long-Term Sustainability Plan* (Commonwealth of Australia, 2015) 13.

anthropogenic activities are more problematic for the ‘southern two-thirds’ of the Great Barrier Reef region, [110] and reiterated the issues raised in the *2014 Great Barrier Reef Outlook Report*.[111] The plan stipulates that SEA needs to address cumulative impacts in a thorough method,[112] and identifies actions, such as guideline development, for reducing cumulative environmental impacts.[113] Monitoring was also identified as necessary for increasing knowledge about actual cumulative impacts.[114] Synergistic impacts were not discussed within this plan.

1.3 Key points

The discussion above demonstrates that whilst the need to address cumulative (and synergistic) impacts within the Australian marine environment has been an issue discussed for more than 25 years, the extent of concern for both cumulative and synergistic impacts is increasing. When considered in conjunction with the issues raised in earlier chapters, [115] in particular the shortcomings associated with inadequate legal provisions and guidance,[116] a review of the ways in which the Australian marine environmental assessment legal frameworks can address, incorporate or require the consideration and assessment of cumulative and synergistic impacts is necessary. This can be achieved through legislative frameworks that require the consideration of the precautionary principle, as well as through express requirements for cumulative and synergistic impact assessment. Through gaining additional insight from a general perspective, the following sections seek to identify this potential.

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[110] Ibid, 2, Appendix H.
[111] Ibid, 10-11.
[112] Ibid, 31.
[113] Ibid, 38.
[114] Ibid, 65.
[115] See, eg, the discussion in Chapter 2, section 4 (defining cumulative and synergistic impacts separately), and Chapter 3, section 2.3 (challenges for the effective environmental assessment of cumulative and synergistic impacts).
[116] See, eg, Robert Senner, ‘Appraising the sustainability of project alternatives: An increasing role for cumulative effects assessment’ (2011) 31 *Environmental Impact Assessment Review* 502, 503 – 504; Jennifer Dixon and Burrell E Montz, ‘From Concept to Practice: Implementing Cumulative Impact Assessment in New Zealand’ (1995) 19 (3) *Environmental Management* 445, 446; Pamela Hubbard, *Cumulative effects assessment and regional planning in Southern Ontario: A manuscript prepared for the Canadian Environmental Assessment Research Council* (Canadian Environmental Assessment Research Council, 1990) 45, 47 – 49; Elizabeth A Masden et al, ‘Cumulative impact assessments and bird/wind farm interactions: Developing a conceptual framework’ (2010) 31 *Environmental Impact Assessment Review* 1, 1; Riki Therivel and Bill Ross, ‘Cumulative effects assessment: Does scale matter?’ (2007) 27 *Environmental Impact Assessment Review* 365, 372; Monique Dubé and Kelly Munkittrick, ‘Integration of Effects-Based and Stressor-Based Approaches into a Holistic Framework for Cumulative Effects Assessment in Aquatic Ecosystems’ (2001) 7 (2) *Human and Ecological Risk Assessment: An International Journal* 247, 251; Peter N Duinker et al, ‘Scientific dimensions of cumulative effects assessment: toward improvements in guidance for practice’ (2013) 21 *Environmental Reviews* 40, 50.

2. Cumulative and synergistic impact assessment: Australia's *Intergovernmental Agreement on the Environment, National Strategy for Ecologically Sustainable Development* and approach to applying the precautionary principle

The role of ESD and the application of the precautionary principle are integral to achieving goals of environmental protection within the Australian legal context;[117] with cumulative impacts having been identified as a risk that can result from the poor application of ESD principles.[118] Following an introduction to ESD within the Australian context within Chapter 1, this section of Chapter 4 discusses the ESD frameworks within the *Intergovernmental Agreement on the Environment* (IGAE) and the *National Strategy for Ecologically Sustainable Development*. Further, after a discussion of the relationship between cumulative and synergistic impact assessment and the application of the precautionary principle within Chapter 3, the discussion in this section of Chapter 4 will briefly address the application of the precautionary principle within the Australian legal context.

2.1 ESD, the *Intergovernmental Agreement on the Environment* and the *National Strategy for Ecologically Sustainable Development*

In 1992, the Australian Federal, State, Territory and local governments entered into the *Intergovernmental Agreement on the Environment*.[119] Recognising the roles and responsibilities of each level of government within the development and application of environmental policy and legislation,[120] the agreement also formally recognised ESD[121] and incorporated *Principles of Environmental Policy*.[122] These principles provide guidance on environmental policy, implementation and decision-making processes.[123] In addition, the IGAE contains agreement on the benefits of environmental monitoring and the 'integration of environmental data'.[124] Since

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[117] See, eg, The Hon Justice Paul L Stein, 'Are Decision-makers too Cautious with the Precautionary Principle' (2000) 17 *Environmental and Planning Law Journal* 3, 3; Jacqueline Peel, 'Ecologically Sustainable Development: More than Mere Lip Service?' (2008) 12 (1) *The Australasian Journal of Natural Resources Law and Policy* 1, 2; Guy J Dwyer and Mark P Taylor, 'Moving from consideration to application: The uptake of principles of ecologically sustainable development in environmental decision-making in New South Wales' (2013) 30 *Environmental and Planning Law Journal* 185, 185.

[118] See, eg, Dwyer and Taylor, above n 117, 187; Mark Patrick Taylor and Christopher Ives, 'Legislative and policy challenges for the protection of biodiversity and bushland habitats: An evidence-based approach' (2009) 26 *Environmental and Planning Law Journal* 35, 37.

[119] Council of Australian Governments, *Intergovernmental Agreement on the Environment*, 1 May 1992, <http//:www.environment.gov.au/about-us/publications/intergovernmental-agreement>.

[120] Ibid, Section 2.

[121] Ibid, Preamble.

[122] Ibid, Section 3.

[123] Ibid, Sections 3 and 4.

[124] Ibid, Schedule 1(1).

inception, the IGAE has been implemented by governments through legislation,[125] and underpinned the formulation of legislation such as the *EPBC Act 1999* (Cth).[126]

The IGAE provides for the consideration of cumulative impacts in a regional context within legal, policy and administrative frameworks when making decisions relating to land use, development proposals and resource utilisation.[127] The Agreement extends this to the consideration of cumulative impacts arising from use and development within the marine and coastal environments.[128]

The *National Strategy for Ecologically Sustainable Development* (National Strategy) was also developed.[129] This document reflected the principles set out in the IGAE,[130] and provided the following definition for ESD:

> using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased.[131]

The National Strategy makes reference to cumulative impacts within the context of EIA and 'Intersectoral Issues' whereby Objective 15.2 is 'to increase the sensitivity of the EIA process, its planning and policy context and consequent decision making, to cumulative and regional impacts'.[132] It is noted that the IGAE and National Strategy do not refer to synergistic impacts.

Court, Wright and Guthrie commented on the relationship between environmental assessment and ESD in the 1990s, and stated that the implementation of ESD was dependent upon SEAs that incorporated cumulative impact assessment, and therefore aided in the identification of environmental thresholds.[133] Reflecting this comment in part, the 2009 review of the

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[125] See, eg, Explanatory Memorandum, Environment Protection and Biodiversity Conservation Bill 1998 (Cth), 8; Environment and Natural Resources Committee, Parliament of Victoria, *Inquiry into the Environmental Effects Statement Process in Victoria* (2011) 8.
[126] Explanatory Memorandum, Environment Protection and Biodiversity Conservation Bill 1998 (Cth), 7; also see Allan Hawke, *The Australian Environment Act - Report of the Independent Review of the Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth of Australia, 2009) 52.
[127]Council of Australian Governments, *Intergovernmental Agreement on the Environment*, 1 May 1992, Schedule 2(3)(ii), <http//:www.environment.gov.au/about-us/publications/intergovernmental-agreement>.
[128] See, eg, Council of Australian Governments, *Intergovernmental Agreement on the Environment*, 1 May 1992, Schedule 2(2), <http//:www.environment.gov.au/about-us/publications/intergovernmental-agreement>.This is indicated in Schedule 2(2) with the reference to the marine environment as being part of the consideration of natural resource use required to be undertaken in an ecologically sustainable manner.
[129] Ecologically Sustainable Development Steering Committee, *National Strategy for Ecological Sustainable Development*, (Australian Government Publishing Service, 1992) Part 1, <http://www.environment.gov.au/about/esd/publications/national-esd-strateg-part1>.
[130] Ibid.
[131] Ibid.
[132] Ecologically Sustainable Development Steering Committee, *National Strategy for Ecological Sustainable Development*, (Australian Government Publishing Service, 1992) Part 3 Chapter 15, <http://www.environment.gov.au/node/13017>.
[133] John Court, Colin Wright and Alasdair Guthrie, 'Environmental Assessment and Sustainability: Are we ready for the challenge?' (1996) 3 *Australian Journal of Environmental Management* 42, 43 – 44.

Commonwealth Government's *Environmental Protection and Biodiversity Conservation Act 1999*, argued that the principles of ESD are too complex to apply within the assessment of individual projects.[134] Improving requirements for considering cumulative and synergistic impacts within Australian marine EIA legal frameworks and the scientific method for assessing these impacts types could, as discussed in Chapters 2 and 3, assist in increasing knowledge and reducing uncertainty. Should this occur, it might assist in addressing issues raised by the concerns of Court, Wright and Guthrie, and in relation to the review of the *EPBC Act 1999* (Cth).

The ESD principles, as set out in the IGAE and National Strategy, include the precautionary principle, the conservation of biological diversity, intra-generational equity, intergenerational equity, and pricing mechanisms.[135] The application of the precautionary principle as a mechanism for addressing cumulative and synergistic impacts is examined further below.

2.2 The precautionary principle in Australian environmental law

Discussed in Chapter 1, the Australian version of the precautionary principle[136] as adopted within the IGAE and the National Strategy differs slightly from that included in the *Rio Declaration on Environment and Development*.[137] The principle as adopted in Australia provides for the use of discretionary instead of mandatory application,[138] whilst broadening the ambit of 'measures to prevent environmental degradation' that can be used by removing 'cost-effective'[139] as a limiting factor.[140]

The association between the application of the precautionary principle and the assessment of cumulative and synergistic impacts is also discussed in Chapters 1 and 3. The Chapter 3 discussion about sharing the burden of proof raises multiple points that warrant further examination within the Australian legal context, for example, how this approach would affect liability legislation associated with other ESD principles (e.g. intra-generational equity,

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[134] Hawke, above n 126, 53; also see Hawke cited in Environment and Natural Resources Committee, Parliament of Victoria, above n 276, 54.
[135] Council of Australian Governments, *Intergovernmental Agreement on the Environment*, 1 May 1992, Section 3 <http//:www.environment.gov.au/about-us/publications/intergovernmental-agreement>; Ecologically Sustainable Development Steering Committee, above n 132, Part 1.
[136] Refer to glossary.
[137] United Nations General Assembly, *Report of the United Nations Conference on Environment and Development: Annex 1 Rio Declaration on Environment and Development* UN Doc A:CONF.151:26(Vol.1) (3 – 14 June 1992), Principle 15 <http//:www.un.org/documents/ga/conf151/aconf15126-1annex1.htm>.
[138] See, eg, United Nations General Assembly, above n 137, Principle 15.
[139] United Nations General Assembly, above n 137, Principle 15.
[140] Council of Australian Governments, *Intergovernmental Agreement on the Environment*, 1 May 1992, Section 3.5.1 <http//:www.environment.gov.au/about-us/publications/intergovernmental-agreement>; United Nations General Assembly, above n 137 , Principle 15.

intergenerational equity, and pricing mechanisms such as the 'polluter pays'). This thesis does not examine these issues, nor does it examine the legal expression of all concepts directly associated with the precautionary principle (e.g. Best Available Data). Instead, the discussion focuses on how the precautionary principle is expressed within Australian legislation.

The need to apply the precautionary principle through appropriate regulatory mechanisms is emphasised due to the difficulty of avoiding scientific uncertainty associated with cumulative (and synergistic) impacts.[141] The benefits of policy and/or legal requirements referencing the precautionary principle include increased application in environmental assessments and decision-making. As an example of a direct connection between the application of the precautionary principle and the need to assess cumulative impacts as a means of effecting application, the *GBRR Program Report* states 'a cumulative impact assessment policy will incorporate this principle and increase rigour of environmental assessment processes.'[142] As discussed below, however, there is no express legislative requirement to consider cumulative impacts within this SEA process. In circumstances such as this, another element of the precautionary principle that should be given consideration within an Australian context is that of strength of application. As has been discussed by commentators such as Gullett and Wyman, the approach to the principle's application is dependent upon the decision-maker[143] and the extent of application should be achieved with a degree of 'commonsense'.[144] The role of the precautionary principle and the uncertainty of environmental impacts has been emphasised by Gullett through comment that, as a means of managing cumulative impacts, there is need for legislation containing environmental protection measures to be precautionary in approach.[145] Gullett's opinion about incorporation of the precautionary principle into legislation has also been reiterated, from a general perspective, by Wyman.[146] Furthering this argument, the inclusion of requirements for the application of the precautionary principle would still be of assistance to decision-makers in situations where cumulative and synergistic impacts are required by legislation to be considered within environmental assessments.

The precautionary principle is included in various examples of legislation for marine environmental assessment, management and protection. However, whilst there are examples

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[141] See, eg, Terrence Iverson and Charles Perrings, 'Precaution and proportionality in the management of global environmental change' (2012) 22 *Global Environmental Change* 161, 161.
[142] Great Barrier Reef Marine Park Authority, above n 98, 79.
[143] See, eg, Lisa Wyman, 'Acceptance of the Precautionary Principle – Australian v International Decision-makers' (2001) 18 (4) *Environmental and Planning Law Journal* 395, 397; Warwick Gullett, 'Environmental Protection and the "Precautionary Principle": A response to Scientific Uncertainty in Environmental Management' (1997) 14 *Environmental and Planning Law Journal* 52, 64.
[144] Wyman, above n 143, 397.
[145] Warwick Gullett, above n 143, 53, 64 - 65.
[146] Wyman, above n 143, 407.

with requirements to apply the precautionary principle,[147] there are also examples of 'intended' reference whereby a general requirement to apply ESD is expressed instead.[148] There are also examples of environmental assessment legislation within the Australian context that do not include reference to the precautionary principle or ESD, such as Victoria's *Environmental Effects Act 1970*. That this Act did not reference the precautionary principle as an element of impact assessment considerations, was raised as a concern in the *Inquiry into the Environmental Effects Statement Process in Victoria.*[149] With legislative approaches such as that of the *Environmental Effects Act 1970* (Vic) where there is no express requirement to consider cumulative and synergistic impacts, or apply the general ESD principles or the precautionary principle (in particular), the consideration of these impact types is dependent upon a non-statutory approach. Submissions to the *Inquiry into the Environmental Effects Statement Process in Victoria*, observed that the reliance upon discretionary documents for guidance can be problematic,[150] 'and results in uncertainty for proponents and the community and a lack of transparency for assessments completed under the Act'.[151] These potential problems can result in exclusion from, or an inconsistent approach to, assessment of cumulative and synergistic impacts.

Judicial review of statutory decision-making about marine use and development proposals has addressed the consideration of cumulative impact concerns alongside the need to apply the precautionary principle.[152] Whilst a brief example is provided below, the application of the precautionary principle and consideration of cumulative and synergistic impacts from a judicial perspective will not be reviewed in depth within this thesis. It is noted that examples of cases decided upon at an international level, and involving Australia, have also demonstrated the

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[147] See, eg, *Fisheries Management Act 1991* (Cth), s3A(b); *Environment Protection and Biodiversity Conservation Act* (Cth), s3A(b); *Environmental Planning and Assessment Act 1979* (NSW) s5(a)(vii) with reference to the meaning contained within the *Protection of the Environment Administration Act 1991* (NSW) s6(2)(a); *Environmental Protection Act 1986* WA s4A (1); *Environmental Management and Pollution Control Act 1994* (Tas) Sch 1 Pt 1 cl 1(a), Sch 1 Pt 2 cl 3(h). Currency update: the provision in the *Environmental Planning and Assessment Act 1979* (NSW) is now mirrored in section 1.3 with the reference to the meaning of the precautionary principle in section 1.4 (as contained in the *Protection of the Environment Administration Act 1991* (NSW) s6(2)(a)).

[148] See, eg, *Development Act 1993* (SA) s 3(c); *Offshore Petroleum and Greenhouse Gas Storage Regulations 2011* (Vic) r 5; *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) reg 3. Currency update: The *Development Act 1993* (SA) was replaced by the *Planning, Development and Infrastructure Act 2016* (SA) on the 1st April 2017. Refer to section 12 of the *Planning, Development and Infrastructure Act 2016* (SA) for a similar provision.

[149] Environment and Natural Resources Committee, Parliament of Victoria, above n 276, 52 – 53.

[150] Energy Supply Association of Australia, Australian Conservation Foundation, Environmental Defenders Office (Victoria), Victorian Planning and Environmental Law Association, Lawyers for Forests as cited in Environment and Natural Resources Committee, Parliament of Victoria, above n 276, 52.

[151] Environment and Natural Resources Committee, Parliament of Victoria, above n 276, 52.

[152] See, eg, *Port Stephens Pearls Pty Ltd v Minister for Infrastructure and Planning* [2005] NSWLEC 426, [56], Annexure A Figure 8; also see *Port Stephens Pearls Pty Ltd v Minister for Infrastructure and Planning* [2005] NSWLEC 426 cited in Warwick Gullett, 'Contesting the merits of aquaculture development: Port Stephens Pearls Pty Ltd v Minister for Infrastructure and Planning [2005] NSWLEC 426' (2006) 11 (1) *The Australasian Journal of Natural Resources Law and Policy* 109, 113 - 114, 116.

connection between cumulative impacts and a precautionary approach.[153]

As an Australian domestic example, Talbot J's decision in *Port Stephens Pearls Pty Ltd v Minister for Infrastructure and Planning* [2005] NSWLEC 426 (the *Port Stephens* case) resulted in conditions requiring post-approval monitoring.[154] Talbot J explained that a precautionary approach was required in response to the concerns raised about cumulative impacts,[155] and that they could be managed through the imposition of general environmental monitoring conditions.[156] Gullett discussed Talbot J's consideration of the Minister's original decision, and emphasised Talbot J's comment that the 'application of the precautionary principle as a driving force behind the consideration of the application does not lead to a determination to refuse consent'.[157] Gullett provided critique of the Minister's decision stating that the issues of uncertainty triggering the precautionary principle were not substantiated, and that although they appeared to be due to potential cumulative impacts, as evidenced by other decisions in Australian courts, the application of 'the principle cannot be used as a shield for decision-makers to deny development consent unless there are real risks associated with the proposal.'[158] This emphasises the need to improve knowledge about cumulative and synergistic impacts as a means of better understanding what the real risks actually are.

2.3 Key points

As discussed within this section, there is a connection between the problems associated with the uncertainty about cumulative and synergistic impacts, and the application of ESD and the precautionary principle. This section also demonstrates that although increased legislative requirements to apply ESD and the precautionary principle in decision-making about cumulative and synergistic impacts can facilitate greater attention to cumulative and synergistic impact assessment, improved outcomes would be achieved if this occurred in combination with appropriate legal requirements for the assessment of these impact types. The next section

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153 See, eg, Simon Marr, 'The Southern Bluefin Tuna Cases: The Precautionary Approach and Conservation and Management of Fish Resources' (2000) 11 *European Journal of International Law* 815, 819.
154 *Port Stephens Pearls Pty Ltd v Minister for Infrastructure and Planning* [2005] NSWLEC 426, [56], Annexure A Figure 8; also see *Port Stephens Pearls Pty Ltd v Minister for Infrastructure and Planning* [2005] NSWLEC 426, cited in Gullett, above n 152, 113, 114.
155 *Port Stephens Pearls Pty Ltd v Minister for Infrastructure and Planning* [2005] NSWLEC 426, [55]; also see *Port Stephens Pearls Pty Ltd v Minister for Infrastructure and Planning* [2005] NSWLEC 426 quoted in Gullett, above n 152, 114.
156 See, eg, *Port Stephens Pearls Pty Ltd v Minister for Infrastructure and Planning* [2005] NSWLEC 426, [56]; also see *Port Stephens Pearls Pty Ltd v Minister for Infrastructure and Planning* [2005] NSWLEC 426 cited in Gullett, above n 152, 116.
157 *Port Stephens Pearls Pty Ltd v Minister for Infrastructure and Planning* [2005] NSWLEC 426 [56] quoted in Gullett, above n 152, 114.
158 Gullett, above n 152, 116.

reviews the potential for Australian marine environmental focused legal requirements to require the assessment of cumulative and synergistic impacts.

3. Assessing cumulative and synergistic impacts within Australia's legal frameworks for the environmental assessment of large-scale marine use and development

In the 1990s James argued that general environmental legal frameworks in Australia did not contain adequate mechanisms to avoid cumulative impacts.[159] Other commentary focused on a tendency to assess environmental impacts in isolation.[160] This section focuses on more recent approaches, and reviews the way in which cumulative and synergistic impacts can be required to be considered within Australian legislative frameworks for marine environmental assessment.[161] The first part of the discussion focuses on the requirements to consider and assess these impact types in legislation applicable to general environmental assessment, the environmental management of large-scale marine use and development, and environmental protection. The second part provides examples of legislation where there is the potential for PAM to consider cumulative and synergistic impacts. The third part discusses the ways in which Australian judicial decision-making can influence legislative requirements for assessing cumulative and synergistic impacts. A discussion on the key points arising from this section is also provided.

3.1 Legislative requirement for the consideration and assessment of cumulative and synergistic impacts

The different legal jurisdictions in Australia provide for different types of legislative requirement applicable to marine environmental assessment and protection.[162] The law applicable to large-scale use and development in Australia's marine environment is varied and can include legislation that addresses general environmental assessment, industry specific environmental management (development and operation), and environmental protection (conservation and targeted species/ area protection).

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159 David James, 'Environmental Impact Assessment: Improving Processes and Techniques' (1995) 2 *Australian Journal of Environmental Management* 78, 82.
160 See, eg, Warwick Gullett, 'Environmental Impact Assessment and the Precautionary Principle: Legislating Caution in Environmental Protection' (1998) 5 (3) *Australian Journal of Environmental Management* 146, 148.
161 Currency as at April 2015. Footnotes are used to acknowledge significant changes to the legislation since this time (i.e. 'currency update'). The review for these changes was undertaken August 2018. This ensures an approach to currency that is consistent with the Otways Marine Area case study (Chapter 5).
162 Refer to Glossary and Chapter 1 for a discussion about the definition of marine environmental protection for the purpose of this thesis.

The discussion in this section begins by reviewing the approaches to general environmental assessment legislation within the Australian legal frameworks to require the consideration and assessment of cumulative and synergistic impacts. As in Chapter 3, the focus is on SEA and EIA. The discussion then addresses the ways in which environmental management legislation for specific industries (i.e. sectors) is capable of addressing cumulative and synergistic impacts. The third part of this section focuses on examples of the ways in which environmental protection legislation can incorporate cumulative and synergistic impact consideration and assessment.

3.1.1 Environmental assessment legislation

The framework and decision-making processes for the environmental assessment of cumulative and synergistic impacts from large-scale marine use and development are determined by legislation; with policy used to provide guidance. Within the context of SEA, anthropogenic activities occurring within the marine environment can be assessed from a broad based perspective that addresses a number of uses at the same time. Examples of SEA use for managing the Australian marine environment include the management of fisheries,[163] offshore petroleum,[164] and protected areas.[165]

Legislative examples of the requirement for SEA are found in the *EPBC Act 1999* (Cth),[166] and Western Australia's *Environmental Protection Act 1986*.[167] The legislative approach for requiring the assessment of cumulative and synergistic impacts within SEA is not necessarily prescribed within legislative provisions.[168] The directions for the assessment of particular impact types may instead be detailed within policy, agreements and associated terms of reference.[169] For example, the *Great Barrier Reef Region Strategic Assessment Terms of*

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[163] One example of use is for Commonwealth fisheries. See, eg, *Environment Protection and Biodiversity Conservation Act 1999* (Cth) ch 4 pt 10 div 2.
[164] One example of use is for offshore petroleum in a marine area adjacent to Western Australia known as the North West Shelf. See, eg, Australian Government Department of the Environment, *Strategic assessment of the Browse Basin liquefied natural gas precinct* <http://www.environment.gov.au/node/18603> ; Australian Government Productivity Commission, *Review on Regulatory Burden on Upstream Petroleum (Oil and Gas) Sector: Productivity Commission Research Report* (Commonwealth of Australia, 2009) 137.
[165] See, eg, Great Barrier Reef Marine Park Authority, *Great Barrier Reef Region Strategic Assessment: Strategic Assessment Report* (Great Barrier Reef Marine Park Authority, 2014).
[166] See, eg, Part 10. This part enables the requirement of a strategic environmental assessment.
[167] See, eg, Section 38(3). This section provides a referral power to the Environment Protection Authority for assessment (s 40).
[168] See, eg, *Environment Protection and Biodiversity Conservation Act 1999* (Cth) pt 10; See, eg, *Environmental Protection Act 1986* (WA) pt IV div 1.
[169] See, eg, *Environment Protection and Biodiversity Conservation Act 1999* (Cth) s 146(1B); *Environmental Protection Act 1986* (WA) s 40.

Reference requires the assessment of cumulative impacts,[170] whereas the power to formulate the terms of reference is found within the *EPBC Act 1999* (Cth).[171]

For individual projects, decisions to approve use and development in Australia are often made on a case by case basis within a statutory decision making framework that provides for EIA.[172] The State, Northern Territory and Commonwealth governments have legislation that provides for the requirement and assessment of EIAs within the general environmental assessment framework.[173]

The assessment of cumulative and synergistic impacts is dependent upon particular requirements. An example of explicit provisions for the requirement of cumulative impact assessment can be found within the *Environmental Planning and Assessment Regulation 2000* (NSW). These regulations provide a general requirement to consider cumulative impacts within an environmental assessment.[174] Commenting on the *Environmental Planning and Assessment Act 1979* (NSW), Walmsley and Lashko cited submissions by the New South Wales Environmental Defenders Office and critiqued that the Act neglected ESD and the assessment of 'cumulative impacts of climate change'. [175] The critique reflects a perception that the focus of the legislation is on anthropogenic activities and fails to account for environmental change. Further, the absence of reference to synergistic impacts within the *Environmental Planning and Assessment Act 1979* (NSW) was highlighted by Walmsley and Lashko. However, whilst the discussion about the impacts on marine biodiversity acknowledged the synergistic interaction of climate change and anthropogenic activities,[176] the overall discussion focused significantly more on the need to incorporate cumulative impacts within decision-making processes.[177] This indicates that synergistic impacts are considered as a subset of cumulative impacts.

General EIA requirements for the assessment of environmental impacts can be prescribed

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170 Australian Government Great Barrier Reef Marine Park Authority, *Great Barrier Reef Region Strategic Assessment Terms of Reference* (Great Barrier Reef Marine Park Authority, 2012) 6, 12.
171 *Environment Protection and Biodiversity Conservation Act 1999* (Cth) s 146(1B).
172 Refer to Chapter 3 for a general discussion on the purpose of environmental impact assessment and the limitations and benefits of assessing cumulative and synergistic impacts with this environmental assessment tool.
173 See, eg, *Environment Protection and Biodiversity Conservation Act 1999* (Cth) ch 2; *Environmental Protection Act 1986* (WA) pt IV; *Environmental Effects Act 1978* (Vic); *Development Act 1993* (SA) pt 4; *Environmental Planning and Assessment Act 1979* (NSW) pt 5; *Environmental Assessment Act 2013* (NT); *Environment Management and Pollution Control Act 1994* (Tas) pt 5. Currency update: The *Development Act 1993* (SA) was partially replaced by the *Planning, Development and Infrastructure Act 2016* (SA) on the 1st April 2017. Refer to Part 7, Division 2, Subdivision 4 of the *Planning, Development and Infrastructure Act 2016* (SA) for a similar provision.
174 *Environmental Planning and Assessment Regulation 2000* (NSW), r 228(2)(o).
175 Rachel Walmsley and Anna Lashko, 'Are our marine biodiversity laws climate ready?' (2011) 2 *National Environmental Law Review* 37, 42.
176 Ibid, 43.
177 Ibid, 42, 43, 45.

within legislation through use of broader terms such as 'significant effect'.[178] When these terms are used in conjunction with non-legislative instruments (i.e. policy) directing the specific content of an EIA, the assessment of cumulative and synergistic impacts can still be considered necessary. For example, Victoria's *Environment Effects Act 1978* does not contain any explicit requirement to consider cumulative or synergistic impacts, but it is supported by the *Ministerial guidelines for assessment of environmental effects under the Environment Effects Act 1978.*[179] The guidelines state that cumulative impacts should be assessed if potentially significant, including in relation to other anthropogenic activities within the surrounding area.[180]

The inclusion of cumulative and synergistic impact assessment within guidelines is beneficial when primary legislative frameworks do not include specific consideration requirements or definitions for these impact types.[181] Whilst the requirements of legislation can enable discretionary application, the difference between the use of legislation and the use of non-legislative instruments for determining content is that legislative requirements must be applied. Further, as the application of non-legislative instruments can be discretionary, this presents a risk that even if the consideration of cumulative and synergistic impacts is recommended (e.g. as part of guidelines), an assessment may not necessarily be undertaken. Alternatively, when an assessment is undertaken there is a risk of inconsistency in approach. The issue of inconsistency also arises in situations where there is no guidance (e.g. no definitions) within the subordinate statutory instruments. To minimise inconsistency in relation to statutory requirements, for example, when using 'terms of reference' under the *EPBC Act 1999* (Cth),[182] the requirements for assessment as stipulated by the 'terms of reference' should aim to incorporate definitions of cumulative and/or synergistic impacts already used in the broader statutory framework. [183]

The use of general terms such as 'significant' impact/ effect within Australian environmental assessment legal frameworks has been commented on as a threshold test that limits the effective assessment of cumulative (and synergistic) impacts. Focusing on the assessment of cumulative impacts under the *EPBC Act 1999* (Cth), Haigh raised concern that the EIA process

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[178] See, eg, *Environmental Effects Act 1978* (Vic) s 8.
[179] Victorian Government Department of Sustainability and Environment, *Ministerial Guidelines for the Assessment of Environmental Effects under the Environmental Effects Act 1978* (Victorian Government, 7th ed, 2006).
[180] Ibid, 18.
[181] See, eg, *Environment Protection Biodiversity Conservation Act 1999* (Cth) s 527E. Here the legislation defines the meaning of 'impacts' as having reference to 'direct' impacts and 'indirect' impacts whereby causation is 'substantial'. In addition to the definition of 'impact' failing to reference cumulative or synergistic impacts, there is no explicit requirement for cumulative or synergistic impacts within the Act. It is noted that there are requirements within the *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth) to consider cumulative impacts (see, eg, reg 2B.01(5)(l)), but no definition is provided. The examples are discussed further in Chapter 5.
[182] Section 146.
[183] Refer to Chapters 2 and 3 for detailed discussion on this matter.

for determining 'significance' risked damage to World Heritage Areas due to the neglect of smaller cumulative impacts that were indirect but could still compound over time;[184] thus causing a delay in 'substantive protection'.[185] Macintosh has also stated concern about cumulative impacts being neglected within the significant impact threshold test,[186] and the failure to consider these impact types within the final element of the decision-making process.[187]

Commentary by Macintosh and Wilkinson has also identified the shortcomings of the significant impact threshold test for addressing cumulative impacts with concern about the capacity of EIA to address these problems.[188] They suggest that the SEA process is a better approach.[189] Macintosh and Wilkinson, in seeking to minimise cumulative impacts, suggested a new zoning approach 'to shift the focus of the regulatory process from the nature and magnitude of the impacts to the characteristics of the action'.[190] An alternative approach for the identification of cumulative (and synergistic) impacts before the 'significant' threshold is reached is provided by McGrath. McGrath's approach focuses on the planning framework, but instead suggests the need to increase consideration requirements within decision-making, as opposed to at the earlier stage of the 'significant impact test'.[191] These opinions of Macintosh and Wilkinson, and McGrath, have merit. However, to ensure effectiveness, it is considered that cumulative and synergistic impacts should be considered at all stages of a decision-making process to minimise the chance of missed information and neglected impacts. Further, it is considered that the complexities for the application of zoning within a marine environmental strategic planning framework would require that more than one mechanism be applied to ensure effectiveness.

3.1.2 Sector environmental management legislation

Large-scale marine use and development within the marine environment has often been

184 David J Haigh, 'Hinchinbrook – in defence of world heritage' (1999) 6 (1) *The Australasian Journal of Natural Resources Law and Policy* 47, 58, 69.
185 Ibid, 58.
186 Andrew Macintosh, 'Why the Environment Protection and Biodiversity Conservation Act's referral, assessment and approval process is failing to achieve its environmental objectives' (2004) 21 *Environmental and Planning Law Journal* 288, 305 – 307; Andrew Macintosh, 'The Environment Protection and Biodiversity Conservation Act 1999 (Cth) – An evaluation of its cost effectiveness' (2009) 26 *Environmental and Planning Law Journal* 337, 350.
187 Macintosh (2004), above n 186, 305.
188 Andrew Macintosh and Debra Wilkinson, 'EPBC Act – The case for reform', (2005) 10 (1) *The Australasian Journal of Natural Resources Law and Policy* 139, 164.
189 Ibid, 164.
190 Ibid, 171.
191 Chris McGrath, 'Swirls in the stream of Australian environmental law: Debate on the EPBC Act' (2006) 23 *Environmental and Planning Law Journal* 165, 182.

managed within Australian legal frameworks via an individual sector approach.[192] In addition to environmental legislation incorporating SEA and EIA frameworks, there is legislation applicable to specific types of anthropogenic activity within the marine environment. These legislative frameworks contain provisions for the environmental management (including assessment) of isolated projects or activities within decision-making processes.

The Australian regulatory framework for the approval of offshore petroleum provides an example for the environmental management and assessment of an individual sector. Within this framework the environmental management and associated assessment requirements can be found within the Commonwealth's *Offshore Petroleum and Greenhouse Gas Storage Act 2006*[193] and the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009;*[194] as well as within several of the parallel State acts and regulations for offshore petroleum.[195]

The fisheries and aquaculture regulatory frameworks for approval are further examples. Within Australia, examples of fisheries management legislation addressing environmental management and protection include the *Fisheries Management Act 1991* (Cth)[196] for Commonwealth jurisdiction, South Australia's *Fisheries Management Act 2007,*[197] Victoria's *Fisheries Act 1995*[198] and the New South Wales *Fisheries Management Act 1994*.[199] The environmental management of aquaculture can be provided for at this level of government through either specific legislation[200] or guidelines associated with fisheries legislation.[201] Alternatively, general environmental management and assessment legislation can be utilised, for example, within the Commonwealth jurisdiction the *EPBC Act 1999* (Cth) applies.[202] This demonstrates that in instances where there is the potential for cumulative and synergistic impacts to occur in either State or Territory marine waters as well as Commonwealth marine waters because of a single project, both general environmental assessment legislation and individual sector

[192] Commonwealth of Australia (Volume 1), above n 10, 11.
[193] See, eg, Part 6.4; Sch 2A, Pt 2.
[194] See, eg, Part 2.
[195] See, eg, *Petroleum (Submerged Lands) (Management of Environment) Regulations 2012* (Tas)*; Petroleum (Submerged Lands) (Environment) Regulations 2012* (WA)*; Offshore Petroleum and Greenhouse Gas Storage Act 2010* (Vic) pt 6.4; *Offshore Petroleum and Greenhouse Gas Storage Regulations 2011* (Vic) ch 2.
[196] See, eg, Division 2.
[197] See, eg, Part 5.
[198] See, eg, Section 28.
[199]See, eg, Section 7G.
[200] See, eg, *Fisheries Management (Aquaculture) Regulation 2012* (NSW) reg 7; *Aquaculture Act 2001* (SA) pt 10A; *Aquaculture Regulations 2005* (SA) s 27.
[201] See, eg, *Fisheries Act 1995* (Vic) s 3, 43; *Fisheries Regulations 2009* (Vic) pt 12; Fisheries Victoria, DPI, *Guidelines for Environmental Baseline Surveys and Ongoing Monitoring of Aquaculture Fisheries Reserves in Port Phillip and Western Port: Fisheries Victoria DPI Management Report Series No. 35* (Department of Primary Industries, 2006) <http//:www.depi.vic.gov.au/fishing-and-hunting/aquaculture/aquaculture-management/guideines-and-ongoing-management-of-aquaculture-fisheries-reserves> .
[202] See, eg, Part 3 div 1 sub-div F.

legislation can be applied to the same activity. This results in the potential for inconsistency, unless a common approach is taken (for example, see the discussion on bilateral agreements in section 4.2).

Whilst there is no explicit requirement to consider cumulative or synergistic impacts in any of the examples provided above, there is the potential to require consideration as part of any impact assessment or management plan process undertaken. Requirements not detailed within Acts or regulations can, instead, be stipulated by guidelines for both environmental management and marine environmental protection. For example, guidelines for the protection of fisheries from seismic surveys in Western Australia have been developed under the *Fish Resources Management Act 1994* (WA) to incorporate cumulative impact consideration for the interaction of impacts from seismic surveying and other activities on species or fisheries.[203] As another example, the New South Wales the *Guidelines for Environmental Assessment of Fishing Related Activities*, developed in association with the *Fisheries Management Act 1994* (NSW), identify that cumulative impact assessment should be included as part of the 'Review of Environmental Factors'.[204]

3.1.3 Environmental protection legislation

Environmental legislation that is specifically aimed at reducing marine pollution, as well as targeting the protection of identified marine habitats, species and regions, is also capable of incorporating cumulative and synergistic impact assessment. Environmental protection legislation can be applied in situations that involve the environmental assessment of proposed large-scale marine use and development, as well as the continuing impacts of anthropogenic activities.

Australian marine pollution laws have been developed to apply both from a general (e.g. multiple different activities) and individual sector focus. From a marine environmental pollution perspective, examples of legislation relating to individual sectors include those for shipping (e.g. *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth) and the *Marine Pollution Act 2012* (NSW)). Examples of pollution controls that can apply to multiple sectors include legislation such as the *Environmental Protection Act 1986* (WA), *Environment Protection Act 1970* (Vic) and the *Environment Management and Pollution Control Act 1994* (Tas). Focusing on these examples, the requirements for marine sourced pollution legislation to

[203] Government of Western Australia Department of Fisheries, *Guidance statement on undertaking seismic surveys in Western Australian waters* (Department of Fisheries, 2013) 5.
[204] New South Wales Government (Fisheries, Compliance and Regional Regulations Division), *Guidelines for Environmental Assessment of Fishing Related Activities,* (Industry and Investment NSW, 2009) 13.

effectively consider cumulative and synergistic effects can be limited when the regulatory focus is on addressing reactive post-incident measures (e.g. oil spills).[205] It is acknowledged, however, that pollution control measures are also proactive through mitigation measures that seek to limit additional impacts within a marine environment,[206] and that the consideration of cumulative and synergistic impacts could be factored into prevention requirements (i.e. through legislative reform).

In comparison, marine environmental protection legislation that is targeted to protect habitats and identified areas can incorporate requirements (i.e. express or implied) for the consideration and assessment of cumulative (and synergistic) impacts that are more proactive in terms of prevention. This is because the legislation can involve a statutory decision-making process that requires detailed impact assessments to be undertaken prior to the approval and commencement of an activity. Examples of this legislation include the *Marine Parks Act 2007* (SA), *Great Barrier Reef Marine Park Act 1975* (Cth), and the *Marine Estate Management Act 2014* (NSW). As an example of expressed requirements to consider cumulative impacts, South Australia's *Marine Parks Act 2007* provides that there is a 'general duty of care' to consider the 'cumulative effect on a marine park' when determining 'measures to prevent or minimise harm to a marine park'.[207] The approvals process for activities within Queensland's marine parks also requires cumulative impact consideration under the *Marine Parks Regulation 2006*.[208]

In relation to species protection, legislative examples that could include the consideration and assessment of cumulative and synergistic impacts within statutory decision-making process (i.e. express or implied) include Acts such as the *Threatened Species Conservation Act 1995* (NSW),[209] *Nature Conservation Act 1992* (Qld) and the *Flora and Fauna Guarantee Act 1988* (Vic). The *EPBC Act 1999* (Cth), whilst also providing for environmental assessment frameworks, provides for both habitat,[210] species[211] and area protection.[212] The associated *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth) contain examples of cumulative impact assessment requirements for the protection of marine areas in

[205] This is based on the premise that an oil spill occurs due to an accident and that via clean up procedures legislative frameworks are only capable of mitigating any potential cumulative or synergistic impacts.
[206] See, eg, *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth) pt II; *Environment Protection Act 1970* (Vic) s 39, 63.
[207] Section 37.
[208] Regulation 11(1)(j). Currency update: The *Marine Parks Regulations 2006* (Qld) was replaced by the *Marine Parks Regulations 2017* (Qld) on the 1st September 2017. Regulation 11(1)(j) mirrors the previous provision.
[209] Currency update: The *Threatened Species Conservation Act 1995* (NSW) was replaced by the *Biodiversity Conservation Act 2016* (NSW) on 25th August 2017.
[210] See, eg, Ch 2 pt 3 sub A.
[211] See, eg, Ch 2 pt 3 sub C.
[212] See, eg, Ch 2 pt 3 sub B.

relation to World Heritage management plans,[213] and Ramsar wetlands.[214]

Specific requirements for the consideration and assessment of cumulative and synergistic impacts are absent for all but one of these examples. The inadequate approach is emphasised where the *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth) limit express requirements to only two matters, when the *EPBC Act 1999* (Cth) applies to a broad range of areas, species and anthropogenic activities.

3.2 Environmental assessment and management legal framework provisions for post-approval monitoring of cumulative and synergistic impacts

The benefits of PAM[215] for the prevention and management of cumulative and synergistic impacts, including the identification and mitigation of the actual impacts from approved use and development, are discussed in Chapter 3.[216] The value of PAM as a mechanism for providing iterative feedback within environmental assessment (EIA and SEA) and decision-making processes was also discussed in that chapter.[217] This section focuses on the requirements to undertake PAM within Australian legislative frameworks for marine environmental assessment.

Within the Australian frameworks for SEA, the monitoring of cumulative and synergistic impacts can be required as part of a strategic planning approach that aims to improve knowledge about current and potential future impacts within a selected area.[218] An example of cumulative (and synergistic) monitoring can be found within the *GBRR Strategic Assessment*

[213] *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth) reg 2B.01(5)(l), sch 5(2)(2.02)(d).
[214] *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth) sch 6(2)(2.02)(e).
[215] Also refer to the glossary.
[216] See, eg, L W Canter (1996) in Lourdes M Cooper and William R Sheate, 'Integrating cumulative effects assessment into UK strategic planning: implications of the European Union SEA Directive' (2004) 22 (5) *Impact Assessment and Project Appraisal* 5, 15; L W Canter, *Environmental Impact Assessment* (McGraw – Hill Book Co, 1996) 48; Gordon E Beanlands and Peter N Duinker, 'Lessons from a Decade of Offshore Environmental Impact Assessment' (1984) 9 *Ocean Management* 157, 169 – 170; International Association for Impact Assessment in cooperation with Institute of Environmental Assessment, UK, *Principles of Environmental Impact Assessment Best Practice,* (1999), 4 <http//:www.iaia.org/publicdocuments/special-publications/Principles%20of%201A_web.pdf>; International Association for Impact Assessment in cooperation with Institute of Environmental Assessment (1999) cited in Ian Thomas and Mandy Elliot, *Environmental Impact Assessment in Australia: theory and practice* (The Federation Press, 4th ed, 2005), 18 – 19.
[217] See, eg, R Bisset and P Tomlinson (1983) cited in A K M Rafique Ahammed and Bronte Merrick Nixon, 'Environmental impact monitoring in the EIA process of South Australia', (2006) 26 *Environmental Impact Assessment Review* 426, 428 – 429; Dubé and Munkittrick, above n 116, 256; L W Canter (1996) in Cooper and Sheate, above n 216, 15; Canter, above n 216, 48; Therivel and Ross, above n 116, 372 – 373.
[218] An area can be selected, for example, based on geographical region or ecosystem. See, eg, NSW Government Marine Parks Authority, *NSW Marine Parks Strategic Research Framework 2010 – 2015* (Marine Parks Authority), 5 <http//:www.mpa.nsw.gov.au/pdf/Marine-Parks-Strategic-Framework-2010-2015> as associated with the *Marine Parks Act 1997* (NSW); *Marine Parks Act 2007* (SA) s 13(1)(d).

Report approach to the assessment of these impact types.[219] The scientific knowledge gained from the monitoring of cumulative (and synergistic) impacts occurring within the Great Barrier Reef region was discussed as important for informing a revised strategic approach, adaptive management and whether new activities should be approved.[220] As mentioned above, the requirement for the consideration of cumulative (and synergistic) impacts within the *GBRR Strategic Assessment Report* was stipulated within the *Great Barrier Reef Region Strategic Assessment Terms of Reference*.[221] Further, in addition to direct inclusion within strategic planning and SEA when there is no specific legislative requirement, the monitoring of cumulative and synergistic impacts can be required indirectly via legislative requirements for general monitoring provisions.[222]

Australian marine environmental assessment legal frameworks can require monitoring through the incorporation of conditions when approvals for use and development are granted.[223] The requirements incorporated into general environmental assessment or individual sector environmental management legislation can occur via broad powers to impose conditions relevant to an approval,[224] powers to require environmental management plans,[225] and monitoring powers to ensure operational compliance.[226] The potential for the monitoring of cumulative (and synergistic) impacts can also be required as part of monitoring that is undertaken when a detrimental impact is at risk of being inconsistent with the extent of impacts allowable under an approval.[227]

The consideration and assessment of cumulative impacts within adaptive management is integral to monitoring and decision-making processes.[228] As an example within the individual sector environmental management context, the Victorian *Offshore Petroleum and Greenhouse Gas Storage Regulations 2011* requires that environmental plans be reviewed either every five years, or in response to a ministerial request.[229] Further, if as evidenced after monitoring the

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[219] See, eg, Great Barrier Reef Marine Park Authority, above n 91, 6 - 66, 6 - 71 – 6 – 72.
[220] Ibid, 6 – 72, 8 – 55, 13-30.
[221] Australian Government Great Barrier Reef Marine Park Authority, above n 170, 6, 12.
[222] See, eg, *Environment Protection and Biodiversity Conservation Act 1999* (Cth), s 176(4)(f). This section relates to monitoring requirements within bioregional plans.
[223] See, eg, Office of the Environmental Monitor, *Annual Review No. 3 – January 2011, Reporting period: 8 February 2008 to 31 December 2010* (Victorian Government - Office of the Environmental Monitor, 2011) iii (note: this review discusses the conditions of approval requiring monitoring of the Victoria's Port Phillip Bay Channel Deepening Project); Australian Government (Approvals and Wildlife Division), Woodside Energy Ltd (EPBC 2002/621) *Final Approval Instrument 14/4/04*, Condition 1 <http://www.environment.gov.au/cgi-bin/epbc/epbc_ap.pl?name=current_referral_detail&proposal_id=621>.
[224] See, eg, *Environmental Protection Act 1986* (WA), s 45.
[225] See, eg, *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) reg 10A.
[226] See, eg, *Environment Protection and Biodiversity Conservation Act 1999* (Cth) ch 6 pt 17 div 3.
[227] See, eg, *Marine Parks Act 2007* (SA) s 40(2)(e), s 37(2)(f); *Environmental Protection Act 1986* (WA) s 48.
[228] See, eg, Walmsley and Lashko, above n 175, 42, 43, 45.
[229] Part 2.2 div 4.

impacts from a previously approved use and development are considered beyond remediation or inconsistent with an approval already granted, legislative requirements can include provisions for retrospectively amending conditions of approval. An example of retrospective power can be found within Western Australia's *Environmental Protection Act 1986*.[230]

3.3 Consideration of cumulative and synergistic impacts by Australian courts

The following discussion examines several examples of judicial decisions that have addressed cumulative and synergistic impact assessment requirements. The decisions are from several different jurisdictions, and have been examined to determine the extent of influence (if any) that has been had on the approach to the application of legal requirements applicable to the assessment of cumulative and synergistic impacts.

Within Australia, judicial decisions have addressed cumulative impacts within the context of legislative requirements to assess environmental impacts.[231] This is evidenced by decisions from different jurisdictions that discuss the need for cumulative impacts to be considered within the EIA process for proposed use and development that impacts on the marine and/or terrestrial environment. For example, the New South Wales Land and Environment Court's decision of *Telstra Corporation Limited v Hornsby Shire Council [2006] NSWLEC 133*, Preston CJ and Brown C commented that:

> Threats to the environment that should be addressed include.....cumulative impacts of multiple or repeated actions or decisions. Where threats may interact or be interrelated (for example where action against one threat may exacerbate another threat) they should not be addressed in isolation.[232]

These comments focused on applying the precautionary principle, and the need to consider cumulative impacts as an environmental threat, when making decisions about the merits of a proposal under the *Environmental Planning and Assessment Act 1979* (NSW).[233]

The Supreme Court of New South Wales – Court of Appeal has made decisions in response to questions of law that influence the way legislation addresses cumulative impacts. The decision

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[230] See, eg, sections 46, 48.

[231] See, eg, *Queensland Conservation Council Inc v Minister for the Environment and Heritage* [2003] FCA 1463 (19 December 2003), [38 – 41]; *Minister for the Environment and Heritage v Queensland Conservation Council Inc* (2004) 139 FCR 24, 35 – 40 [43 – 62] (Nathan Dam Case); *Brown v Forestry Tasmania, Commonwealth of Australia and State of Tasmania (No 4)* (2006) 157 FCR 1, 16 [102], 22 [146]*; Tarkine National Coalition Incorporated v Minister for the Environment* [2014] FCA 468, [106–115].

[232] *Telstra Corporation Limited v Hornsby Shire Council* [2006] NSWLEC 133, [130]. It is noted that Preston CJ and Brown J cited R Cooney and B Dickson (eds) *Biodiversity and the Precautionary Principle, Risk and Uncertainty in Conservation and Sustainable Use* (Earthscan, 2005) 302, Guideline 6.

[233] *Telstra Corporation Limited v Hornsby Shire Council* [2006] NSWLEC 133, [13], [126 – 131].

of *Hoxton Park Residents Action Group Inc v Liverpool City Council and Others*,[234] is an example of this and included discussion that section 79C of the *Environment Planning and Assessment Act 1979* (NSW) (EP&A Act) should not be understood as 'limited' in its requirement for the consideration and assessment of cumulative impacts, even though there was no specific 'mandatory' provision.[235] The reasoning for this was that 'to do so would be inconsistent with the objects set out in s 5 of the EP&A Act.'[236]

Examples of decisions within the Federal Court of Australia to have had influence on the application of Commonwealth legislation include the *Queensland Conservation Council Inc v Minister for the Environment and Heritage*[237] and the associated Full Court appeal decision the *Minister for the Environment and Heritage v Queensland Conservation Council Inc* (*Nathan Dam Case*);[238] *Brown v Forestry Tasmania, Commonwealth of Australia and State of Tasmania (No 4)*;[239] and more recently *Tarkine National Coalition Incorporated v Minister for the Environment*.[240]

In the *Nathan Dam Case* the Full Court of the Federal Court of Australia upheld the decision of *Queensland Conservation Council Inc v Minister for the Environment and Heritage*, by stating that Kiefel J was correct in determining that the Minister had failed to consider all adverse impacts (including reference to cumulative impacts) for consideration under section 75 of the *EPBC Act 1999* (Cth).[241] As determined by Kiefel J, the legal provisions did not expressly exclude 'cumulative' or 'indirect' impacts.[242] With the facts of the case applicable to the Great Barrier Reef World Heritage Area,[243] the case addressed cumulative impacts occurring in the marine environment.

The decision of *Brown v Forestry Tasmania, Commonwealth of Australia and State of Tasmania (No 4)* focused on environmental assessment, management and protection legislation.[244] The decision included conclusions as to whether the proposed forestry operations could be considered a significant impact for the purposes of assessment under the *EPBC Act*

[234] (2011) 81 NSWLR 638.
[235] *Hoxton Park Residents Action Group Inc v Liverpool City Council and Others* (2011) 81 NSWLR 638, 654 [55].
[236] Ibid, 654 [55].
[237] [2003] FCA 1463, [38 – 41].
[238] (2004) 139 FCR 24, 35 – 40 [43 – 62].
[239] (2006) 157 FCR 1, 2, 22 [146].
[240] [2014] FCA 468, 270 – 272 [106–115].
[241] *Minister for the Environment and Heritage v Queensland Conservation Council Inc* (2004) 139 FCR 24, 24 – 25, 38 – 40 [54 – 63].
[242] *Queensland Conservation Council Inc v Minister for the Environment and Heritage* [2003] FCA 1463, [38 – 41].
[243] See, eg, *Minister for the Environment and Heritage v Queensland Conservation Council Inc* (2004) 139 FCR 24, 24 – 25, 30 [18 - 22].
[244] *Brown v Forestry Tasmania, Commonwealth of Australia and State of Tasmania (No 4)* (2006) 157 FCR 1, 2.

1999 (Cth).[245] Referencing the *Nathan Dam Case*, the conclusions by Marshall J included that cumulative impacts could result in significant impacts, and therefore trigger assessment under the Act.[246]

Legal commentary on cumulative impacts has focused on the *Nathan Dam Case*.[247] In general, this commentary has addressed the influence of the decision to require the consideration of cumulative impacts within the ambit of EIA methodology under the *EPBC Act 1999* (Cth).[248] The comments included anticipation that the decision would enable more attention toward cumulative impact assessment.[249] Given the subsequent changes to the *EPBC Act 1999* (Cth), however, it is arguable that an increase in assessment of cumulative (and synergistic) impacts could be attributed toward a combination of this decision and the application of the legislation.

The Commonwealth Government amended the *EPBC Act 1999* (Cth) to include a definition of the term 'impact' following the *Nathan Dam Case* and *Brown v Forestry Tasmania, Commonwealth of Australia and State of Tasmania (No 4)*.[250] The definition was provided to enable clearer direction as to what constitutes an indirect impact,[251] being:

> (a) the event or circumstance is a direct consequence of the action; or
> (b) for an event or circumstance that is an indirect consequence of the action – subject to subsection (2), the action is a substantial cause of that event or circumstance.[252]

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[245] Ibid, 2.
[246] Ibid, 2, 22 [146].
[247] See, eg, Chris McGrath, 'Key Concepts of the Environment Protection and Biodiversity Conservation Act 1999 (Cth)', (2005) 22 *Environmental and Planning Law Journal* 20, 37 – 39; Chris McGrath, 'Avoiding the legal pitfalls in the EPBC Act by understanding its key concepts' (2005) 3 *National Environmental Law Review* 32, 38-40; D E Fisher, 'Dams, Irrigation and World Heritage Areas – The Nathan Dam Case' (2004) 21 *Environmental and Planning Law Journal* 85, 85 - 92; Peter Wulf, 'Diffuse land base pollution and the Great Barrier Reef World Heritage Area: The Commonwealth's responsibilities and implications for the Queensland sugar industry' (2004) 21 *Environmental and Planning Law Journal* 424, 424, 437, 443; D E Fisher, 'Editorial Commentary: The meaning of impacts – The Nathan Dam Case on Appeal' (2004) 21 *Environmental and Planning Law Journal* 325, 327; Nicole Sommer, 'Editorial Note: Queensland Conservation Council Inc v Minister for the Environment and Heritage' [2003] FCA 1463 (Nathan Dam Case)' (2004) 9(1) *The Australasian Journal of Natural Resources Law and Policy* 145, 149, 151, 152; Lee Godden and Jacqueline Peel, *Environmental Law: Scientific, Policy & Regulatory Dimensions* (Oxford University Press, 2010) 301 – 304; Commonwealth of Australia, *Independent Review of the Environment Protection and Biodiversity Conservation Act 1999: Interim Report* (Commonwealth of Australia, 2009) 86 [4.232].
[248] See, eg, McGrath, above n 247, 37 – 39; Macintosh (2004), above n 186, 299, 305 – 307, 310; Peter Wulf, 'Offshore Petroleum and the Environment Protection and Biodiversity Conservation Act 1999 (Cth): Consideration of all adverse impacts', (2005) 22 *Environmental and Planning Law Journal* 296, 308 – 309, 315; Wulf, above n 247, 437.
[249] Wulf, above n 247, 437.
[250] *Environment Protection and Biodiversity Conservation Act 1999* (Cth) s 527E. This section was added to the Act in 2006 via section 783 of the *Environment and Heritage Legislation Amendment Act (No.1) 2006* (Cth).
[251] Explanatory Memorandum, Environment and Heritage Legislation Amendment Bill (No.1) 2006 (Cth), 93 [519]; Commonwealth Parliamentary Library, *Environment Protection and Heritage Legislation Amendment Bill (No.1)*, No 53 of 2006-07, 22 November 2006, 3.
[252] *Environment Protection and Biodiversity Conservation Act 1999* (Cth) s 527E. It is noted that subsection 2 provides that 'secondary persons' and 'secondary actions' can only be characterized as an impact if it is facilitated to a 'major extent' and the 'secondary action' and 'event' or 'circumstance' are capable of being reasonably anticipated.

Reviewing the definition of impact provided in s527E of the *EPBC Act 1999* (Cth), it is arguable that, if cumulative impacts are to be considered within the definitions of direct and indirect impacts, then only those related to an isolated use and/or development could be contemplated.[253] The argument is based on the potential limitation of Section 527E whereby 'substantial' causation is a required nexus for any indirect impacts that need assessing.[254] Godden and Peel suggested that this could result in an exclusion of cumulative impacts associated with the combination of the proposed activity and other (existing) activities.[255] If this limitation and the strong nexus requirement are considered, due to the characteristics of synergistic impacts having a high capacity to interact with impacts from more than one source, any argument for including synergistic impacts would appear more tenuous.[256]

In concluding their discussion on the s 527E amendment, Godden and Peel expressed the opinion that the current definition provides for a wider ambit of assessment capable of managing the problems caused by '*death by a thousand cuts*'.[257] There is, however, a potential difficulty with this interpretation. This being that without appropriate integration of a proposed use and development with existing and future anthropogenic activities, the potential for the poor transfer of knowledge about cumulative and synergistic impacts remains high. In addition, as the term 'indirect' is more a measure of nexus than magnitude, whilst a link can be drawn between requirements to consider 'indirect' impacts and the potential to include cumulative impacts within legislative requirements such as those within the *EPBC Act 1999* (Cth), there is still reason for expressly requiring and defining cumulative (and synergistic) impacts within legislation.

In the decision of *Tarkine National Coalition Incorporated v Minister for the Environment*, Tracey J considered questions surrounding the appropriateness of approving a hematite mine when endangered species were at risk, alongside the failure to consider relevant considerations such as cumulative impacts during the decision-making process.[258] The decision to approve the mine was made under the *Environmental Management and Pollution Control Act 1994* (Tas) and the *EPBC Act 1999* (Cth), with a bilateral agreement in place for assessment purposes of both Acts under the Tasmanian framework.[259] Tracey J determined that there was no requirement '…either expressly, or by necessary implication, to have regard to the cumulative

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[253] *Environment Protection and Biodiversity Conservation Act 1999* (Cth), s 527E. Also see, eg, Godden and Peel, above n 247, 303; McGrath, above n 247, 37.
[254] *Environment Protection and Biodiversity Conservation Act 1999* (Cth), s 527E(1)(b).
[255] Godden and Peel, above n 247, 303.
[256] Refer to Chapter 2 for discussion on synergistic impacts.
[257] Godden and Peel, above n 247, 303.
[258] (2014) 202 LGERA 244, 244.
[259] *Tarkine National Coalition Incorporated v Minister for the Environment* (2014) 202 LGERA 244, 244.

impact, actual or potential, of the projects and proposed projects…' and that the relevant matters were considered appropriately without needing to take cumulative impacts into account.[260] This decision demonstrates that in order for the effective consideration of cumulative (or synergistic) impacts to occur within environmental assessment, express requirements within legislation are necessary.

In relation to synergistic impacts, the judicial decisions addressing synergistic impacts within the context of Australian environmental law and assessment requirements appear to be limited in comparison with cumulative impacts. Examples can be found within decisions of the New South Wales Land and Environment Court, where brief reference is made to synergistic effects within the context of native vegetation removal and development,[261] and water pollution.[262] However, the reference to synergistic impacts within these decisions did not influence the way in which the relevant legislation was applied.

3.4 Key points

This review of the Australian legislative framework demonstrates that there are examples where cumulative impacts are already required to be assessed within legislative frameworks for environmental assessment, individual sector management and protection. The review also demonstrates that there are potential limitations to the effective assessment of both cumulative and synergistic impacts apparent within these frameworks.

The shortcomings associated with the approach to cumulative (and synergistic) impact assessment are evident within the examples. The potential for the absence of definition when there is a legislative requirement, as well as the potential for inconsistency associated with non-legislative instruments is identified within the environmental assessment examples. Other concerns about the effective assessment of cumulative and synergistic impacts include the shortcomings associated with the application of the significant impact threshold. It is also important to consider environmental change in combination with the cumulative and synergistic impacts of anthropogenic activities.

The examples associated with individual sector management, emphasise the shortcomings with legislative frameworks that do not address the need to consider cumulative (and synergistic)

[260] Ibid, 272 [115].
[261] *Valhalla Village Pty Ltd v Wyong Shire Council*, [2008] NSWLEC 1476 [109].
[262] *Environment Protection Authority v Pancorp Australia Pty Ltd* [2002] NSWLEC 38, [40]; *Environment Protection Authority v Rail Infrastructure Corporation* (2002) 119 LGERA 409, [68].

interactions from multiple anthropogenic activities occurring in an area. Where examples do address this issue, the need for a common and integrative approach is emphasised. The shortcomings identified through the environmental protection examples reiterate this concern. Further, these examples demonstrate that the effective consideration and assessment of cumulative and synergistic impacts associated with environmental protection via pollution focused law can be difficult to address when legislation is reactive. As discussed, further reform to ensure that the cumulative and synergistic impacts are monitored would be beneficial.

The shortcomings identified in this section, when considered with the challenges for cumulative and synergistic impact assessment and definition previously discussed in the Chapters 2 and 3,[263] indicate a need for additional research. To gain more insight into the requirements for assessment and provision of definitions, the Otways Marine Area case study in Chapter 5 analyses the Commonwealth, South Australian, Victorian and Tasmanian legislative frameworks for environmental assessment.

The need for additional research is further supported when it is acknowledged that the extent to which the legislative frameworks for marine environmental assessment within Australian jurisdictions provide specific requirements for the assessment of cumulative impacts has not been reviewed from a broad perspective since the mid-1990s. This review was commissioned by the Commonwealth Environment Protection Agency and published within Court, Wright and Guthrie's *Assessment of cumulative impacts and strategic assessment in environmental impact assessment*.[264] Within the context of synergistic impacts as a distinct impact type, no thorough review has been undertaken.[265]

Examples of general legislative powers for the inclusion of PAM conditions that assist with increasing knowledge and iterative feedback about cumulative and synergistic impacts are also identified in the discussion. Further research in the area of the shortcomings and benefits of PAM for cumulative and synergistic impact assessment is identified as important. This is addressed within Chapter 7 through an analysis of the Danish approach to PAM for offshore wind farms. The guidance from the Chapter 7 analysis can then be used to inform recommendations for improving Australian legal framework approaches.

Finally, the influence of judicial decisions on the application of legislation and the assessment

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[263] See, eg, the discussion in Chapter 2, section 4 (defining cumulative and synergistic impacts separately), and Chapter 3, section 2.3 (challenges for the effective environmental assessment of cumulative and synergistic impacts).
[264] Court, Wright and Guthrie, above n 27.
[265] Ibid, Appendix I.3. Whilst the analysis of cumulative impacts by Court, Wright and Guthrie defined synergistic impacts, the need to assess them as separate impact types was not addressed.

of cumulative and synergistic impacts has been demonstrated as having had an effect on the approach to the requirements to assess these impact types. This has occurred within subsequent judicial decisions and has prompted the amendment of existing legislation. The extent of this influence is difficult to determine without additional research, however, due to the limited scope of this thesis this area will not be addressed further.

4. The challenge of fragmented environmental assessment legislative frameworks and approaches for the consideration of cumulative and synergistic impacts

The issues that can arise because of regulatory fragmentation during decision-making processes and associated cumulative and synergistic impact assessment are examined in the first part of this section. This is followed by analysis of a mechanism that aims to overcome jurisdictional causes of fragmentation with EIA legislation between the Federal, State, and Northern Territory governments. This mechanism is the bilateral agreement arrangements under the *EPBC Act 1999* (Cth). The third part of this section includes a review of the approach to the management of cumulative and synergistic impact consideration and assessment within the Great Barrier Reef region. This example is used to demonstrate the potential for fragmentation to occur when there is more than one level of government involved in marine area management. The final part of this section is a summary of the key points.

4.1 The implications of fragmentation within legal frameworks and decision-making

The issue of fragmentation due to multiple levels of government and different jurisdictions has been identified as an obstacle to cumulative impact assessment.[266] Fragmentation can be problematic from a number of perspectives, including that of the EIA process, the proponent's management of a proposal, and the ability to achieve mitigation outcomes.[267] The fragmentation between government approaches relative to the statutory approvals process for proposed use and development has been identified as a cause of poor prediction.[268] The fragmented nature of decision-making has also been identified as a contributory cause of cumulative impacts.[269]

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[266] Robert (Bob) Connelly, 'Canadian and international EIA frameworks as they apply to cumulative effects' (2011) 31 *Environmental Impact Assessment Review* 453, 454; Dr Alexandra S Wawryk, 'Legislating for offshore wind energy in South Australia' (2011) 28 *Environmental and Planning Law Journal* 265, 267 – 268; Adrian J Bradbrook and Alexandra S Wawryk, 'The Legal Regime Governing the Exploitation of Offshore Wind Energy in Australia' (2001) 18 (1) *Environmental and Planning Law Journal* 30, 31.
[267] Connelly, above n 266, 454.
[268] James, above n 159, 79 – 80.
[269] Rowena Maguire and Angela Phillips, 'The role of property law in environmental management: An examination of environmental markets' (2011) 28 *Environmental and Planning Law Journal* 215, 220; James, above n 159, 81.

In Australia, the potential for conflicting approaches to environmental decision-making by multiple governments has been identified as a constraint on consistent decision-making.[270] For example, Wawryk discussed that the environmental assessment of future offshore wind farms in Australia would be complicated by the application of legal frameworks for more than one jurisdiction.[271]

Concern about the fragmentation of decision-making about anthropogenic activities in the coastal environment was raised by the Federal Government's report *The Injured Coastline: Protection of the Coastal Environment.*[272] This type of fragmentation, within Australian legislative and policy frameworks, was acknowledged in the 1996 SoE report as complicating the achievement of consistent goals and environmental outcomes.[273] Wells and Cornwall contributed to the 'fragmentation' discussion with focus on a case study from the 2011 SoE Report.[274] Highlighting a case study on fisheries and the fragmented governance structure associated with Australian jurisdictions, the inconsistencies with the life cycle of fish that occurs within multiple jurisdictions and an absence of common cumulative impact assessment approach to ensure sustainable ecosystems and fisheries within Australia, were emphasised as concerns.[275]

Inadequate legal requirements for monitoring actual impacts have been identified as causing a fragmented approach.[276] This can occur when the regulation of environmental decision-making does not require PAM and, thus, contributes to the exacerbation of environmental issues.[277] An example of this can be found in approvals made under the *Coastal Management Act 1995* (Vic).[278] This Act provides the decision-making power for anthropogenic activities occurring

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[270] See, eg, Sarah Robertson, 'Local Government and Sustainable Development: Its Recent Evolution in Australia and New Zealand' (1996) 1 *Local Government Law Journal* 227, 228; Nick Harvey, 'The Relationship Between Ecologically Sustainable Development and Environmental Impact Assessment in Australia: A Critique of Recent National Reports' (1992) 9 *Environmental and Planning Law Journal* 265, 266; Maguire and Phillips, above n 269, 220; Paul Havemann et al, 'Traditional use of marine resources agreements and dugong hunting in the Great Barrier Reef World Heritage Area' (2005) 22 *Environmental and Planning Law Journal* 258, 275; Wawryk, above n 266, 267 – 268; Bradbrook and Wawryk, above n 266, 31.
[271] Wawryk, above n 266, 267 – 268; Also see Bradbrook and Wawryk, above n 266, 31.
[272] House of Representatives Standing Committee on Environment, Recreation, and the Arts, Parliament of the Commonwealth of Australia, above n 25, 46 – 48, 78.
[273] See, eg, State of the Environment Advisory Council, above n 34, 11; Nicholas Brunton, 'Environmental Regulation: The Challenge Ahead' (1999) (24)3 *Alternative Law Journal* 137, 142.
[274] Australian State of the Environment Committee (2011) cited in Katherine Wells and Amanda Cornwall, 'Managing Australia's ocean resources: the next step' (2012) 2 *National Environmental Law Review* 37, 41; State of the Environment 2011 Committee, above n 48, 417 – 418.`
[275] Australian State of the Environment Committee (2011) cited in Wells and Cornwall, above n 274, 41; State of the Environment 2011 Committee, above n 48, 417 – 418.
[276] Environment and Natural Resources Committee, Parliament of Victoria, above n 125,208.
[277] Ibid.
[278] This Act was repealed and replaced in 2018 by the *Marine and Coastal Act 2018* (Vic).

within the Victorian marine environment,[279] including those that have been through the EIA process defined by the *Environmental Effects Act 1978* (Vic). The Environment and Natural Resources Committee addressed this issue within the *Inquiry into the Environmental Effects Statement Process in Victoria*, and stated that there was an unacceptable continued reliance upon assumptions that there were no 'significant impacts' resulting from use and development approved under the Victorian EIA process.[280] With a focus on cumulative impacts and the resulting environmental detriment, James suggested that the 'fragmentation of governmental responsibilities' for impact monitoring was a significant constraint on assessment.[281] Fraser, Ellis and Hussain have identified one example of the challenges this type of fragmentation causes for understanding the extent of cumulative impacts in the Australian marine environment that can occur as a result of oil and gas operations.[282] Discussing this example, Fraser, Ellis and Hussain explained that the assessment of offshore oil or gas spills, as a result of operations, was complicated by a lack of access to adequate data.[283] They reasoned that access to data is often constrained by the inconsistency in regulatory approaches to the coordination and dissemination of information by different governments.[284]

In an effort to address fragmentation concerns, bilateral agreements between different governments can be used. An example of the way this mechanism is used in Australia is discussed below.

4.2 Bilateral agreements: An inadequate mechanism for reducing fragmentation

The use of bilateral agreements for the purpose of accrediting States to undertake Commonwealth decision-making was determined under the *Heads of agreement on Commonwealth and State roles and responsibilities for the Environment.*[285] With the object of streamlining environmental assessment processes,[286] the power has since been provided for under the *EPBC Act 1999* (Cth).[287] Assessment Bilateral Agreements are in place between the Commonwealth and each of Australian Capital Territory, New South Wales, South Australia,

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[279] Section 40. The corresponding decision-making power can be found in the *Marine and Coastal Act 2018* (Vic), Part 7, Division 2.
[280] Ibid.
[281] James, above n 159, 81.
[282] G S Fraser, J Ellis and L Hussain, 'An international comparison of governmental disclosure of hydrocarbon spills from offshore oil and gas installations' (2008) 56 *Marine Pollution Bulletin* 9, 9.
[283] Ibid.
[284] Ibid.
[285] Council of Australian Governments, *Heads of agreement on Commonwealth and State roles and responsibilities for the Environment*, November 1997, Clause 5 <http//:www.environment.gov.au/resources/heads-agreement-commonwealth-and-state-roles-and-responsibilities-environment>.
[286] *Environment Protection and Biodiversity Conservation Act 1999* (Cth) s 44.
[287] Chapter 3.

Tasmania, Queensland, Victoria and Western Australia.[288]

For all States, the Northern Territory and the Australian Capital Territory, Approval Bilateral Agreements (ABAs) are either subject to a 'Notice of intention to develop a draft bilateral agreement'[289] or are in draft phase.[290] The purpose of ABAs, is in part, to minimise fragmented decision-making.[291] The approach, however, has been criticised as flawed by McGrath, with comments made that the 'one stop shop' policy removes the 'oversight role' that the Commonwealth Government has in decision-making processes, even though the assessment process is managed by the States or Territories.[292] As the ABAs exclude Commonwealth marine areas,[293] this concern is partially alleviated given that the potential for dual processes and 'oversight role' remains the same should a proposed large-scale marine use and development occur in both State/ Territory and Commonwealth waters. It is noted that the State/ Territory would be responsible for both the assessment and approvals,[294] if a proposed project within State/ Territory waters is likely to have a significant impact on Commonwealth marine waters (or other Commonwealth matters of national environmental significance within the marine environment).[295] The lack of Commonwealth input into a decision-making process that impacts on Commonwealth marine waters could create further risk of a 'fragmented' approach. This is because cumulative impacts are deemed to be an impact for the purpose of the bilateral agreements,[296] and there is no apparent definition of cumulative impacts within the

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[288] Australian Government Department of the Environment, *One stop shop for environmental approvals* <http://www.environment.gov.au/epbc/one-stop-shop>; Australian Government Department of the Environment, *Tasmania Bilateral Agreement Information* <http://www.environment.gov.au/protection/environment-assessments/bilateral-agreements/tas>; Australian Government Department of the Environment, *Victoria Bilateral Agreement Information* <http://www.environment.gov.au/protection/environment-assessments/bilateral-agreements/vic>.

[289] Australian Government Department of the Environment, *Northern Territory Bilateral Agreement Information* <http://www.environment.gov.au/protection/environment-assessments/bilateral-agreements/nt>; Australian Government Department of the Environment (Victoria), above n 288.

[290] Australian Government Department of the Environment, *Australian Capital Territory Bilateral Agreement Information* <http://www.environment.gov.au/protection/environment-assessments/bilateral-agreements/act>; Australian Government Department of the Environment, *New South Wales Bilateral Agreement Information* <http://www.environment.gov.au/protection/environment-assessments/bilateral-agreements/nsw> ; Australian Government Department of the Environment, *Queensland Bilateral Agreement Information* <http://www.environment.gov.au/protecction/environment-assessments/bilateral-agreements/qld> ; Australian Government Department of the Environment, *South Australia Bilateral Agreement Information* <http://www.environment.gov.au/protection/environment-assessments/bilateral-agreements/sa> ; Australian Government Department of the Environment (Tasmania), above n 288; Australian Government Department of the Environment, *Western Australia Bilateral Agreement Information* <http://www.environment.gov.au/protection/environment-assessments/bilateral-agreements/wa> .

[291] Australian Government Department of the Environment, above n 288.

[292] Dr Chris McGrath, 'One stop shop for environmental approvals a messy backward step for Australia' (2014) 31 *Environmental and Planning Law Journal* 164, 176 – 177.

[293] See, eg, Commonwealth of Australia and The State of Western Australia, *Draft Approval Bilateral Agreement made under Sections 44 and 45 of the Environment Protection and Biodiversity Conservation Act 1999 (Cth)*, Clause 4.2 <http://www.environment.gov.au/system/files/pages/69324f7e-a815-485e-aafe-552a7b787a37/files/wa-draft-bilateral-agreeement.pdf> .

[294] See, eg, Commonwealth of Australia and The State of Western Australia, above n 293, cl 2.1 (Note).

[295] See, eg, *Environment Protection and Biodiversity Conservation Act 1999* (Cth), part 3.

[296] See, eg, Commonwealth of Australia and The State of Western Australia, above n 293, cl 5.2 (Note).

draft bilateral agreements or the *EPBC Act 1999* (Cth). The risk arises when the approach to managing both cumulative and synergistic impacts within Commonwealth marine waters differs between jurisdictions. Further to the discussion in Chapter 2, focusing on the acknowledgement of the influence of different social, political, environmental and economic needs between jurisdictions,[297] the value of site-specific knowledge about a particular environment[298] must also be considered.

To examine the concerns about fragmentation further, the example of the Great Barrier Reef region is revisited. The discussion below focuses on the legislative and decision-making frameworks that utilise SEA and EIA for cumulative and synergistic impact assessment.

4.2.1 Fragmentation within the SEA and EIA legal requirements and approaches for the Great Barrier Reef region

The following discussion demonstrates several of the potential issues that could cause constraints for achieving integrated cumulative and synergistic impact assessment within Australian marine environmental assessment frameworks. The discussion addresses the fragmented approach to requirements for consideration and assessment within environmental assessment legislation for SEA and EIA, as well as inconsistencies in approach to the application of SEA and EIA frameworks. Due to the international criticism about marine environmental protection for the Great Barrier Reef World Heritage Area (GBRWHA) and the significant efforts to identify improved strategies, specific examples applicable to the Great Barrier Reef region are used to illustrate the issues raised.

The potential for a fragmented regulatory approach between Australian jurisdictions is made apparent within the legal frameworks and processes applicable to environmental assessment in the Great Barrier Reef region. The region is subject to legislative approval processes including under the *Great Barrier Reef Marine Park Act 1975* (Cth) for the marine protected area under Commonwealth responsibility, the *EPBC Act 1999* (Cth) for the GBRWHA and impacts on individual protected species, and Queensland's *Marine Parks Act 2004* and the *Coastal Protection and Management Act 1995* for the creation and management of the marine protected areas within Queensland's territorial waters. In addition, anthropogenic activities such as commercial fishing and shipping within the region are subject to individual sector

[297] See Chapter 2, section 2.3.
[298] Dubé and Munkittrick, above n 116, 251.

environmental management controls.[299] As an example of the need for multiple decisions to be made under the dual jurisdiction framework, with boundaries internal to both Australia (Queensland and Commonwealth waters) and the Commonwealth Government's own jurisdiction (Marine Park and World Heritage Area), 'trans-boundary' fragmentation was demonstrated by the Commonwealth Government in March 2015. In this instance, a decision was made to prohibit dredge spoil dumping from within the Great Barrier Reef Marine Park.[300] For the entire GBRWHA to be protected from dredge spoil dumping, however, the prohibition also needed to be enacted by the Queensland Government.[301]

Another example is found in instances where different legislative provisions apply to the protection and environmental assessment of a marine area. This fragmented approach is demonstrated within the primary Commonwealth environmental assessment legislation applicable to the Great Barrier Reef region through the absence of specific statutory requirements that can link cumulative or synergistic impacts identified within an SEA required under the *EPBC Act 1999* (Cth),[302] with EIAs that may be undertaken in association with decision-making under the *Great Barrier Reef Marine Park Act 1975* (Cth).[303] Further, in relation to environmental approvals assessed under the *EPBC Act 1999* (Cth) when determining an assessment approach or making a decision as to whether to approve a project proposal, the Minister must consider relevant SEA information even though this information is limited to an SEA created under the Act itself.[304] Problems can arise in these instances, as the requirement for inclusion of information within SEAs under Part 10 of the *EPBC Act 1999* (Cth) is generally wide in its ambit and does not include specific reference to cumulative or synergistic impacts, or past EIAs applicable to the assessment area.[305] In this example, the potential for a legal connection between the requirement to undertake an SEA and then consider the outcomes of the SEA within EIAs is limited, whether or not cumulative and synergistic impacts are required to be considered. Inadequate integration between SEA and EIA legal requirements

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[299] See, eg, *Fisheries Act 1994* (Qld), *Fisheries Management Act 1991* (Cth), *Transport Operations (Marine Pollution) Act* 1995 (Qld) and the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth).
[300] The Hon. Greg Hunt MP Minister for the Environment, *Orders given to ban dumping of capital dredge material in Marine Park,* 24 January 2015 <http://www.environment.gov.au/minister/hunt/2015/mr20150124.html>; Australian Broadcasting Corporation, *Great Barrier Reef: Dredge spoil in marine park to be banned under draft federal laws proposed by Environment Minister Greg Hunt,* 16 March 2015 <http://abc.net.au/news/2015-03-16/greg-hunt-introduces-draft-laws-ban-dumping-of-dredge-spoil/6322136>.
[301] See, eg, The Hon. Greg Hunt MP cited in Australian Broadcasting Corporation, above n 300. It is noted that the *Sustainable Ports Development Act 2015* (Qld) commenced on November 2015. The Act seeks to control dredge spoil dumping within the GBRWHA (see, eg, div 3).
[302] Part 10. It is noted that there is no specific provision requiring an SEA under the *Great Barrier Reef Marine Park Act 1975* (Cth).
[303] See, eg, s 35.
[304] Sections 87(3)(b) and 136(2)(e). It is also noted that the environmental assessment associated with management plans for fisheries must be revised should any actual impacts be found to be greater than predicted: *Environment Protection and Biodiversity Conservation Act 1999* (Cth) s 152.
[305] As discussed earlier in this chapter, this is dependent upon decisions made about the determined 'terms of reference'.

creates the potential for problems both ways; with the potential for a lack of legal requirement to input data gathered during PAM[306] into existing or future SEAs. Further, it is noted that there are no legislative provisions within the applicable legislation that encourage the sharing of information obtained via monitoring.

The risk of fragmentation when impacts identified as problematic in one form of environmental assessment are neglected for consideration in subsequent assessments was also highlighted by an example within the *GBRR Strategic Assessment Report*. The report stated that:

> There is generally a good understanding by staff of the Authority of the direct and indirect impacts of dredging on the values of the Reef and policies for the disposal of dredge material and environmental impact management require direct and indirect impacts to be considered. However, this is often considered on an application-by-application basis and the consequential and cumulative impacts of dredging and spoil disposal are less well understood. The Authority has little knowledge about the condition and trend of many of the ecosystems and species at risk from port development.[307]

The potential for further fragmented approaches within SEA has been raised by Marsden within discussion about the *GBRR Strategic Assessment Report* and Australia's management of World Heritage Areas.[308] In demonstrating potential for fragmentation, Marsden acknowledged that the *GBRR Strategic Assessment Report* has sought to address the issue of cumulative impacts (amongst other impact types) and plan for the review of current and future management and planning regimes.[309] However, Marsden also criticised the approach for being 'as much a data collection exercise as an evaluation of the environmental effects of specific policy, plan and program making.'[310] The potential problems for fragmentation within the SEA development process were further highlighted in the comments by Marsden that whilst the 'terms of reference'[311] eventually used were created under the *EPBC Act 1999* (Cth) process, neither the Great Barrier Reef Marine Park Authority or Queensland Government had consistent legislative provisions to enable the SEA terms of reference to be defined.[312] Another issue highlighted by Marsden was the failure of the *GBRR Strategic Assessment Report*, to coincide with, and evaluate, a number of other ports and shipping management plans and strategies that were directly relevant to matters being addressed.[313]

An example of fragmented approach within EIA is demonstrated by the *Abbot Point*

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[306] As required by an environmental decision-making process that encompasses an EIA.
[307] See, eg, Great Barrier Reef Marine Park Authority, above n 91, 8-24 – 8-25.
[308] Simon Marsden, 'Australian World Heritage in danger' (2014) 31 *Environmental and Planning Law Journal* 192, 202 – 209.
[309] Ibid, 202.
[310] Ibid.
[311] Australian Government Great Barrier Reef Marine Park Authority, above n 170.
[312] Marsden, above n 308, 202.
[313] Ibid, 203 – 204.

Cumulative Impact Assessment report released in 2013. This report stated that the cumulative impact assessment process undertaken was a voluntary process to provide decision-makers with a better understanding of potential impacts from the port expansion on the marine environment;[314] including those areas 'within and adjacent to the Great Barrier Reef World Heritage Area and Marine Park'.[315] The first step in the method for assessing cumulative impacts was discussed as the need to define 'cumulative impact'.[316] It is acknowledged that there is no definition for cumulative impacts in the *EPBC Act 1999* (Cth). Instead, the process is reliant upon the definition of 'impact' under section 527E to identify parameters for a cumulative impact definition. As discussed in section 3.3, this could suggest that the definition delineates narrow parameters for what needs to be assessed. It is also noted that the definition within the *Abbot Point Cumulative Impact Assessment* was restricted to 'additive' impacts; therefore excluding synergistic interactions.[317] In addition, the assessment referenced the *GBRR Strategic Assessment Report* process, as well as the *Great Barrier Reef Outlook Report* for 2009.[318] The 'fragmentation' example apparent within this cumulative impact assessment is essentially created by a time lag between the determination of the method and approach, for example, the selection of a definition modelled on the constraints of section 527E of the *EPBC Act 1999* (Cth), and the potentially broader definition of cumulative impacts associated with the final *GBRR Strategic Assessment Report*.[319] The definition in the *GBRR Strategic Assessment Report* being: 'the impact on the environment resulting from the effects of one or more impacts, and the interactions between those impacts, added to other past, present, and reasonably foreseeable future pressures.'[320]

The *GBRR Strategic Assessment Report* also demonstrated a fragmented approach to the definition of cumulative impacts within a revised adaptive management approach to the permission framework by the Great Barrier Reef Marine Park Authority under the *Great Barrier Reef Marine Park Act 1975* (Cth). The approach is to address matters requiring assessment under the *EPBC Act 1999* (Cth) in a way that is intended to require cumulative impact consideration within 'the context of all impacts affecting the matter'.[321] As discussed in Section 3.3 above, the s527E definition of 'impacts'[322] is limited to those matters that are connected by significant nexus, and would not appear to include 'all impacts affecting the

[314] Eco Logical Australia Pty Ltd and Open Lines Consulting Pty Ltd, *Abbot Point Cumulative Impact Assessment* (2013), 1- 1 <http//:www.nqbp.com.au>.
[315] Ibid, 1 – 8.
[316] Ibid, 4 – 3.
[317] Ibid, 4 – 4.
[318] Ibid, 1- 13 – 1-14.
[319] Great Barrier Reef Marine Park Authority, above n 91, xiii.
[320] Ibid.
[321] See, eg, Great Barrier Reef Marine Park Authority, above n 91, 13-20 – 13-21.
[322] *Environment Protection and Biodiversity Conservation Act 1999* (Cth), s 527E.

matter'.

Carter and Ross have also raised concerns about the lack of a cohesive planning process within this region.[323] Further, it is stated that even though there has been increased assessment of cumulative impacts alongside SEA,[324] the continued approach to decision-making for individual projects is fragmented and fails to 'unite issues that affect and operate at landscape and seascape scales' even though 'science and public concern often make the connections'.[325] Carter and Ross considered that the reasons for this are often due to the influence of politics within decision-making failing to 'address and respond to long-term changes in system dynamics and energy flows that emerge in broad-scale environmental issues.'[326]

As demonstrated through the above Great Barrier Reef region examples, the potential for fragmentation within environmental assessment frameworks appears to be greater for cumulative and synergistic impact assessment when there are few legal requirements and consistent approaches (e.g. connection between legislative requirements and definitions). The uncontrolled influences of decision-making, for example politics, can also undermine a cohesive approach.

4.3 Key points

The concerns about fragmentation include inconsistency in approach between different governments, and an inadequate approach to requiring the monitoring and assessment of actual cumulative impacts to ensure that the outcomes of decision-making processes do not cause any unanticipated significant detriment. The concerns are not only identified within the general discussion, but are also evident within the discussion on bilateral agreements and the Great Barrier Reef region example. Understanding what the problems are is useful for informing improved approaches to the minimisation of fragmentation in Australian environmental assessment frameworks. The solutions to the fragmentation problems need to provide for more consistency in approach to cumulative and synergistic impact assessment within legal frameworks and decision-making. It is also important for any solutions to acknowledge that marine environmental assessment will differ depending upon the species, ecosystem and habitat characteristics, as well as the cumulative and synergistic impacts caused by both anthropogenic

[323] R W (Bill) Carter and Helen Ross, 'Broadening of environmental concerns: insights from management of the Great Barrier Reef' (2015) 22 (3) *Australasian Journal of Environmental Management* 265, 265 – 266.
[324] Ibid, 266.
[325] Ibid.
[326] Ibid.

activities and environmental change occurring in a particular area. The research undertaken within the case studies in Chapters 5[327], 6[328] and 7[329] seeks to address these issues further from the perspective of legal frameworks and jurisdictions, EIA, PAM and associated decision-making processes.

5. Conclusion

This chapter identifies the ways in which Australia's legal frameworks can address, incorporate or require the consideration and assessment of cumulative and synergistic impacts. This is placed into the context of the ways in which this can be achieved through the application of Ecologically Sustainable Development (ESD) and the precautionary principle, as well as through express legal provisions Further to establishing an Australian context, this chapter provides a transition between the issues identified with the assessment of cumulative and synergistic impacts in Chapters 2 and 3, and the case study analysis undertaken within Chapters 5, 6 and 7.

An outline of the governance structure for Australian marine waters within the different Australian jurisdictions was given. The inadequacy of consideration given to cumulative and synergistic impacts within environmental assessment and acknowledgment that this has been problematic for achieving marine environmental protection in Australia was subsequently addressed. The discussion demonstrated the ongoing concern about these impact types detrimentally affecting Australian coastal and marine environments, including the loss of biodiversity. The need to increase the consideration and assessment of these impacts within the context of community and scientific understanding, resource management and environmental decision-making was also emphasised. Recent examples of cumulative and synergistic impacts are also discussed, with particular focus on the problems for the species and ecosystems within the Great Barrier Reef region.

The Great Barrier Reef region example addresses the international level of concern expressed about these impact types detrimentally affecting the World Heritage Area, and the intended approaches within the *GBRR Strategic Assessment Report*, the *2014 Great Barrier Reef Outlook Report*, and the *Reef 2050 Long-Term Sustainability Plan* to effectively address the issues. It is noted that within both the World Heritage Committee decisions and

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[327] Otways Marine Area.
[328] Victoria's Port Phillip Bay Channel Deepening Project.
[329] Offshore wind farms in Denmark: the assessment of cumulative and synergistic impacts.

recommendations, and the Australian strategic responses, cumulative impacts receive significantly more attention than synergistic impacts.

This chapter demonstrates that ESD, and in particular the precautionary principle, can play a significant role within cumulative and synergistic impact assessment in instances when requirements for application are present within legislative frameworks. If there is to be reliance on the precautionary principle to aid assessment and decision-making about cumulative and synergistic impact assessment, inclusion is critical within environmental assessment legislation that also incorporates specific requirements for cumulative and synergistic impact assessment (including general environmental assessment, industry specific environmental management and marine environmental protection).

The review of Australia's legal frameworks for the environmental assessment of large-scale marine use and development shows that there is potential within the Federal and State/ Territory jurisdictions for the consideration of cumulative and synergistic impacts. The examples discussed within section 3.1 of the chapter demonstrate that this occurs within three areas of legislation applicable to marine environmental assessment. This includes general environmental assessment, individual sector environmental management and marine environmental protection legislation. The examples reviewed, however, indicate a limited approach to the consideration of cumulative and synergistic impacts as distinct impact types. The legislative extent of requirement to consider cumulative and synergistic impacts is analysed in greater detail within the Otways Marine Area case study (Chapter 5).

Within section 3.2 of this chapter it is demonstrated that post-approval monitoring requirements within SEA and EIA frameworks are capable of requiring the monitoring of cumulative and synergistic impacts. This can occur both informally through strategic plans and formally through legislative requirements, when an approval is granted, with the imposition of monitoring conditions. There is also the potential for legal requirements to enable the mitigation of cumulative and synergistic impacts found to exist after the operation of an approved large-scale marine use and development has commenced.

Section 3.3 demonstrates that cumulative impacts have been discussed as central factors within Australian judicial decisions focusing on environmental assessment. The decisions, in particular the *Nathan Dam Case*, have caused legislative amendments aimed at improved clarity within legislative definitions (e.g. s527E *EPBC Act 1999* (Cth). Yet it appears that the resultant amendments do not include cumulative and synergistic impacts. As discussed in this section, recent judicial decisions indicate that there is still a need for express requirements and definition within legislation if cumulative and synergistic impacts are to be considered effectively.

Several of the problems associated with fragmentation caused by multiple jurisdictions (or levels of government) are discussed in section 4 of this chapter. In particular, it is demonstrated that bilateral agreements are not an effective solution for improving cumulative and synergistic impact assessment. As a result of the Great Barrier Reef discussion example, it is demonstrated that fragmented approaches to SEA and EIA and the application of legislative frameworks, without clear definitions or express requirements for consideration, can challenge the effective integration and assessment of cumulative and synergistic impacts. These shortcomings associated with fragmented regulatory approaches are also found within the management frameworks of other Australian marine areas. Although from different perspectives, this is demonstrated further within the case study analyses within Chapters 5, 6 and 7.

Finally, if the further research undertaken in the Chapters 5 and 6 case studies demonstrates the need for improvement to the extent of cumulative and synergistic impact assessment requirements within Australian legal frameworks, it is suggested that recommendations for improvement reflect a more consistent Australian approach. Recommendations to address these matters are provided within Chapter 8. The Danish offshore wind farm case study in Chapter 7 provides an example of a legal framework with existing requirements to consider cumulative and synergistic impacts within environmental assessment. Given this, the research in this chapter also includes analysis of the issue of uncertainty and the role of ESD and the precautionary principle. The conclusions about the shortcomings and benefits of the approaches analysed within Chapter 7 are then used to inform the recommendations for improving the Australian situation (as detailed in Chapter 8).

CHAPTER 5: OTWAYS MARINE AREA

'Understanding the current CIA requirements and practice in the context of a state environmental review is the first step towards improving the difficult task of measuring cumulative impacts over time and across landscapes'[1]

Chapter outline

1. Introduction

A case study that focuses on cumulative and synergistic impact assessment requirements within legislation can provide guidance as to how to improve the approach to assessing these impact types in Australian marine environmental assessment. The review of different types of marine

[1] Zhao Ma, Dennis R Becker and Michael A Kilgore, 'Assessing cumulative impacts within state environmental review frameworks in the United States' (2009) 29 *Environmental Impact Assessment Review* 390, 397. It is noted that this study did not address synergistic impacts as a distinct impact type.

environmental assessment legislation across several jurisdictions enables the analysis to be in-depth.

This case study focuses on the extent to which cumulative and synergistic impact assessment requirements have been addressed within Australian marine environmental assessment legal frameworks. There are two aims for this case study. The first is to determine the extent to which the Commonwealth, South Australian, Tasmanian, and Victorian Acts and delegated legislation (e.g. regulations, rules and orders) require the consideration of cumulative[2] and/ or synergistic[3] impacts. This aim is addressed through the analysis of legislative text. The legislation reviewed applies to the environmental assessment of large-scale marine use and development within the marine mesoscale bioregion known as the 'Otways bioregion'[4] (sometimes known as the Otways Area).[5] For the purpose of this case study analysis the area will be identified as the 'Otways Marine Area' (refer to Figure 5-1 Map of the Otways Marine Area). The environmental assessment tools examined are strategic environmental assessment (SEA)[6] and environmental impact assessment (EIA).[7]

The second aim of the case study is to discuss and evaluate legal provisions that specifically address cumulative and/or synergistic impacts. The implications and limitations of the absence of such legal provisions will be identified. To assist with the identification of potential limitations and implications, the case study analysis includes a review of alternative terminology often associated with cumulative and synergistic impacts. These terms are 'indirect',[8] 'significant',[9] 'adverse',[10] 'impact' and 'effect',[11] and were selected based on their linguistic association with cumulative and synergistic impacts within the literature, legislation and case law discussed within Chapters 2, 3 and 4.[12]

To support both aims, legislative examples that have been subject to recent environmental law

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[2] Refer to glossary.
[3] Refer to glossary.
[4] See, eg, ERIN, Department of the Environment and Heritage, Australian Government, *Map 2 IMCRA 4.0: Meso-scale Bioregions* (Commonwealth of Australia, 2006) <http://www.environment.gov.au/system/files/resources/2660e2d2-7623-459d-bcab-1110265d2c86/files/map2-msb.pdf>; Jan Barton, Adam Pope and Steffan Howe, *Marine Natural Values Study Vol 2: Marine Protected Areas of the Otway Bioregion. Parks Victorian Technical Series Number 75* (Parks Victoria, 2012) 4.
[5] See, eg, Australian Government National Oceans Office, *South-East Regional Marine Plan: Implementing Australia's Oceans Policy in the South-East Marine Region* (National Oceans Office, 2004) 43.
[6] Refer to glossary.
[7] Refer to glossary.
[8] Refer to glossary.
[9] Refer to the glossary for an explanation about the use of the term 'significant' as a term to describe the measurement of an impact.
[10] Refer to glossary.
[11] As identified in Chapter 2, section 2.1, the term 'effect' is considered interchangeable with 'impact' Chapter 2.
[12] Refer to section 1.2 of this chapter for further justification and references.

reform are discussed. The legislative examples selected are from the Commonwealth, South Australian, Tasmanian, and Victorian jurisdictions, and the discussion examines the extent of consideration given to cumulative and/ or synergistic impacts.

The remainder of this section describes the case study area boundaries, and method for legislative analysis. The second section analyses the requirements to consider cumulative and synergistic impacts. The third section discusses key implications identified in the results analysis, with a focus on what these implications mean for marine environmental assessment and protection in the Otways Marine Area. The fourth section discusses examples of environmental assessment law reform undertaken, in particular by the Commonwealth and Victorian governments, and whether the reform conclusions about cumulative and synergistic impacts have resulted in amendments to the legislation. A conclusion on the appropriateness and extent of use in legislation, for the terms analysed, is provided in the final section of this chapter.

As evidenced in discussion within Chapter 2, cumulative and synergistic impacts are different and it is submitted that they should be defined separately. Reflecting the approach to legislative analysis in Chapter 4, for the purpose of this chapter 'cumulative' and 'synergistic' impacts are identified as distinct impact types, thus reference to one impact type does not include reference to the other. However, as with the approach in Chapters 3 and 4, the term 'cumulative (and synergistic)' is used when it is anticipated that the use of the term 'cumulative' includes 'synergistic' impacts.

1.1 The Otways Marine Area

The Otways Marine Area is located within Australia's south-eastern marine region.[13] The area is a bioregion under the national marine bioregion classification system; a geographical based system used to assist in identifying and managing protected areas.[14] The Otways Marine Area was selected because of particular 'physical and biological attributes'[15] (e.g. wave action, sea temperature, habitats, and biodiversity).[16] The bioregion demonstrates 'how physical processes

[13] See, eg, ERIN, Department of the Environment and Heritage, Australian Government, above n 4; Australian Government National Oceans Office, above n 5, 43; Barton, Pope and Howe, above n 4, 4.
[14] Parks Victoria, *Victoria's System of Marine National Parks and Marine Sanctuaries: Management Strategy 2003 – 2010* (Parks Victoria and the Department of Sustainability and Environment, 2003) 4, 122.
[15] Parks Victoria, above n 14, 4 (also see page 118); Barton, Pope and Howe, above n 4, 1.
[16] Parks Victoria, above n 14, 33 – 35; Barton, Pope and Howe, above n 4, 1.

have influenced the distribution of ecosystems and biodiversity over scales of 100 - 1000km'.[17] The location of the Otways Marine Area is depicted in Figure 5-1, with the western margin of the bioregion extending into South Australian, Commonwealth and Tasmanian marine waters.[18] The eastern margin extends across Victorian, Commonwealth and Tasmanian marine waters.[19] The Commonwealth, South Australian, Victorian and Tasmanian legislation that applies to this area relates to the area below the low water mark and therefore is not inclusive of local government jurisdiction.

Large-scale anthropogenic activities occurring within this area include commercial fishing (both wild catch and aquaculture), shipping, petroleum operations, waste dumping, research, species and environmental protection, and submarine cables and pipelines.[20] The Otways Marine Area has not yet been identified as a suitable location for greenhouse gas storage (an emerging industry in Australian offshore areas).[21] Other emerging industry projects, such as marine renewable energy from wave generated power, have been intended for the Otways Marine Area but not successfully completed.[22] The impact interactions from anthropogenic activities occurring within the Otways Marine Area can be considered and assessed from an environmental, habitat or species impact perspective, as well as for any designated marine protected areas.[23]

[17] Parks Victoria, above n 14, 33; Barton, Pope and Howe, above n 4, 1.
[18] See, eg, ERIN, Department of the Environment and Heritage, Australian Government, above n 4; Australian Government National Oceans Office, above n 5, 43; Barton, Pope and Howe, above n 4, 4; M B Alcocks and N J Taffs, *Australia's Maritime Zones Edition 5* (Geoscience Australia, 5th edn, 2014) <http://www.ga.gov.au/corporate_data/81859/Australias_Maritime_Zones_Edition_5.pdf>.
[19] See, eg, ERIN, Department of the Environment and Heritage, Australian Government, above n 4; Australian Government National Oceans Office, above n 5, 43; Barton, Pope and Howe, above n 4, 4; Alcocks and Taffs, above n 18.
[20] See, eg, Australian Government National Oceans Office, above n 5, 42; J Larcombe et al, *Marine Matters – Atlas of marine activities and coastal communities in Australia's South-East Marine Region* (Bureau of Rural Sciences, 2002) Maps 6 – 32, Map 69, Maps 74 – 77, Map 82, Map 89, Map 91 – 92.
[21] See, eg, Australian Government Geoscience Australia, *Geoscience Australia Greenhouse Gas Storage Projects* (Commonwealth of Australia, 2012), 1 <http://www.ga.gov.au/corporate_data/74730/74730.pdf>; Australian Government Department of Industry and Science, *Acreage Release Areas VIC14-GHG-1, VIC14-GHG-2 and VIC14-GHG-3, Gippsland Basin, offshore Victoria* <http://www.industry.gov.au/resource/LowEmissionsFossilFuelTech/Greenhouse-Gas-Storage-Acreage-Release/Pages/Acreage-Release-Areas.aspx> .
[22] See, eg, Lily Partland (ABC South West Victoria), *Portland wave power project dumped* (17 July 2014) <http://www.abc.net.au/local/stories/2014/07/17/4048030.htm>.
[23] Barton, Pope and Howe, above n 4, 4; Government of South Australia, *Lower South East Marine Park: Management Plan Summary* (Department of Environment, Water and Natural Resources, 22nd November 2012) <http://marine-park-management-summary-19-lower-south-east-plan.pdf>.

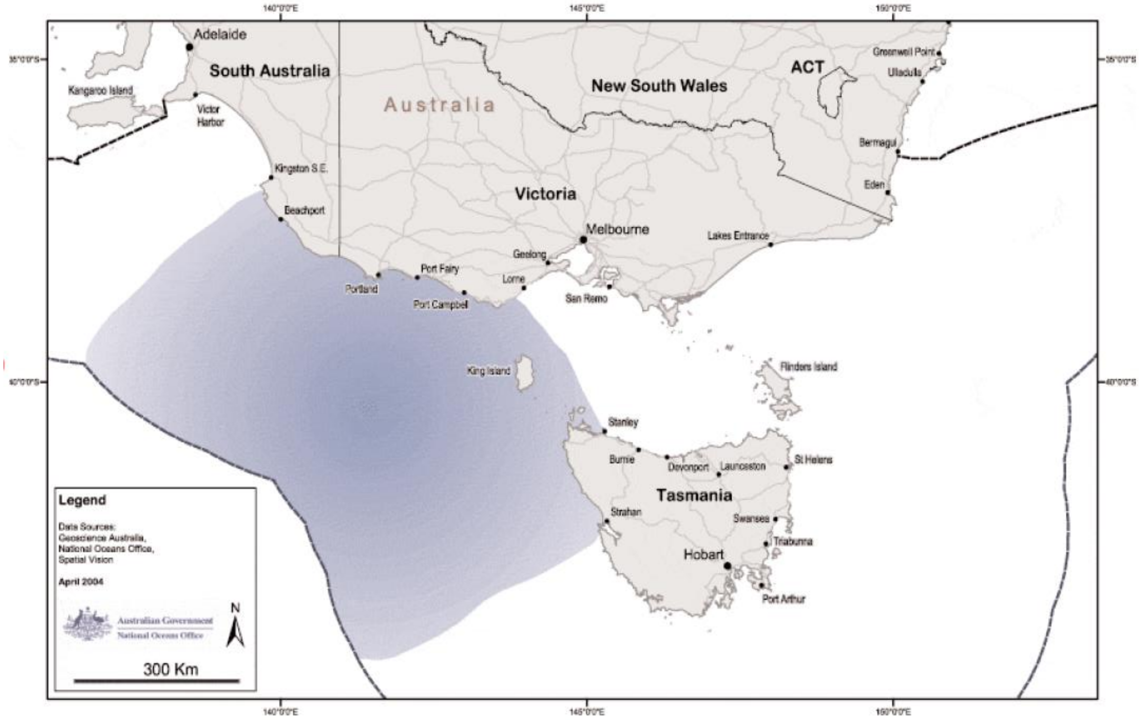

Figure 5-1: Map of the Otways Marine Area (Source: Australian Government National Oceans Office)[24]

1.2 The method used for legislative analysis

The analysis within this chapter focuses on legislation requiring environmental assessment (focusing on either SEA and/or EIA), industry-specific legislation for large-scale marine uses, and general frameworks for marine protected areas and species protection within the Otways Marine Area. The selection of legislation is consistent with the discussion in Chapter 4 on the potential for environmental assessment frameworks to require the consideration of cumulative and synergistic impacts. The legislation reviewed includes Acts and delegated legislation (e.g. regulations, rules and orders) from all four jurisdictions (refer to Appendix A - Otways Marine Area legislation analysis (June 2015)). The legislation is current as of June 2015.

The method of analysis occurs in two stages. Stage 1 consists of an analysis of the Acts and delegated legislation to determine the presence or absence of the terms 'cumulative' and 'synergistic' impacts within the context of environmental assessment requirements. If a requirement to consider either of these impact types was found to be present, then the mandatory or discretionary nature of the requirement was identified, as was any definition

[24] Australian Government National Oceans Office, above n 5, 43.

provided for the term. If a definition was present, the analysis identified whether that definition distinguished cumulative impacts from synergistic impacts. The legislation was also analysed to determine whether cumulative and/or synergistic impacts were expressly excluded from definitions (if any) of these terms.

Alternative terms to apply to cumulative or synergistic impacts were also identified within the qualitative analysis. Stage 2 of the analysis considered the presence of the terms 'indirect', 'significant' and 'adverse' impacts and/or effects, as well as 'impacts' and 'effects' as stand-alone terms. The selection of the terms 'indirect', 'significant' and 'adverse', as relevant to cumulative and/or synergistic impacts, are based on the discussions within Chapters 2 - 4. These discussions highlighted that 'indirect impact' is a term associated with cumulative impacts in literature[25] and Australian judicial decisions.[26] The literature and Australian case law demonstrate that there has been similar use of 'significant'[27] and 'adverse'[28] as terms associated with 'cumulative' impacts. The terms 'indirect', 'significant' and 'adverse' can also be used in conjunction with synergistic impacts.

The terms are consistently used within legislative requirements for environmental assessment in Australian legal frameworks,[29] and policy guidelines supporting the implementation of these frameworks.[30] Whilst used within these legal frameworks, consideration was also given to the

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[25] See, eg, Beanlands et al (eds), The Canadian Environmental Assessment Research Council (CEARC) and the United States National Research Council (NRC), *Cumulative Environmental Effects: A Binational Perspective,* (CEARC, NRC, 1986) 161; Beanlands et al (1986) cited in Cheryl K Contant and Lyna L Wiggins, 'Defining and analyzing cumulative environmental impacts' (1991) 11 *Environmental Impact Assessment Review* 297, 302; Thomas G Dickert and Andrea E Tuttle, 'Cumulative Impact Assessment in Environmental Planning: A Coastal Wetland Watershed Example' (1985) 5 *Environmental Impact Assessment Review* 37, 39; Daniel M Franks, David Brereton and Chris J Moran, 'Managing the cumulative impacts of coal mining on regional communities and environments in Australia' (2010) 28 (4) *Impact Assessment and Project Appraisal* 299, 300; Jill A E Harriman and Bram F Noble, 'Characterizing Project and Strategic Approaches to Regional Cumulative Effects Assessment in Canada' (2008) 10 (1) *Journal of Environmental Assessment Policy and Management* 25, 35. Also refer to the discussion in Chapter 2, sections 2.1 & 5.

[26] See, eg, *Queensland Conservation Council Inc v Minister for the Environment and Heritage* [2003] FCA 1463, [38 – 41]; *Minister for the Environment and Heritage v Queensland Conservation Council Inc* (2004) 139 FCR 24, 38 [53].

[27] See, eg, Brian J Preston, 'The environmental impact statement threshold test: when is an activity likely to significantly affect the environment?' (1990) 7 *Environmental and Planning Law Journal* 147, 149, 151 – 153; David P Lawrence, 'Impact significance determination – Pushing the boundaries' (2007) 27 *Environmental Impact Assessment Review* 770, 778; Jill Gunn and Bram F Noble, 'Conceptual and methodological challenges to integrating SEA and cumulative effects assessment' (2011) 31 *Environmental Impact Assessment Review* 154, 155; Justine Bell et al, 'Legal frameworks for unique ecosystems – how can the EPBC Act offsets policy address the impact of development on seagrass' (2014) 31 *Environmental and Planning Law Journal* 34, 44; *Brown v Forestry Tasmania, Commonwealth of Australia and State of Tasmania (No 4)* (2006) 157 FCR 1, 2, 22 [146].

[28]See, eg, Preston, above n 27, 153; Gunn and Noble, above n 27, 155; *Minister for the Environment and Heritage v Queensland Conservation Council Inc* (2004) 139 FCR 24, 24 – 25, 38 – 40 [54 – 63].

[29] See, eg, *Environment Protection and Biodiversity Conservation Act 1999* (Cth) s 527E; *Environmental Effects Act 1978* (Vic) s 3(2); *Environmental Management and Pollution Control Act 1994* (Tas) s 5.

[30] See, eg,Victorian Government Department of Sustainability and Environment, *Ministerial Guidelines for the Assessment of Environmental Effects under the Environmental Effects Act 1978* (Victorian Government, 7th ed, 2006) 18; Australian Government Department of the Environment, *Matters of National Environmental Significance:*

contextual presence or absence of the terms 'impacts' or 'effects' as stand-alone terms (i.e. not associated with indirect, significant, or adverse) due to their general nature enabling reference to a broad array of environmental impact types. The focus on the use of these terms as examples of reference to cumulative and/or synergistic impacts allows for a contextual analysis in instances when 'impacts' or 'effects' are neither measured (e.g. 'significant') or characterised (e.g. 'indirect' or 'adverse').

1.3 Limitations

The assessed legislation is limited to Acts and delegated legislation that encompass broader frameworks for environmental assessment. Legislation, including delegated legislation that only apply to specific species,[31] individual marine protected areas, specific fisheries or site-specific activities have not been included in the analysis.[32] Further, repealed legislation that is subject to transitional arrangements is also excluded.

It is noted that whilst the term 'interaction' can be used to describe the combination of impacts, it does not identify an impact type.[33] This is evidenced through the terms 'cumulative' and 'synergistic' providing additional meaning in respect of identifying the magnitude of the outcome for the impact interactions.[34] For these reasons, the term 'interaction' has not been identified as an appropriate search term and is excluded from analyses.

2. Results

The results of the Stage 1 'cumulative and synergistic' impact analysis and the Stage 2 'indirect, significant, adverse, impact and effect' analysis are summarised in this section. Appendix A includes the complete results analysis; with 55 Acts and 57 delegated legislation instruments reviewed. The results are summarised within this chapter in Tables 5-1, 5-2, 5-3 and 5-4. The legislative provisions supporting the results are also detailed as part of the discussion.

Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth of Australia, 2013) 2.

[31] Order and family classification focused legislation is included e.g. whales and dolphins. Genus and species classification focused legislation is excluded e.g. *Fisheries (Abalone) Rules 2009* (Tas) which is applicable to the abalone genus *Haliotis* only as per rule 3.

[32] See, eg, *Fisheries Management (Southern Bluefin Tuna Fishery) Regulations 1995* (Cth).

[33] See, eg, Dickert and Tuttle, above n 25, 39.

[34] Ibid.

2.1 Legal requirements for cumulative and synergistic impact assessment

Legislative requirements to consider and/or assess cumulative impacts are found within nine Acts, and two examples of delegated legislation (Table 5-1 and Appendix A). The legislative provisions associated with these results are discussed below.

The *Marine Parks Act 2007* (SA) contains a requirement to consider the cumulative impacts of an activity.[35] The reference is contained within the 'general duty of care' that 'a person' must apply when considering the extent of environmental 'harm' that may be caused by anthropogenic activities within a marine park. [36] Whether this extends to assessment within decision-making is ambiguous for two reasons. The first is that instead of a definitive requirement for environmental assessment, the provision provides that it is only 'regard' that must be given to these impact types.[37] The second is that the provision, whilst not necessarily directly related to an environmental assessment process, requires consideration to be given to several elements that might otherwise form part of, for example, an EIA (i.e. identification of the harm, risk, scientific knowledge, and degree of impact). [38] The ambiguity is problematic within an SEA or EIA framework when there is an absence of specific requirements to consider and/or assess these impacts, because it can result in a varying or minimal level of consideration and assessment.

The *Natural Resource Management Act 2004* (SA) provides that 'regard must be had', when undertaking statutory duties, to the effect of cumulative impacts from anthropogenic activities on 'natural resources'.[39] The *Development Act 1993* (SA) states that cumulative effects are a factor to consider in ministerial decisions on whether a project is 'major'.[40] The legislative provisions are not explicit in requiring the scientific environmental assessment of cumulative impacts. Instead, they suggest a less detailed level of consideration is sufficient. This creates a potential for cumulative impacts to be neglected within marine environmental assessment related decision-making processes for both SEA and EIA. The discretionary nature of the provisions exacerbate this risk. This arises with the use of 'regard' in the *Natural Resource Management Act 2004* (SA)*;* a word that encourages consideration but not necessarily assessment. There is a provision in the *Development Act 1993* (SA) that states that 'the cumulative effect of the development' is something that 'may' lead to the consideration of a

[35] Section 37(2)(f).
[36] *Marine Parks Act 2007* (SA) s 37(2)(f).
[37] Ibid.
[38] Ibid s 37(2).
[39] Section 9(2)(g).
[40] Section 46(1a).

project that is major.[41] This provision suggests that the assessment of cumulative impacts is not always an essential element of the classification process.

The requirement for the consideration of cumulative impacts within the *Petroleum and Geothermal Energy Act 2000* (SA) is limited to 'classifying activities that are likely to be recurrent'.[42] There is no specific requirement for an environmental assessment of cumulative impacts.

The 1992 *Intergovernmental Agreement on the Environment* (IGAE) is included in schedules of the *National Environment Protection Council (South Australia) Act 1995* (SA),[43] *National Environment Protection Council (Victoria) Act 1995* (Vic),[44] *National Environment Protection Council (Tasmania) Act 1995* (Tas),[45] and the *National Environment Protection Council Act 1994* (Cth).[46] As discussed in Chapter 4, Schedule 2 of the IGAE includes agreement that the parties to the IGAE will enable legislative frameworks for assessing and approving the use and development of natural resources, and that these frameworks 'should provide for…the assessment of the regional cumulative impacts of a series of developments and not simply the consideration of individual development proposals in isolation.'[47] The discretionary nature of this part of the agreement (i.e. use of the word 'should') means that the implementation of legislative provisions for cumulative impact assessment within frameworks for SEA or EIA cannot be guaranteed even when intended. This reflects the independent approaches that can be taken by the Commonwealth, State and Territory governments when determining the content of environmental assessment focused legislation. Further, the primary aim of the 'National Environment Protection Council' suite of legislation is to establish the National Environment Protection Council within each jurisdiction.[48] The IGAE is included within the Acts to inform the development of 'national environment protection measures'[49] but does not provide a framework and processes for environmental assessment.

The second Victorian Act to contain reference to cumulative impact assessment requirements is

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41 Section 46(1a).
42 Section 98(4).
43 Schedule 1 – Intergovernmental Agreement on the Environment.
44 Schedule – The Agreement.
45 Schedule 1 – Intergovernmental Agreement on the Environment.
46 Schedule – Intergovernmental Agreement on the Environment.
47 Council of Australian Governments, *Intergovernmental Agreement on the Environment,* 1 May 1992, Schedule 2(3)(ii) <http//:www.environment.gov.au/about-us/publications/intergovernmental-agreement>.
48 *National Environment Protection Council (South Australia) Act 1995* (SA) s 3; *National Environment Protection Council (Victoria) Act 1995* (Vic) s 3; *National Environment Protection Council Act 1994* (Cth) s 3; *National Environment Protection Council (Tasmania) Act 1995* (Tas) s 3.
49 *National Environment Protection Council (South Australia) Act 1995* (SA) s 7, s 15; *National Environment Protection Council (Victoria) Act 1995* (Vic) s7, s 15; *National Environment Protection Council Act 1994* (Cth) s 7, s 15; *National Environment Protection Council (Tasmania) Act 1995* (Tas) s 7, s 15.

the *Heritage Act 1995* (Vic), which provides for consideration of these impact types within the preparation of World Heritage Area management plans.[50] A plan must include methods for managing detrimental cumulative impacts from activities on 'world heritage values'.[51] The *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth) also provides a similar mandatory requirement for methods that avoid and minimise cumulative impacts to form part of bilaterally accredited World Heritage management plans.[52] The discretionary requirement to address cumulative impacts is also in the Australian World Heritage management principles,[53] and the Australian Ramsar management principles.[54] The application of these management principle provisions is discretionary in both instances, with the consideration of cumulative impacts being a matter that 'should' be addressed. Although different processes are addressed by the requirements relating to addressing cumulative impacts within bilaterally accredited management plans, and the consideration given within management principles, the application of mandatory and discretionary provisions could result in a situation where the approach to cumulative impact assessment is inconsistent. To avoid this potential problem, it is recommended that a consistent mandatory approach is adopted within the legislation.

The *Wildlife (Marine Mammals) Regulations 2009* (Vic) include reference to the term 'cumulative' within an environmental impact context.[55] The regulation includes a requirement that permit holders move boats away from whales after 'a cumulative total of 60 minutes per tour'.[56] Whilst an assessment of the cumulative impacts is not expected, the effect of this requirement is to directly address the need to minimise cumulative impacts on a species and assist with its protection.

The results between the jurisdictions, for both Acts and delegated legislation (Table 5-1 and Appendix A), should not be compared statistically without considering the intent of the requirements. For example, whilst South Australia provides for cumulative impact assessment requirements in five instances, the comparison of examples between jurisdictions shows significant differences in approach. This indicates that any assumption that there is a greater intention on the part of the South Australian government to include cumulative impact consideration and assessment within legislation is inconclusive. As demonstrated with the

[50] Section 62O(2)(c).
[51] *Heritage Act 1995* (Vic) s62O(2)(c). Currency update: This Act was replaced in 2017 by the *Heritage Act 2017* (Vic). Section 183 provides for the same provision.
[52] Regulation 2B.01(5)(l).
[53] *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth) Schedule 5(2)(2.02)(d).
[54] Ibid, Schedule 6(2)(2.02)(e).
[55] Regulation 16(14).
[56] *Wildlife (Marine Mammals) Regulations 2009* (Vic) reg 16(14).

South Australian examples, the requirements provide for limited detail and guidance as to when and how the cumulative impact consideration is to occur. The South Australian legislation does not specifically direct the consideration of cumulative impacts within environmental assessment tools such as SEA or EIA, although it does address the protection of habitats and species, creation of the National Environment Protection Council and its functions, and resource use and development. For Victoria, the Commonwealth, and Tasmania, the examples aid the implementation of international agreements such as the *Convention Concerning the Protection of the World Cultural and Natural Heritage* (World Heritage Convention)[57] and the *Convention on Wetlands of International Importance Especially as Waterfowl Habitat* (Ramsar Wetlands Convention),[58] creation of the National Environment Protection Council and its functions, and species protection. The overall breadth of the approach to consideration within general environmental assessment processes, such as SEA and EIA, is limited for all legislation containing reference to cumulative impact assessment.

There are no definitions for cumulative impacts within any of the Acts or delegated legislation reviewed (Table 5-1 and Appendix A). It follows from the absence of reference to synergistic impacts that there is no attempt to differentiate cumulative and synergistic impacts (Table 5-1 and Appendix A). The absence of definition for both terms results in a situation where there is no direction as to whether synergistic impacts are assumed to be a type of cumulative impact,[59] or whether synergistic impacts are deemed to be distinct.[60]

[57] *Convention Concerning the Protection of the World Cultural and Natural Heritage* opened for signature 16 November 1972, 1037 UNTS 151 (entered into force 17 December 1975).
[58] *Convention on Wetlands of International Importance Especially as Waterfowl Habitat* opened for signature 2 February 1971, 996 UNTS 245 (entered into force 21 December 1975).
[59] An approach discussed within Chapter 2, section 3.
[60] The preferred approach for the purpose of this thesis as discussed within Chapter 2, sections 4 and 6.

Table 5-1: The terms 'cumulative' and 'synergistic' within Commonwealth, South Australian Tasmanian and Victorian marine environmental assessment focused legislation – June 2015 (refer to Appendix A).

	Commonwealth	Victoria	Tasmania	South Australia
Acts (total no. reviewed)	**13**	**14**	**14**	**14**
'Cumulative' (no. included within)	1	2	1	5
Mandatory requirement to consider 'cumulative' impacts (no. included within)	0	1	0	1
Discretionary requirement to consider 'cumulative' impacts (no. included within)	1	1	0	4
Definition of 'cumulative' (no. included within)	0	0	0	0
Synergistic (no. included within)	0	0	0	0
Mandatory requirement to consider 'synergistic' impacts (no. included within)	0	0	0	0
Discretionary requirement to consider 'synergistic' impacts (no. included within)	0	0	0	0
Definition of 'synergistic' (no. included within)	0	0	0	0
Definition differentiation between 'cumulative' and 'synergistic' impacts (no. included within)	0	0	0	0

Table 5-1 *cont.*

Delegated legislation (total no. reviewed)	**20**	**11**	**8**	**18**
‘Cumulative’ (no. included within)	1	1	0	0
Mandatory requirement to consider ‘cumulative’ impacts (no. included within)	1	1	0	0
Discretionary requirement to consider ‘cumulative’ impacts (no.of included within)	1	0	0	0
Definition of ‘cumulative’ (no. included within)	0	0	0	0
‘Synergistic’ (no. included within)	0	0	0	0
Mandatory requirement to consider ‘synergistic’ impacts (no. included within)	0	0	0	0
Discretionary requirement to consider ‘synergistic’ impacts (no. included within)	0	0	0	0
Definition of ‘synergistic’(no. included within)	0	0	0	0
Definition differentiation between ‘cumulative’ and ‘synergistic’ impacts (no. included within)	0	0	0	0

Table 5-1 *cont.*

The review of the legislation identified examples of alternative terms and principles that have potential to incorporate cumulative and synergistic impacts. These included the 'Principle of integrated environmental management' found within the *Environment Protection Act 1970* (Vic). Section 1J of the Act states the Principle to be: 'If approaches to managing environmental impacts on one segment of the environment have potential impacts on another segment, the best practicable environmental outcome should be sought'. The Principle could be applied to include the consideration and assessment of cumulative and synergistic impacts within environmental management approaches.

'Combined effects' is also an alternative term that may encompass cumulative and synergistic if present in the legislation reviewed. This term is used within the *Environmental Management and Pollution Control Act 1994* (Tas)[61] and the *Environment Protection Act 1993* (SA).[62] In both Acts, the term forms part of the definition of environmental harm, and the requirements to assess environmental harm require the consideration of 'pollution alone or from the combined effects of pollution and other factors'.[63] As there is no definition within either of the Acts that excludes reference to cumulative or synergistic impacts, and combinations of impacts result in cumulative or synergistic impacts,[64] decisions about avoiding or mitigating 'environmental harm' could also include consideration and assessment of these impact types.[65]

2.2 Legal requirements for assessing cumulative and synergistic impacts through the use of terms 'indirect impacts', 'significant', 'adverse', 'impact' and 'effect'

The results for the terms 'indirect impacts', 'significant', 'adverse', 'impact' and 'effect' are discussed in three parts. The results for the term 'indirect' are discussed first and include analysis of the applicable legislative provisions within the potential context of cumulative and synergistic impact assessment. The analysis then focuses on the presence or absence of the terms 'significant' and 'adverse', followed by 'impact' and 'effect'. The discussion for these later two parts concentrates on the potential context and connection with cumulative and synergistic impacts. Examples are provided of applicable provisions from each Act or delegated legislative instrument assessed that include the terms 'significant', 'adverse', 'impact', or 'effect'.

[61] Section 5(5)(b).
[62] Section 5(5)(b).
[63] *Environmental Management and Pollution Control Act 1994* (Tas) s 5(5)(b); *Environment Protection Act 2009* (SA) s 5(5)(b).
[64] Refer to discussion in Chapter 2 section 5 for examples.
[65] See, eg, *Environmental Management and Pollution Control Act 1994* (Tas) s 37, s 38; *Environment Protection Act 1993* (SA) s 93(2)(b)(ii).

2.2.1 'Indirect' impacts/effects

Legislative requirements to assess 'indirect' impacts are included in four Acts (Table 5-2 and Appendix A) and five pieces of delegated legislation (Table 5-2 and Appendix A). The jurisdictions that contain Acts with requirements to consider 'indirect' impacts are the Commonwealth, Tasmania and South Australia. As with the alternative term 'combined effects', both the *Environmental Management and Pollution Control Act 1994* (Tas) and the *Environment Protection Act 1993* (SA) refer to 'indirect' impacts within their similar definitions of environmental harm.[66] In these instances 'environmental harm' can be caused both directly and indirectly and, as noted in relation to the connection between cumulative and synergistic impacts and 'combined effects', there are discretionary assessment requirements for 'environmental harm'.[67]

The *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (*EPBC Act 1999* (Cth)) identifies 'indirect' impacts within the definition of 'impact' when 'the action is a substantial cause of that event or circumstance'.[68] As discussed in Chapter 4,[69] the connection between cumulative (and synergistic) impacts and the term 'indirect' are limited by the nexus requirements for a 'substantial cause'.[70]

The *National Environment Protection Measures (Implementation) Act 1998* (Cth) enables the implementation of 'national environment protection measures' and environmental protection in response to Commonwealth activities that impact on the environment.[71] Whilst the Act contains provisions for environmental assessment,[72] 'indirect' impacts are only referred to in the context of penalty limits associated with a contravention of the regulations.[73] This limits the opportunity for consideration and assessment of cumulative and/ or synergistic impacts before an anthropogenic activity occurs.

All jurisdictions have examples of delegated legislation containing reference to 'indirect' impacts. These include regulations relating to the environmental management of offshore petroleum within the Commonwealth, Tasmanian, and Victorian jurisdictions. In these

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[66] *Environmental Management and Pollution Control Act 1994* (Tas) s 5(5)(a); *Environment Protection Act 1993* (SA) s 5(5)(a).
[67] See, eg, *Environmental Management and Pollution Control Act 1994* (Tas) s37, s38; *Environment Protection Act 1993* (SA) s 93(2)(b)(ii).
[68] Section 527E(1)(b).
[69] Refer to section 2.3.
[70] See, eg, Lee Godden and Jacqueline Peel, *Environmental Law: Scientific, Policy & Regulatory Dimensions* (Oxford University Press, 2010) 303; also refer to Chapter 4, section 3.3 for an expanded discussion.
[71] Section 3.
[72] See, eg, *National Environment Protection Measures (Implementation) Act 1998* (Cth) pt 5.
[73] *National Environment Protection Measures (Implementation) Act 1998* (Cth) s 21(6)(a).

examples, the use of the term focuses on the assessment of the indirect risks and/or impacts of activities as part of the preparation of environmental management plans. This is achieved within: the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth);[74] the *Offshore Petroleum and Greenhouse Gas Storage Regulations 2011* (Vic);[75] and the *Petroleum (Submerged Lands) Management of Environment Regulations 2012* (Tas).[76] All of these requirements are limited to the indirect activities associated with offshore petroleum and do not require consideration of the potential for cumulative or synergistic impact interactions caused by other anthropogenic activities or environmental change. The *Environmental Management and Pollution Control (Waste Management) Regulations 2000* (Tas) is a further example of limited application for indirect impact considerations. This occurs in situations when, in an effort to avoid environmental harm, the disposal of 'controlled wastes' in an indirect manner is prohibited.[77]

The final example of delegated legislation is that of South Australia's *Development Regulations 2008* (SA). This example demonstrates that the ambit of indirect anthropogenic activities deemed to be 'Activities of major environmental significance', and therefore controlled, is narrow; with the reference confined to the context of 'Earthworks Drainage' being 'discharged directly or indirectly into marine waters'.[78] This restriction could also apply to cumulative and synergistic impacts if they were to be considered an indirect impact.

The potential for uncertainty and inconsistency in assessment approach arises when no definition is provided for the term 'indirect' impacts, and it is difficult to determine whether cumulative and/or synergistic impacts are included within an assessment framework. The review of the legislation (Table 5-2 and Appendix A), did not reveal any examples of expressed legislative intention to exclude these impacts types from 'indirect' impacts. Further, the potential for the inclusion of these impact types has not been expressly discounted as, excepting for the examples provided above that focus on 'environmental harm', all instances of 'indirect' impacts apply to limited situations. As such, if cumulative and/or synergistic impacts can be considered within the meaning of 'indirect' impacts, there are few provisions that are capable of including requirements that facilitate assessment between different anthropogenic activities and in conjunction with known environmental change.

[74] Regulation 13(6).
[75] Regulation 15(4).
[76] Regulation 16(2)(b).
[77] Regulation 8(1)(a).
[78] Schedule 22 clause 7(6).

Table 5-2: The term 'indirect' within Commonwealth, Victorian, Tasmanian and South Australian marine environmental assessment focused legislation – June 2015 (refer to Appendix A).

	Commonwealth	Victoria	Tasmania	South Australia
Acts (total no. reviewed)	**13**	**14**	**14**	**14**
Indirect (no. included within)	2	0	1	1
Cumulative or synergistic impacts expressly excluded from 'indirect' (no. included within)	0	0	0	0
Delegated legislation (total no. reviewed)	**20**	**11**	**8**	**18**
Indirect (no. included within)	1	1	2	1
Cumulative or synergistic impacts expressly excluded from 'indirect' (no. included within)	0	0	0	0

2.2.2 'Significant' and 'adverse'

The results for the use of 'significant' and 'adverse' impacts (Table 5-3 and Appendix A), and 'impact', and 'effect' terms (Table 5-4 and Appendix A), show that there are additional terms within the legislation capable of pertaining to cumulative and synergistic impacts. The results focus on 'significant' and 'adverse' as descriptors of magnitude or characteristics (respectively) for environmental impacts (Table 5-3), and instances where the terms 'impact' and 'effect' are used without descriptions of magnitude or characteristics (i.e. as 'stand-alone' terms) (Table 5-4). Whilst combined terms such as 'significant impact' or 'adverse effect' can be defined to include cumulative or synergistic impacts, and cumulative and synergistic impacts can be 'significant' or 'adverse', the terms 'significant' or 'adverse' cannot be used by themselves.

The terms 'significant' and 'adverse' are present within the Acts and delegated instruments for all jurisdictions. For the majority of occurrences the terms 'significant' and 'adverse' are associated with the terms 'impact' or 'effect', however, the use of these terms was also found to be associated with other terms, for example, 'risk'. As discussed, in Chapters 3 and 6, the term 'risk' when used within an environmental assessment context focuses on the assessment of the likelihood of cumulative and synergistic impacts occurring as a result of an anthropogenic activity and/ or environmental change. The use of the term in legislation, however, does not equate to an improved approach to the requirements for assessing cumulative and synergistic impacts.

Reviewing the use of the term 'significant' within the legislation (Table 5-3 and Appendix A), examples of the use of the term are found as 'significant impact',[79] 'significant effect',[80] and 'significant risk'.[81] The term 'significant'[82] is a measure of impact magnitude and can be used in association with cumulative and/ or synergistic impacts. However, as cumulative and synergistic impacts are characterised by interaction of impacts across space and time,[83] the use of the term 'significant' is a limitation. As discussed in Chapters 2 and 3, when environmental assessments are limited to 'significant impacts' (or effects), there is a risk that impacts predicted to be insignificant will be neglected.[84] Due to the potential for interactions to become

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[79] See, eg, *Environment Protection and Biodiversity Conservation Act 1999* (Cth) s 12; *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth) reg 2B.01(5)(h); *National Environment Protection Council Act 1994* (Cth) Schedule – Intergovernmental Agreement on the Environment sch 2(3)(v); *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) reg 17(6); *Environment Protection Act 1970* (Vic) s 49AD; *National Environment Protection Council (Victoria) Act 1995* (Vic) Schedule – The Agreement sch 2(3)(v); *Offshore Petroleum and Greenhouse Gas Storage Regulations 2011* (Vic) reg 15(4); *National Environment Protection Council (Tasmania) Act 1995* (Tas) Schedule 1 – Intergovernmental Agreement on the Environment sch 2(3)(v); *Petroleum (Submerged Lands) Management of Environment Regulations 2012* (Tas) reg 7(3); *State Policies and Projects Act 1993* (Tas) s 16(1)(e); *Development Act 1993* (SA) s 10A(6); *National Environment Protection Council (South Australia) Act 1995* (SA) Schedule 1 – Intergovernmental Agreement on the Environment sch 2(3)(v).

[80] See, eg, *Environmental Effects Act 1978* (Vic) s 3(2); *Flora and Fauna Guarantee Act 1988* (Vic) s 40(2)(d); *Marine Farm Planning Act 1995* (Tas) s 23(3); *Threatened Species Protection Act 1995* (Tas) s 40(2)(b).

[81] See, eg, *Hazardous Waste (Regulation of Exports and Imports) Act 1989* (Cth) s 17(4); *Hazardous Waste (Regulation of Exports and Imports) (OECD Decision) Regulations 1996* (Cth) reg 16(3)(b); *Living Marine Resources Management Act 1995* (Tas) s 51(2); *Marine Parks Act 2007* (SA) s 19(8)(b)(ii); *Petroleum and Geothermal Energy Act 2000* (SA) s 95(1)(b).

[82] Refer to glossary.

[83] See, eg, L M Cooper and W R Sheate, 'Cumulative Effects Assessment: A review of UK Environmental Impact Statements' (2002) 22 *Environmental Impact Assessment Review* 415, 416, 422 - 423; Benjamin S Halpern et al, 'Managing for cumulative impacts in ecosystem-based management through ocean zoning' (2008) 51 *Ocean and Coastal Management* 203, 205; Samuli Korpinen, Manuel Meidinger and Maria Laamanen, 'Cumulative impacts on seabed habitats: An indicator for assessments of good environmental status' (2013) 74 *Marine Pollution Bulletin* 311,313; Great Barrier Reef Marine Park Authority, *Great Barrier Reef Region Strategic Assessment: Strategic assessment report* (Great Barrier Reef Marine Park Authority, 2014) XIII; Natalie C Ban, Hussein M Alidina and Jeff A Ardron, 'Cumulative impact mapping: Advances, relevance and limitations to marine management and conservation, using Canada's Pacific Waters as a case study' (2010) 34 *Marine Policy* 876, 883; Murray Raff, 'Ten Principles of Environmental Impact Assessment' (1997) 14 *Environmental and Planning Law Journal* 207, 210; Harry Spaling and Barry Smit, 'Cumulative Environmental Change: Conceptual Frameworks, Evaluation Approaches, and Institutional Perspectives' (1993) 17 (5) *Environmental Management* 587, 589.

[84] See, eg, Peter N Duinker and Gordon E Beanlands, 'The significance of environmental impacts: an exploration of the concept' (1986) 10 (1) *Environmental Management* 1, 1; Dickert and Tuttle, above n 25, 39; Lennart Folkeson, Hans Antonson, and J O Helldin, 'Planners' views on cumulative effects. A focus-group study concerning transport infrastructure planning in Sweden' (2013) 30 *Land Use Policy* 243, 247; David J Haigh, 'Hinchinbrook – in defence

significant if accumulation over time and/ or interaction within spatial areas occurs, this can result in unanticipated impacts that detrimentally impact on the resilience of an ecosystem, habitat, or species.[85]

The definition, and therefore meaning, of what constitutes 'significant' within legislative provisions for environmental assessment is an issue discussed in the literature. The problems identified have focused on an unwillingness to give the word a narrow definition,[86] as well as efforts to associate the term with impacts that are 'important' or 'adverse'.[87] Further, Lawrence argued that the meaning of significance, and the decisions made when determining what impacts are significant, differ when considering cumulative and synergistic impacts as opposed to isolated impacts.[88] The argument concentrated on the inadequacy of applying the same standards for determination to isolated impacts when considering the 'uncertainty' and complexities of cumulative and synergistic impacts.[89] When this occurs in a legal framework, it raises the issue of uncertainty as to what must be considered when the term 'significant' is used and emphasises the need for more precision in legislative definitions.

This potential for uncertainty is emphasised by the analysis results (Table 5-3), with less than half of the Australian environmental assessment legislation reviewed containing reference to 'significant' as a measure of impact. It is acknowledged that the risk of uncertainty can be reduced through policy (e.g. environmental assessment guidelines) and/or decision-making processes. These are often discretionary processes, however, and without clear legislative requirements the potential for uncertainty as to what needs to be assessed within an SEA or EIA remains.

The term 'adverse' is used to describe the negative characteristics of an impact (or effect) (Table 5-3 and Appendix A). It does not require a certain magnitude of the impact type, nor does it identify the specific impact type. Given this, the cumulative and synergistic impacts at risk of being neglected by legislative provisions that only focus on 'significant' impacts (or effects) or 'significant adverse' impacts (or effects) are potentially reduced. The term 'adverse'

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of world heritage' (1999) 6 (1) *The Australasian Journal of Natural Resources Law and Policy* 47, 58, 69. Also see more discussion on this topic in Chapter 2, sections 4 and 5, and Chapter 3, sections 2 and 3.

[85] See, eg, Marten Scheffer et al, 'Anticipating Critical Transitions' (2012) 338 *Science* 344, 345; Duinker and Beanlands, above n 84, 1; Dickert and Tuttle, above n 25, 39.

[86] See, eg, Preston, above n 27, 151 – 155.

[87] Ibid, 153 – 154; Godden and Peel, above n 70, 173 - 174; *Queensland Conservation Council Inc v Minister for the Environment and Heritage* [2003] FCA 1463, [31 - 37]; *Minister for the Environment and Heritage v Queensland Conservation Council Inc* (2004) 139 FCR 24, 31 - 33 [26 - 28].

[88] Lawrence, above n 27, 778, 781.

[89] Ibid.

was most often used as ‘adverse impact’[90] and ‘adverse effect’[91] within the legislation. As a variation, the term ‘adversely affect’ also occurred a number of times.[92]

Within the legislation reviewed, the terms ‘significant’ or ‘adverse’ are also found to be combined, with examples such as ‘significant adverse impact’[93] and ‘significant adverse external effects’.[94] The inclusion of ‘significant’ limits the extent to which ‘adverse’ cumulative or synergistic impacts could be assessed when undertaking SEA or EIA. Other less common examples of the use of descriptor terms include ‘adverse consequences’,[95] ‘significant pollution’,[96] ‘significant environmental harm’,[97] ‘adverse interactions’,[98] ‘adverse risk’,[99] ‘significant damage’,[100] and ‘significant environmental incidents’.[101] It is anticipated that without any express intention to exclude cumulative or synergistic impacts, these impact types can be included within the definitions of these additional terms, as well as any associated assessment requirements.

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[90] See, eg, *Environment Protection and Biodiversity Conservation Act 1999* (Cth) s 75; *Fisheries Management Act 1991* (Cth) Schedule 2 – Fish Stocks Agreement (*Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks*) art 6(7); *Hazardous Waste (Regulation of Exports and Imports) (OECD Decision) Regulations 1996* (Cth) Schedule 1 – OECD Decision app 2; *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) reg 26(4)(d)(ii); *Offshore Petroleum and Greenhouse Gas Storage (Greenhouse Gas Injection and Storage) Regulations 2011* (Cth) reg 4.2(4)(ii); *Environment Protection Act 1970* (Vic) s 1K(c); *National Parks Act 1975* (Vic) s 19G(4); *Offshore Petroleum and Greenhouse Gas Storage Regulations 2011* (Vic) reg 176(3)(b)(ii); *Marine Farm Planning Act 1995* (Tas) s 4(1)(b); *National Parks and Reserves Management Act 2002* (Tas) sch 1; *Petroleum (Submerged Lands) Management of Environment Regulations 2012* (Tas) reg 32(2)(c)(ii).

[91] See, eg, *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth) reg 9A.19(1)(a)(ii); *Environmental Management and Pollution Control Act 1994* (Tas) s5 (1); *Living Marine Resources Management Act 1995* (Tas) s 136 (2)(a)(ii); *Natural Resource Management Act 2002* (Tas) sch 1 cl 2(c); *Nature Conservation Act 2002* (Tas) sch 1 cl 2(c); *National Parks and Reserves Management Act 2002* (Tas) sch 1 cl 2(c); *State Policies and Projects Act 1993* (Tas) sch 1 cl 2(c); *Threatened Species Protection Act 1995* (Tas) sch 1 cl 2(c); *Aquaculture Act 2001* (SA) s 4(1)(c); *Development Act 1993* (SA) s 46B(4)(d); *Environment Protection Act 1993* (SA) s 10(1)(a)(i)(C); *Fisheries Management Act 2007* (SA) s 7(5)(c); *Marine Parks Act 2007* (SA) s 8(2)(c); *Natural Resources Management Act 2004* (SA) s 7(1)(e); *Petroleum and Geothermal Energy Act 2000* (SA) s 95(1)(a).

[92] See, eg, *Flora and Fauna Guarantee Act 1988* (Vic) s 27(c); *National Parks and Wildlife Act 1972* (SA) s 60J(3); *Whales Protection Act 1988* (Tas) s 11(b); *Heritage Act 1995* (Vic) s 36(7); *Wildlife Act 1975* (Vic) s 81D(1)(c); *Environmental Management and Pollution Control (Waste Management) Regulations 2010* (Tas) reg 8(1)(c).

[93] *Environment Protection and Biodiversity Conservation Act 1999* (Cth) s 271(3)(c); *Fisheries Management Act 1991* (Cth) Schedule 2 – Fish Stocks Agreement (*Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks*) art 6(7); *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (Cth) s 593(2)(f); *Development Regulations 2008* (SA) reg 63(2)(c); *Offshore Petroleum and Greenhouse Gas Storage Act 2010* (Vic) s 422(1)(b).

[94] *National Environment Protection Council Act 1994* (Cth) Schedule – Intergovernmental Agreement on the Environment Section 2.2.1(ii); *National Environment Protection Council (Victoria) Act 1995* (Vic) Schedule – The Agreement Section 2.2.1(ii); *National Environment Protection Council (Tasmania) Act 1995* (Tas) Schedule 1 – Intergovernmental Agreement on the Environment Section 2.2.1(ii); *National Environment Protection Council (South Australia) Act 1995* (SA) Schedule 1 – Intergovernmental Agreement on the Environment Section 2.2.1(ii).

[95] See, eg, *Hazardous Waste (Regulation of Exports and Imports) Act 1989* (Cth) s 56A(1)(e)(ii).

[96] See, eg, *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth) s 27(1A)(b).

[97] See, eg, *Aquaculture Act 2001* (SA) s 52(3)(c)(ii)(B).

[98] See, eg, *Aquaculture Regulations 2005* (SA) reg 19(1)(a)(ii).

[99] See, eg, *Environmental Management and Pollution Control Act 1994* (Tas) sch 1 cl 3(b).

[100] *Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011* (Cth) reg 5.02.

[101] *Environment Protection Act 1993* (SA) s 10(1)(b)(ix)B.

The absence of express exclusion of cumulative and synergistic impacts within the legislation (Table 5-3 and Appendix A) can be construed as increasing the potential for their consideration and assessment. However, the absence does not reduce the potential risk for effectively assessing cumulative and synergistic impacts within SEA or EIA. As discussed in Chapter 3, the absence of a specific requirement to assess cumulative and synergistic impacts increases the possibility that they will not be considered or assessed.[102] The risk therefore arises when the terms 'significant' or 'adverse' impacts (or effects) are used within the legislation and there is no express intention to assess cumulative and synergistic impacts.

Table 5-3: The terms 'Significant' and 'Adverse' within Commonwealth, Victorian, Tasmanian and South Australian marine environmental assessment focused legislation – June 2015 (refer to Appendix A).

	Commonwealth	Victoria	Tasmania	South Australia
Acts (total no. reviewed)	**13**	**14**	**14**	**14**
Significant (no. included within)	6	5	5	6
Adverse (no. included within)	5	7	10	9
Exclusion of 'cumulative' or 'synergistic' impacts (no. included within)	0	0	0	0

[102] See, eg, Spaling and Smit, above n 83, 589; Nicole E Seitz, Cherie J Westbrook, and Bram F Noble, 'Bringing science into river systems cumulative effects assessment practice' (2011) 31 *Environmental Impact Assessment Review* 172, 173; Monique Dubé and Kelly Munkittrick, 'Integration of Effects-Based and Stressor-Based Approaches into a Holistic Framework for Cumulative Effects Assessment in Aquatic Ecosystems' (2001) 7 (2) *Human and Ecological Risk Assessment: An International Journal* 247, 248 – 251; Riki Therivel and Bill Ross, 'Cumulative effects assessment: Does scale matter?' (2007) 27 *Environmental Impact Assessment Review* 365, 372; Jennifer Dixon and Burrell E Montz, 'From Concept to Practice: Implementing Cumulative Impact Assessment in New Zealand' (1995) 19 (3) *Environmental Management* 445, 446.

Table 5-3 ***cont.***

Delegated legislation (total no. reviewed)	**20**	**11**	**8**	**18**
Significant (no. included within)	4	1	1	1
Adverse (no. included within)	4	1	2	2
Exclusion of 'cumulative' or 'synergistic' impacts (no. included within)	0	0	0	0

2.2.3 'Impact' and 'effect'

For the Commonwealth,[103] Victorian,[104] Tasmanian[105] and South Australian[106] jurisdictions, examples of 'impact' and 'effect' being used as 'stand-alone' terms were found in principal and delegated legislation (Table 5-4 and Appendix A). The results for the presence of the term 'effect', as a stand-alone term, showed its use in relation to environmental assessment

[103] See, eg, *Australian Heritage Council Act 2003* (Cth) s 24A(2)(f); *Environment Protection and Biodiversity Conservation Act 1999* (Cth) s 527E; *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth) reg 2A.03; *Fisheries Management Act 1991* (Cth) Schedule 2 – Fish Stocks Agreement (*Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks*) Article 6(6), art 7(2)(f); *Fisheries Management Regulations 1992* (Cth) pt 3A div 11; *Hazardous Waste (Regulation of Exports and Imports) Act 1989* (Cth) Schedule – *Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal,* Annex III; *National Environment Protection Council Act 1994* (Cth) s 14(1)(e); *National Environment Protection Measures (Implementation) Act 1998* (Cth) s 5; *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (Cth) s 643; *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) reg 4.
[104] See, eg, *Environment Protection Act 1970* (Vic) s 1J; *Fisheries Act 1995* (Vic) s 28(6)(g)(ii); *Heritage Act 1995* (Vic) s 62O(2)(c); *National Environment Protection Council (Victoria) Act 1995* (Vic) s 14(1)(e); *Offshore Petroleum and Greenhouse Gas Storage Regulations 2011* (Vic) reg 6; *Port Management Act 1995* (Vic) s 91D(1)(c).
[105] See, eg, *Environmental Management and Pollution Control Act 1994* (Tas) s 5(1); *Living Marine Resources Management Act 1995* (Tas) s 210(2)(c); *Fisheries Rules 2009* (Tas) r 15(6); *Marine Farm Planning Act 1995* (Tas) s 23; *Mineral Resources Development Act 1995* (Tas) s 11(2)(c)(v); *National Environment Protection Council (Tasmania) Act 1995* (Tas) s 14(1)(e); *National Parks and Reserved Land Regulations 2009* (Tas) reg 33(2)(a); *Petroleum (Submerged Lands) Management of Environment Regulations 2012* (Tas) reg 11.
[106] See, eg, *Aquaculture Regulations 2005* (Cth) reg 17(1)(b)(i)(B); *Coast Protection Act 1972* (SA) s 14(3)(b); *Development Act 1993* (SA) s 46B(4)(cc); *Development Regulations 2008* (SA) reg 63; *Environment Protection Act 1993* (SA) s 5(3)(b)(i); *Fisheries Management Act 2007* (SA) s 43(2); *Marine Parks Act 2007* (SA) s 8(1)(b)(ii); *National Parks and Wildlife Act 1972* (SA) s 60I(2)(a); *Natural Resources Management Act 2004* (SA) s 7(1)(e); *Natural Resources Management (General) Regulations 2005* (SA) reg 10(5)(b); *National Environment Protection Council (South Australia) Act 1995* (SA) s 14(1)(e); *Petroleum and Geothermal Energy Act 2000* (SA) s 97; *Petroleum and Geothermal Energy Regulations 2013* (SA) reg 10.

requirements within the Acts and delegated legislation of the Commonwealth,[107] Victoria,[108] and South Australia.[109] For the Tasmanian legislation reviewed, the use of the term was only found in the Acts.[110]

Table 5-4: The terms 'Impact' and 'Effect' (as stand-alone terms) within Commonwealth, Victorian, Tasmanian and South Australian marine environmental assessment focused legislation – June 2015 (refer to Appendix A).

	Commonwealth	**Victoria**	**Tasmania**	**South Australia**
Acts (total no. reviewed)	**13**	**14**	**14**	**14**
Impact ('stand-alone' no. included within)	7	5	5	9
Effect ('stand-alone' no. included within)	8	7	5	7
Exclusion of 'cumulative' or 'synergistic' impacts (no. included within)	0	0	0	0

[107] See, eg, *Environment Protection and Biodiversity Conservation Act 1999* (Cth) s 516A(6)(c); *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth) reg 2B.01(5)(e)(ii); *Environment Protection (Sea Dumping) Act 1981* (Cth) s 18(4); *Fisheries Management Act 1991* (Cth) Schedule 2 – Fish Stocks Agreement (*Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks*) Preamble; *Hazardous Waste (Regulation of Exports and Imports) Act 1989* (Cth) s 3(1); *Hazardous Waste (Regulation of Exports and Imports) (OECD Decision) Regulations 1996* (Cth) Schedule 1 OECD Decision app 1; *National Environment Protection Measures (Implementation) Act 1998* (Cth) s 5; *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (Cth) s 576B(2)(a); *Offshore Petroleum and Greenhouse Gas Storage (Greenhouse Gas Injection and Storage) Regulations 2011* (Cth) reg 3.3(10); *Offshore Minerals Act 1994* (Cth) s 177(3)(g)(ii); *Protection of the Sea (Powers of Intervention) Act 1981* (Cth) s 10(2)(e).
[108] See, eg, *Environmental Effects Act 1978* (Vic) s 4(1); *Environment Protection Act 1970* (Vic) s 4; *Fisheries Act 1995* (Vic) s 140(2); *Marine (Drug, Alcohol and Pollution Control) Act 1988* (Vic) s 38(1)(b); *Offshore Petroleum and Greenhouse Gas Storage Act 2010* (Vic) sch 4(11); *Offshore Petroleum and Greenhouse Gas Storage Regulations 2011* (Vic) reg 166 (2)(i); *Pollution of Waters by Oil and Noxious Substances Act 1986* (Vic) – Schedule 1 *The International Convention for the Prevention of Pollution from Ships, 1973* art 12; *Wildlife Act 1975* (Vic) s 29(b).
[109] See, eg, *Development Act 1993* (SA) s 4(4); *Development Regulations 2008* (SA) reg 17(5)(d); *Environment Protection Act 1993* (SA) s 24(4)(c); *Marine Parks Act 2007* (SA) sch 1 pt 4(1); *National Parks and Wildlife Act 1972* (SA) s 49(2)(a); *Offshore Minerals Act 2000* (SA) s 177(3)(g)(ii); *Protection of Marine Waters (Prevention of Pollution from Ships) Act 1987* (SA) Schedule 1 – *International Convention for the Prevention of Pollution from Ships 1973*, art 12(1); *Petroleum (Submerged Lands) Act 1982* (SA) s 151(2)(g).
[110] See, eg, *Environmental Management and Pollution Control Act 1994* (Tas) s 99(2)(d); *Living Marine Resources Management Act 1995* (Tas) s 131; *Marine Farm Planning Act 1995* (Tas) s 24(2); *Petroleum (Submerged Lands) Act 1982* (Tas) s 151(2)(g); *Threatened Species Protection Act 1995* (Tas) s 44(3)(a).

Table 5-4 ***cont.***

Delegated legislation (total no. reviewed)	**20**	**11**	**8**	**18**
Impact ('stand-alone' no. included within)	3	1	3	4
Effect ('stand-alone' no. included within)	3	1	0	1
Exclusion of 'cumulative' or 'synergistic' impacts (no. included within)	0	0	0	0

The ordinary meaning of the term 'impact' has been discussed within Australian case law, for example, the *Minister for the Environment and Heritage v Queensland Conservation Council Inc*.[111] The case involved an appeal against a decision by the Federal government's Environment Minister that interpreted the meaning of 'impact' narrowly to limit the extent of impact assessment required for an EIA.[112] This approach avoided the assessment of indirect cumulative impacts.[113] In this case, Black CJ, Ryan and Finn JJ, as a Full Court of the Federal Court of Australia, cautioned against paraphrasing the definitions of words found in the *EPBC Act 1999* (Cth) with a narrow construction when the ordinary meaning of the words would result in a wider ambit of consideration.[114] As identified in Chapter 2, the term 'effect' is considered interchangeable with 'impact'.[115] Therefore, the issues surrounding an absence of express exclusion of cumulative and synergistic impacts from environmental assessment requirements are therefore extended to situations where legislation contains provisions to assess general environmental 'impacts' or 'effects'.

The absence of an express exclusion of cumulative or synergistic impacts when considered

[111] *Minister for the Environment and Heritage v Queensland Conservation Council Inc* (2004) 139 FCR 24, 38 [53].
[112] Ibid, 38 - 40 [53] – [61].
[113] Ibid.
[114] Ibid, 38 [53].
[115] See, eg, Larry Canter and Bill Ross, 'State of practice of cumulative effects assessment and management: the good, the bad and the ugly' (2010) 28(4) *Impact Assessment and Project Appraisal* 261, 262; John D Court, Colin J Wright, Alasdair C Guthrie, *Assessment of cumulative impacts and strategic assessment in environmental impact assessment: prepared for the Commonwealth Environment Protection Agency*, (Commonwealth of Australia, 1994) Appendix I.3; Folkeson, Antonson, and Helldin, above n 84, 243; Spaling and Smit, above n 83, 587, 589, 591; also see the discussion in Chapter 2, section 2.1.

alongside the inclusion of 'impact' and 'effect' (as stand-alone terms) within the Acts, demonstrates that cumulative and synergistic impacts can be incorporated into elements of environmental assessment procedures within at least one third of the Acts reviewed (Table 5-4).[116] There is less potential to incorporate the assessment of cumulative and synergistic impacts within the delegated legislation if the stand-alone terms 'impact' and 'effect' are to be relied upon. Instead, it would be expected that those regulations that include requirements relevant to environmental assessment are consistent in approach with the parent Act. There are, however, complexities associated with facilitating a legislative approach that only relies upon the assessment of cumulative and synergistic impacts when the requirements for environmental assessment of 'impacts' or 'effects' are present. These relate to the potential for inconsistent methodological approaches and associated economic inefficiencies, and are discussed further in Section 4.2 of this chapter.

There are also examples of legislation applicable to the Otways Marine Area that aim to prevent pollution and the damage it can cause in the marine environment.[117] As evidenced in Chapter 2, pollution is a cause of both cumulative and synergistic impacts,[118] and as actual impacts are not the same as predicted impacts[119] the mitigation and prevention of pollution is integral to environmental management. The absence of express requirement creates ambiguity as to whether cumulative or synergistic impacts should be considered in the implementation of other legislation, such as the *Navigation Act 2012* (Cth) and *Pollution of Waters by Oil and Noxious Substances Act 1986* (Vic) (even though they address pollution from specific activities). These Acts address environmental pollution by punitive measures.[120] The approach is predicated on the identification of cumulative or synergistic impacts after an event has occurred. The challenges associated with accurately predicting cumulative and synergistic impacts, when the extent of pollution to occur is unknown, is exacerbated by complex regulatory challenges associated with the identification of cumulative and synergistic impacts and the prevention of impacts (e.g. pollution from multiple vessels in different locations). In

[116] Further research into the type and extent of environmental assessment required by all provisions is necessary to ascertain the potential effectiveness of the requirements.
[117] See, eg, *Navigation Act 2012* (Cth), s 3, pts 3 – 4; *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth); *Pollution of Waters by Oil and Noxious Substances Act 1986* (Vic); *Pollution of Waters by Oil and Noxious Substances Act 1987* (Tas).
[118] See the examples discussed in Chapter 2, Table 2-1.
[119] See, eg, Richard F Ambrose, Russell J Schmitt and Craig W Osenberg, 'Predicted and Observed Environmental Impacts: Can we Foretell Ecological Change?' in Russell J Schmitt and Craig W Osenberg (eds), *Detecting ecological impacts: concepts and applications in coastal habitats* (Academic Press, 1996) 345, 367; L W Canter (1996) in Lourdes M Cooper and William R Sheate, 'Integrating cumulative effects assessment into UK strategic planning: implications of the European Union SEA Directive' (2004) 22(5) *Impact Assessment and Project Appraisal* 5, 15; L W Canter, *Environmental Impact Assessment* (McGraw – Hill Book Co, 1996) 48; Therivel and Ross, above n 102, 367, 380.
[120] See, eg, *Pollution of Waters by Oil and Noxious Substances Act 1986* (Vic) s 8; *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth) s 9.

such situations, using the shipping industry as an example, it is recommended that management programmes be developed to facilitate the collection and use of data to inform future environmental focused decision-making about shipping and other anthropogenic activities.

3. Key implications

The preceding analysis of legislation demonstrates that there are several key implications for the consideration of cumulative and synergistic impacts within environmental assessments associated with the Otways Marine Area. These implications are important to consider when identifying ways in which marine environmental assessment and protection can be improved. The implications stem from inadequate provisions for assessing cumulative and synergistic impacts, inadequate use of definitions and terms, and the need for further consideration of environmental change alongside anthropogenic activities. In discussing these implications, this case study does not aim to determine whether any past EIA or SEA undertaken within the Otways Marine Area has actually addressed cumulative and synergistic impacts, and no assumptions can be made about the likelihood or effectiveness of assessment. The inadequacies detected in the Acts are further explored below.

3.1 Inadequate provisions for requiring the assessment of cumulative and synergistic impacts

As demonstrated in the results of the review, there are no requirements to address synergistic impacts (as a distinct impact type). Further, there is limited scope for requirement to assess cumulative impacts within the legislation (Table 5-1 and Appendix A). The shortcomings become more evident when the application of the provisions is considered. A number of the Acts require the consideration of cumulative impacts as part of environmental assessment, but the requirements are poorly defined. Examples include, the *Natural Resource Management Act 2004* (SA) where consideration is part of a statutory duty,[121] and the *Marine Parks Act 2007* (SA) where 'regard' must be had within the context of a 'general duty of care.'[122] Without stating how it is that the 'duty' is to be expressed, it is difficult to achieve effective and consistent outcomes.

Other limiting approaches are evident in the *Development Act 1993* (SA), which affords decision-makers discretion to consider cumulative impacts, but this is only relevant for 'major'

[121] Section 9(2)(g).
[122] Section 37(2)(f).

projects.[123] Whilst the *Development Act 1993* (SA) takes a broader approach to the interaction of activities and considers both the cumulative impacts of the project and from other proposals or anthropogenic activities, the *Petroleum and Geothermal Energy Act 2000* (SA) is limited to 'classifying activities that are likely to be recurrent'.[124] The restrictions of this Act result in a situation where the consideration and assessment of the interaction of cumulative impacts from other anthropogenic activities within the Otways Marine Area may not occur.

The *Wildlife (Marine Mammals) Regulations 2009* (Vic) are also restricted to a specific activity impact on whales.[125] As marine mammals are impacted by other anthropogenic activities within the Otways Marine Area (e.g. offshore petroleum and fishing), it is suggested that a more effective approach would be a focus that considers cumulative and synergistic impacts on whales from a broader perspective. However, as discussed by New et al, although anthropogenic activities such as seismic testing have a greater impact on whales, the minimisation of relatively insignificant impacts is still of benefit when the ongoing effects of cumulative (and synergistic) impacts are considered.[126] Further, the legislation does not address the number of different boats that are permitted to approach the whales in one day, or other marine mammals impacted by tourism, such as, dolphins and seals. Addressing these issues would require more extensive requirements for both impact types in more of the legislative examples reviewed.

There are no locations within the Otways Marine Area listed as World Heritage places.[127] With the focus on cumulative impact consideration for World Heritage area management being (at present) unwarranted, there is no cause to apply the requirements to consider these impact types within management plans derived under the *Heritage Act 1995* (Vic), [128] or the *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth).[129] Similarly, there are no Ramsar Wetlands located within the Otways Marine Area,[130] and the Australian Ramsar management principles contained within the *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth) [131] are not applicable. The implications of the restricted

[123] Section 46(1a).
[124] Section 98(4).
[125] Regulation 16(14).
[126] Leslie F New et al, 'The modelling and assessment of whale watching impacts' (2015) 115 *Ocean & Coastal Management* 10, 14.
[127] Australian Government Department of the Environment, Australia's World Heritage List <http://www.environment.gov.au/heritage/places/world-heritage-list>.
[128] Section 62O(2)(c).
[129] Regulation 2B.01(5)(l), Schedule 5(2)(2.02)(d).
[130]Australian Government Department of Sustainability, Environment, Water, Population and Communities, *Ramsar wetlands of Australia,* (Environmental Resources Information Network, Australian Government, Department of Sustainability, Environment, Water, Population and Communities, January 2013) <http://www.environment.gov.au/water/topics/wetlands/database/maps/pubs/ramsar-sites-australia.pdf> .
[131] *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth) Schedule 6(2)(2.02)(e).

requirements within the *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth) and the *Heritage Act 1995* (Vic) to the Otways Marine Area include the further narrowing of the circumstances in which cumulative impact assessment may be undertaken.

The *EPBC Act 1999* (Cth) provides for a broad range of environmental assessment and protection processes.[132] The Otways Marine Area covers a large area in which numerous and varied anthropogenic activities occur and impact on the marine environment, habitats and species. As it is likely that this Act is applicable to activities occurring within the Otways Marine Area, the region would benefit from a broader approach to cumulative and synergistic impact assessment requirements within the Act and associated *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth). Similarly, a broader approach would also assist in addressing the inadequate consideration of these impact types within the general environmental assessment legislation found in Victoria,[133] South Australia,[134] and Tasmania.[135] However, as concluded in the results discussion (section 2.1), the requirements to consider cumulative impacts as part of general environmental assessment processes (i.e. SEA and EIA) are limited. Further, there are no specific requirements to assess synergistic impacts.

The narrow approach is also evident within the *National Environment Protection Council (South Australia) Act 1995* (SA),[136] *National Environment Protection Council (Victoria) Act 1995* (Vic),[137] the *National Environment Protection Council (Tasmania) Act 1995* (Tas),[138] and the *National Environment Protection Council Act 1994* (Cth).[139] The parallel approach of this legislative framework ensures that, as discussed above, each of the Acts include a copy of the 1992 IGAE; a document that guides the incorporation of cumulative impact assessment within environmental assessment processes.[140] These Acts, as also addressed above, are focused on environmental protection measures,[141] and not on establishing general framework and processes for environmental assessment; thus limiting the opportunities to assess cumulative impacts. The Acts do include within their objectives a focus on compatible approaches between

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[132] Refer to discussion in Chapter 4, section 3.
[133] See, eg, *Environmental Effects Act 1978* (Vic).
[134] See, eg, *Development Act 1993* (SA).
[135] See, eg, *Environmental Management and Pollution Control Act 1994* (Tas).
[136] Schedule 1 – Intergovernmental Agreement on the Environment.
[137] Schedule – The Agreement.
[138] Schedule 1 – Intergovernmental Agreement on the Environment.
[139] Schedule – Intergovernmental Agreement on the Environment.
[140] Council of Australian Governments, *Intergovernmental Agreement on the Environment*, 1 May 1992, Schedule 2(3)(ii) <http//:www.environment.gov.au/about-us/publications/intergovernmental-agreement>.
[141] See, eg, *National Environment Protection Council (South Australia) Act 1995* (SA) s7, s15; *National Environment Protection Council (Victoria) Act 1995* (Vic) s7, s15; *National Environment Protection Council Act 1994* (Cth) s7, s15; *National Environment Protection Council (Tasmania) Act 1995* (Tas) s7, s15.
[141] Section 62O(2)(c).

jurisdictions.[142] Concentrating on the need to reduce jurisdictional fragmentation,[143] inclusion of the IGAE (in a revised or new form) within a national legislative framework that provides minimum standards for cumulative and synergistic impact assessment could be an effective method of improving the approach to the assessment of these impact types.

There is a risk of a restricted approach to the assessment of cumulative or synergistic impacts within the Otways Marine Area if legislative requirements are inadequate. The implications of relying upon legal requirements when there are minimal requirements for the consideration of cumulative impacts, and no requirements addressing synergistic impacts, is that cumulative and synergistic impacts occurring within the Otways Marine Area may be assessed, and therefore identified, less often. Further, the potential dependency on policy (including guidelines[144]) is increased. Owing to the discretionary nature of policy in terms of approach and application there is a risk of inconsistency in extent and approach to application (as discussed in Chapter 4).[145]

The outcomes of Chapter 2 emphasised that the assessment and monitoring of cumulative and synergistic impacts assists with improved knowledge about marine environments.[146] The lack of knowledge about the Otways Marine Area ecology and the impacts of anthropogenic activities and environmental change are identified as challenges for effective management.[147] Further, monitoring and adaptive management practices are recognised as important elements of programmes designed to enable environmental protection.[148] The minimal extent and generally discretional nature of provisions requiring cumulative impact assessment, when combined with inadequate attention to synergistic impact assessment, contributes to environmental management methods that perpetuate a lack of knowledge about environmental impacts within the Otways Marine Area. Increased requirements, as well as an increase in the use of mandatory language and the breadth in application of legislative provisions, could assist in achieving increased marine environmental knowledge as well as opportunities for protection

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[142] *National Environment Protection Council (South Australia) Act 1995* (SA) s 3(b); *National Environment Protection Council (Victoria) Act 1995* (Vic) s 3(b); *National Environment Protection Council (Tasmania) Act 1995* (Tas) s 3(b); *National Environment Protection Council Act 1994* (Cth) s 3(b).
[143] Refer to the discussion in Chapter 4, section 4.
[144] See, eg, Victorian Government Department of Sustainability and Environment, above n 30.
[145] See, eg, Chapter 4, Section 3.1.1.
[146] See, eg, Caitlin M Crain et al, 'Understanding and Managing Human Threats to the Coastal Marine Environment', (2009) 1162 *The Year in Ecology and Conservation Biology 2009: Ann. N.Y. Acad. Sci* 39, 49; Carle Folke et al, 'Regime Shifts, Resilience, and Biodiversity in Ecosystem Management' (2004) 35 *Annual Review of Ecology, Evolution and Systematics* 557, 573; Also see the discussion surrounding Folke et al in Richard Curtin and Raúl Prellezo, 'Understanding marine ecosystem based management: A literature review', (2010) 34 *Marine Policy* 821, 822; Great Barrier Reef Marine Park Authority, above n 83, 10-6; Ban, Alidina and Ardron, above n 83, 883; L W Canter (1996) in Cooper and Sheate, above n 119, 15; Canter, above n 119 48; Therivel and Ross, above n 102, 367, 372 – 373.
[147] See, eg, Barton, Pope and Howe, above n 4, iv – v, 25 – 26.
[148] Ibid.

and general management of this area.

Addressing the issues discussed would provide for more consistency and less regulatory fragmentation[149] when assessing cumulative and synergistic impacts. When the Otways Marine Area legislative framework is considered, fragmentation is also a risk when multiple decisions are being made by different governments about different anthropogenic activities within the region. As acknowledged in earlier chapters,[150] whilst it is important to manage the particular values and impacts associated with a particular area (site-specific focus), it is recommended that this be achieved in a legislative framework that has minimum assessment requirements as a common element.

3.2 Inadequate use of definitions and terms

For cumulative and synergistic impacts there are no definitions within the results (Table 5-1 and Appendix A). When a definition is absent there is a potential for inconsistency in application of environmental assessment approach and scientific methodology for these impact types.[151] For the Otways Marine Area, the risk of inadequate definitions includes inconsistent methodology or minimal level of attention to the assessment of cumulative or synergistic impacts. This pattern of inadequate or absent definition is repeatedly raised as an issue in the context of cumulative and synergistic impacts (see Chapters 2 and 3).

If definitions are provided for cumulative and synergistic impacts in the future, having four jurisdictions within the Otways Marine Area could mean that there is further inconsistency in need of resolution; this being the different approaches that the Federal and State governments are able to take when legislating for matters applicable to their jurisdiction.[152] As the environmental characteristics of the Otways Marine Area can result in high levels of interaction between anthropogenic activities, species, habitats, ecological systems and environmental change,[153] there is a need for balance between jurisdictional compatibility and area specific issues.

[149] Refer to the discussion in Chapter 4, section 4.
[150] See, eg, the discussion in Chapter 4, sections 3.1, 4.1 and 4.2.
[151] See, eg, Cheryl K Contant and Lyna L Wiggins, 'Defining and analyzing cumulative environmental impacts' (1991) 11 *Environmental Impact Assessment Review* 297, 298; Spaling and Smit, above n 83, 588; Chris Cocklin, Sharon Parker and John Hay, 'Notes on Cumulative Environmental Change I: Concepts and Issues' (1992) 35 *Journal of Environmental Management* 31, 34; Gunn and Noble, above n 27, 156; Seitz, Westbrook and Noble, above n 102, 174; Peter N Duinker et al, 'Scientific dimensions of cumulative effects assessment: toward improvements in guidance for practice' (2013) 21 *Environmental Reviews* 40, 42.
[152] Refer to the discussion in Chapter 4, sections 3 and 4.
[153] See, eg, Barton, Pope and Howe, above n 4, 17 - 21.

These issues are highlighted in a study by Ma, Becker and Kilgore, where it was identified that 26 US states provided legal requirements for the assessment of cumulative impacts when undertaking environmental assessment (applicable to all habitats).[154] The study concluded that definitions for cumulative impacts could be found within approximately half of the legal frameworks,[155] and that the definitions generally reflected the National Environmental Policy Act (NEPA) definition.[156] That the federal NEPA regulations appear to have influenced the approach to cumulative impact assessment, within state based frameworks independent of the NEPA requirements, raises the question of whether leading by example at the Commonwealth government level could influence the Australian state and territory government approaches. The research by Ma, Becker and Kilgore also identifies that the significant differences between US state-based approaches to cumulative impact assessment is indicative of a recommendation against using the same framework in all instances and that, instead, requirements and programmes for implementation should reflect individual needs.[157]

There are also opportunities for cumulative and synergistic impacts to be incorporated within specific impact types through the use of terms such as ‘indirect impacts’ (Table 5–2 and Appendix A) and generally through the use of terms such as ‘impact’ and ‘effect’ (Table 5-4 and Appendix A). As also identified, there are complications associated with reliance upon these substitute terms. Cumulative (and synergistic) impacts can be indirect,[158] and the term is important for identifying the time lag and secondary consequence elements of impacts that occur between the interaction of anthropogenic activities and environmental change in the marine environment. However, the term ‘indirect’ is incomplete as a descriptor of cumulative (and synergistic) impacts due to the fact that these impact types can also be immediate in their consequences.[159] Therefore, instead of just using ‘indirect’, the term should be used alongside ‘direct’ as part of any specific legal requirements for cumulative or synergistic impact assessment.

In the interests of increasing opportunities for environmental protection, it could be argued that

[154] Ma, Becker and Kilgore, above n 1, 392. It is noted that this study did not address synergistic impacts as a distinct impact type.
[155] Ma, Becker and Kilgore, above n 1, 392.
[156] Ibid. Also refer to the discussion in Chapter 2, section 2.3 Defining cumulative impacts within the legal context, for further discussion on the NEPA definition.
[157] Ma, Becker and Kilgore, above n 1, 397.
[158] See, eg, Beanlands et al (eds), above n 25, 161; Beanlands et al (1986) cited in Contant and Wiggins, above n 25, 302; Dickert and Tuttle, above n 25, 39; *Queensland Conservation Council Inc v Minister for the Environment and Heritage* [2003] FCA 1463, [38 – 41]; Franks, Brereton and Moran, above n 25, 30; Harriman and Noble, above n 25, 35.
[159] See, eg, Beanlands et al (eds), above n 25, 161; Beanlands et al (1986) cited in Contant and Wiggins, above n 25, 302; Dickert and Tuttle, above n 25, 39.

the use of terms 'impact' or 'effect' should trigger the need to assess cumulative and synergistic impacts. If this approach were to be applied then every legal requirement for the consideration or assessment of an environmental impact would result in the need to address these impact types. The argument, however, is challenged in instances where there is no specific reference to cumulative or synergistic impacts. This is because the absence of specific requirement and definition can result in uncertainty, with an indiscriminate and ad hoc approach for the extent of consideration given, and/or the assessment methods. A further interpretation is that assuming that every reference to 'impact' or 'effect' is an automatic requirement could impose extra economic cost due to poor efficiency in assessment methods, constraints on the effective sharing of data due to inconsistency in assessment methods, and an inability to use knowledge in an iterative manner.

When the use of language such as 'impact' or 'effect' is applied to encompass cumulative and synergistic impacts without providing clarity (e.g. specific definitions), the assessment of these impacts can have negative economic implications (e.g. for project proponents and governments). For example, section 96A of the *Petroleum (Submerged Lands) Act 1982* (SA) includes the term 'effect'. In short, the provision enables the Minister to impose conditions on offshore petroleum permit holders that require an operator to be insured for the matters relating to the 'clean – up or other remedying of the effects of the escape of petroleum'.[160] If the fiscal costs of cumulative and synergistic impacts are accounted for in an example such as this, the environmental harm and associated complexities that can arise because of insufficient knowledge and the long term and potentially widespread nature of such impacts, could also result in a highly complex and uncertain economic outcome.

The concerns raised above, when considered with the need for specific requirements and definitions to achieve consistent approaches to cumulative and synergistic impact consideration and assessment, demonstrate the flawed argument of substitution with general terms such as 'impact' or 'effect'. Further, as discussed earlier in this chapter, there have been examples of the terms 'significant' and 'adverse' being associated with cumulative impacts. Relying upon the identification of impacts or effects as 'adverse' merely identifies that the impacts must be negative in characteristic; the type of impact identified is no less general than that of 'impact' or 'effect', and the risk remains of inconsistency and associated consequences. Using the term 'significant', as discussed in section 2.2.2 and Chapter 4,[161] there is also a risk of not accounting for future cumulative and synergistic impacts that occur because of smaller impacts

[160] *Petroleum (Submerged Lands) Act 1982* (SA), s 96A.
[161] Section 2.1.1; see, eg, Chris McGrath, 'Swirls in the stream of Australian environmental law: Debate on the EPBC Act' (2006) 23 *Environmental and Planning Law Journal* 165, 182.

compounding. Within the Otways Marine Area, the assessment of 'significant' impacts is relevant to the neglect of seemingly 'minor' cumulative and synergistic impacts that could result from the combination of impacts from anthropogenic activities and environmental change that for example, are underestimated in magnitude (particularly in the case of synergistic impacts), occur over long periods of time, or occur in either a piece-meal or indirect manner. The legislation should therefore avoid limiting cumulative and synergistic impact considerations to those that are 'significant' and instead facilitate attention to smaller impacts before they compound and cause an unreasonable level of detriment.

That cumulative and synergistic impacts have not been expressly excluded (Tables 5-2, 5–3, and 5-4 and Appendix A) from any application of the terms 'indirect', 'significant', 'adverse', 'impact' or 'effect', raises the question of 'why not'? That there is no exclusion suggests that legislators may have insufficient awareness about the potential environmental detriment that can be caused through the ongoing neglect of cumulative and synergistic impacts,[162] and therefore do not identify the need to make specific references. Alternatively, because of the historical complexities of adequate definitions,[163] reliance upon policy which allows for significantly more discretion in application could be preferred as a more flexible approach to assessment requirements. The limitations of this position include supporting the position of some project proponents, where the most cost-effective method of EIA is preferred despite the resulting avoidance of complex assessments.[164] It is not that the Otways Marine Area legislation cannot accommodate these types of impacts; instead, the results (Table 5-1 and Appendix A) evidence the need for more direction and certainty.

3.3 Considering environmental change

The legislation assessed as expressly facilitating cumulative impact assessment, is generally weak in ensuring the consideration of impacts from environmental change. As discussed in Chapter 4, research within Australia's south-east marine area (which includes the Otways Marine Area) has demonstrated the potential for detrimental cumulative and synergistic impacts that arise from interactions between environmental change, such as climate change, and anthropogenic activities.[165] The research has identified the importance of understanding

[162] Refer to Chapter 2, Table 2–1, for examples of these impacts within the marine environment.
[163] See, eg, Duinker et al, above n 151, 42.
[164] Peter N Duinker and Lorne A Greig, 'The Impotence of Cumulative Effects Assessment in Canada: Ailments and Ideas for Redeployment' (2006) 37 (2) *Environmental Management* 153, 156. Refer to the discussion in Chapter 3, section 2.1.
[165] See, eg, Thomas Wernberg et al, 'Impacts of climate change in a global hotspot for temperate marine biodiversity and ocean warming' (2011) 400 *Journal of Experimental Marine Biology and Ecology* 7, 13; Gary P Griffith, Elizabeth A Fulton and Anthony J Richardson, 'Effects of fishing and acidification-related benthic mortality on the southeast Australian marine ecosystem' (2011) 17 *Global Change Biology* 3058, 3059, 3065 – 3073.

cumulative and synergistic impacts.[166]

Data gathered about cumulative and synergistic impacts may be insufficient without legislative objectives, or particular requirements for assessment provisions that enable the consideration of environmental change impacts in addition to those from anthropogenic activities. For example, the *Petroleum and Geothermal Energy Act 2000* (SA) provision applicable to cumulative impact considerations neglects the potential interactions between impacts from offshore petroleum and environmental change.[167] Further, whilst the objectives of this Act include 'to minimise environmental damage', the focus is restricted to minimisation from petroleum and other activities related to the Act, and does not appear to support additional considerations.[168]

In contrast, the *Marine Parks Act 2007* (SA) provides an example of the way legislation can specifically incorporate the need to consider environmental change within the marine environment alongside anthropogenic activities. This occurs through inclusion of an objective focused to 'assist in – the adaptation to the impacts of climate change in the marine environment'.[169] In providing for cumulative impact consideration in the 'duty of care' context,[170] combined with the applicable objectives, the *Marine Parks Act 2007* (SA) demonstrates that the consideration of cumulative impacts should address the environmental harm caused by both environmental change and anthropogenic activities.

The *Wildlife (Marine Mammals) Regulations 2009* (Vic) does not expressly require the assessment of environmental change.[171] However, it is a purpose of the *Wildlife Act 1975* (Vic) governing the Regulations to 'protect and conserve' wildlife.[172] It could be argued that this purpose facilitates the consideration of issues relating to environmental change. A similar approach can be found in the relationship between the cumulative impact assessment provisions in the *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth),[173] and the *EPBC Act 1999* (Cth) as the parent Act. The Act includes objectives to facilitate environmental protection and ecologically sustainable development.[174]

When the provisions are considered together, objectives capable of supporting the

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[166] Wernberg et al, above n 165, 12.
[167] Section 98(4).
[168] *Petroleum and Geothermal Energy Act 2000* (SA) s 3(d).
[169] Section 8(1)(b)(ii).
[170] Section 37(2)(f).
[171] Regulation 16(14).
[172] Section 1A.
[173] Regulation 2B.01(5)(l), Schedule 5(2)(2.02)(d), Schedule 6(2)(2.02)(e).
[174] *Environment Protection and Biodiversity Conservation Act 1999* (Cth) s 3(1).

consideration of environmental change alongside anthropogenic activity impacts can also be found within other Acts that facilitate cumulative impact consideration. The *Natural Resource Management Act 2004* (SA),[175] and the *Development Act 1993* (SA)[176] are two such examples. The *Heritage Act 1995* (Vic), however, provides an example of a less specific connection between the cumulative impact provision, assessment of environmental change, and the objectives. The *Heritage Act 1995* (Vic) could be construed as providing for the management of World Heritage values that are natural. This interpretation is based on the Act containing a definition that 'world heritage values' have the same meaning as the *EPBC Act 1999* (Cth) (which includes natural values).[177] Contradicting this, however, is the purpose of the *Heritage Act 1995* (Vic) which focuses solely on the protection of places of cultural significance.[178] In this respect the relationship between the *Heritage Act 1995* (Vic) provisions for cumulative impact assessment[179] and the objectives does not appear to support the consideration of environmental change. This occurs even though the management plans required to include cumulative impact considerations must be prepared in a way that supports 'World Heritage values'.

The suite of legislation that enables the National Environment Protection Council and national environment protection measures is also limited within the objectives. Instead of seeking to protect the environment directly, these Acts seek to protect people from the detrimental impact of pollution.[180] This is another example where the relationship between the objectives and the relevant provisions for considering cumulative impacts are constrained in the capacity for also addressing environmental change.[181]

There is inadequate provision of objectives supportive of both environmental change and anthropogenic activity consideration within the context of cumulative impacts, as well as synergistic impacts. Increased specificity and direction within the impact assessment provisions is recommended to avoid uncertainty and inconsistency of approach, should the Acts in discussion be amended to include these impact types. Considering this, the following section

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[175] Section 9(2)(g) and Section 7.
[176] Section 46(1a) and Section 3(c).
[177] See, eg, *Heritage Act 1995* (Vic) s 3; *Environment Protection and Biodiversity Conservation Act 1999* (Cth) s 12.
[178] Section 1.
[179] Section 62O(2)(c).
[180] *National Environment Protection Council (South Australia) Act 1995* (SA) s 3; *National Environment Protection Council (Victoria) Act 1995* (Vic) s 3; *National Environment Protection Council (Tasmania) Act 1995* (Tas) s 3; *National Environment Protection Council Act 1994* (Cth) s 3.
[181] *National Environment Protection Council (South Australia) Act 1995* (SA) Schedule 1 – Intergovernmental Agreement on the Environment Schedule 2(3)(ii); *National Environment Protection Council (Victoria) Act 1995* (Vic) Schedule – The Agreement Schedule 2(3)(ii);
National Environment Protection Council (Tasmania) Act 1995 (Tas) Schedule 1 – Intergovernmental Agreement on the Environment Schedule 2(3)(ii); *National Environment Protection Council Act 1994* (Cth) Schedule – Intergovernmental Agreement on the Environment Schedule 2(3)(ii).

examines past law reform approaches to the incorporation of cumulative and synergistic impact assessment requirements.

4. Environmental assessment law reform

Past law reform processes have raised the need to improve the attention given to cumulative impacts within legislation for general environmental assessment frameworks. In a 1994 review of Commonwealth EIA processes, recommendations were made that cumulative impact assessment be required within EIA and SEA legislative frameworks as soon as practicable.[182] Court, Wright and Guthrie commented that should the Commonwealth Government 'wish to fundamentally and extensively amend or even replace its existing EIA legislation', at that stage the *Environment Protection (Impact of Proposals) Act 1974* (Cth), then cumulative impact assessment requirements should form part of any changes or new legislation.[183] The Commonwealth enacted the *EPBC Act 1999* (Cth) several years after this report.

More recently, and prior to the assessment time point for the Otways Marine Area legislation,[184] significant environmental assessment law reform processes occurred in association with several of the Acts analysed that address general environmental assessment. The significant law reform processes focused on in this discussion are those associated with the *EPBC Act 1999* (Cth) and the *Environmental Effects Act 1978* (Vic) (*EE Act 1978* (Vic)). From a less significant perspective, law reform has also occurred in relation to the *Environmental Management and Pollution Control Act 1994* (Tas) and the *Development Act 1993* (SA). The way in which these particular law reform processes have addressed cumulative and synergistic impact assessment is detailed further below.

4.1 Tasmania and South Australia

The extent of environmental assessment process reform applicable to the marine environment in Tasmania prior to 2015 was less significant than that occurring for the Commonwealth and Victoria (discussed in sections 4.2 and 4.3 below). A number of amendments to the *Environmental Management and Pollution Control Act 1994* (Tas) were made in 2012.[185] These changes occurred after a selective consultative process,[186] and the final amendments

[182] Court, Wright and Guthrie, above n 115, 8.3 – 8.4 (Recommendations 8.1.2 and 8.1.3).
[183] Ibid, 8.10 – 8.11 (Recommendations 8.3.1).
[184] June 2015.
[185] *Environmental Management and Pollution Control Amendment Act 2012* (Tas).
[186] Steve Howett, *Fact Sheet: Environmental Management and Pollution Control Amendment Bill 2012* (Environment Protection Authority Tas, 2012) <http//:www.epa.tas.gov.au/documents/empca_amendment_2012_fact_sheet.pdf> .

focused on changes to both administrative and enforcement elements of the Act.[187] The amendments did not incorporate any reference to cumulative or synergistic impacts into the Act.[188]

The *Development Act 1993* (SA), as discussed earlier, contains a discretionary requirement to consider cumulative impacts when assessing major projects.[189] From within the South Australian legislation reviewed, the *Development Act 1993* (SA) has been considered as part of a recent planning reform process.[190] The Expert Panel on Planning Reform released a report in December 2014,[191] and the South Australian Government responded to the report in March 2015.[192] The objectives of this reform focus on land use planning and development approval processes[193] and do not discuss the marine environment. Whilst the Expert Panel on Planning Reform's report did not mention cumulative or synergistic impacts, it is noted that the recommendations include reference to ensuring consistency of approach with Commonwealth law.[194]

The South Australian Government's final report made a sole reference to cumulative impacts within the context of giving 'additional consideration' to these impact types and 'climate change impacts' (environmental change) when drafting legislative amendments.[195] Should such changes occur within the *Development Act 1993* (SA) framework and operation, it is anticipated that this would be applicable to a marine area such as the Otways Marine Area.[196] No reference to synergistic impacts was made.

4.2 Commonwealth law reform: *Environment Protection and Biodiversity Conservation Act 1999 (Cth)*

The Commonwealth Government's *EPBC Act 1999* (Cth) is required to be reviewed every ten

[187] Howett, above n 187.
[188] *Environmental Management and Pollution Control Act 1994* (Tas).
[189] Section 46(1a).
[190] South Australia's Expert Panel on Planning Reform, *The Planning System We Want*, (Government of South Australia, 2014) Appendix 1.
[191] South Australia's Expert Panel on Planning Reform, above n 190.
[192] Government of South Australia, *Transforming our Planning System: Response of the South Australian Government to the final report and recommendations of the Expert Panel on Planning Reform* (Government of South Australia, 2015).
[193] South Australia's Expert Panel on Planning Reform, above n 190, Appendix 1.
[194] Ibid, Reform 12.5.
[195] Government of South Australia, above n 192, 11.
[196] Currency update: It is noted that the *Development Act 1993* (SA) has been partially repealed since the commencement of the *Planning, Development and Infrastructure Act 2016* (SA) on 1st April 2017. The *Planning, Development and Infrastructure Act 2016* (SA) contains provisions that would enable a broader consideration of cumulative impacts within the decision-making framework. See, eg, s 14(a)(ii).

years.[197] In 2008 the most recent review process was commenced.[198]

In March 2009, criticism about inadequate requirements for the consideration and assessments of cumulative impacts was acknowledged in the Senate, Standing committee on the Environment, Communications and the Arts, *The operation of the Environment Protection and Biodiversity Conservation Act 1999 First Report* (EPBC Senate Report).[199] The EPBC Senate report discussed that the consideration of these impact types was implied within the SEA processes provided for under section 10 the *EPBC Act 1999* (Cth).[200] The recommendations within this report included that the *EPBC Act 1999* (Cth) be amended to include requirements for the consideration of both cumulative and indirect impacts, as well as the provision of guidelines for assessment methods.[201] The criticism within this report extended to Australia's responsibilities relating to international environmental law,[202] and suggested that the duties to international conventions such as the *Convention on Wetlands of International Importance, 1971* and the *Convention concerning the Protection of the World Cultural and Natural Heritage, 1972* were being undermined.[203] This criticism is emphasised because, as discussed in section 2.1 (of this chapter), the *EPBC Act 1999* (Cth) provides direct reference to cumulative impact consideration in association with the management of Ramsar wetlands and World Heritage Areas.

In October 2009, the *Report of the Independent Review of the Environment Protection and Biodiversity Conservation Act 1999* (EPBC Review) was provided to the Federal Government.[204] The EPBC Review provided an independent review of the *EPBC Act 1999* (Cth) pursuant to the statutory review requirements.[205] The EPBC Senate Report was conducted as a separate parliamentary (internal) review, with the outcomes referred to the independent reviewer, Dr Hawke, for consideration.[206]

The EPBC Review includes discussions around a lack of consideration given to cumulative

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[197] *Environment Protection and Biodiversity Conservation Act 1999* (Cth), s522A.
[198] Australian Government Department of the Environment, *Independent review of the Environment Protection and Biodiversity Conservation Act 1999* <http//:www.environment.gov.au/legislation/environment-protection-and-biodiversity-conservation-act/epbc-review-2008>.
[199] The Senate, Standing Committee on the Environment, Communications and the Arts, Parliament of Australia, *The operation of the Environment Protection and Biodiversity Conservation Act 1999 First Report* (March 2009) 23, 101.
[200] The Senate, Standing Committee on the Environment, Communications and the Arts, above n 199, 48, 101.
[201] Ibid, 103.
[202] Ibid, 98.
[203] Ibid.
[204] Allan Hawke, *The Australian Environment Act - Report of the Independent Review of the Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth of Australia, 2009).
[205] *Environment Protection and Biodiversity Conservation Act 1999* (Cth), s522A.
[206] The Senate, Standing Committee on the Environment, Communications and the Arts, above n 199, 7.

impacts within the *EPBC Act 1999* (Cth) environmental assessment and approval processes.[207] Applicable to the marine environment, the concern extends to the current tests relating to the determination of a 'significant impact',[208] biodiversity management and protection,[209] as well as the general management of marine areas and fisheries.[210]

Other examples where cumulative impacts are addressed include within discussion about the determination of 'significant adverse impacts' on 'ecosystems of national significance'; with the United Nations Food and Agriculture Organization (FAO) *International Guidelines for the Management of Deep-Sea Fisheries in the High Seas: Annex F of the Report of the Technical Consultation on International Guidelines for the Management of Deep Sea Fisheries in the High Seas (2008)* (FAO guidelines) referenced by the EPBC Review as a guiding document.[211] The EPBC Review quotes the FAO guidelines which state that cumulative impact assessment should occur as part of this process.[212]

The EPBC Review suggests that cumulative impacts are best assessed within SEA and that the *EPBC Act 1999* (Cth) should support increased incorporation within the SEA and bio-regional planning frameworks.[213] Even though attention is given to cumulative impacts within the EPBC Review's discussion, there is no direct reference to the need to improve the consideration of these impacts within the final recommendations.[214]

Neither the EPBC Senate Report nor the EPBC Review included reference to the term synergistic impacts. The 2011 *Australian Government Response to the Senate Standing Committee on Environment, Communications and the Arts Committee Report: Operations of the Environment Protection and Biodiversity Conservation Act 1999 (First, Second and Final Reports)* contained no reference to cumulative or synergistic impacts.[215]

In August 2011 the Australian Government provided a response to the EPBC Review.[216] This

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[207] Ibid, 10, 54, 78, 156, 160, 174.
[208] Ibid, 160, 174.
[209] See, eg, Hawke, above n 204, 100, 123.
[210] Hawke, above n 204, 215.
[211] Food and Agricultural Organisation of the United Nations (FAO) *International Guidelines for the Management of Deep-Sea Fisheries in the High Seas: Annex F of the Report of the Technical Consultation on International Guidelines for the Management of Deep Sea Fisheries in the High Seas* (2008) cited in Hawke, above n 204, 106.
[212] Food and Agricultural Organisation of the United Nations (FAO) cited in Hawke, above n 204, 106.
[213] See, eg, Hawke, above n 204, 78, 80, 83, 116, 156, 158 and 215.
[214] Ibid, Part 1 - Recommendations.
[215] Australian Government, *Australian Government Response to the Senate Standing Committee on Environment, Communications and the Arts Committee Report: Operations of the Environment Protection and Biodiversity Conservation Act 1999 (First, Second and Final Reports)* (Commonwealth of Australia, September 2011).
[216] Department of Sustainability, Environment, Water, Population and Communities, *Australian Government Response to the Report of the Independent Review of the Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth of Australia, 2011).

response provided support for an increased focus on ‘whole of ecosystem’[217] approaches that incorporate cumulative impact assessment within strategic planning frameworks; particularly within integrated and regional planning.[218] The report details that support for this approach was underpinned by the outcomes of the August 2011 Council of Australian Government’s (COAG) meeting as part of the intention to undertake substantial reform at all government levels.[219] Synergistic impacts are not discussed within the Australian Government response.

In 2012 and 2013, the then Australian Labor Government anticipated the introduction of the *Environment Protection and Biodiversity Conservation Amendment Bill*.[220] This Bill was intended to effect the Australian Government response to the EPBC Review.[221] Since the change of government to Coalition Liberal/National Party control, prior to the 2013 spring sitting of Federal parliament, no further amendments to the *EPBC Act 1999* (Cth) have been proposed by the Government that would enable increased requirements for the assessment of cumulative or synergistic impacts.[222]

4.3 Victorian law reform: *Environmental Effects Act 1978* (Vic)

In 2011, the Victorian Parliament’s Environment and Natural Resources Committee delivered the *Inquiry into the Environmental Effects Statement Process in Victoria* (EES Inquiry Report).[223] The EES Inquiry Report applies the same definition for cumulative impacts as provided for in the *Ministerial Guidelines for Assessment of environmental effects under the Environment Effects Act 1978 (Vic)*.[224] There is no reference to synergistic impacts within this report.

As a ‘key issue’ identified within submissions and public hearings, the EES Inquiry Report

[217] Department of Sustainability, Environment, Water, Population and Communities, above n 216, 23.
[218] Ibid, 15 – 17, 19, 23, 25.
[219] Department of Sustainability, Environment, Water, Population and Communities, above n 216, 16; Council of Australian Governments, *Council of Australian Governments Meeting Canberra 19 August 2011 Communique* <http://www.coag.gov.au/coag_meeting_outcome/2011-08-19/index.cfm> 3.
[220] See, eg, Australian Government Department of the Prime Minister and Cabinet, *Legislation Proposed for Introduction in the 2012 Winter Sittings* (2012) 8; Australian Government Department of the Prime Minister and Cabinet, *Legislation Proposed for Introduction in the 2013 Autumn Sittings* (2013) 9.
[221] Australian Government Department of the Prime Minister and Cabinet (2012), above n 220, 8; Australian Government Department of the Prime Minister and Cabinet (2013), above n 220, 9.
[222] Information correct as of July 2015.
[223] Environment and Natural Resources Committee, Parliament of Victoria, *Inquiry into the Environmental Effects Statement Process in Victoria* (2011).
[224] Department of Sustainability and Environment (2006, 7th ed) cited in Environment and Natural Resources Committee, Parliament of Victoria, above n 223, 228; Victorian Government Department of Sustainability and Environment, above n 30, 18.

noted that there was a need for assessment of cumulative impacts at the SEA stage.[225] The report also referenced expert analysis of environmental assessment approaches to support the position that assessment within SEA is preferred as EIA appears to be an inadequate mechanism.[226] The Federal Government's preferred approach to incorporating cumulative impacts within SEA was also identified.[227]

Other matters raised in submissions and public hearings included emphasis on the assessment of cumulative impacts as being critical to EIA,[228] and the need for legislation to address these impact types from both the temporal and spatial perspective.[229] The complexity of assessing cumulative impacts within the EIA framework for individual projects was also raised due to knowledge limitations about 'environmental values' and the general impacts from other proposed and existing activities.[230] Other concerns about the effective use of cumulative impact assessment within EIA focused on the possibility of unexpectedly reaching environmental thresholds and having to inform project proponents that there is no more environmental capacity for additional approvals.[231] The EES Inquiry Report identified information from public hearing submissions that SEA was an appropriate tool to assist in avoiding such issues.[232]

Based on the evidence, the Committee concluded that SEA was useful for identifying

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[225] See, eg, Environment and Natural Resources Committee, Parliament of Victoria, above n 223, xxi, 4, 213, 225; Department of Planning and Community Development (correspondence, 2010) cited in Environment and Natural Resources Committee, Parliament of Victoria, above n 223, 219.

[226] B Noble and G Harriman Gunn in K S Hanna (ed) (2009) cited in Environment and Natural Resources Committee, Parliament of Victoria, above n 223, 214; International Institute for Environment and Development (1999) cited in Environment and Natural Resources Committee, Parliament of Victoria, above n 223, 214, 216; M Elliot and I Thomas (2009) cited in Environment and Natural Resources Committee, Parliament of Victoria, above n 223, 216.

[227] Department of Sustainability, Environment, Water, Population and Communities (September 2010) cited in Environment and Natural Resources Committee, Parliament of Victoria, above n 223, 219.

[228] Mr P Gamblin (public hearing transcript of evidence) quoted in Environment and Natural Resources Committee, Parliament of Victoria, above n 223, 228.

[229] Professor L Godden (public hearing transcript of evidence) quoted in Environment and Natural Resources Committee, Parliament of Victoria, above n 223, 228.

[230] Department of Sustainability and Environment (2006, 7th ed) cited in Environment and Natural Resources Committee, Parliament of Victoria, above n 223, 229; Victorian Government Department of Sustainability and Environment, above n 30, 18.

[231] Associate Professor G Middle (public hearing transcript of evidence) quoted in Environment and Natural Resources Committee, Parliament of Victoria, *Inquiry into the Environmental Effects Statement Process in Victoria September* (2011), above n 223, 228 – 229.

[232] Mr P Vestergen (public hearing transcript of evidence) quoted in Environment and Natural Resources Committee, Parliament of Victoria, above n 223, 229; Ms N Rivers (public hearing transcript of evidence) Environment and Natural Resources Committee, Parliament of Victoria, above n 223, 229; Dr A Morrison-Saunders (public hearing transcript of evidence) Environment and Natural Resources Committee, Parliament of Victoria, above n 223, 229; Professor L Godden, (public hearing transcript of evidence) Environment and Natural Resources Committee, Parliament of Victoria, above n 223, 229; Associate Professor G Middle (public hearing transcript of evidence) Environment and Natural Resources Committee, Parliament of Victoria, above n 223, 229; Mr A Macintosh (public hearing transcript of evidence) Environment and Natural Resources Committee, Parliament of Victoria, above, n 223, 229; Environment Victoria (submission no. 39) cited in Environment and Natural Resources Committee, Parliament of Victoria, above n 223, 229; Environment and Natural Resources Committee, Parliament of Victoria, above n 223, 230.

significant cumulative impacts.[233] However, it was also acknowledged within the EES Inquiry Report that the *EE Act 1978* (Vic) failed to provide a suitable framework for SEA.[234] In comparison, it was noted that Western Australia's *Environmental Protection Act 1986* (WA) provided an example of SEA method within the Act's environmental assessment framework.[235]

The Victorian Government responded to the EES Inquiry Report in March 2012.[236] Whilst the response acknowledges recommendations about the need for reform of the environmental effects statement processes, there is no mention of the need to improve the approach to cumulative impact assessment.[237] Since the release of this response there have been no amendments to the *EE Act 1978* (Vic) that enable legislative requirements for the assessment of cumulative or synergistic impacts.[238]

4.4 Missed opportunities

Since 2009 there has been opportunity for change to the legislation discussed. As demonstrated, however, there have not been any significant changes, even though the motivation to amend the legislation to increase cumulative impact consideration has been acknowledged. Although there have been Commonwealth and Victorian recommendations to increase the role of cumulative impact assessment within SEA, any subsequent opportunities to amend legislation have not been taken. Further, as discussed and concluded in Chapters 2 and 3 of this thesis, synergistic impacts should be identified as a distinct type of impact from cumulative impacts and should also be considered within environmental assessment processes. The absence of acknowledgement that synergistic impacts are distinct, is another missed opportunity within the reform process.

Focusing on the elements required to ensure successful SEA, the EES Inquiry Report discussed the need for: good knowledge bases and data;[239] sufficient economic resources to achieve the

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233 Environment and Natural Resources Committee, Parliament of Victoria, above, n 223, 235.
234 Ibid, 217; Victorian Government (submission no. 40) cited in Environment and Natural Resources Committee, Parliament of Victoria, above n 223, 217; The *Planning and Environment Act 1987* (Vic) was also mentioned; however, this Act does not apply to Victorian jurisdictional areas below low water mark.
235 Environment and Natural Resources Committee, Parliament of Victoria, above n 223, 99, 102, 222. For an evaluation of the approach to SEA within the Act as of April 2015 refer to Chapter 4, section 3.1.1.
236 Victorian Government, *Government Response to the ENRC Inquiry into the Environmental Effects Statement Process in Victoria* (1 March 2012) <http//:www.parliament.vic.gov.au/images/stories/committees/enrc/EES/Govt_Response_to_the_ENRC_Inquiry_into_the_Environment_Effects_Statement_Process_in_Victoria_1_March_2012.pdf>.
237 Victorian Government, above n 236.
238 Information correct as of July 2015.
239 Mr P Vestergen (public hearing transcript of evidence) quoted in Environment and Natural Resources Committee, Parliament of Victoria, above n 223, 233.

required level of base information;[240] and identified environmental values and existing conditions.[241] A challenge for effective SEA identified within the discussion included the need for continual update of knowledge and a flexible framework that enables response to environmental change.[242] Another challenge was raised in the question of whether SEA method is adequate to provide the level of information needed to apply conditions to individual projects.[243] As also commented upon, the challenges must be addressed if EIA for individual project approvals are to become exempt after an SEA has been undertaken.[244]

The requirements for successful SEA, as well as the challenges associated with SEA, are relevant to the effective assessment of cumulative and synergistic impacts. The potential for environmental change and impacts from anthropogenic activities to become more apparent over long time frames is particularly relevant to this. However, as discussed in Chapter 3, the assessment of cumulative and synergistic impacts, whilst important within the context of SEA, should not be neglected within EIA frameworks.[245] Instead, the capacity of EIA to effectively assess cumulative and synergistic impacts should also be improved. The focus of the Commonwealth and Victorian environmental assessment law reform processes, should they progress to legislative amendments, should seek to incorporate improved capacity within both the SEA and EIA frameworks for both cumulative and synergistic impacts.

The 2012 amendments to the *Environmental Management and Pollution Control Act 1994* (Tas) were not intended to focus on cumulative or synergistic impacts, and could be seen as a missed opportunity to address these impact types within environmental assessment. The amendment process, perhaps due to limited public consultation, could be a factor affecting this outcome. The outcomes of the South Australian law reform process, which result in changes to the operation of the *Development Act 1993* (SA), should be extended to address environmental assessment processes affecting the marine environment, as well as provide for a more significant discussion on cumulative and synergistic impacts. This is of particular concern as any legislative changes that result from the process could have a flow-on effect for legislation

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[240] Mr J Gilmore (public hearing transcript of evidence) quoted in Environment and Natural Resources Committee, Parliament of Victoria, above n 223, 233.
[241] Mr P Vestergen (public hearing transcript of evidence) quoted in Environment and Natural Resources Committee, Parliament of Victoria, above n 223, 233.
[242] Environmental Defenders Office (Victoria) (submission no. 27) quoted in Environment and Natural Resources Committee, Parliament of Victoria, above n 223, 232.
[243] Dr A Morrison - Saunders (submission no. 53) quoted in Environment and Natural Resources Committee, Parliament of Victoria, above n 223, 232.
[244] Ms Nicola Rivers (public hearing transcript of evidence) quoted in Environment and Natural Resources Committee, Parliament of Victoria, above n 223, 232.
[245] See, eg. Harriman and Noble, above n 25, 44 – 46; Therivel and Ross, above n 102, 384; Lourdes M Cooper and William R Sheate, 'Integrating cumulative effects assessment into UK strategic planning: implications of the European Union SEA Directive' (2004) 22 (5) *Impact Assessment and Project Appraisal* 5, 6; Duinker and Greig, above n 164, 158; Duinker et al, above n 151, 49; Also refer to Chapter 2, section 2.2.

that operates within the marine environment.

Finally, the ineffective law reform occurring in the discussed examples, is reflected in the absence of increased requirements to consider cumulative impacts as well as the neglect of synergistic impacts within the Otways Marine Area legislation.[246]

5. Conclusion

The contribution made by this chapter includes the analysis of environmental assessment legislation applicable the Otways Marine Area and the conclusions about improving the approach to the assessment of cumulative and synergistic impacts. It is evident that provisions focused on cumulative impact assessment are minimal, and for synergistic impacts non-existent, in the Commonwealth, South Australian, Tasmanian and Victorian legislation reviewed.

The conclusions reached in relation to the provisions associated with cumulative impacts included inadequate legislative direction within the environmental assessment context as well as ambiguity due to the absence of definitions. Appropriate definitions will enable a distinction between cumulative and synergistic impacts. In addition, adequate definitions are able to provide for legislation specific parameters that support the objectives of a particular Act. In contrast, when the absence of legislative direction intended to guide the application of cumulative and synergistic impact assessment occurs, the risk exists of inconsistency in application of the legislation. This is further emphasised when the provisions are discretionary rather than mandatory. Inconsistency in the scientific methods of assessment for cumulative and synergistic impacts within environmental assessments, such as SEA and EIA, is also highlighted within the analysis and discussions.

The case study analysis of the terms ‘indirect’ ‘significant’, ‘adverse’, ‘impact’ and ‘effect’, emphasised a number of limitations for the use of these terms as substitutes for cumulative or synergistic impacts. The potential concerns include ambiguous intention and inadequate application associated with the use of ‘indirect’, as well as a neglect of ‘direct’ cumulative and/ or synergistic impacts if the term was to be relied upon. For the use of ‘significant’, in addition to similar concerns about inadequate clarity, due to the need for cumulative or synergistic impacts to be of a certain magnitude before they are included in environmental assessments,

[246] As of June 2015.

smaller impacts are neglected. This limited approach may undermine the ability to prevent cumulative and synergistic impacts before they cause a level of unreasonable environmental detriment.

The analysis undertaken also enables an interpretation that the use of ‘adverse’ within legislative provisions does not provide sufficient clarity about the impact types needing to be assessed. This is similar to the use of the general terms, ‘impact’ and ‘effect’ (as stand-alone terms). The broad-based approach of general terms, combined with greater prevalence of requirements for the assessment of environmental impacts within the legislation reviewed, increases the risks of inconsistency in application and methodology if relied upon for cumulative and synergistic impact assessment requirements.

Overall, it is concluded that alternative terminology should not be relied upon to facilitate cumulative and synergistic impact assessment. Instead, when the assessment of these impact types is required, requirements should be specific and supported by adequate definitions.

For the future consideration of law reform for legislation applicable to the Otways Marine Area, there should be progression of the law reform discussions[247] about the role of cumulative impact assessments within SEA for both the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) and the *Environment Effects Act 1978* (Vic). This progression should not only focus on the legislation central to the reviews and government responses discussed in section 4 of this chapter, but should also extend to (where appropriate) the remainder of the legislation assessed and applicable to the Otways Marine Area. Further, not only should these Acts be amended to address cumulative impacts and provide definitions within the SEA context, they should also incorporate and distinguish synergistic impacts, and improve upon requirements and definitions for both cumulative and synergistic impact assessments within EIA. Making changes at both Federal (Commonwealth jurisdiction) and State (Victoria, South Australia and Tasmanian jurisdictions) government levels should be achieved in a way that enables a balance between consistency in approach between governments and levels of government, whilst responding to the specific requirements of the Otways Marine Area environment. Integral to achieving area specific responses, the different Acts, whether industry specific, general environmental assessment, or marine species and area protection focused, should facilitate the assessment of cumulative and synergistic impacts not just of the anthropogenic activity being regulated, but also in a way that enables consideration

[247] See, eg, Hawke, above n 204; Department of Sustainability, Environment, Water, Population and Communities, above n 216; Environment and Natural Resources Committee, Parliament of Victoria, above n 223; Victorian Government, above n 236.

of other proposed or existing activities within a region. Requirements to assess the interactions from environmental change should also be included.

If the legislative approach is adjusted to enable a more precautionary, proactive and directed assessment of cumulative and synergistic impacts within environmental assessment, there will be further opportunities for the development of assessment methods for cumulative and synergistic impacts, as well as greater consistency in application. In contrast, if express requirements to consider these impact types remain limited within legislation, cumulative and synergistic impacts may remain difficult to assess within environmental assessment and related decision-making processes. The potential for inconsistencies within an EIA decision-making process when there are inadequate requirements for cumulative and synergistic impact assessment is established within legislation is explored further in Chapter 6 in relation to the *Environmental Effects Act 1978* (Vic) and Victoria's Port Phillip Bay Channel Deepening Project.

CHAPTER 6: VICTORIA'S PORT PHILLIP BAY CHANNEL DEEPENING PROJECT

'Practitioners of CEA can produce a more valuable tool if they concentrate on developing reliable predictions based on factual evidence and leave the final evaluation of those predictions to the decision makers. Decision makers need to hear what will or may happen. They have to decide whether or not it is acceptable. The task for CEA practitioners is educational and it is not going to be performed successfully by those making claims that cannot be substantiated and are unlikely to be borne out by the future state of the environment.'[1]

Chapter outline

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[1] George Hegmann and G A (Tony) Yarranton, 'Alchemy to reason: Effective use of Cumulative Effects Assessment in resource management', (2011) 31 *Environmental Impact Assessment Review* 484, 488.

1. Introduction

The focus of this case study is the Victorian EIA process required for the assessment of the Channel Deepening Project (CDP), and the reporting of post-approval monitoring. The approach to cumulative and synergistic impact assessment within these processes is analysed. The potential shortcomings in the approach to cumulative and synergistic impact assessment, are examined together with the potential for remedy through the use of explicit legal requirements and clearer definitions.[2]

In 2007 the Victorian Government approved the deepening of the shipping channel in Port Phillip Bay.[3] Dredging commenced in early 2008 and was completed at the end of 2009, with the extent of dredged material amounting to 22.9 million cubic metres.[4] Monitoring of the dredging impacts across Port Phillip Bay was required during works and after completion until May 2012.[5] As an example, these monitoring programmes focused on turbidity and underwater noise.[6] Further selective monitoring programmes required until 2019 focused on other aspects, including bathymetric surveys.[7]

Approval for the CDP was required under the *Coastal Management Act 1995* (Vic).[8] The associated environmental impact assessment (EIA) process was governed by the *Environment Effects Act 1978* (Vic).[9] At the Commonwealth government level approval was required under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (*EPBC Act 1999* (Cth)).[10] This was because of the potential for significant impacts on 'wetlands of international importance',[11] 'listed threatened species and communities',[12] 'listed migratory species',[13] and

[2] Refer to Chapter 2, sections 2, 3 and 4 and Chapter 3, section 2 for detailed discussion on these issues.
[3] Office of the Environmental Monitor, *Channel Deepening Project Closeout of Environmental Approvals – June 2012* (Victorian Government Office of the Environmental Monitor, 2012) 5.
[4] Ibid, 5.
[5] Ibid, 4.
[6] Ibid, 9.
[7] Ibid, 8.
[8] Section 40. This section was applicable from the commencement of the Act. Also see Brad Jessup, 'The Port Phillip Channel Deepening Project and Environmental Law: A model for ecologically sustainable development?' in Warwick Gullett, Clive Schofield and Joanna Vince, *Marine Resources Management* (LexisNexis Butterworths, 2011) 297, 304.
[9] *Environmental Effects Act 1987* (Vic), s 37; also see Jessup, above n 8, 304.
[10] See, eg, Chapter 2 pt 3 Requirements for Approvals, Chapter 4, Environmental assessments and approvals. As per the version of the legislation applicable from the 2nd July 2007 until July 2008.
[11] Commonwealth of Australia, *Environment Protection and Biodiversity Conservation Act 1999 Decision whether action needs approval*, (20 March 2002) <http://www.epbcnotices.environment.gov.au/_entity/annotation/dbd16693-b668-e511-b934f-005056ba00a7/a71d58ad-4cba-48b6-8dab-f3091fc31cd5?t=1538855162978> ; Also see *Environment Protection and Biodiversity Conservation Act 1999* (Cth) ss 16, 17B.
[12] Commonwealth of Australia, above n 11; Also see *Environment Protection and Biodiversity Conservation Act 1999* (Cth) ss 18, 18A.
[13] Commonwealth of Australia, above n 11; Also see *Environment Protection and Biodiversity Conservation Act 1999* (Cth) ss 20, 20A.

‘protection of the environment from actions involving Commonwealth land’.[14] The ‘Environmental Effects Statement’ required by the *Environment Effects Act 1978* (Vic) was identified as the accredited EIA process.[15]

The EIA process for the CDP commenced in 2002, and the environmental effects statement (EES) was completed by the Port of Melbourne Corporation (as the project proponent) in 2004.[16] After a review of the EES and public submissions, the Panel of Inquiry identified to the Minister for Planning (the Minister) that significant additional assessment work needed to be undertaken before recommendations could be made.[17] To address the additional assessment requirements, the Port of Melbourne Corporation was then instructed by the Minister to undertake a Supplementary Environmental Effects Statement (SEES).[18] The guidelines for the SEES content and process were issued by the Minister in late 2005.[19] After commencing the SEES process, agreement was reached between the Victorian Government and the Port of Melbourne Corporation that the SEES would replace the original EES, and be assessed as ‘stand-alone’ documentation.[20]

The documents reviewed for this case study were publicly available at the time of the assessment and monitoring processes, and comprise: legislation; ministerial guidelines; environmental assessment reports; independent panel reports; ministerial assessments; management plans; and post-approval monitoring reports. The second section of this chapter analyses the approach to cumulative and synergistic impact assessment within the *Environment*

[14] Commonwealth of Australia, above n 11; Also see *Environment Protection and Biodiversity Conservation Act 1999* (Cth) ss 26, 27A.
[15] Commonwealth of Australia, *Environment Protection and Biodiversity Conservation Act 1999 Decision on Assessment Approach*, (21 May 2002) <http://www.environment.gov.au/cgi-bin/epbc/epbc_app.pl?name=current_referral_detail&proposal_id=576>.
[16] Department of Transport, Planning and Local Infrastructure, *Port Phillip Bay Channel deepening proposal* (7 October 2014) <http://www.dpli.vic.gov.au/planning/environmental-assessment/projects/port-phillip-bay-channel-deepening-proposal>.
[17] See, Rynd Smith et al, *Port Phillip Bay Channel Deepening Environmental Effects Statement Volume 1 Panel Report* (11 February 2005) <http://www.dtpli.vic.gov.au/_data/assets/pdf_file/0007/233584/EES_Channel_Deepening_Panel_Inquiry_Table_of_Contents.pdf>, <http://www.dtpli.vic.gov.au/_data/assets/pdf_file/0007/233584/EES_Channel_Deepening_Panel_Inquiry_Exec_Summary.pdf>; <http://www.dtpli.vic.gov.au/_data/assets/pdf_file/0007/233584/EES_Channel_Deepening_Panel_Inquiry_Report_-_Body.pdf>; <http://www.dtpli.vic.gov.au/_data/assets/pdf_file/0007/233584/EES_Channel_Deepening_Panel_Inquiry_Report_-_Conclusions.pdf>; Minister for Planning, Government of Victoria, *Statement by the Minister for Planning: Current Status of assessment process under the Environment Effects Act 1978 for the proposed Port Phillip Bay Channel Deepening Project* (Victorian Government, 2005) 2-3.
[18] Minister for Planning, Government of Victoria, *Minister’s Statement Port Phillip Bay Channel Deepening Supplementary Environmental Effects Statement* (Victorian Government, July 2005).
[19] Minister for Planning, Government of Victoria, *Assessment Guidelines Issued by the Minister for Planning for Port Phillip Bay Channel Deepening Supplementary Environmental Effects Statement, Proponent: Port of Melbourne Corporation* (Victorian Government, October 2005).
[20] Minister for Planning, Government of Victoria, *Port Phillip Bay Channel Deepening Project Assessment under Environment Effects Act 1978*, (Victorian Government, November 2007) 12.

Effects Act 1978 (Vic), and the general and project-specific ministerial guidelines for the CDP. Other Victorian legislation applicable to the CDP includes the *Flora and Fauna Guarantee Act 1988* (Vic), *National Parks Act 1975* (Vic), and the *Fisheries Act 1995* (Vic). These Acts provide for the protection of habitats and species,[21] as well as requirements for approvals.[22] However, these Acts were not assessed as part of the analysis because they did not provide the framework for the general EIA process or the primary requirement for decision-making after the completion of the EIA process.

The third section of this chapter analyses three aspects of the approach to cumulative and synergistic impacts within the SEES:[23] the consistency of approach to the assessment of cumulative and synergistic impacts within the SEES; the predictions about cumulative and synergistic impacts; and the extent to which cumulative and synergistic impacts are addressed within the risk assessment process. The fourth section critiques the extent of consideration given to cumulative and synergistic impacts within the SEES focused Panel of Inquiry report,[24] the final ministerial assessment and recommendations,[25] and the Victorian and Federal Government approvals.[26] The fifth section addresses the requirements for the post-approval monitoring of cumulative and synergistic impacts. This is achieved through a review of the approach within the Port of Melbourne Corporation Environmental Management Plan[27] and subsequent reporting within the Office of the Environmental Monitor documentation.[28] The final section of this chapter provides the conclusion.

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[21] See, eg, *Flora and Fauna Guarantee Act 1988* (Vic), *National Parks Act 1975* (Vic).
[22] See, eg, *Fisheries Act 1995* (Vic).
[23] Port of Melbourne Corporation, *Main Volume Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007a); Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b).
[24] Dr Allan Hawke, Ms Kathryn Mitchell and Dr Mike Lisle-Williams, *Environment Effects Act 1978 Port Phillip Bay Channel Deepening Supplementary Environmental Effects Statement Report of the Inquiry* (1st October 2007) (2007a); Dr Allan Hawke, Ms Kathryn Mitchell and Dr Mike Lisle-Williams, *Environment Effects Act 1978 Port Phillip Bay Channel Deepening Supplementary Environmental Effects Statement Appendix to the Report of the Inquiry Environmental Assessment Report* (1st October 2007) (2007b).
[25] Minister for Planning, Government of Victoria, above n 20.
[26] Minister for the Environment and Climate Change, Government of Victoria, *Section 40 Coastal Management Act 1995 Consent for Use and Development of Coastal Crown Land* (14th December 2007); Australian Government Department of the Environment, Water, Heritage and the Arts, *Approval Port Phillip Bay Channel Deepening (EPBC 2002/576)*, (20 December 2007) <http://www.environment.gov.au/epbc/notices/assessments/2002/576/approval-decision.pdf>;
Australian Government Department of the Environment, Water, Heritage and the Arts, *Notification of Variation to Approval Decision*, (3 July 2008) <http://www.environment.gov.au/cgi-bin/epbc/epbc_app.pl?name=current_referral_detail&proposal_id=576>.
[27] See, eg, Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan SEMSO5-08 Rev 12* (Port of Melbourne Corporation, 17/5/2011).
[28] See, eg, Office of the Environmental Monitor, *Annual Review No. 1 – March 2009, Reporting period: 8 February 2008 to 31 March 2009* (Victorian Government Office of the Environmental Monitor, 2009); Office of the Environmental Monitor, *Annual Review No. 4 – January 2012, Reporting period: 1 January to 31 December 2011* (Victorian Government Office of the Environmental Monitor, 2012); Office of the Environmental Monitor (2012), above n 3.

As evidenced in discussion within Chapter 2, cumulative and synergistic impacts are different and should be defined separately. When legislation is referenced, for the purpose of this chapter 'cumulative' and 'synergistic' impacts are identified as distinct impact types and reference to one impact type does not include reference to the other. This is the same as the approach taken in Chapters 4 and 5. However, as with the approach in Chapters 3, 4 and 5 to discussion within literature, the term 'cumulative (and synergistic)' is used when it is anticipated that the references used assumed synergistic impacts to be included as a type of cumulative impact.

2. Victoria's environmental effects assessment process: Assessment requirements for cumulative and synergistic impacts

This section analyses the Victorian legal requirements, as well as the general and project specific guidelines for the preparation of the Victorian Channel Deepening Project SEES. The discussion also addresses the focus on the original EES and subsequent recommendations for an improved assessment process as contained within the *Port Phillip Bay Channel Deepening Environmental Effects Statement Panel Report*[29] (Channel Deepening EES Panel Report). The analysis, and subsequent interpretation of information, focuses on the approach to requiring cumulative and/or synergistic impact assessment, and the mandatory or discretionary nature of these requirements.

2.1 *Environment Effects Act 1978* (Vic) and Ministerial guidelines

The *Environment Effects Act 1978* (Vic) (the Act) does not include any express requirement to include cumulative and/or synergistic impact assessment within either EESs or SEESs. During the time in which assessments and decisions were made (2002 – 2007) the Act was applicable to public works that could have a 'significant effect' on the environment.[30] The potential for significant[31] environmental impacts from the proposed CDP was the trigger for requiring an environmental effects statement.[32] Whilst there was no definition of 'significance' associated with EIA within the Act at the time of the CDP,[33] as established in Chapter 5,[34] the term is capable of incorporating reference to 'significant' cumulative and/or synergistic impacts. As also discussed in Chapter 5, the use of this term without express reference to cumulative and

[29] Smith et al, above n 17.
[30] *Environment Effects Act 1978* (Vic) s 3(2). See Versions 021 – 025.
[31] Refer to the glossary for an explanation about the use of the term 'significant' as a term to describe the measurement of an impact.
[32] See, eg, Minister for Planning, Government of Victoria, *Assessment Guidelines for the Port Phillip Bay Channel Deepening Environmental Effects Statement – Proponent: Victorian Channels Authority,* (Government of Victoria, October 2002) 1.
[33] This is still the situation.
[34] For examples, refer to the discussion in Chapter 5, sections 2.2 and 3.2.

synergistic impacts, can result in these impact types being excluded from, or missed by, an EIA process.

There are no decision making powers associated with the *Environment Effects Act 1978* (Vic). The Act provides procedural powers for requiring EESs and supplementary EESs.[35] Ministerial Guidelines providing general advice to the preparation of statements can be determined, but are not legally binding.[36] During the CDP assessment process under the Act, both the *Guidelines for Environmental Impact Assessment and the Environment Effects Act*[37] (1995 Guidelines) and the 2006 *Ministerial Guidelines for Assessing Environmental Effects under the Environment Effects Act 1978*[38] (2006 Guidelines) were applicable as general Ministerial Guidelines. Whilst the 1995 Guidelines were applicable at the time the Minister issued the 2005 *Assessment Guidelines Issued by the Minister for Planning for Port Phillip Bay Channel Deepening Supplementary Environmental Effects Statement, Proponent: Port of Melbourne Corporation*[39] (SEES Ministerial Assessment Guidelines 2005), the 2006 Guidelines were issued during the SEES preparation. The 2006 Guidelines were also referred to as applicable to the process within the Minister's final assessment and recommendations.[40]

The 1995 Guidelines provided a sole reference to significant cumulative impacts as a type of impact that should be addressed within an EES.[41] In comparison, the 2006 Guidelines referenced the assessment of cumulative impacts more often,[42] and provided a definition for 'cumulative effects', being, 'where a project, in combination with one or more other proposed projects, or existing activities in an area, may have an overall significant effect on the same environmental asset.'[43] However, this is a narrow definition because of the potential need to consider the impacts on multiple environmental assets from multiple activities, and ensure a better understanding of predicted and actual cumulative impacts. The definition is also considered narrow because of the restricted focus on anthropogenic activities, instead of addressing environmental change as well, and the limitations associated with identifying environmental impacts when only one environmental asset is the subject of an assessment. Further, as identified in the 2006 Guidelines, the extent of cumulative impact assessment required was limited by exemptions for assessments of impacts that are insignificant, difficult to

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[35] *Environment Effects Act 1978* (Vic) s 4, s 5. See Versions 021 – 025.
[36] Ibid, s 10.
[37] Department of Planning and Development, Government of Victoria, *Guidelines for Environmental Impact Assessment and the Environment Effects Act*, (Government of Victoria, 6th ed, 1995).
[38] Victorian Government Department of Sustainability and Environment, *Ministerial Guidelines for the Assessment of Environmental Effects under the Environmental Effects Act 1978* (Victorian Government, 7th ed, 2006).
[39] Minister for Planning, Government of Victoria, above n 19.
[40] Minister for Planning, Government of Victoria, above n 20, 7.
[41] Department of Planning and Development, Government of Victoria, above n 37, 7.
[42] Victorian Government Department of Sustainability and Environment, above n 38, 5, 9, 18.
[43] Ibid, 9, 18.

undertake, or for the later stages of multi-stage projects where a 'significant' cumulative impact is unlikely.[44]

Within the 2006 Guidelines there was a pre-emptive response to the potential issue of limitations on quantitative data collection and prediction, with qualitative assessments deemed acceptable.[45] The information was also recommended to be provided in a format that allowed cumulative impacts to be identified by the Minister.[46] Further, the 2006 Guidelines provided that the consideration of cumulative impacts with other existing activities in an area was limited to reasonable awareness.[47] These approaches allowed for flexibility in the extent of information required to be provided, and enabled the potential for situations where minimal information was provided and inconsistent approaches taken between different project proposals.

Synergistic impacts are not referred to in either document. The 2006 Guidelines, however, state that when identifying a 'significant effect', the 'potential for more extended adverse effects in space and time, as a result of interactions of different effects and environmental processes affecting environmental assets' is a 'factor'.[48] The 'magnitude' of adverse effects also needs to be considered.[49] Combining these two factors, an implied reference to synergistic impacts is apparent. Further, the 1995 Guidelines and the 2006 Guidelines recommended the consideration of 'indirect effects'.[50] As discussed in earlier chapters, indirect impacts can refer to both cumulative and synergistic impacts;[51] however, as with cumulative impacts in the 2006 Guidelines, limitations to significance and modelling capabilities were deemed to be acceptable reasons for limiting the extent of assessment undertaken.[52]

Finally, in both the 2006 Guidelines and 1995 Guidelines the uncertainty associated with the predicted cumulative impacts was required to be identified.[53] It could be concluded that the requirement to identify uncertainty was intended to assist with the application of the precautionary principle when the EESs were assessed within the decision-making process.

[44] Ibid, 5, 18.
[45] Ibid, 18.
[46] Ibid.
[47] Ibid, 9.
[48] Ibid, 6.
[49] Ibid.
[50] See, eg, Victorian Government Department of Sustainability and Environment, above n 38, 19; Department of Planning and Development, Government of Victoria, above n 37, 7.
[51] See, eg, the discussion in Chapter 2, section 2, Chapter 5, section 2.2.1.
[52] See, eg, Victorian Government Department of Sustainability and Environment, above n 38, 18.
[53] Ibid, 10, 19, 20; Department of Planning and Development, Government of Victoria, above n 37, 7.

2.2 The project specific guidelines

The Act provided for the Minister's ability to develop and issue project specific scoping requirements.[54] Prior to the issue of the SEES Ministerial Assessment Guidelines 2005, the Minister considered the assessment of the EES by the Panel of Inquiry in the *Port Phillip Bay Channel Deepening Environmental Effects Statement Panel Report*[55] (Channel Deepening EES Panel Report). This report identified concern, as raised by the Panel of Inquiry, about the absence of information relating to the synergistic impact of toxins within sediment.[56] Other concerns included focus on the lack of assessment for cumulative impacts relating to the effects of dredging and sediment,[57] the monitoring of noise,[58] the proposed dredging in conjunction with other similar projects,[59] as well as concerns within the risk framework methodology.[60]

All matters set out in the 2002 project specific *Assessment Guidelines for the Port Phillip Bay Channel Deepening Environmental Effects Statement – Proponent: Victorian Channels Authority*[61] (EES Ministerial Assessment Guidelines 2002) were carried forward within the SEES Ministerial Assessment Guidelines 2005. [62] This was achieved through the inclusion of a reference to the continued application.[63] In this context, within the project specific guidelines for both 2002 and 2005, reference was made to the requirement to consider cumulative impacts.[64] Synergistic impacts were not discussed. Within the project specific SEES Ministerial Assessment Guidelines 2005 there was an additional requirement to consider the cumulative effects related to nitrogen levels within Port Phillip Bay from the dredging and other co-existing impacts.[65]

Terminology within the guidelines has the potential to incorporate 'cumulative' and/or 'synergistic' impacts. This includes a discretionary requirement to consider 'indirect' impacts and 'combined' effects within the EES Ministerial Assessment Guidelines 2002.[66] There was no specific reference to 'indirect' environmental impacts within the SEES Ministerial Assessment Guidelines 2005, although the reference to 'combined' effects was repeated.[67] Further, directly related to the effects of environmental change, the 'potential combined effects of channel

[54] *Environment Effects Act 1978* (Vic) s10. See Versions 021 – 025.
[55] Smith et al, above n 17.
[56] Ibid, 128.
[57] Ibid, 196.
[58] Ibid, 262.
[59] Ibid, 351.
[60] Ibid, 64 – 67.
[61] Minister for Planning, Government of Victoria, above n 32.
[62] Minister for Planning, Government of Victoria, above n 19, 30.
[63] Ibid, 30.
[64] Ibid, 20; Minister for Planning, Government of Victoria, above n 32, 5, 13.
[65] Minister for Planning, Government of Victoria, above n 19, 32.
[66] See, eg, Minister for Planning, Government of Victoria, above n 32, 5, 8, 15.
[67] Minister for Planning, Government of Victoria, above n 19, 32.

deepening and changes in sea level due to climate changes in the future' were required to be considered.[68] The requirements to consider 'interactions', including providing models for 'system interactions',[69] information about 'ecological interactions',[70] and the effects of sediment 'interactions' with benthic organisms,[71] also provided a basis for considering cumulative and synergistic impacts that could cause environmental change in addition to the impacts of anthropogenic activities.

When the EES Ministerial Assessment Guidelines 2002 and SEES Ministerial Assessment Guidelines 2005 are compared, it could be suggested that the concerns raised in the Channel Deepening EES Panel Report were not addressed to the extent recommended. There was minimal difference in the extent of consideration required for cumulative and synergistic impacts for the EES (EES Ministerial Assessment Guidelines 2002) and the SEES (SEES Ministerial Assessment Guidelines 2005). The shortcomings were reiterated with no increase in emphasis placed on the importance of requiring the consideration of these impact types through the inclusion of the EES Ministerial Assessment Guidelines 2002 as an appendix within the SEES Ministerial Assessment Guidelines 2005.[72] Whilst the importance of including the earlier guidelines is acknowledged, an opportunity was missed to improve cumulative and synergistic impact assessment requirements.

The requirement for considering and assessing cumulative and synergistic impacts, through the use of the terms 'indirect', 'combined' and 'interactive' within the project specific guidelines, can cause inconsistency and ineffectiveness in assessment. This is evidenced by the absence of direct connection between these terms. Compared to the use of 'interactive/ interaction' and 'combined' effects, the focus on the assessment of 'indirect' impacts was more evident within the Channel Deepening EES Panel Report,[73] than the subsequent SEES Ministerial Assessment Guidelines 2005.[74] As discussed in detail within Chapter 5,[75] the potential use of alternative terms for cumulative and synergistic impacts can cause confusion. This is highlighted when public documents use terms that can have multiple meanings. Such situations can result in diminished clarity that potentially affects the level of accountability that might otherwise be anticipated for government documents. The effective collation and analysis of data at a later

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[68] Minister for Planning, Government of Victoria, above n 32, 15; Minister for Planning, Government of Victoria, above n 19, 32.
[69] Minister for Planning, Government of Victoria, above n 19, 6; Minister for Planning, Government of Victoria, above n 32, 13.
[70] Minister for Planning, Government of Victoria, above n 19, 21.
[71] Ibid, 33; Minister for Planning, Government of Victoria, above n 32, 16.
[72] Minister for Planning, Government of Victoria, above n 19, 32.
[73] Smith et al, above n 17, 27, 240, 268.
[74] Minister for Planning, Government of Victoria, above n 19, 37. This reference only occurred within the context of the EES Ministerial Assessment Guidelines 2002 being included within the appendices.
[75] Refer to the discussion in Chapter 5, sections 2.2 and 3.

stage of an assessment or monitoring process can also be hindered. This is a situation that could also cause public confusion and perceptions of inadequate transparency in decision-making processes.

As with the general Ministerial guidelines,[76] the EES Ministerial Assessment Guidelines 2002 and the SEES Ministerial Guidelines 2005 also included the need to identify uncertainty as part of the EIA process and discussion within the SEES.[77] This need to consider uncertainty focused on the capacity to accurately predict environmental impacts. This recognises that the application of the precautionary principle should occur within the decision-making process.

2.3 Discretionary approach

The language used in the legislation, general guidelines, project specific guidelines and Panel of Inquiry report recommendations is discretionary when discussing the legal status and requirements. This has implications for the extent to which cumulative and synergistic impacts are likely to be assessed, and the consistency of guidance for the assessment approach may be compromised.

As an example, the SEES Ministerial Assessment Guidelines 2005 and the incorporated EES Ministerial Assessment Guidelines 2002 both included discretionary language for the assessment of cumulative impacts.[78] As discussed above, the legal status of the guidelines has no binding effect despite the Ministerial power within the *Environment Effects Act 1978* (Vic) to provide them. Further, any ministerial advice resulting from an environmental effects assessment is not a decision and has no legal effect. Instead, the advice is used for informing decision-making, and any subsequent approvals or refusals, under other legislation.[79]

The absence of stipulated and common definition, within all documents discussed in this section of the chapter, for either cumulative or synergistic impacts also underlies this discretionary approach. As discussed in detail within Chapters 2 and 3, a problem associated with a perceived inadequacy in requirement for consideration arises from an absence of definitions within the legislation and supporting policy. This situation allows for project proponents to provide their

[76] See, eg, Victorian Government Department of Sustainability and Environment, above n 38, 10, 19, 20; Department of Planning and Development, Government of Victoria, above n 37, 7.
[77] Minister for Planning, Government of Victoria, above n 32, 8, 12; Minister for Planning, Government of Victoria, above n 19, 6, 26, 27.
[78] See, eg, Minister for Planning, Government of Victoria, above n 19, 20; Minister for Planning Government of Victoria, above n 32, 13.
[79] See, eg, *Coastal Management Act 1995* (Vic), s 40; Environment and Natural Resources Committee, Parliament of Victoria, *Inquiry into the Environmental Effects Statement Process in Victoria* (2011), 169 – 171.

own non-mandatory definition as well as the potential for additional elements from experts and those responsible for the assessment and decision making process. This can potentially lead to inconsistency in approach to assessment within the effect statement research and preparation, as well as assessment within decision-making. In addition, where there is inconsistency in requirement and definition, the potential exists for omission within assessment processes.

A suggested approach for addressing these issues is the provision of mandatory requirements and definitions within legislation. To achieve this effectively it is also important to consider the maintenance of any discretionary elements that may benefit decision-making processes and complement the mandatory elements. Further, to enable the update of any mandatory requirements through efficient processes, the elevation of 'guidelines' from policy to delegated legislation could also be considered.

3. Supplementary Environmental Effects Statement (SEES)

The SEES as published in the Port of Melbourne Corporation's *Main Volume Supplementary Environmental Effects Statement Channel Deepening Project* and *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* is examined in this section.[80] The analysis focuses on the discussion and assessment of cumulative and synergistic impacts provided by the Port of Melbourne Corporation (as the project proponent) and the expert scientists engaged to undertake the EIA. The approach to definitions and assessment methods (where indicated) for these impact types are reviewed as part of the analysis; with concerns about inconsistences and uncertainties identified. The SEES definition and intended use of other terms such as 'interactive' and 'combined effects' are also critiqued. The use of the term 'indirect', as discussed in Chapter 5, is inadequate for determining whether, and how, cumulative or synergistic impacts should be assessed within an EIA process. However, for the purpose of the SEES analysis, 'indirect' impacts have been reviewed as a means of comparison.

The predictions about cumulative and synergistic impacts on the Port Phillip Bay marine environment are also summarised (refer to Table 6-1: Channel Deepening Process: cumulative, synergistic, indirect, combined, interactive impact assessment summary and Appendix B - CDP Supplementary Environmental Effects Statement: Stated predictions for cumulative, synergistic, indirect, combined and interactive effects) and analysed. The final component is an analysis of the SEES risk assessment process to determine any shortcomings associated with the risk assessment approach to cumulative and synergistic impacts.

[80] Port of Melbourne Corporation 2007a, above n 23; Port of Melbourne Corporation 2007b, above n 23.

3.1 Definitions and assessment methods for cumulative and synergistic impacts

In addition to the discretionary requirements to address cumulative impacts within the SEES, the SEES acknowledged Victorian policy recommendations for including the assessment of these impact types.[81] The need for assessment was discussed by experts within workshops on the intended SEES process.[82] The SEES definition provided for cumulative included 'additive' and 'interactive'. [83] The definition of 'interactive' incorporating 'synergistic' or 'countervailing' impacts.[84] The term 'combined effect' was also used to describe cumulative impacts.[85] A definition of 'additive', focusing on the combination of effects being equal to the 'sum of individual effects' is provided.[86] The definition of 'interactive' includes the definition of 'synergistic' as 'those interactive effects that are greater than the sum of individual effects'.[87] In contrast, the definition of 'countervailing effects are those interactive effects that are less than the sum of the individual effects'.[88]

The parameters for cumulative and synergistic effect assessment within the risk assessment method are broad. Instructions for consideration of those impacts occur both inside and across the project areas (refer to Figure 6-1: Channel Deepening Project – Project Area Map), as well as from other anthropogenic activities and environmental change.[89] 'Additive' and 'combined effects' from the proposal were considered within the project areas.[90] The cumulative impact types considered between project areas included impacts within a similar time frame and for the same environmental asset when the location varies, as well as life-cycle impacts.[91] The consideration given to external anthropogenic activities and environmental change included invasive species, 'nutrient discharge', contaminants and pollution.[92]

[81] See, eg, Victorian Government, *Victorian Coastal Strategy 2002* (Victorian Coastal Council, 2002) cited in Port of Melbourne Corporation 2007a, above n 23, 5-13.
[82] Port of Melbourne Corporation 2007a, above n 23, 5-46; URS Australia Pty Ltd, 'Section 5 Risk Assessment – Identification of Risks' in Port of Melbourne Corporation 2007b, above n 23, 5-20 - 5-23.
[83] Port of Melbourne Corporation 2007a, above n 23, 5-46 – 5-47; URS Australia Pty Ltd, 'Section 5 Risk Assessment – Identification of Risks' in Port of Melbourne Corporation 2007b, above n 23, 5-20 - 5-23.
[84] Port of Melbourne Corporation 2007a, above n 23, 5-46 – 5-47; URS Australia Pty Ltd, 'Section 5 Risk Assessment – Identification of Risks' in Port of Melbourne Corporation 2007b, above n 23, 5-20 - 5-23.
[85] Port of Melbourne Corporation 2007a, above n 23, 5-46 – 5.47; URS Australia Pty Ltd, 'Section 5 Risk Assessment – Identification of Risks' in Port of Melbourne Corporation 2007b, above n 23, 5-20 - 5-21.
[86] Port of Melbourne Corporation 2007a, above n 23, 5-46; URS Australia Pty Ltd, 'Section 5 Risk Assessment – Identification of Risks' in Port of Melbourne Corporation 2007b, above n 23, 5-21.
[87] Port of Melbourne Corporation 2007a, above n 23, 5.47; URS Australia Pty Ltd, 'Section 5 Risk Assessment – Identification of Risks' in Port of Melbourne Corporation 2007b, above n 23, 5-21.
[88]Port of Melbourne Corporation 2007a, above n 23, 5-47; URS Australia Pty Ltd, 'Section 5 Risk Assessment – Identification of Risks' in Port of Melbourne Corporation 2007b, above n 23, 5-21.
[89] Port of Melbourne Corporation 2007a, above n 23, 5-46 – 5.47; URS Australia Pty Ltd, 'Section 5 Risk Assessment – Identification of Risks' in Port of Melbourne Corporation 2007b, above n 23, 5-20 – 5- 22.
[90] URS Australia Pty Ltd, 'Section 5 Risk Assessment – Identification of Risks' in Port of Melbourne Corporation 2007b, above n 23, 5-22.
[91] Ibid.
[92] Ibid.

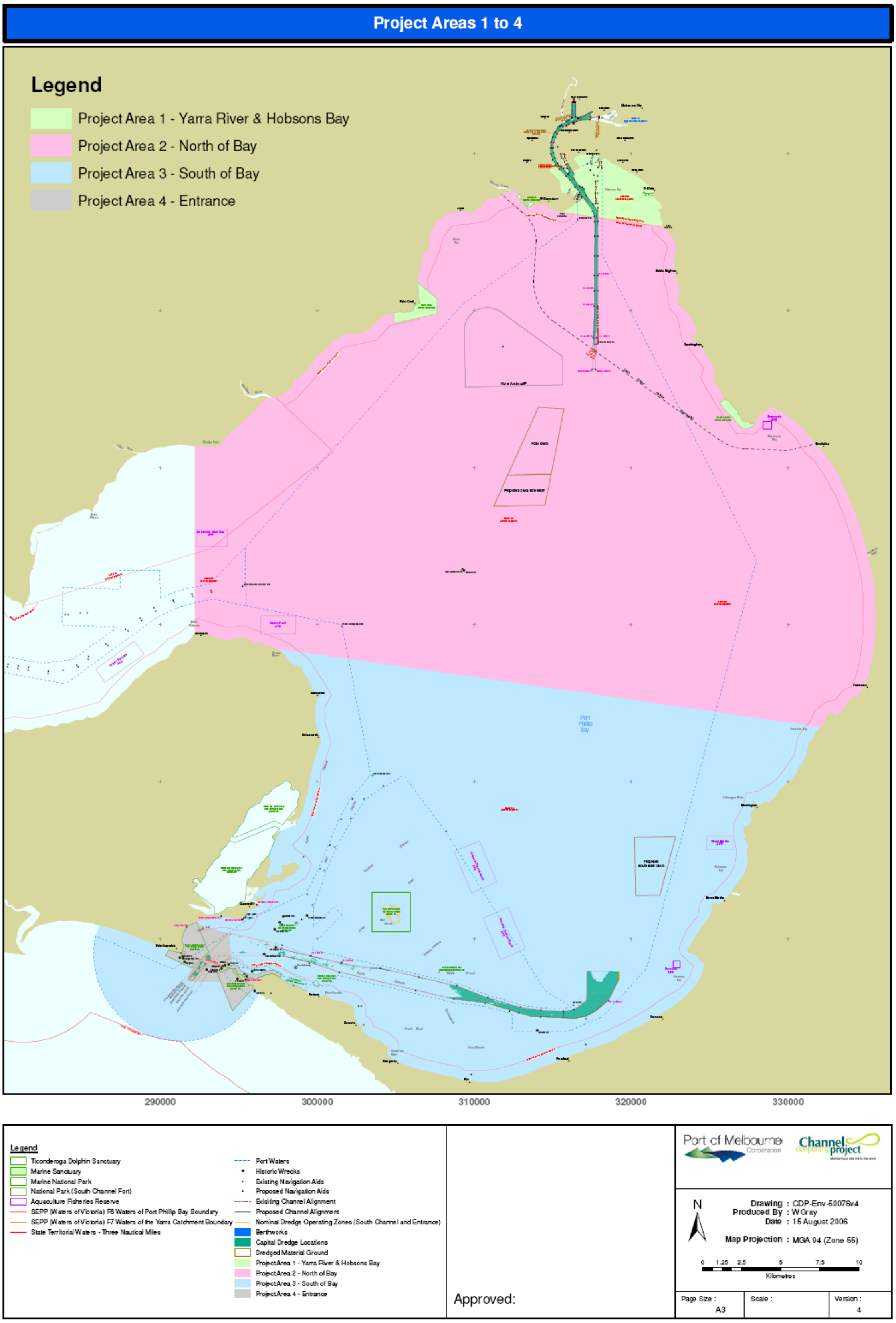

Figure 6-1: Channel Deepening Project – Project Area Map (Source: Port of Melbourne Corporation and URS Australia Pty Ltd)[93]

[93] URS Australia Pty Ltd, 'Channel Deepening Project Risk Assessment for SEES' in Port of Melbourne Corporation 2007b, above n 23, 4-3.

The SEES approach to the definition of cumulative impacts does not differentiate cumulative and synergistic impacts. This has occurred through the provision of both 'additive' and 'interactive' as terms to describe 'cumulative' impacts. As discussed in Chapter 2,[94] an inadequate distinction between cumulative and synergistic impacts can result in the neglect of synergistic impacts types within environmental assessment. Further, any control over the definition of cumulative and/or synergistic impacts and/or method of assessment undertaken by experts preparing the technical reports for the SEES was potentially limited. This is because of the discretionary legal requirements guiding the SEES (as discussed in section 2.3), and the absence of a cohesive and accountable assessment approach stipulated within the risk assessment method.[95]

The absence of definitions in the SEES technical reports does not necessarily indicate the actual assessment approach (e.g. scientific method) taken by a technical expert. The review of the SEES technical reports, however, provided limited evidence of the use of alternative definitions. Further, the assessment limitations were qualified in only a small number of instances. For example, within the 'SEES Head Technical report: Nutrient Cycling' the limitation on considering synergistic impacts within the CDP risk factors was discussed.[96] In the discussion it was acknowledged that whilst the prior Port Phillip Bay Environmental Study adopted a nonlinear model when assessing the health of the bay in the 1990s,[97] the CDP impacts would not be significant enough to justify synergistic impact assessment; with, instead, an approach taken assuming that any impacts would be additive.[98] Within other technical reports, comments acknowledged the theoretical possibility of cumulative impacts occurring,[99] and the increased possibilities with external influences.[100]

When considering the broader terminology used throughout the SEES, there are instances of alternative terms being used to identify impacts that could be considered to have cumulative and/ or synergistic impact characteristics. For example, as discussed above 'combined effects'

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94 Refer to the discussion in Chapter 2, sections 2, 3 and 4.
95 See, Port of Melbourne Corporation 2007a, above n 23, 5-46 – 5.47; URS Australia Pty Ltd, 'Section 5 Risk Assessment – Identification of Risks' in Port of Melbourne Corporation 2007b, above n 23, 5-20 – 5-23.
96 Andrew R Longmore, 'SEES Head Technical report: Nutrient Cycling' in Port of Melbourne Corporation 2007b, above n 23, 102.
97 See, eg, CSIRO Australia, Port Phillip Bay Environmental Study Final Report June 1996 in CSIRO Australia, *Port Phillip Bay Environmental Study Technical Reports* (CSIRO Publishing, 1999) 73.
98 Andrew R Longmore, 'SEES Head Technical report: Nutrient Cycling' in Port of Melbourne Corporation 2007b, above n 23, 102.
99 See, eg, Brett Lane & Associates Pty Ltd, 'Report No. 6036 (1.10) December 2006' in Port of Melbourne Corporation 2007b, above n 23, 10, 288, 299; CEE Consultants Pty Ltd, 'Channel Deepening Project Overview Impact Assessment Plankton Communities' in Port of Melbourne Corporation 2007b, above n 23, 37; Gregory P Jenkins and Lachlan McKinnon, 'Aquaculture and Fisheries SEES' in Port of Melbourne Corporation 2007b, above n 23, 139, 213.
100 See, eg, Dr Dale F Cooper Broadleaf Capital International Pty Ltd, 'Risk Management Peer Review' in Port of Melbourne Corporation 2007b, above n 23, 19 of 37.

has been linked in definition to cumulative impacts. Further the SEES acknowledges that due consideration had been given to these impact types within the workshops and assessments.[101] Comment was made in the Risk Management Peer Review that the consideration of 'combined effects' improves the level of certainty associated with identifying potentially significant risks and impacts.[102] Comment was also provided about the theoretical potential for combined effects causing phytoplankton growth,[103] and increased uncertainty for seagrass impact predictions.[104] For the term 'interactive', use is limited to inclusion within references to statements that these types of impacts had been considered, and further acknowledgement within the assessment on plankton communities that it is included in the 'cumulative' definition.[105] The inclusion of opposing meanings for the term 'interactive' was not addressed, and it is unclear as to whether the 'interactive' impacts considered were synergistic or countervailing.

The commentary about cumulative and synergistic impacts included both general discussion and the assessment on predicted impacts. The general discussion focused on concerns raised about cumulative impacts related to identifying the need to consider cumulative effects from noise,[106] and assertions that the assessments for the North Channel sediment contamination ignored the potential for both cumulative (additive) and synergistic impacts to arise from interactions between contaminants.[107] Other comments reflected the need for discussion only if their assessment was predicted as more than minor.[108] The predicted impacts are discussed below in section 3.2.

The use of the term 'indirect' is commented upon several times, but it is not directly related to the other terms defined and discussed within the SEES. No definition is provided for 'indirect' impacts, however, the comments include, for example, confirmation of the Channel Deepening

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[101] See, eg, Andrew R Longmore, 'SEES Head Technical report: Nutrient Cycling' in Port of Melbourne Corporation 2007b, above n 23, 102; Brett Lane & Associates Pty Ltd, 'Report No. 6036 (1.10) December 2006' in Port of Melbourne Corporation 2007b, above n 23, 288.

[102] See, eg, Dr Dale F Cooper Broadleaf Capital International Pty Ltd, 'Risk Management Peer Review' in Port of Melbourne Corporation 2007b, above n 23, 7 of 37; URS Australia Pty Ltd, 'Section 5 Risk Assessment – Identification of Risks' in Port of Melbourne Corporation 2007b, above n 23, 5- 18.

[103] See, eg, Jennifer Hale, 'Supplementary Environment Effects Statement, Head Technical Report: Nutrient-cycling-Appendix 1 Phytoplankton Blooms December 2006' in Port of Melbourne Corporation 2007b, above n 23, 4.

[104] CEE Consultants Pty Ltd, 'Channel Deepening Project Overview Impact Assessment Seagrass' in Port of Melbourne Corporation 2007b, above n 23, 18.

[105] See, eg, CEE Consultants Pty Ltd, 'Channel Deepening Project Overview Impact Assessment Plankton Communities' in Port of Melbourne Corporation 2007b, above n 23, 37.

[106] See, eg, C Salgado Kent and R D McCauley, 'Underwater Noise Impacts CDP Report 2006' in Port of Melbourne Corporation 2007b, above n 23, 23.

[107] See, eg, Dr Ian Irvine, Peer Review, 'South and North Channels Supplementary EES Channel Deepening Project 1/3/2007' in Port of Melbourne Corporation 2007b, above n 23, 31, 47, 54.

[108] See, eg, CEE Consultants Pty Ltd, 'Overview Impact Assessment Sessile Soft Seabed Communities' in Port of Melbourne Corporation 2007b, above n 23, 3; CEE Consultants Pty Ltd, 'Overview Impact Assessment Shallow Rocky Reef Communities' in Port of Melbourne Corporation 2007b, above n 23, 2.

EES Panel Report requirements to consider indirect impacts,[109] and that the targeted protection of habitats and species would also result in the protection of other habitats and species indirectly affected.[110] The potential for indirect effects was also acknowledged within the assessment of impacts relating to, for example, dredge ground material,[111] sessile soft sediment communities,[112] marine mammals and penguins,[113] fish (in general),[114] and anchovy.[115] The predicted indirect impacts are identified in further detail below (section 3.2).

The SEES contains multiple approaches to the definition and method for cumulative and synergistic impact assessment. There are concerns, as raised above, about the adequacy of legal provisions to require consistent approaches to terms and definitions within methodology. Further, inconsistent approaches indicate disregard for the public review of EIA documents. This includes situations where there are members of the public that are without the expertise and required understanding of the data and supporting methods. Such situations may lead to confusion about the extent of consideration given. It is suggested that clear legal requirements would not only improve consistency and assessment outcomes, but minimise the potential for superficial consideration throughout the process.

3.2 Prediction of cumulative and synergistic impacts

This part identifies whether cumulative and synergistic impacts have been predicted to occur for the 'environmental values and assets' specified in the SEES.[116] The assessment undertaken focused on how these impact types were predicted to affect the species, ecosystems, habitats and marine environmental processes as identified within the SEES profile.[117] To achieve this, the

[109] Sinclair Knight Merz, 'Peer Review of Channel Design Report' in Port of Melbourne Corporation 2007b, above n 23, 6.
[110] Port of Melbourne Corporation 2007a, above n 23, 17-33.
[111] See, eg, Parsons Brinckerhoff, 'Dredged Material Ground: Assessment of Optimal Location for Material to be Dredged in the South of the Bay' in Port of Melbourne Corporation 2007b, above n 23, 39.
[112] See, eg, CEE Consultants Pty Ltd, 'Overview Impact Assessment Sessile Soft Seabed Communities' in Port of Melbourne Corporation 2007b, above n 23, 2.
[113] See, eg, Applied Ecology Solutions Pty Ltd, 'Marine Mammals and Penguins' in Port of Melbourne Corporation 2007b, above n 23, 3, 100, 102, 105, 124-126, 156.
[114] See, eg, Gregory P Jenkins and Lachlan McKinnon, 'Aquaculture and Fisheries SEES' in Port of Melbourne Corporation 2007b, above n 23, 20, 136 – 137, 143.
[115] Ibid, 174.
[116] For the purpose of this thesis, the SEES analysis does not focus on the cumulative impact of greenhouse gas emissions caused by shipping activities. Aside from the substantive SEES focus on dredging impacts, the reasons include that the shipping occurs after completion of the dredging, and the SEES focus on shipping is narrow. It is also noted that the references to 'cumulative' within the shipping context are focused on a predicted reduction in 'cumulative greenhouse gas emissions' and not the impacts that occur as a result of the greenhouse gas emissions: O'Brien Consulting Greenhouse, 'Energy, Environment, Greenhouse Gas Emissions and Climate Change Head Technical Report - Final 2007' in in Port of Melbourne Corporation 2007b, above n 23, 63, 64, 67, 69, 71.
[117] The 'Values/Assets/ Activities' have been selected based on a combination of the environmental values and assets, and anthropogenic activities identified in: URS Australia Pty Ltd, 'Section 7 Risk Assessment – Evaluation of Outputs' in Port of Melbourne Corporation 2007b, above n 23, 7- 1; Table 6-1 List of Asset Categories and Definitions in URS Australia Pty Ltd, 'Section 6 Risk Assessment – Analysis of Risks' in Port of Melbourne Corporation 2007b, above n 23, 6- 1; the environmental value and assets associated with cumulative/synergy terms

conclusions about 'indirect', 'combined' and 'interactive' impacts (as predicted impacts) were also reviewed. The accuracy of the scientific assessments has not been questioned as part of this analysis. Instead, concerns are raised about the consistency of approach to presentation and discussion within public documents.

Identification of the potential extent of detriment caused by cumulative impacts from anthropogenic activities and environmental change is addressed, to a limited extent within the SEES. As demonstrated in Table 6-1 and Appendix B, the potential for cumulative impacts to occur as a result of the proposed channel deepening was raised as a minor concern for sessile soft bed communities.[118] The potential for a cumulative impact on seabirds was also identified as a problem should 'other factors have significant consequences for marine birds, such as the impact of storms on breeding success'.[119] Noise was the only activity assessed as likely to cause a cumulative impact.[120] Compared to the predictions for detrimental cumulative impacts, Table 6-1 and Appendix B show more SEES references for identified habitats, protected areas and species where the potential for cumulative impacts to occur was predicted as non-problematic.[121]

The terms 'combined effects' and 'interactive' have been used within the SEES to assist with the definition of cumulative and synergistic impacts (as discussed above). Short-term 'combined' impacts were raised as a potential issue for sessile soft sediment communities.[122] No reference to the potential for synergistic or 'interactive' impacts was found within the SEES identifying these impact types as detrimental for environmental values and assets.

etc. when found in text (Refer to Appendix B for references). Values and assets related to property, social, economic and public health and safety matters are not included.

[118] CEE Consultants Pty Ltd, 'Channel Deepening Project Overview Impact Assessment Sessile Soft Seabed Communities' in Port of Melbourne Corporation 2007b, above n 23, 53. (note: minimal impact)

[119] Brett Lane & Associates Pty Ltd, 'Report No. 6036 (1.10) December 2006 in Port of Melbourne Corporation', in Port of Melbourne Corporation 2007b, above n 23, 289.

[120] Port of Melbourne Corporation 2007a, above n 23, 14-35 (note: not specified re noise levels); Simon Mustoe and Nathan Waugh AES Applied Ecology Solutions Pty Ltd, 'Marine Mammals and Penguins' in Port of Melbourne Corporation 2007b, above n 23, 117. (note: dredge plumes)

[121] See, eg, Andrew R Longmore, 'SEES Head Technical report: Nutrient Cycling' in Port of Melbourne Corporation 2007b, above n 23, 102 – 104; Port of Melbourne Corporation, 'Appendix 67' in Port of Melbourne Corporation 2007b, above n 23, 21; Port of Melbourne Corporation 2007a, above n 23, 14-40; Gregory P Jenkins and Lachlan McKinnon, 'Aquaculture and Fisheries SEES' in Port of Melbourne Corporation 2007b, above n 23, 214; Port of Melbourne Corporation 2007a, above n 23, 12-49 - 12-50, 13-79; Port of Melbourne Corporation 2007a, above n 23, 12-62; Simon Mustoe and Nathan Waugh AES Applied Ecology Solutions Pty Ltd, 'Marine Mammals and Penguins' in Port of Melbourne Corporation 2007b, above n 23, 144, 154, 166, 174. (note: CE unlikely); Simon Mustoe and Nathan Waugh AES Applied Ecology Solutions Pty Ltd, 'Marine Mammals and Penguins' in Port of Melbourne Corporation 2007b, above n 23, 144, 154, 166, 174. (note: CE unlikely).

[122] CEE Consultants Pty Ltd, 'Channel Deepening Project Overview Impact Assessment Sessile Soft Seabed Communities' in Port of Melbourne Corporation 2007b, above n 23, 86, 87. (note: short term impact).

Table 6-1: Channel Deepening Process: cumulative, synergistic, indirect, combined, interactive impact assessment summary (note: refer to Appendix B for referencing).

Legend: *Y* = impact type assessed and predicted to be problematic within SEES; *N* = impact type assessed and predicted to be non-problematic within SEES; *blank space* = impact type not discussed as assessed within SEES.

	Cumulative		**Synergistic**		**Indirect**		**Combined**		**Interactive**	
Values/ Assets/ Activities	Y	N	Y	N	Y	N	Y	N	Y	N
Landform Bathymetry (geomorphology and bathymetry)										
Hydrodynamic										
Sediment transport and coastal processes										
Nitrogen cycle										
Nutrient cycle		N								
Water quality (turbidity, nutrients, contaminant mobilisation etc.)										
Biological/ ecological processes (seabed water column habitat, primary production & food web)		N			Y					
Seabed and water column habitat										
Fish (unspecified)		N			Y					
Bream		N								
Anchovy		N			Y					
Seabirds (unspecified)	Y	N			Y					
Penguins		N								
Pied Cormorant		N			Y					
Sygnathids (pipefish, sea dragons and seahorses)		N			Y					
Plankton		N			Y					
Seagrass										
Marine Mammals (unspecified)		N			Y	N				
Dolphins					Y					
Marine protected areas		N								
Sessile soft bed communities	Y	N					Y			
Shallow reef habitat					Y					
Deep reef habitat										
Protected marine fauna (unspecified)										
Ramsar Wetlands (including bird species, flora, fauna (seagrass) and ecological features etc.)					Y	N				
Listed Threatened Species & Communities										
Terrestrial Ecology		N								
General ecosystem/ ecological impacts					Y					
Cumulative effect of noise	Y	N								
Rockfall					Y					
Dredging										
Plumes/ suspended sediment					Y					
Contaminants		N								
Algal Blooms						N				
Oil Spills						N				

Detrimental impacts on the marine environment from indirect impacts are identified more often than from cumulative, synergistic, combined and/or interactive impacts. This is reflected within the prediction for problematic indirect impacts on environmental values and assets, with Table 6-1 (also refer to Appendix B) showing these impact types as problematic for 14 of the 36 identified environmental values and assets (including species, processes and habitats).[123] In relation to Ramsar Wetlands[124] and marine mammals[125] 'indirect' impacts were identified as of no concern. Algal blooms[126] and oil spills[127] were also identified as being non-problematic where indirect impacts were concerned. Rock falls[128] and plumes/suspended sediments[129] were the only 'impacts' resulting from the activities indicated as likely to cause an indirect impact/effect. A question raised by the results of this analysis is whether the greater emphasis on indirect impacts compared to cumulative and/or synergistic impacts has occurred as a result of specific requirements set out in the Channel Deepening EES Panel Report.

The use of alternative terms such as 'indirect' to refer to cumulative or synergistic impacts can result in inadequate clarity in definition and understanding of assessment requirements.[130] The high prediction for indirect impacts when compared to the other impact types reviewed, particularly when there is no definition provided for such effects within the assessment methodology, can raise doubt as to what types of impacts were being considered within the expert assessments when the impacts were predicted. Further, as discussed above, the definition provided in the 2006 Guidelines emphasised a distal nexus in terms of time or space from direct

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[123] M Edmunds, P Pickett and A Judd (Australian Marine Ecology), 'Port Phillip Bay Channel Deepening Project Supplementary Environmental Effects Statement – Marine Ecology Specialist Studies Volume 10: Ecological Processes and Inventory' in Port of Melbourne Corporation 2007b, above n 23, 41; Port of Melbourne Corporation 2007a, above n 23, 9-9, 9-22, 12 – 53, 13-87, 13-87, 13-88, 14-35, 15-12, 16-24; Gregory P Jenkins and Lachlan McKinnon, 'Aquaculture and Fisheries SEES' in Port of Melbourne Corporation 2007b, above n 23, 20, 136 – 137, 143, 174; Brett Lane & Associates Pty Ltd, 'Report No. 6036 (1.10) December 2006' in Port of Melbourne Corporation 2007b, above n 23, 191, 210, 216, 218 – 220, 234, 236, 265, 271, 283; M Edmunds et al (Australian Marine Ecology), 'Port Phillip Bay Channel Deepening Project Supplementary Environmental Effects Statement – Marine Ecology Specialist Studies Volume 7: Water Column' in Port of Melbourne Corporation 2007b, above n 23, 23, 27; CEE Consultants Pty Ltd, 'Channel Deepening Project Overview Impact Assessment Plankton Communities' in Port of Melbourne Corporation 2007b, above n 23, 37; Simon Mustoe and Nathan Waugh AES Applied Ecology Solutions Pty Ltd, 'Marine Mammals and Penguins' in Port of Melbourne Corporation 2007b, above n 23, 117, 124; M Edmunds et al (Australian Marine Ecology), 'Port Phillip Bay Channel Deepening Project Supplementary Environmental Effects Statement – Marine Ecology Specialist Studies Volume 8: Shallow Reefs' in Port of Melbourne Corporation 2007b, above n 23, 117.

[124] Port of Melbourne Corporation 2007a, above n 23, 15-12, 15-13.

[125] Simon Mustoe and Nathan Waugh AES Applied Ecology Solutions Pty Ltd, 'Marine Mammals and Penguins' in Port of Melbourne Corporation 2007b, above n 23, 3.

[126] Brett Lane & Associates Pty Ltd, 'Report No. 6036 (1.10) December 2006' in Port of Melbourne Corporation 2007b, above n 23, 193, 194, 271, 283.

[127] Ibid, 283.

[128] Port of Melbourne Corporation 2007a, above n 23, 14-35.

[129] Ibid, 13-87, 13-88; Brett Lane & Associates Pty Ltd, 'Report No. 6036 (1.10) December 2006' in Port of Melbourne Corporation 2007b, above n 23, 210, 216, 218 – 220, 234, 265; Simon Mustoe and Nathan Waugh AES Applied Ecology Solutions Pty Ltd, 'Marine Mammals and Penguins' in Port of Melbourne Corporation 2007b, above n 23, 117; Gregory P Jenkins and Lachlan McKinnon, 'Aquaculture and Fisheries SEES' in Port of Melbourne Corporation 2007b, above n 23, 174.

[130] As mentioned above, and discussed in Chapter 5, sections 2.2 and 3.

effects, but did not provide clarity as to the impact types.[131] The repetition of the Channel Deepening EES Panel Report requirements to consider indirect impacts within the SEES,[132] was a missed opportunity to determine what type of impacts were to be considered indirect (e.g. cumulative and/ or synergistic). Providing definitions that distinguished between these impact types could have improved understanding of how to manage predicted impacts. The potential for the definition of 'indirect' impacts to include cumulative and synergistic impacts,[133] leads to a conclusion that it is difficult to justify the exclusion of cumulative and/or synergistic impacts when indirect impacts are identified. This is emphasised further through the absence of express exclusion from the 2006 Guidelines definition and the potential for inconsistency and inadequate clarity associated with definitions provided within the SEES.

The definition of 'cumulative', includes 'additive' (as discussed above) and utilises this term to distinguish the different types of 'cumulative' impacts being considered (i.e. additive, synergistic and antagonistic). A review of the SEES demonstrates that the use of the term 'additive' to describe cumulative impacts occurs less frequently than the use of the term 'cumulative'.[134] Several of these instances occur as a means of distinguishing such impacts from synergistic impacts.[135] Other examples where the term 'additive' has been used include a conclusion that the additive effect of sedimentation on sessile soft bed communities and similarly on seagrass would be of little significance,[136] and that the 'additive' effect of noise was

[131] Victorian Government Department of Sustainability and Environment, above n 38, 18.
[132] Sinclair Knight Merz, 'Peer Review of Channel Design Report' in Port of Melbourne Corporation 2007b, above n 23, 6.
[133] See, eg, Peter Wulf, 'Offshore Petroleum and the Environment Protection and Biodiversity Conservation Act 1999 (Cth): Consideration of all adverse impacts', (2005) 22 *Environmental and Planning Law Journal* 296, 313 – 316; David J Haigh, 'Hinchinbrook – in defence of world heritage' (1999) 6 (1) *The Australasian Journal of Natural Resources Law and Policy* 47, 58, 69; Daniel M Franks, David Brereton and Chris J Moran, 'Managing the cumulative impacts of coal mining on regional communities and environments in Australia' (2010) 28 (4) *Impact Assessment and Project Appraisal* 299, 300; *Queensland Conservation Council Inc v Minister for the Environment and Heritage* [2003] FCA 1463, [38 – 41]; *Minister for the Environment and Heritage v Queensland Conservation Council Inc* (2004) 139 FCR 24, 38 [53]. More detailed discussion about this matter can be found in Chapters 4 and 5.
[134] See, eg, Dr Ian Irvine, 'Peer Review, South and North Channels Supplementary EES Channel Deepening Project 1/3/2007' in Port of Melbourne Corporation 2007b, above n 23, 31, 47, 54; Andrew R Longmore, 'SEES Head Technical report: Nutrient Cycling' in Port of Melbourne Corporation 2007b, above n 23, 102; CEE Consultants Pty Ltd, 'Channel Deepening Project Overview Impact Assessment Plankton Communities' in Port of Melbourne Corporation 2007b, above n 23, 37; CEE Consultants Pty Ltd, 'Channel Deepening Project Overview Impact Assessment Sessile Soft Seabed Communities' in Port of Melbourne Corporation 2007b, above n 23, 76; Dr Dale F Cooper Broadleaf Capital International Pty Ltd, 'Risk Management Peer Review' in Port of Melbourne Corporation 2007b, above n 23, 19 of 37; C Salgado Kent and R D McCauley, 'Underwater Noise Impacts CDP Report 2006' in Port of Melbourne Corporation 2007b, above n 23, 62; CEE Consultants Pty Ltd, 'Channel Deepening Project Overview Impact Assessment Seagrass' in Port of Melbourne Corporation 2007b, above n 23, 32, 64.
[135] Dr Ian Irvine, Peer Review, 'South and North Channels Supplementary EES Channel Deepening Project 1/3/2007' in Port of Melbourne Corporation 2007b, above n 23, 31, 47, 54; Andrew R Longmore, 'SEES Head Technical report: Nutrient Cycling' in Port of Melbourne Corporation 2007b, above n 23, 102; CEE Consultants Pty Ltd, 'Channel Deepening Project Overview Impact Assessment Plankton Communities' in Port of Melbourne Corporation 2007b, above n 23, 37.
[136] CEE Consultants Pty Ltd, 'Channel Deepening Project Overview Impact Assessment Sessile Soft Seabed Communities' in Port of Melbourne Corporation 2007b, above n 23, 76; CEE Consultants Pty Ltd, 'Channel Deepening Project Overview Impact Assessment Seagrass' in Port of Melbourne Corporation 2007b, above n 23, 32, 64.

improbable.[137] The use of the term ‘additive’ instead of ‘cumulative’, whilst accurate, is another example of the potential perception of inconsistency and confusion, when both terms are used and a document (such as the SEES) is read by those with insufficient expertise (e.g. many members of the public).

The absence of clear and distinct definitions for cumulative and synergistic impacts within the SEES indicates potential for inconsistency with the method for assessment. This is detailed within the process for the assessment of predicted impacts within the SEES. Whilst there has been a focus on cumulative and synergistic impact assessment through the provision of definitions (as discussed above), and the SEES parameters for assessing cumulative impacts include synergistic impacts,[138] there is a lack of specific assessment method and guidance for these impact types. With the assessment statements within the SEES focusing on cumulative impacts (refer to Appendix B), given the SEES definitions, it is possible that any conclusive assessment on cumulative impacts includes synergistic impacts. However, without explicit assessment methods stated by the experts undertaking the assessments, there is still potential for inadequate consideration to be given to synergistic impacts. This is highlighted within the few references to synergistic impacts within the SEES where it is acknowledged that, due to the complexities associated with nonlinear characteristics, an assessment within the context of nutrient cycling was not undertaken,[139] and that consideration was inadequate within the assessment of contaminated sediment.[140] The issue of inconsistency in approach is emphasised when statements such as this are compared with statements by URS Australia Pty Ltd - the consulting firm hired to coordinate the SEES - that experts had automatically considered synergistic and interactive effects within assessments.[141]

For situations where there has been no use of the term ‘synergistic’, the common use of the term ‘cumulative’ within the SEES, without further clarification, could suggest that the type of impact/effect can encompass all three elements provided by the SEES definition (i.e. additive, synergistic and antagonistic). This absence of distinction could limit the outcomes and understanding of the nature of the impacts discussed within an EIA, and possibly the effectiveness of any relevant environmental management plan and/or monitoring programme.

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[137] C Salgado Kent and R D McCauley, ‘Underwater Noise Impacts CDP Report 2006’ in Port of Melbourne Corporation 2007b, above n 23, 62.
[138] Port of Melbourne Corporation 2007a, above n 23, 5-46 – 5-47; URS Australia Pty Ltd, ‘Section 5 Risk Assessment – Identification of Risks’ in Port of Melbourne Corporation 2007b, above n 23, 5-20 - 5- 21.
[139] Andrew R Longmore, ‘SEES Head Technical report: Nutrient Cycling’ in Port of Melbourne Corporation 2007b, above n 23, 102.
[140] Dr Ian Irvine, ‘Peer Review, South and North Channels Supplementary EES Channel Deepening Project 1/3/2007’ in Port of Melbourne Corporation 2007b, above n 23, 31, 47, 54.
[141] URS Australia Pty Ltd, ‘Section 5 Risk Assessment – Identification of Risks’ in Port of Melbourne Corporation 2007b, above n 23, 5-22.

Again, the potential for inconsistency leads to the recommendation that the provision of clear and distinct definitions within a legal framework may be of assistance.

3.3 Risk assessment

The following discussion is a review of the selected SEES risk assessment approach to address cumulative and synergistic impacts. The review begins with a discussion on the benefits and limitations of using risk assessment. The risk assessment approach within the SEES, as well as the analysis undertaken for the purpose of this thesis, is then identified. This focuses on the identified risks and predicted effects for the four key project areas[142] (refer to Figure 6-1: CDP Project Area Map) and highlights potential shortcomings in the approach to addressing these impact types. The limitations that can arise as a result of any inferences are also discussed.

Campbell and Gallagher discuss the beneficial use of risk assessment in instances when there is inadequate access to data.[143] Risk assessment as a process, however, is constrained in its ability to address complexities. Edmunds, for example, in providing feedback on Victoria's EES process, detailed some of the failings of risk assessment:

> From my experience there are frequent misapplications of ecological risk assessments, resulting in misrepresentations of hazards, likelihoods and consequences. Furthermore, risk assessments are treated as the results of robust scientific processes, which they are not, and generally have little scrutiny and testing for accuracy and bias. The EES process is generally over-reliant and over-trusting of risk assessment outcomes.[144]

Further, Micheli et al have demonstrated that as a result of their application of the risk assessment tool Productivity Susceptibility Analysis to assess the cumulative impacts from multiple fisheries, not all risk assessment methods can assess synergistic impacts.[145] As part of this, Micheli et al discussed that the inability of the risk assessment tool to address synergistic impacts 'may underestimate risk'.[146] As discussed by Hering et al, and Ojaveer et al, the inadequate level of knowledge about actual synergistic impacts is a constraint on the

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[142] URS Australia Pty Ltd, 'Channel Deepening Project Risk Assessment for SEES' in Port of Melbourne Corporation 2007b, above n 23, Appendix F, 8-9 of 55 (Table 1 South of the Bay: Key Pathways for all Predicted Effects), 12-13 of 55 (Table 2 South of the Bay: Key Pathways for Significant Risk to Assets), 16 of 55 (Table 3 Yarra River and Hobsons Bay: Key Pathways for all Predicted Effects), 19-22 of 55 (Table 4 Yarra River and Hobsons Bay: Key Pathways for Significant Risk to Assets), 25 of 55 (Table 5 North of the Bay: Key Pathways for all Predicted Effects), 28 - 29 of 55 (Table 6 North of the Bay: Key Pathways for Significant Risk to Assets), 33-34 of 55 (Table 7 The Entrance: Key Pathways for all Predicted Effects), 37 of 55 (Table 8 The Entrance: Key Pathways for Significant Risk to Assets).
[143] Marnie L Campbell and Charmaine Gallagher, 'Assessing the relative effects of fishing on the New Zealand marine environment through risk analysis' (2007) 64 *ICES Journal of Marine Science* 256, 256.
[144] Dr Matt Edmunds (public hearing transcript of evidence) quoted in Environment and Natural Resources Committee, Parliament of Victoria, above n 79, 139.
[145] Fiorenza Micheli et al, 'A risk-based framework for assessing the cumulative impact of multiple fisheries' (2014) 176 *Biological Conservation* 224, 234.
[146] Ibid.

development of risk assessment tools capable of assisting with the prediction of these impact types.[147]

The value of identifying potential shortcomings is emphasised by the limitations of methods used to undertake risk assessment (e.g. event trees and matrices) and a subsequent restriction on the impact types capable of being addressed to those that involve relatively simple and isolated interactions.[148] Further, due to the complexity of assessment, inadequate data and high levels of uncertainty, the potential for neglect of cumulative and synergistic impacts assessment is increased.[149]

Applying this to the SEES framework, identifying shortcomings in the risk assessment approach to cumulative and synergistic impacts can assist in providing guidance as to how the Victorian legal framework for EIA and associated decision-making processes could be improved.

3.3.1 Risk assessment approach and analysis

As part of the SEES preparation, the risk assessment process relied upon and assisted with informing the expert technical reports.[150] The process identified the 'likelihood and consequences' associated with 'the identified risk events' and adverse 'predicted effects'.[151] This aided the response to the 2006 Guidelines requirements to identify uncertainty.[152] The report prepared by URS Australia Pty Ltd, however, acknowledges the linear approach of the event trees, and the subsequent lack of capability to consider nonlinear environmental interactions (i.e. synergistic impacts).[153] Any consideration given to these interactions was identified as a topic to be addressed by the experts within their assessment and report preparation.[154] Further, the risk assessment report acknowledged that the evaluation was not all

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[147] Daniel Hering et al, 'Managing aquatic ecosystems and water resources under multiple stress – An introduction to the MARS project' (2015) 503 – 504 *Science of the Total Environment* 10, 12; Henn Ojaveer et al, 'Classification of Non-Indigenous Species Based on their Impacts: Considerations for Application in Marine Management' (2015), 5/13, *PloS Biol* 13(4): e1002130.doi:10.1371/journal.pbio.1002130.
[148] See, eg, Great Barrier Reef Marine Park Authority, *Great Barrier Reef Region Strategic Assessment: Strategic assessment report* (Great Barrier Reef Marine Park Authority, 2014) 2-6; Rory Sullivan and Amanda R Hunt, 'Commentary (cont): Risk assessment: the myth of scientific objectivity' (1999) 16 *Environmental and Planning Law Journal* 522, 526, 527.
[149] See, eg, Great Barrier Reef Marine Park Authority, above n 148, 2-6; Sullivan and Hunt, above n 148, 526, 527.
[150] See, eg, URS Australia Pty Ltd, 'Channel Deepening Project Risk Assessment for SEES' in Port of Melbourne Corporation 2007b, above n 23, 3-4, 4-1.
[151] Ibid, 3-4, 4-1, 5-2.
[152] Victorian Government Department of Sustainability and Environment, above n 38, 10, 19, 20; See, eg, URS Australia Pty Ltd, 'Channel Deepening Project Risk Assessment for SEES' in Port of Melbourne Corporation 2007b, above n 23, 3-3.
[153] See, eg, URS Australia Pty Ltd, 'Channel Deepening Project Risk Assessment for SEES' in Port of Melbourne Corporation 2007b, above n 23, 5-5.
[154] Ibid, 5-5, 5-20 – 5-22.

encompassing, but instead focused on important factors not substantively addressed within the CDP design or environmental management plan.[155]

To understand the potential for cumulative and synergistic impacts to occur, the Channel Deepening Project activities, and the '*Risk Assessment Outputs'*[156] identified in the '*Key Pathway'* tables for all '*predicted effects'* and '*significant risk to assets'* were reviewed. The information contained within the *Key Pathway* tables for the four main project areas, being '*South of the Bay', 'Yarra River and Hobsons Bay', 'North of the Bay',* and '*The Entrance'*, was focused on.[157] This information was then overlaid to enable a further stage of analysis that demonstrated the potential for cumulative and synergistic interactions (Table 6-2 (Predicted Effects) and Table 6-3 (Risk Events)). For the purpose of this thesis, only information about impacts on environmental assets was included. Information relating to the anthropogenic activities, subsequent environmental impacts, affected environmental assets (e.g. habitats and species), and the 'pathway consequence level' for identified 'predicted effects'[158] or 'pathway risk level'[159] for identified 'significant risks to assets' is focused upon[160] and summarised to gain insight into the theoretical potential for cumulative and synergistic impacts to occur. As detailed in the SEES, 'predicted effects' are identified if the chance of the impact (effect) occurring is 50% or more.[161] 'Risk events' are identified in instances where there is less certainty as to occurrence (i.e. < 50% chance).[162]

The summarised information in Table 6-2 shows the potential for cumulative and synergistic

[155] Ibid, 7-1.
[156] Ibid, Appendix F.
[157] URS Australia Pty Ltd, 'Channel Deepening Project Risk Assessment for SEES' in Port of Melbourne Corporation 2007b, above n 23, Appendix F, 8-9 of 55 (Table 1 South of the Bay: Key Pathways for all Predicted Effects), 12-13 of 55 (Table 2 South of the Bay: Key Pathways for Significant Risk to Assets), 16 of 55 (Table 3 Yarra River and Hobsons Bay: Key Pathways for all Predicted Effects), 19-22 of 55 (Table 4 Yarra River and Hobsons Bay: Key Pathways for Significant Risk to Assets), 25 of 55 (Table 5 North of the Bay: Key Pathways for all Predicted Effects), 28 - 29 of 55 (Table 6 North of the Bay: Key Pathways for Significant Risk to Assets), 33-34 of 55 (Table 7 The Entrance: Key Pathways for all Predicted Effects), 37 of 55 (Table 8 The Entrance: Key Pathways for Significant Risk to Assets).
[158] URS Australia Pty Ltd, 'Channel Deepening Project Risk Assessment for SEES' in Port of Melbourne Corporation 2007b, above n 23, 5-10; URS Australia Pty Ltd, Channel Deepening Project Risk Assessment for SEES in Port of Melbourne Corporation 2007b, above n 23, Appendix F, 8-9 of 55 (Table 1 South of the Bay: Key Pathways for all Predicted Effects), 16 of 55 (Table 3 Yarra River and Hobsons Bay: Key Pathways for all Predicted Effects), 25 of 55 (Table 5 North of the Bay: Key Pathways for all Predicted Effects), 33-34 of 55 (Table 7 The Entrance: Key Pathways for all Predicted Effects).
[159] URS Australia Pty Ltd, 'Channel Deepening Project Risk Assessment for SEES 'in Port of Melbourne Corporation 2007b, above n 23, Appendix F, 12-13 of 55 (Table 2 South of the Bay: Key Pathways for Significant Risk to Assets), 19-22 of 55 (Table 4 Yarra River and Hobsons Bay: Key Pathways for Significant Risk to Assets), 28 - 29 of 55 (Table 6 North of the Bay: Key Pathways for Significant Risk to Assets), 37 of 55 (Table 8 The Entrance: Key Pathways for Significant Risk to Assets).
[160] See, eg, URS Australia Pty Ltd, 'Channel Deepening Project Risk Assessment for SEES' in Port of Melbourne Corporation 2007b, above n 23, 8-9 of 55 (Appendix F: Table 1 South of the Bay: Key Pathways for all Predicted Effects), 12-13 of 55 (Table 2 South of the Bay: Key Pathways for Significant Risk to Assets).
[161] URS Australia Pty Ltd, 'Channel Deepening Project Risk Assessment for SEES' in Port of Melbourne Corporation 2007b, above n 23, 3-2.
[162] Ibid, 3-2.

interactions associated with the identified predicted effects. Table 6-3 summarises the potential for these type of interactions to occur in association with the 'significant risks to assets'. The potential for cumulative interactions to occur is identified as being across time and/ or space and a focus on compounding interactions when the impact type is the same. The potential for temporal and spatial synergistic interactions to occur between different impact types is also identified. The identification is made on the basis that the impacts are not occurring in isolation or within a confined non-interactive environment. The fluidity of the marine environment, and the potential movement and dispersion of impacts (e.g. chemicals, sediment, and noise) is also acknowledged.

Several limitations to both the input data and method of review and analysis are acknowledged as a consequence of identifying the potential interactions. For example, Tables 6-2 and 6-3 are limited by a failure to consider environmental variables including environmental change (e.g. climate change) and other unidentified compounding factors. The information from the SEES *Key Pathway* tables is also limited to the extent of predicted effects, significant risks, activities and causal pathways identified by the SEES Risk Assessment process.[163] It is also noted that the *Key Pathway* tables provide inadequate information as to the potential for interactions from activities associated with non-CDP projects and activities, both existing and proposed within the project areas or other areas of the bay. Given the limitations, Tables 6-2 and 6-3 can only be seen as theoretical in representation of the possible synergistic and cumulative effect outcomes. Further, Tables 6-2 and 6-3 do not provide for scientific conclusions as to the potential interactions identified.

Tables 6-2 and 6-3 do not indicate the extent of any potential impact. In this respect, the information relating to the pathway consequence and risk levels (e.g. 'minor' and 'moderate' for predicted effects and 'less than very low' to 'medium' for risk events), can be considered in addition to the potential combinations. Acknowledging this assists in providing information about the potential magnitude of an impact, be it isolated, synergistic or cumulative on an environmental asset.

[163] URS Australia Pty Ltd, 'Channel Deepening Project Risk Assessment for SEES' in Port of Melbourne Corporation 2007b, above n 23, Appendix F, 8-9 of 55 (Table 1 South of the Bay: Key Pathways for all Predicted Effects), 12-13 of 55 (Table 2 South of the Bay: Key Pathways for Significant Risk to Assets), 16 of 55 (Table 3 Yarra River and Hobsons Bay: Key Pathways for all Predicted Effects), 19-22 of 55 (Table 4 Yarra River and Hobsons Bay: Key Pathways for Significant Risk to Assets), 25 of 55 (Table 5 North of the Bay: Key Pathways for all Predicted Effects), 28 - 29 of 55 (Table 6 North of the Bay: Key Pathways for Significant Risk to Assets), 33-34 of 55 (Table 7 The Entrance: Key Pathways for all Predicted Effects), 37 of 55 (Table 8 The Entrance: Key Pathways for Significant Risk to Assets).

Table 6-2: Channel Deepening Process Key Pathways Predicted Effects: Potential for cumulative and synergistic impacts[164]

Legend: *Mi* – Minor (consequence value of 1 to < 10) as identified in SEES *Key Pathway* tables; *Mo* – Moderate (consequence value of 10 to < 100) as identified in *Key Pathways* tables; *blank space* – no consequence value identified in SEES *Key Pathway* tables; *red colour* – South of the Bay; *yellow colour* – Yarra River and Hobsons Bay; *blue colour* – North of the Bay; *green colour* – Entrance.

	Environmental Asset											
	Marine ecosystem	Nutrient cycle	Deep habitat	Shallow habitat	Water column habitat	Marine assemblages & species	Fish	Marine mammals	Microphytobenthos	Penguins	Seabirds	**Overall potential for cumulative impact (across time (T) and**
Activity - Impact/Effect												
Dredging												
night lighting							Mi					**T**
underwater noise							Mi Mi Mo	Mi				**T&S**
marine pest translocation												

[164] The information used in this table has been extracted from URS Australia Pty Ltd, 'Channel Deepening Project Risk Assessment for SEES' in Port of Melbourne Corporation 2007b, above n 23, 5-10; URS Australia Pty Ltd, Channel Deepening Project Risk Assessment for SEES in Port of Melbourne Corporation 2007b, above n 23, Appendix F, 8-9 of 55 (Table 1 South of the Bay: Key Pathways for all Predicted Effects), 16 of 55 (Table 3 Yarra River and Hobsons Bay: Key Pathways for all Predicted Effects), 25 of 55 (Table 5 North of the Bay: Key Pathways for all Predicted Effects), 33-34 of 55 (Table 7 The Entrance: Key Pathways for all Predicted Effects).

Table 6-2 ***cont.***

	Overall potential for cumulative impact (across time (T) and	Seabirds	Penguins	Microphytobenthos	Marine mammals	Fish	Marine assemblages & species	Water column habitat	Shallow habitat	Deep habitat	Nutrient cycle	Marine ecosystem
marine pest habitat creation												
habitat replacement/ smothering	T&S						Mi				Mi	
habitat/ flora/ fauna removal	T&S					Mo	Mi		Mi Mo			
rockfall	T									Mo		
abiotic change	T&S					Mi	Mo		Mi Mo			
canyon structure change	T					Mi				Mi		
Plume												
cyst/ microorganism suspension												
clogging	T&S	Mi Mi Mi			Mi	Mi Mi Mi		Mi	Mo			
settled sediment/ smothering	T								Mi			
reduced light	T&S	Mi Mi		Mi Mi	Mo	Mo Mi Mi Mi		Mi Mi Mi	Mi Mo		Mi Mi	
reduced visibility	T&S	Mi Mi	Mi			Mi Mi Mi Mi						
reduced denitrification												

Table 6-2 *cont.*

Overall potential for cumulative impact (across time (T) and									
Seabirds							Y	Y	Y
Penguins									
Microphytobenthos									
Marine mammals							Y		Y
Fish							Y Y	Y Y	Y
Marine assemblages & species							Y		Y
Water column habitat							Y		Y
Shallow habitat							Y Y	Y	Y
Deep habitat								Y	Y
Nutrient cycle							Y		Y
Marine ecosystem									
	toxicity	increased nutrients/ bioavailability	*Vessel*	oil/fuel spill - operational	oil/fuel - collision	grounding impact	Potential synergies by project area (Y = Yes)		Potential synergies across bay (Y = Yes)

Table 6-3: Channel Deepening Process Key Pathways Risk Events: Potential for cumulative and synergistic impacts[165]

Legend: *M* – medium as identified in SEES *Key Pathway* tables; *L* – low as identified in SEES *Key Pathway* tables; *VL* – very low as identified in SEES *Key Pathway* tables; *<VL* - less than very low as identified in SEES *Key Pathway* tables; *blank space* – no risk level identified in SEES *Key Pathway* tables; *red colour* – South of the Bay; *yellow colour* – Yarra River and Hobsons Bay; *blue colour* – North of the Bay; *green colour* – Entrance.

	Environmental Asset											
	Marine ecosystem	Nutrient cycle	Deep habitat	Shallow habitat	Water column habitat	Marine assemblages & species	Fish	Marine mammals	Microphytobenthos	Penguins	Seabirds	**Overall potential for cumulative impact (across time (T) and space (S))**
Activity - Impact/Effect												
Dredging												
night lighting												
underwater noise												

[165] The information used in this table has been extracted from URS Australia Pty Ltd, 'Channel Deepening Project Risk Assessment for SEES 'in Port of Melbourne Corporation 2007b, above n 23, Appendix F, 12-13 of 55 (Table 2 South of the Bay: Key Pathways for Significant Risk to Assets), 19-22 of 55 (Table 4 Yarra River and Hobsons Bay: Key Pathways for Significant Risk to Assets), 28 - 29 of 55 (Table 6 North of the Bay: Key Pathways for Significant Risk to Assets), 37 of 55 (Table 8 The Entrance: Key Pathways for Significant Risk to Assets).

Table 6-3 *cont.*

	marine pest translocation	marine pest habitat creation	habitat replacement/ smothering	habitat/ flora/ fauna removal	rockfall	abiotic change	canyon structure change		*Plume*	cyst/ microorganism suspension	clogging
Overall potential for cumulative impact (across time (T) and	T	T	T	T						T&S	T
Seabirds										<VL VL; VL	L
Penguins										<VL VL; L <VL; <VL	
Microphytobenthos											
Marine mammals											
Fish	<VL										L M
Marine assemblages & species											
Water column habitat											
Shallow habitat			L								L
Deep habitat											
Nutrient cycle	<VL <VL			<VL						<VL <VL; VL	
Marine ecosystem		L									M

Table 6-3 ***cont.***

	settled sediment	reduced light	reduced visibility (effects on fish movement across the bay)	reduced visibility (effects on food availability and reproduction)	reduced denitrification	toxicity	increased nutrients/ bioavailability
Overall potential for cumulative impact (across time (T) and			T	T&S	T&S	T&S	T&S
Seabirds				M		<VL	
Penguins				L			
Microphytobenthos							
Marine mammals				L			
Fish			L, VL	M, L, <VL, L	<VL, <VL	<VL, <VL	VL, VL, <VL, <VL, L, VL
Marine assemblages & species							
Water column habitat							VL
Shallow habitat							
Deep habitat							
Nutrient cycle					VL, <VL, <VL, VL, <VL, <VL		<VL, <VL, VL, VL, <VL, L, VL
Marine ecosystem							

Table 6-3 ***cont.***

	Vessel	oil/fuel spill - operational	oil/fuel - collision	grounding impact	Potential synergies by project area (Y = Yes)	Potential synergies across bay (Y = Yes)
Overall potential for cumulative impact (across time (T) and		T	T&S	T		
Seabirds			<VL <VL <VL <VL <VL <VL <VL		Y Y Y	Y
Penguins			<VL <VL <VL <VL <VL <VL <VL		Y Y Y	Y
Microphytobenthos						
Marine mammals			<VL		Y	Y
Fish					Y Y Y	Y
Marine assemblages & species						
Water column habitat						
Shallow habitat		<VL	<VL <VL	<VL <VL	Y	Y
Deep habitat						
Nutrient cycle					Y Y Y	Y
Marine ecosystem						Y

3.3.2 Limitations

The inferences that can be drawn from Tables 6-2 (Predicted Effects) and Table 6-3 (Risk Events) relate to the potential cumulative and synergistic impacts that can occur within the individual project areas as well as the wider Port Phillip Bay environment. Selected examples are used to demonstrate the concerns raised by the analysis, and as discussed earlier, the scientific assessments undertaken as part of the risk assessment process have not been analysed. Consideration is given to the role of risk assessment for predicting cumulative and synergistic impacts, when presented within the EIA framework, and the implications this can have within decision-making processes.

Table 6-2 demonstrates that there is potential for interactions to include cumulative impacts across time (occurring within the same area only), as well as across time and space (occurring within the same area as well as across multiple areas). Focusing on the potential cumulative impacts for fish, as an example, the table shows that there could be impacts from repetitive underwater noise across time, as well as across space (Yarra River and Hobsons Bay area and the Entrance). Table 6-2 demonstrates that there is the potential for synergistic interactions that might impact on fish due to the combination of impacts and effects from the activities of:

- night lighting (e.g. causing altered fish behaviour[166]);
- underwater noise (e.g. causing altered fish behaviour[167]);
- habitat/ flora/ fauna removal (e.g. potential decrease in fish food sources[168]);
- abiotic change (e.g. changes to seabed habitat[169]);
- canyon structure change (e.g. potentially affecting fish behaviour[170]);
- clogging (e.g. of gills to reduce health or cause mortality[171]);
- reduced light (i.e. inhibiting photosynthesis and therefore fish habitat[172]); and/or
- reduced visibility (e.g. affecting fish movement[173]).

As also demonstrated, these synergistic interactions could occur within a single area or across multiple areas.

[166] See, eg, URS Australia Pty Ltd, 'Channel Deepening Project Risk Assessment for SEES 'in Port of Melbourne Corporation 2007b, above n 23, Appendix F, 33-34 of 55 (Table 7 The Entrance: Key Pathways for all Predicted Effects).
[167] Ibid, 7 – 36.
[168] Ibid, Appendix F, 16 of 55 (Table 3 Yarra River and Hobsons Bay: Key Pathways for all Predicted Effects).
[169] Ibid, 7 – 11.
[170] Ibid, Appendix F, 33-34 of 55 (Table 7 The Entrance: Key Pathways for all Predicted Effects).
[171] Ibid, 7-32.
[172] Ibid, Appendix F, 8-9 of 55 (Table 1 South of the Bay: Key Pathways for all Predicted Effects).
[173] Ibid, Appendix F, 12-13 of 55 (Table 2 South of the Bay: Key Pathways for Significant Risk to Assets).

Focusing on the example of fish, Table 6-3 demonstrates that there is the potential for significant risk events to occur due to cumulative impacts from repetitive exposure to reduced visibility (across time), and across time and space due to the impacts of reduced visibility within multiple areas (Yarra River and Hobsons Bay, and South of the Bay). The potential for synergistic interactions creating a significant risk event for fish, as identified in Table 6-3, is identified by the combinations of impacts that might occur from activities such as:

- marine pest translocation (e.g. causing habitat change and/or species displacement[174]);
- clogging;
- reduced visibility;
- reduced denitrification;[175]
- toxicity (e.g. from released contaminants[176]); and
- increased nutrients/ bioavailability (e.g. impacts from algal blooms[177]).

Again, risk events caused by synergistic interactions could occur within a single area or across multiple areas.

This analysis approach can also be applied to the remainder of the environmental assets included within both Tables 6-2 and 6-3. When this approach is applied it demonstrates the potential for more cumulative and synergistic interactions to be classified as 'predicted effects' and/or identified as 'risk events' than acknowledged within the SEES risk assessment process. Whether these potential cumulative and/or synergistic impacts are likely to occur (and therefore be identified as risk events or predicted effects by the risk assessment), as well as whether the interactions will be beneficial or detrimental for the environmental asset requires further scientific analysis. The inference, however, that there is an increased likelihood of predicted effects and/or significant risk events establishes that there is inadequacy within the process for assessing cumulative and/ or synergistic impacts. Further, for all examples illustrated in Table 6-2, it is noted that where the predicted effects are identified as having a consequence level, the potential for the magnitude of the impact on environmental assets from both cumulative and synergistic impacts could increase due to the compounding characteristics of cumulative impacts. Where the consequence levels of the significant risk events are identified within Table 6-3, the potential for the magnitude of impact on environmental assets from both cumulative and synergistic impacts could also increase due to the nonlinear characteristics of synergistic

[174] Ibid, 7-38.
[175] Ibid, Appendix F, 28 - 29 of 55 (Table 6 North of the Bay: Key Pathways for Significant Risk to Assets).
[176] Ibid, Appendix F, 19-22 of 55 (Table 4 Yarra River and Hobsons Bay: Key Pathways for Significant Risk to Assets).
[177] Ibid, Appendix F, 19-22 of 55 (Table 4 Yarra River and Hobsons Bay: Key Pathways for Significant Risk to Assets).

impacts. This could result in the certainty of occurrence increasing and therefore shift some of the identified ‘risk events’ into the ‘predicted effects’ category. The consequences of this would also need to be reflected in any impact avoidance or mitigation strategy.

The difficulty of accurately anticipating risk for cumulative or synergistic impacts is further highlighted when consideration is given to the simplified approach to the tables used for this assessment, and the overlay method undertaken for Tables 6-2 and 6-3. Not only are potential combinations ignored, the risk assessment matrices demonstrate that the range of variables being considered was insufficient. This includes the representation of environmental variables caused by the fluidity of the marine environment (e.g. dispersion and dilution), environmental change (e.g. biodiversity loss and climate change), and human caused variables such as differing time periods between repetitive actions, or inadequate scientific knowledge about impact interactions. As identified in the *Advice on the Channel Deepening Project Supplementary Environmental Effects Statement, Independent Expert Group, May 2007, to the Secretary Department of Sustainability and Environment* (Independent Expert Group Report), development of the risk assessment was dependent upon the existing knowledge of experts advising the proponent.[178] It is also necessary to consider that the development of a risk assessment by experts might also be subject to parameters set by a proponent’s project coordinator.[179] The parameters associated with the workshops undertaken to develop the risk assessment process included focus on cumulative impacts.[180] Given the inferences from Tables 6-2 and 6-3, it is considered that the consideration of synergistic impacts was not a focus of any such parameters.

The prediction levels summarised in Table 6-2, and the consequence levels summarised in Table 6-3, demonstrate the restricted approach to linear assessments and a failure to address the complexities associated with cumulative impacts and the nonlinear interactions caused by synergistic impacts. The lack of mathematical and numerical modelling applicable to the risk assessment was acknowledged by the Independent Expert Group Report.[181]

Campbell and Gallagher’s comment (see above) about the use of risk assessment when data is limited is applicable to the limited knowledge there is about cumulative and synergistic

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[178] Graham Mitchell et al, *Advice on the Channel Deepening Project Supplementary Environmental Effects Statement, Independent Expert Group, May 2007, to the Secretary Department of Sustainability and Environment*, (Department of Sustainability and Environment, May 2007), 10 <http://www.dtpli.vic.gov.au/_assets/pdf_file/0017/233090/FINAL_IEG_Advice_on_CDP_SEES_1_May_2007.pdf.
[179] See, eg, URS Australia Pty Ltd, ‘Channel Deepening Project Risk Assessment for SEES’ in Port of Melbourne Corporation 2007b, above n 23, 2-2 – 3-2.
[180] Ibid, 5-20, 5-22.
[181] Mitchell et al, above n 178, 10.

impacts,[182] and provides an argument for using risk assessments within environmental assessments. The constraints of the risk assessment tool and the uncertainty about predicted impacts that results (also discussed above) should, however, be acknowledged within environmental assessment documentation. This would then ensure that decision-makers are better informed of the uncertainties. Further, it is suggested that improving legal requirements for cumulative and synergistic impact assessments could assist with alleviating some of the issues raised in relation to the shortcomings of risk assessments discussed above. This could be achieved through an increase in data collection and an associated development of cumulative and synergistic impact assessment methodology (e.g. modelling) that would follow on from mandatory requirements to undertake these assessments.

3.4 Implications of shortcomings in approach to cumulative and synergistic impact predictions and risk assessment

The inference from Tables 6-2 and 6-3 that more scientific analysis was required to predict the likelihood of detrimental (or beneficial) cumulative and synergistic impacts, than demonstrated by the SEES risk assessment, should also be considered alongside the Table 6-1 analysis. There were few concerns raised within expert technical reports as to the potential for detrimental cumulative or synergistic effects (refer to the discussion in section 3.2). It could be reasoned that the potential for such impacts to occur was dismissed after assessment due to a lack of significance. It has also been acknowledged that it is not appropriate to comment on the accuracy of expert assessment within this forum. It is arguable, however, that the absence of legal requirements relating to assessment parameters (for cumulative and synergistic impacts) and the subsequent potential for inconsistencies and inadequacies in approach within the CDP SEES (as discussed above) could result in unidentified and/or unmitigated detrimental impacts on the marine environment. Without a systematic assessment approach, and the inclusion of such impact analysis, there is also potential for inadequate consideration of site specific conditions, as well as constraints on continuously evolving knowledge. Further, a decision-making process associated with an inadequate assessment approach could be seen as neglecting the precautionary principle. The risk of this occurring is emphasised by the statements within the expert reports and risk assessment that, owing to complexity, nonlinear assessment

[182] See, eg, Caitlin M Crain et al, 'Understanding and Managing Human Threats to the Coastal Marine Environment', (2009) 1162 *The Year in Ecology and Conservation Biology 2009: Ann. N.Y. Acad. Sci* 39, 52; Samuli Korpinen, Manuel Meidinger and Maria Laamanen, 'Cumulative impacts on seabed habitats: An indicator for assessments of good environmental status' (2013) 74 *Marine Pollution Bulletin* 311, 313; Selina Agbayani, Candace M Picco and Hussein M Alidina, 'Cumulative impact of bottom fisheries on benthic habitats: A quantitative spatial assessment in British Columbia, Canada' (2015) 116 *Ocean and Coastal Management* 423, 432; Katarina Pavlickova and Monika Vsykupova, 'A method proposal for cumulative environmental impact assessment based on landscape vulnerability evaluation' (2015) 50 *Environmental Impact Assessment Review* 74, 75.

outcomes are avoided.

Whether the shortcomings are the result of inadequate legal foundations or the inadequate identification of parameters associated with the risk assessment process, there are implications for the decision-making making process. These implications concern the level of information provided to decision-makers and the application of, and burden of proof associated with, the precautionary principle. As suggested in Chapter 3,[183] when assessing cumulative and synergistic impacts the onus of the burden of proof should be shared between the proponent and the decision-maker. The shortcomings identified because of the level of cumulative and synergistic impact assessment provided within the SEES demonstrate that the proponent has not established their share of the burden of proof to a suitable degree.

Providing recommendations for the improvement of cumulative impact assessment within environmental assessment decision-making in Canada, Hegmann and Yarranton stated that proponents assessing cumulative impacts need to ensure that the science is robust whilst being prepared to acknowledge uncertainty.[184] Although the SEES process has involved a general acknowledgement of uncertainty,[185] this recommendation can also be applied to circumstances such as the CDP decision-making process where the level of information provided about cumulative and synergistic impacts is inadequate, and the onus of the burden of proof shifts to the decision-maker. In this instance, should there be a decision to approve a proposed project, the application of the precautionary principle within the decision-making process could be constrained unless the limitations, and any uncertainty associated with the conclusions about cumulative and synergistic impacts, is acknowledged. The way in which consideration was given to cumulative and synergistic impacts within the CDP decision-making process is discussed further below.

When considering the risk assessment methodology alongside the discussion associated with the expert assessments within the SEES, it is suggested that the focus on individual environmental assets results in an approach to the assessment of cumulative (and synergistic) impacts that isolates interactions. An improved approach might also include a more holistic assessment, for example, ecosystems approaches and the potential influence of environmental change. An approach such as this would provide an opportunity to consider cumulative and synergistic impacts with a greater level of detail.

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[183] Refer to section 3.1.2

[184] Hegmann and Yarranton, above n 1, 488.

[185] See, eg, URS Australia Pty Ltd, 'Channel Deepening Project Risk Assessment for SEES' in Port of Melbourne Corporation 2007b, above n 23, 3-3.

4. The Report of the Inquiry and the Minister's Final Recommendation

After public exhibition of the SEES in 2007, a panel inquiry was undertaken to provide recommendations to the Minister. The documents released after this inquiry included the *Environmental Effects Act 1978, Port Phillip Bay Channel Deepening Process, Supplementary Environmental Effects Statement, Report of the Inquiry, October 2007*[186] and associated *Environment Effects Act 1978 Port Phillip Bay Channel Deepening Supplementary Environmental Effects Statement Appendix to the Report of the Inquiry Environmental Assessment Report*[187] (both documents hereon referred to as the 'Panel Report 2007'). The Panel Report 2007 also considered the Independent Expert Group Report.[188] In addition to the SEES and the Independent Expert Group's Report, the Panel Report 2007 reviewed public submissions.[189] The recommendations of the Panel Report 2007 focused on approving the CDP subject to modifications and ongoing monitoring.[190] The report and recommendations were then considered by the Minister and the *Port Phillip Bay Channel Deepening Process Assessment under Environmental Effects Act 1978, Minister for Planning, November 2007* (the Minister's Final Recommendation).[191]

This section analyses the extent of consideration given to cumulative and synergistic impacts within the discussion and recommendations of the Independent Expert Report, the Panel Report 2007, and the recommendation made within the Minister's Final Recommendation for a decision under the *Coastal Management Act 1995* (Vic). The statement of reasons[192] and decision of approval[193] made under the Federal Government's *EPBC Act 1999* (Cth) are also reviewed. To ensure consistent analysis, the terms 'combined effects' and 'interactive' have also been reviewed.

[186] Hawke, Mitchell and Lisle-Williams, 2007a, above n 24.
[187] Hawke, Mitchell and Lisle-Williams, 2007b, above n 24.
[188] Mitchell et al, above n 178.
[189] Hawke, Mitchell and Lisle-Williams, 2007a, above n 24, 6.
[190] See, eg, Hawke, Mitchell and Lisle-Williams, 2007a, above n 24, 28 – 32.
[191] Minister for Planning, Victorian Government, above n 20.
[192] Australian Government Department of the Environment, Water, Heritage and the Arts, *Statement of Reasons for Grant of approval under the Environment Protection and Biodiversity Conservation Act 1999* (18 January 2008) <http://www.environment.gov.au/epbc/notices/assessments/2002/576/statement-reasons.pdf>.
[193] Australian Government Department of the Environment, Water, Heritage and the Arts, (20 December 2007) above n 26; Australian Government Department of the Environment, Water, Heritage and the Arts, (3 July 2008) above n 26.

4.1 Addressing cumulative and synergistic impacts within the Independent Expert Group Report, the Panel Report 2007, and the Minister's Final Recommendation

The 2007 Panel Report acknowledged the potential for cumulative and synergistic impacts to occur as a result of turbidity[194] and, as with the Independent Expert Group Report, acknowledged that the SEES has considered the issue.[195] The Panel also referred to comment within the Independent Expert Group Report about the need for 'good predictions' to ensure that cumulative effects are understood.[196]

For cumulative impacts, the Panel Report identifies the 'additive' definition identified within the SEES,[197] as well as notes the Independent Expert Group Report comments (discussed above) about the use of risk assessments in favour of modelling and the subsequent constraints on predictive analysis for addressing complex interactions.[198] Public concern was also raised about the inadequacy of models used to address cumulative and synergistic impacts on the nitrogen cycle.[199]

Comments within the Panel Report 2007 about the extent of predicted cumulative impacts on species were limited to the conclusion that anchovy fish would not be impacted upon by CDP activities across project areas.[200] As indicated in the analysis of the SEES risk assessment process and cumulative and synergistic impact predictions, there was a conclusion in only a small number of instances that cumulative and/or synergistic impacts of any significance are likely to occur. This demonstrated that further scientific assessment was required to ensure an adequate assessment approach. This concern was further evidenced by the Independent Expert Group Report about SEES conclusions on cumulative impacts; with minimal discussion on cumulative impacts associated with the dredge plume,[201] nutrient loads,[202] and the importance of long-term monitoring for understanding the accuracy of impact predictions and risk assessment.[203]

Further reference to cumulative effects within the Panel Report 2007 acknowledged that the Victorian Coastal Strategy emphasised the need for EESs to consider cumulative impacts.[204]

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194 Hawke, Mitchell and Lisle-Williams 2007b, above n 24, 131.
195 Ibid, 131; Mitchell et al, above n 178, 19.
196 Hawke, Mitchell and Lisle-Williams 2007b, above n 24, 132; Mitchell et al, above n 178, 19.
197 Hawke, Mitchell and Lisle-Williams 2007b, above n 24, 143.
198 Ibid, 224 – 225.
199 Ibid, 150.
200 Ibid, 153 & 163.
201 Mitchell et al, above n 178, 19.
202 Ibid, 30.
203 Ibid, 42.
204 Hawke, Mitchell and Lisle-Williams 2007b, above n 24, 33.

The Panel Report 2007 references to synergistic impacts were generally limited with the only other reference acknowledging the SEES conclusion that synergies are unlikely to occur.[205] Synergistic effects were not discussed within the Independent Expert Group Report.[206]

The term 'combined effect/s' was not used within the Panel Report 2007 or the Independent Expert Group Report. The Panel Report 2007 uses the term 'interactive' to discuss impacts when focusing on public concerns about exposure to contaminated sediment and the need for consideration within the environmental management plan,[207] as well as the inadequate consideration within nitrogen cycle modelling to the assessment of nonlinear interactions.[208] The concerns raised by the Independent Expert Group about the lack of appropriate modelling for complex systems, even though the SEES stated that risk assessments incorporated 'additive and interactive cumulative effects', were also discussed.[209]

Considering the overall approach to cumulative and synergistic impacts (including the alternative terms) within the Panel Report 2007 and the Independent Expert Group Report, the limited discussion is reflective of the shortcomings in the SEES approach. Whilst issues of concern about risk assessment capabilities are acknowledged, the recommendations supported the CDP[210] but with no recommendations aimed at counteracting these concerns through specifically addressing the potential for cumulative and/or synergistic impacts. This could have been achieved within recommendations for further research and assessment, modifications, environmental management plan or monitoring programmes. In relation to 'indirect' impacts, however, a reason for the limited concerns can be found in the acknowledgement by the Panel Report 2007, and the Independent Expert Group Report. This reason focused on the possibility that the SEES approach of avoiding the prediction of these impact types was due to the extent of uncertainty as to cause.[211] This raises the question of whether the uncertainty was considered too complex to address, and subsequently contributed to an avoidance of predictions and discussion associated with cumulative and synergistic impacts.

Following the Panel Report 2007 and the Independent Expert Group Report, the approach to cumulative and synergistic impacts was restricted within the Minister's Final Recommendation. The only reference to cumulative impacts within the Minister's Final Recommendation outlined

[205] Ibid, 143.
[206] Mitchell et al, above n 178.
[207] Hawke, Mitchell and Lisle-Williams 2007b, above n 24, 107.
[208] Ibid, 143.
[209] Ibid, 224 – 225.
[210] See, eg, Hawke, Mitchell and Lisle-Williams, 2007a, above n 24, 28 – 32.
[211] Hawke, Mitchell and Lisle-Williams 2007b, above n 24, 231; Mitchell et al, above n 178, 30.

the requirements of the Victorian Coastal Strategy emphasis (as discussed above).[212] There was no discussion about synergistic impacts, 'interactive' or 'combined' effects.[213]

4.2 Victorian and Federal Government Approvals

Following the Minister's Final Recommendation, on 14th December 2007, an approval with conditions was issued under Section 40(1)(b) of the *Coastal Management Act 1985* (Vic) (Victorian Government Approval 2007).[214] The conditions imposed by the Victorian Government Approval 2007 were general, focusing on the environmental management plan requirements, compliance, and monitoring and research programmes.[215] They did not include specific reference to cumulative and/ or synergistic impacts, or 'combined' and 'interactive' effects.

The SEES, the Panel Report 2007, the Independent Expert Group Report, the Minister's Final Recommendation, and the Victorian Government Approval 2007 informed the decision made by the Federal Government Minister for the Environment, Heritage and the Arts in December 2007.[216] Neither the *Statement of Reasons for Grant of approval under the Environment Protection and Biodiversity Conservation Act 1999*[217] (Federal Government Statement of Reasons) nor the *Approval Port Phillip Bay Channel Deepening (EPBC 2002/576)*[218] (Federal Government Approval 2007) included reference to 'cumulative', 'synergistic', or 'interactive' impact types. This was also the case for 'combined effects'.

As discussed within Chapters 3 and 4, the precautionary principle can be applied in a way that facilitates an increase in assessment requirements for, and subsequently knowledge about, cumulative and synergistic impacts within the marine environment.[219] From within the decision-making documents,[220] the Panel Report 2007 included minimal discussion about the precautionary principle as a part of the approach to protection for environmental assets. This

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212 Minister for Planning, Government of Victoria, above n 20, 137.
213 Minister for Planning, Government of Victoria, above n 20.
214 Minister for the Environment and Climate Change, Government of Victoria, above n 26.
215 Ibid, Conditions 1 – 8.
216 Australian Government Department of the Environment, Water, Heritage and the Arts (18 January 2008), above n 192, 7.
217 Australian Government Department of the Environment, Water, Heritage and the Arts (18 January 2008), above n 192.
218 Australian Government Department of the Environment, Water, Heritage and the Arts (20 December 2007), above n 26; Australian Government Department of the Environment, Water, Heritage and the Arts (3 July 2008), above n 26.
219 See, eg, the discussion in Chapter 3, section 3, and Chapter 4, section 2.2.
220 As the scientific approach of the SEES experts is not being examined within this thesis, an analysis of the precautionary principle's application within the SEES is not considered appropriate for the purpose of this discussion.

included: reference to the *EPBC Act 1999* (Cth) consideration requirements for protection of the Australian Grayling as acknowledged within the SEES;[221] a request from a public submitter for the principle's application within the assessment process;[222] and comment that any application of a precautionary approach within the environmental management plan process would be subject to 'CDP timelines and costs'.[223] The precautionary principle was also acknowledged for general[224] and specific[225] application within the Minister's Final Recommendation. The Federal Government Statement of Reasons included reference to the general application of the precautionary principle.[226] There was no reference to the precautionary principle within the report of the Independent Expert Group Report, Federal Government Approval 2007, or the Victorian Government Approval 2007.

As discussed by Jessup, the approach of ' "managing-away" environmental concerns' through conditions of approval, can be used by decision-makers when the extent of uncertainty associated with a project needs to be reduced.[227] Applying this issue to the CDP, Jessup raises the question of whether the CDP, because of the apparent ease of applying approval conditions to manage the environmental impacts, was assessed and approved in a manner that was consistent with the principles of ecologically sustainable development (ESD).[228] Jessup's concerns can also be applied to the shortcomings in approach for the CDP assessment of cumulative and synergistic impacts (as raised in this thesis). These concerns also raise the question of whether the precautionary principle, as a recognised element of ESD in Australia,[229] has been applied to an extent that could be seen as sufficient and effective.

5. Post-approval monitoring reporting for cumulative and synergistic impacts

Chapter 3 examined the value of assessing cumulative and synergistic impacts within post-approval monitoring;[230] including as a means of increasing knowledge about these impact types.[231] As also discussed in Chapter 3, it is important to improve the connection between the assessment of cumulative (and synergistic) impacts within EIA and post-approval monitoring

[221] Hawke, Mitchell and Lisle-Williams 2007b, above n 24, 75 – 76.
[222] Ibid, 211.
[223] Ibid, 227.
[224] See, eg, Minister for Planning, Government of Victoria, above n 20, 128.
[225] Ibid, 120, 124.
[226] Australian Government Department of the Environment, Water, Heritage and the Arts (18 January 2008), above n 192, 11 [60].
[227] Jessup, above n 8, 305.
[228] Ibid.
[229] Refer to the discussion in Chapter 4, section 2.
[230] See, eg, the discussion in Chapter 3, section 3.2.
[231] See, eg, Riki Therivel and Bill Ross, 'Cumulative effects assessment: Does scale matter?' (2007) 27 *Environmental Impact Assessment Review* 365, 367.

programmes.[232] Monitoring requirements were included within the Victorian Government Approval 2007 and Federal Government Approval 2007.

Focusing on publicly available documents, the Environmental Management Plans prepared by the Port of Melbourne Corporation and the reports from the Office of the Environmental Monitor were analysed as part of this case study to determine the approach towards cumulative and synergistic impacts. It is acknowledged that these documents only provide high level overviews of the monitoring undertaken; conversely, even though the complete data has not been reviewed, inferences can be made as to whether cumulative and/or synergistic impacts have been specifically addressed as part of the monitoring programme or results.

5.1 Port of Melbourne Corporation Environmental Management Plan

The Environmental Management Plan (EMP) was designed to mitigate any significant impacts predicted within the SEES to result from the proposed CDP activities.[233] The EMP also responded to the requirements set out in the conditions of approval.[234]

There is no evidence of reference within the EIA context to any of the terms reviewed within the EMP (all versions) published for the construction phase[235] or post-construction phase.[236]

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[232] See, eg, Monique G Dubé, 'Cumulative effect assessment in Canada: a regional framework for aquatic ecosystems' (2003) 23 *Environmental Impact Assessment Review* 723, 741; Monique Dubé et al, 'Development of a new approach to cumulative effects assessment: a northern river ecosystem example' (2006) 113 *Environmental Monitoring and Assessment* 87, 112.

[233] See, eg, Hawke, Mitchell and Lisle-Williams 2007a, above n 24, 19.

[234] See, eg, Australian Government Department of the Environment, Water, Heritage and the Arts (20 December 2007), above n 26, Condition 2; Minister for the Environment and Climate Change, Government of Victoria, above n 26, Conditions 1, 2, and 8.

[235] Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan CDP_IMS_PL_004 Rev 0* (Port of Melbourne Corporation, 13/12/2007); Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan CDP_IMS_PL_004 Rev 1* (Port of Melbourne Corporation, 30/1/2008); Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan CDP_IMS_PL_004 Rev 2* (Port of Melbourne Corporation, 11/4/2008) ; Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan CDP_IMS_PL_004 Rev 3* (Port of Melbourne Corporation, 22/7/2008) ; Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan CDP_IMS_PL_004 Rev 4* (Port of Melbourne Corporation, 2/9/2008); Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan CDP_IMS_PL_004 Rev 5* (Port of Melbourne Corporation, 3/11/2008) ; Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan CDP_IMS_PL_004 Rev 6* (Port of Melbourne Corporation, 23/1/2009); Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan CDP_IMS_PL_004 Rev 7* (Port of Melbourne Corporation, 27/5/2009) ; Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan CDP_IMS_PL_004 Rev 8* (Port of Melbourne Corporation, 5/6/2009); Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan CDP_IMS_PL_004 Rev 9* (Port of Melbourne Corporation, 14/7/2009).

[236] Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan SEMSO5-08 Rev 10* (Port of Melbourne Corporation, 9/3/2010); Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan SEMSO5-08 Rev 11* (Port of Melbourne Corporation, 29/3/2010); Port of Melbourne Corporation, above n 27.

This also applies to the EMP Close-out Report for February 2010.[237] Whilst the conditions set by the Government did not specifically require any further changes to the EMP to monitor cumulative or synergistic impacts, the proponent is not precluded from addressing these matters through their own initiative. As there is no reference to these impact types within the EMP, it could be suggested that this did not occur. The omission suggests an attitude that there is minimum value associated with assessing these types of impacts within the post-approval monitoring and impact mitigation process. The absence of legal requirement for assessing these impact types within monitoring programmes may be one of the reasons for this situation. Inadequate legal requirements also reduce the ability to gain data from post-approval monitoring for feedback into other decision-making processes that affect the Port Phillip Bay environment.

5.2 Office of the Environmental Monitor

There are no provisions in the *Environment Effects Act 1978* (Vic) for the requirement or enforcement of PAM. Instead, the Victorian Government Approval 2007 included requirements for the establishment of the Office of the Environmental Monitor (OEM).[238] The Minister's Final Recommendation provided guidance as to the role, including the ability to investigate and act upon breaches of the approval conditions and EMP requirements to manage environmental impacts.[239] The recommendations detail a broad direction,[240] with no explicit requirement to consider cumulative and/or synergistic impacts within the monitoring process.

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[237] Port of Melbourne Corporation, *EMP Close-out Report –February 2010 Channel Deepening Project – Construction* (Port of Melbourne Corporation, 2010).
[238] Minister for the Environment and Climate Change, Government of Victoria, above n 26, Condition 3.
[239] Minister for Planning, Government of Victoria, above n 20, 95; Office of the Environmental Monitor (March 2009), above n 28, iii.
[240] Minister for Planning, Government of Victoria, above n 20, 95.

There are no references to any concerns about cumulative and synergistic impacts within the quarterly and annual reports provided by the OEM,[241] or within the Reports and Advice.[242] As discussed in Chapter 3,[243] the insufficient attention given to cumulative and synergistic impacts within the monitoring process diminishes the ability to improve monitoring outcomes through the use of an iterative knowledge feedback mechanism. The importance of this is emphasised by the need for future maintenance dredging; for which the assessment of impacts was expressly excluded from the SEES.[244] If future approvals are required, the question is raised as to whether an improved assessment of cumulative and synergistic impacts would have changed the

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[241] Office of the Environmental Monitor, *Quarterly Review No. 1 – June 2008, Reporting Period: 8 February to 31 May 2008* (Victorian Government Office of the Environmental Monitor, 2008); Office of the Environmental Monitor, *Quarterly Review No. 2 – September 2008, Reporting Period: 1 June 2008 to 31 August 2008* (Victorian Government Office of the Environmental Monitor, 2008); Office of the Environmental Monitor, *Quarterly Review No. 3 – December 2008, Reporting Period: 1 September to 30 November 2008* (Victorian Government Office of the Environmental Monitor, 2008); Office of the Environmental Monitor, *Quarterly Review No. 4 – March 2009, Reporting Period: 1 December 2008 to 28 February 2009* (Victorian Government Office of the Environmental Monitor, 2009); Office of the Environmental Monitor, *Quarterly Review No. 5 – June 2009, Reporting Period: 1 March 2009 to 31May 2009* (Victorian Government Office of the Environmental Monitor, 2009); Office of the Environmental Monitor, *Quarterly Review No. 6 – September 2009, Reporting Period: 1 June to 31 August 2009* (Victorian Government Office of the Environmental Monitor, 2009); Office of the Environmental Monitor, *Quarterly Review No. 7 – December 2009, Reporting Period: 1 September to 30 November 2009* (Victorian Government Office of the Environmental Monitor, 2009); Office of the Environmental Monitor, *Quarterly Review No. 8 – March 2010, Reporting Period: 1 December 2009 to 28 February 2010* (Victorian Government Office of the Environmental Monitor, 2010); Office of the Environmental Monitor, *Quarterly Review No. 9 – June 2010, Reporting Period: 1 March 2010 to 31 May 2010* (Victorian Government Office of the Environmental Monitor, 2010); Office of the Environmental Monitor, *Quarterly Review No. 10 – September 2010, Reporting Period: 1 June 2010 to 31 August 2010* (Victorian Government Office of the Environmental Monitor, 2010); Office of the Environmental Monitor, *Quarterly Review No. 11 – December 2010, Reporting Period: 1 September 2010 to 30 November 2010* (Victorian Government Office of the Environmental Monitor, 2010); Office of the Environmental Monitor, *Quarterly Review No. 12 – March 2011, Reporting Period: 1 December 2010 to 28 February 2011* (Victorian Government Office of the Environmental Monitor, 2011); Office of the Environmental Monitor, *Quarterly Review No. 13 – June 2011, Reporting Period: 1 March 2011 to 31 May 2011* (Victorian Government Office of the Environmental Monitor, 2011); Office of the Environmental Monitor, *Quarterly Review No. 14 – September 2011, Reporting Period: 1 June 2011 to 31 August 2011* (Victorian Government Office of the Environmental Monitor, 2011); Office of the Environmental Monitor, *Quarterly Review No. 15 – December 2011, Reporting Period: 1 September 2011 to 30 November 2011* (Victorian Government Office of the Environmental Monitor, 2011); Office of the Environmental Monitor (March 2009), above n 28 ; Office of the Environmental Monitor, *Annual Review No. 2 – January 2010, Reporting period: 8 February 2008 to 28 January 2010* (Victorian Government Office of the Environmental Monitor, 2010); Office of the Environmental Monitor, *Annual Review No. 3 – January 2011, Reporting period: 8 February 2008 to 31 December 2010* (Victorian Government Office of the Environmental Monitor, 2011); Office of the Environmental Monitor (January 2012), above n 28; Office of the Environmental Monitor (2012) above n 3.

[242] Office of the Environmental Monitor, *Report and Advice on Environmental Incident at the Entrance on 20 July 2008* (Office of the Environmental Monitor, 20 August 2008); Office of the Environmental Monitor, *Report and Advice on Environmental Incident – Oil Spill at the Entrance on 30 August 2008* (Office of the Environmental Monitor, 11 September 2008); Office of the Environmental Monitor, *Report on the implementation of the Environmental Management Plan for the Entrance – February 2009* (Office of the Environmental Monitor, 16 February 2009); Office of the Environmental Monitor, *Report and Advice on Environmental Incident – a partial non-conformance with the Project Delivery Standard No.24 in South Channel on 19 April 2009* (Office of the Environmental Monitor, 21 June 2009); Office of the Environmental Monitor, *Report and Advice on Environmental Incident – a partial non-conformance with Project Delivery Standard No.34 in North of the Bay 3 August 2009* (Office of the Environmental Monitor, 26 August 2009); Office of the Environmental Monitor, *Post Construction Requirements – Report on the Implementation of the Environmental Management Plan for the Entrance – September 2009* (Office of the Environmental Monitor, 18 September 2009); Office of the Environmental Monitor, *Report on the implementation of the Environmental Management Plan for the Management of Contaminated Sediment – September 2009* (Office of the Environmental Monitor, 18 September 2009); Office of the Environmental Monitor, *Report on dredging management in the south of Port Phillip Bay to protect seagrass – December 2009* (Office of the Environmental Monitor, 21 December 2009);

[243] Refer to Chapter 3, section 3.2.

[244] Port of Melbourne Corporation 2007a, above n 23, 1-21.

approach to decision-making both in the first instance and as an adaptive mechanism for future decisions. A change in approach would, for example, include the aim of enabling a more complete data analysis approach to longer term environmental changes. The process could also include requirements for studies to be undertaken over long-term timeframes and would acknowledge the importance of long-term monitoring for Port Phillip Bay as previously identified within the CSIRO's Port Phillip Bay Environmental Study Final Report June 1996.[245] This report recommended an 'ongoing monitoring programme' to assist environmental management.[246]

A programme such as this could be broadened to encompass long-term baseline studies, and seek to avoid the concern associated with compromised accuracy of predicted impacts when there is a reliance upon desktop studies instead of undertaking baseline studies.[247] It is also acknowledged that environmental studies have been undertaken in Port Phillip Bay in the past.[248] The potential for environmental change and increased anthropogenic activities since this time, however, triggers the need to ensure further baseline information as well as subsequent measurements are collected. This facilitates a method that establishes the changes arising since the baseline information was originally collected. This would assist in ensuring the currency of information both for different time periods and in relation to specific sites.

6. Conclusion

At the time of the CDP approval, there were no legal requirements within the Victorian environmental effects assessment process to consider and assess the cumulative and/or synergistic impacts from large-scale marine use and development. This was due to the absence of legal requirements within the *Environmental Effects Act 1978* (Vic). Whilst general Ministerial guidelines referred to the assessment of cumulative impacts, [249] and the policy provided definitions, the approach was discretionary and narrow. Synergistic impacts were not addressed in these documents, and this was also the case for the project specific SEES Ministerial Assessment Guidelines 2005.[250] The discretionary and narrow approach to cumulative impacts was also reflected in these guidelines.

245 See, eg, CSIRO Australia, above n 97, 3, 220 – 221.
246 Ibid.
247 See, eg, Adam Barker and Carys Jones, 'A critique of the performance of EIA within the offshore oil and gas sector' (2013) 43 *Environmental Impact Assessment Review* 31, 34; Monique Dubé and Kelly Munkittrick, 'Integration of Effects-Based and Stressor-Based Approaches into a Holistic Framework for Cumulative Effects Assessment in Aquatic Ecosystems' (2001) 7 (2) *Human and Ecological Risk Assessment: An International Journal* 247, 248 – 251; David Kriebel et al, 'The Precautionary Principle in Environmental Science' (2001) 109 (9) *Environmental Health Perspectives* 871, 873.
248 See, eg, CSIRO Australia, above n 97.
249 Department of Planning and Development, Government of Victoria, above n 37; Victorian Government Department of Sustainability and Environment, above n 38.
250 Minister for Planning, Government of Victoria, above n 19.

The general guidelines incorporated 'indirect' impacts; a term that has been concluded upon previously as contributing to the inadequacies of effective cumulative and synergistic impact assessment. The project specific guidelines also included terminology such as 'combined effects' and 'interactions' (or 'interactive'), that could be used as alternative descriptors for cumulative and synergistic impacts. When these terms are used, however, the potential for unclear definitions and inconsistency in approach can be a concern. This was demonstrated through the analysis of the Channel Deepening Project for Port Phillip Bay, in particular the SEES,[251] and the definitions associated with cumulative and synergistic impacts.

Analysis of the SEES established critical shortcomings in respect of effective cumulative and synergistic impact assessment. Aside from an inconsistent approach to the definition and application of cumulative and synergistic terminology (including the use of alternative terms), there was a tendency to avoid nonlinear assessment methods (necessary for understanding synergistic impacts). Further, the analysis of the SEES risk assessment approach (Tables 6-2 and 6-3) indicated that the potential for cumulative and synergistic impacts to occur was greater than the risk assessment acknowledged. This, when compared to the analysis of impacts identified as of concern or not (Table 6-1), demonstrates the potential for cumulative and synergistic impacts from the CDP to remain unidentified and therefore unmitigated. To add to the potential for confusion and omission, the analysis also demonstrates that 'indirect' impacts were more frequently identified as problematic. The lack of express consideration given to the influence of environmental change was also apparent and compounds all of these shortcomings.

Whilst these conclusions are based upon the public documentation available, and do not assert failings in the scientific method associated with the expert reports, if there is incongruence between the science and the public documentation it emphasises the criticisms. The issues raised also underline the importance of ensuring that definitions and application are the responsibility of the decision-maker.

The decision making process that followed the SEES and generally involved the Panel Report 2007,[252] the Minister's Final Recommendation,[253] the Victorian Government Approval 2007[254] and the Federal Government Approval 2007[255] did not identify significant concerns about

[251] Port of Melbourne Corporation, 2007a, above n 23; Port of Melbourne Corporation, 2007b, above n 23.
[252] Hawke, Mitchell and Lisle-Williams, 2007a, above n 24; Hawke, Mitchell and Lisle-Williams, 2007b, above n 24.
[253] Minister for Planning, Government of Victoria, above n 20.
[254] Minister for the Environment and Climate Change, Government of Victoria, above n 26.
[255] Australian Government Department of the Environment, Water, Heritage and the Arts (20 December 2007), above n 26; Australian Government Department of the Environment, Water, Heritage and the Arts (3 July 2008), above n 26.

cumulative or synergistic impacts. Further, the decisions appeared to accept the tendency to avoid complex assessments (i.e. nonlinear). The absence of legal requirement that consideration be given to cumulative and synergistic impacts within decision-making processes again influences approaches such as has occurred within the CDP environmental assessment process. This also extends to the importance of post-approval monitoring, and although emphasised within the decision-making process, the analysis concluded that cumulative and synergistic impacts were not topical within the Environmental Management Plan(s)[256] or reports associated with the Office of the Environmental Monitor.[257]

The analysis within this chapter contributes to the understanding of the issues that can arise throughout an EIA and associated decision-making process when there is an absence of adequate legal requirements to consider and assess cumulative and synergistic impacts. Appropriate to this discussion, Jessup's concluding comment on the approach to ESD within the CDP process identified that 'the challenge is for law-makers to establish a legal regime that sets out protection requirements…and prevents decision-makers from deviating from those conservation requirements'.[258]

Based on the example shortcomings identified within the CDP environmental assessment process for effective cumulative and synergistic impact assessment, several recommendations can be made about improvement within the Victorian framework. The CDP analysis in this chapter clearly identifies that in order to achieve this, improved consistency in extent of application, interpretation, and assessment methods are required. Recommendations for improving the consistency include increased definition and required consideration of these impact types within legislation. The suggested change in approach can be facilitated both within the Act and/ or the translation of guidelines into delegated legislation. Further, improved guidance as to the method for assessment, and a more balanced focus on cumulative and synergistic impacts as distinct impact types is needed. Focus should be on the process as a whole through addressing the need for improved approaches to baseline studies, consistent approaches to scientific method and discussion within public documentation, consideration within assessment inquiries and ministerial recommendations, and integration within decisions. Decisions made should also identify not only requirements associated with the post-approval monitoring process, but also identify ways in which iterative feedback can be utilised for the adaptive management of issues that arise during the construction and post-construction phase, as well as for future decision-making. The application of the precautionary principle (with a shared

[256] Port of Melbourne Corporation (14/7/2009) above n 235; Port of Melbourne Corporation, above n 27.
[257] See, eg, Office of the Environmental Monitor (January 2012), above n 28; Office of the Environmental Monitor (2012) above n 3; Office of the Environmental Monitor (21 December 2009), above n 242.
[258] Jessup, above n 8, 309.

responsibility between proponents and decision-makers for the 'onus of the burden of proof') as well as acknowledgement of uncertainty is also essential.

To provide additional insight into ways the recommended improvements can occur, Chapter 7 focuses on a case study analysis of the environmental assessment of offshore wind farm energy production within Denmark. The applicable Danish legislative and European Union environmental directive frameworks are also reviewed.

CHAPTER 7 – OFFSHORE WIND FARMS IN DENMARK: THE ASSESSMENT OF CUMULATIVE AND SYNERGISTIC IMPACTS

'Qu*is custodiet ipsos custodies? – "Who shall watch the watchers themselves"… The great challenge facing us now is to invent the corrective feedbacks that are needed to keep custodians honest.'* [1]

Chapter outline

[1] G Hardin, 'The Tragedy of the Commons' (1968) 162 *Science* 1243, 1245 – 1246. This concept was raised in relation to the compounding use of oceans and the need for corrective feedback to ensure administrative decisions are accountable.

1. Introduction

The development and use of offshore wind farms (OWF) in Europe is established, with the capacity for this form of renewable energy production continuing to increase.[2] Denmark, as an example, has developed offshore wind turbines with capacity to produce 1700 MW, and an additional 1000 MW is intended by 2020.[3] The approach to the environmental impact assessment (EIA) of Danish OWF has incorporated EIA prior to approval and construction of turbines offshore, and long term monitoring of the impacts caused during and post construction.[4] The impacts assessed and monitored include cumulative and synergistic impacts on marine species and habitats.[5]

Focusing on offshore wind energy development in Denmark, this chapter aims to identify the benefits and shortcomings of the approach to cumulative and synergistic impact assessment undertaken in EIA and post-approval monitoring (PAM). This is achieved through an examination of EIA undertaken for wind farms approved and/or constructed in the Danish marine environment. The chapter reviews European Union (EU) Directives and Danish legislation focusing on EIA requirements to assess cumulative and synergistic impacts from OWF. A comparative review of the EU Directives and Danish legislation applicable to other elements of environmental assessment (e.g. strategic environmental assessment (SEA), marine planning and habitat protection) is undertaken to enable a better understanding of the EIA legislative requirements.

[2] See, eg, European Wind Energy Association, *The European offshore wind industry – key trends and statistics 1st half 2015* (European Wind Energy Association, July 2015) 3; European Wind Energy Association (2013) cited in M Wing Goodale and Anita Milman, 'Cumulative adverse effects of offshore wind energy development on wildlife' (2016) 59 (1) *Journal of Environmental Planning and Management* 1, 1.
[3] See, eg, Danish Energy Agency, *Current Offshore Wind Farm Projects* <http://www.ens.dk/en/supply/renewable-energy/wind-power/offshore-wind-power/current-offshore-wind-farm-projects; Danish Energy Agency, *Danish Experiences from Offshore Wind Development,* (Danish Energy Agency, 2017) 7; Danish Energy Agency, *Table of wind power facilities (end of March 2019)* < http://www.ens.dk/our-services/statistics-data-key-figures-and-energy-maps/overview-energy-sector>.
[4] Danish Energy Agency, *Environmental Impacts* <http://www.ens.dk/en/supply/renewable-energy/wind-power/offshore-wind-power/environmental-impacts>; Danish Energy Agency, *Environmental Reports for Specific Danish Projects* <http://www.ens.dk/supply/renewable-energy/wind-power/offshore-wind-power/environmental-impacts/environmental-reports>.
[5] See, eg, Danish Energy Agency, *Guidance Document on Environmental Impact Assessment: Danish Offshore Wind Farms* (Danish Energy Agency, NIRAS, February 2013) 2; Jakob Tougaard et al, *Harbour seals on Horns Reef, before, during and after construction of Horns Rev Offshore Wind Farm. Final report to Vattenfall A/S. Biological Papers from the Fisheries and Maritime Museum No. 5, Esbjerg, Denmark* (Fisheries and Maritime Museum, October 2006) 54.

The second section of this chapter examines different types of cumulative and synergistic impacts occurring within the marine environment as a result of OWF use and development. The third section examines the issue of uncertainty for the effective EIA of offshore wind farms. This is followed by the fourth section analysis of the approach taken to the assessment of these impact types within the EIA reports for the Anholt and Kriegers Flak offshore windfarms. The fifth section focuses on the environmental monitoring programmes associated with Horns Rev I and Nysted (also known as Rødsand) OWF. The examination of the Danish EIA and PAM examples provides an analysis of past approaches to OWF EIA (Anholt OWF EIA 2010 and Kriegers Flak OWF EIA 2015) and subsequent PAM programmes (Horns Rev and Nysted OWF 1999 – 2012). Within the fourth and fifth sections the approach to cumulative and synergistic impact assessment is analysed to determine potential benefits and shortcomings within the case study sites.

The sixth section focuses on the current Danish guidelines applicable to cumulative and synergistic impact assessment within the EIA process for OWF development. Thus taking the case study-specific benefits and shortcomings and upscaling these to the national level. At the national and EU levels, the seventh section analyses the requirements for assessment of cumulative and synergistic impacts within the Danish and EU environmental assessment legal frameworks applicable to offshore use and development. The EU Environmental Directives and Danish legislation are examined against the identified benefits and shortcomings of approach to cumulative and synergistic impact assessment. The legal framework was reviewed with a currency date of March 2016; an appropriate point in time that is both post the Kriegers Flak OWF EIA 2015 and not disconnected, because of time lag, from the time period in which both EIAs occurred. Selecting an appropriate point in time post the Kriegers Flak OWF EIA 2015 assists with an understanding of whether the legal framework supported any benefits identified for the OWF EIA approach, as well as whether any identified shortcomings were subsequently addressed. The final section provides for the chapter's conclusion.

Evidenced in discussion within Chapter 2, cumulative and synergistic impacts are different and should be defined separately. When legislation is referenced, for the purpose of this chapter 'cumulative' and 'synergistic' impacts are identified as distinct impact types and reference to one impact type does not include reference to the other. This is the same as the approach taken in Chapters 4, 5 and 6. However, as with the approach to discussion within literature in Chapters 3, 4, 5 and 6, the term 'cumulative (and synergistic)' is used when it is anticipated that the references used assumed synergistic impacts to be included as a type of cumulative impact.

2. Cumulative and synergistic environmental impacts from offshore wind farm development

Cumulative and synergistic impacts from OWF can be identified by environmental assessments of an individual project development (i.e. when the project is subject to an EIA) and through broader marine spatial planning (i.e. when the project is subject to an SEA).[6] This section reviews the marine environment impacts that could be caused by the development and use of large-scale OWF. The literature reviewed focused primarily on cumulative impacts; as such, the discussion in this section focuses more on cumulative impacts than synergistic impacts (as a distinct impact type).

The literature identified potential impacts that can accumulate or combine to create positive and negative cumulative impacts. These relate to the construction, operation and decommissioning phases of OWF. Examples of the negative impacts include: noise and vibration from construction activities (e.g. drilling and pile driving), turbine operation, and decommissioning (e.g. explosives); habitat degradation and changes in species population; potential pollution from increases in vessel movement, anti-fouling, suspended sediment levels, and vessel collisions; the potential for changes to food sources, and species diversity and animal behaviour from artificial structures; and electromagnetic effects from cables.[7] The resultant cumulative impacts can occur due to the construction of multiple turbines within an individual OWF, or multiple OWF within a region.[8] Cumulative (and synergistic) impacts can also be caused by the interaction of these impacts with impacts from other anthropogenic activities[9] (e.g. harbour dredging), as well as environmental change.[10]

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[6] See, eg, Malte Busch et al, 'Consequences of a cumulative perspective on marine environmental impacts: Offshore wind farming and seabirds at North Sea scale in context of the EU Marine Strategy Framework Directive' (2013) 71 *Ocean & Coastal Management* 213, 214; Alastor Coleby, 'Assessment of Marine Renewable Energy Industry Stakeholder Requirements in North Scotland' (2010) 12(1) *Journal of Environmental Assessment Policy and Management* 29, 32; Fanny Douvere and Charles N Ehler, 'New Perspectives on sea use management: Initial findings from European experience with marine spatial planning' (2009) 90 *Journal of Environmental Management* 77, 77; Christina Kelly et al, 'Investigating options on how to address cumulative impacts in marine spatial planning' (2014) 102 *Ocean and Coastal Management* 139, 139.

[7] See, eg, Sarah Dolman and Mark Simmonds, 'Towards best environmental practice for cetacean conservation in developing Scotland's marine renewable energy' (2010) 34 *Marine Policy* 1021, 1023.

[8] See, eg, R H W Langston and J D Pullan (2003) cited in Gavin B Stewart, Andrew S Pullin, and Christopher F Coles, 'Poor evidence-base assessment of windfarm impacts on birds' (2007) 34 (1) *Environmental Conservation* 1, 9 <http://doi.10.1017/S0376892907003554>; R H W Langston and J D Pullan, *Windfarms and Birds: An analysis of the effects of windfarms on birds, and guidance on environmental assessment criteria and site selection issues. Report T-PVS/Inf (2003) 12, by Birdlife International to the Council of Europe, Bern Convention on the Conservation of European Wildlife and Natural Habitats. RSPB/Birdlife in the UK* (Secretariat Memorandum prepared by the Directorate of Culture and of Cultural and Natural Heritage, 2003) 3.

[9] See, eg, A D Fox et al, 'Information needs to support environmental impact assessment of the effects of the European marine offshore wind farms on birds' (2006) *Ibis* 129, 141; M Wing Goodale and Anita Milman, 'Cumulative adverse effects of offshore wind energy development on wildlife' (2016) 59 (1) *Journal of Environmental Planning and Management* 1, 2.

[10] See, eg, Han Lindeboom et al, 'Offshore wind park monitoring programmes, lessons learned and recommendations for the future' (2015) 756 *Hydrobiologia* 169, 175.

Whilst all marine species and habitats have the potential to be affected by OWF construction and operation if they are in the OWF habitat region,[11] the literature reviewed focused most often on the impacts on marine mammals[12] and birds (e.g. seabirds and migratory birds).[13] Impacts on marine mammals include an increase in duration and intensity of underwater noise potentially leading to avoidance behaviour.[14] Bird impacts include the avoidance of an area and increased energy expenditure due to turbines located within flight paths,[15] displacement from feeding sites,[16] changes to food availability,[17] and an increase in collision potential.[18] Further, concern is raised about effects of multiple OWF in a spatial region causing pressure on a species that results in population decline and lowered resilience.[19]

The potential for beneficial synergistic impacts on 'fish community structure' also exists.[20] Such impacts can increase with the larger scale wind farms providing artificial reef environments and altering 'biological interactions' within an area.[21] Artificial reefs can provide a positive cumulative impact, and examples of the ways in which this occurs include through increases in biodiversity, food, shelter, and nursery habitat.[22] Bergström et al, however, state that such positive gains for some species can result in negative impacts for others.[23]

Commentators also emphasise the need for monitoring and adaptive management to assist in reducing detrimental environmental effects.[24] The monitoring of cumulative impacts from adequate base-line studies is also identified as critical to enable appropriate comparisons between the health of species and habitat before and after OWF construction, as well as increasing the understanding of cumulative impacts.[25] Effective monitoring of cumulative impacts from OWF has been identified as a challenge.[26] To achieve effective monitoring when large marine areas are involved, Busch et al suggest that a high level coordinated approach

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[11] See, eg, Goodale and Milman, above n 9, 1 - 2.
[12] See, eg, Dolman and Simmonds, above n 7, 1023; P T Madsen et al, 'Wind turbine underwater noise and marine mammals; implications of current knowledge and data needs' (2006) 309 *Marine Ecology Progress Series* 279, 290, 293; Lena Bergström et al, 'Effects of offshore wind farms on marine wildlife – a generalized impact assessment' (2014) 9 *Environmental Research Letters* 1, 8 - 9 <http://doi:10.1088/1748-9326/9/3/034012>.
[13] See, eg, Gavin B Stewart, Andrew S Pullin, and Christopher F Coles, 'Poor evidence-base assessment of windfarm impacts on birds' (2007) 34 (1) *Environmental Conservation* 1, 8 <http://doi.10.1017/S0376892907003554>; Fox et al, above n 9, 130.
[14]See, eg, Dolman and Simmonds, above n 7, 1023 - 1024; Madsen et al, above n 12, 290, 293.
[15] See, eg, Fox et al, above n 9, 135 – 136.
[16] Ibid, 136 – 138.
[17] Ibid, 138.
[18] Ibid, 138 - 140.
[19] Goodale and Milman, above n 9, 7 – 8.
[20] Dan Wilhelmsson, Torleif Malm and Marcus C Ohman, 'The influence of offshore windpower on demersal fish' ICES Journal of Marine Science, 63: 775 – 784 (2006), 782.
[21] Wilhelmsson, Malm and Ohman, above n 20, 782.
[22] Bergström et al, above n 12, 7 -9.
[23] Ibid.
[24] See, eg, Dolman and Simmonds, above n 7, 1026; Goodale and Milman, above n 9, 8, 14; Lindeboom et al, above n 10, 175.
[25] See, eg, Fox et al, above n 9, 136; Goodale and Milman, above n 9, 8, 14.
[26] See, eg, Lindeboom et al, above n 10, 175 - 176.

within the marine spatial planning framework is required to enable effective impact mitigation.[27] Further, Goodale and Milman identified that the question as to whether thresholds set for individual species are appropriate for cumulative impacts, should also be considered if the issue associated with a lowered resilience is to be addressed.[28]

The uncertainty associated with insufficient knowledge and research about the cumulative impacts of OWF development and use is also identified in the literature.[29] The issue of uncertainty in relation to inadequate knowledge about cumulative impacts is examined further below.

3. 'Uncertainty' as an issue for the cumulative and synergistic impacts of offshore wind farms

Throughout the thesis, the issue of uncertainty surrounding cumulative and synergistic impacts has been discussed as focused on by numerous scholars,[30] and identified as an issue for effective EIA.[31] How uncertainty affects the accuracy of predictions and results from scientific modelling and decision-making is part of the scientific discussion surrounding environmental impacts from OWF. For example, Stewart, Pullin and Coles have discussed the uncertainty surrounding the cumulative impact potential for sea ducks around Britain due to variations in scale with different wind farm sites, as well as a tendency to focus on data for other bird species.[32] Further, there is a combination of lack of knowledge about impacts from OWF and marine species that makes it difficult to determine the impacts on marine biodiversity.[33]

Discussing uncertainty in the context of OWF and the impact on birds, Masden et al identified categories for uncertainty within environmental assessment.[34] The categories included 'random' uncertainty, 'systematic' uncertainty, 'linguistic' uncertainty, 'decision-making' uncertainty, 'knowledge' uncertainty, the uncertainty that is associated with inadequate science being improved upon and leading to changes in knowledge, and uncertainty due to inconsistencies in data collection and analysis methods.[35]

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[27] Busch et al, above n 6, 222.
[28] Goodale and Milman, above n 9, 8.
[29] See, eg, Elizabeth A Masden et al, 'Cumulative impact assessments and bird/ wind farm interactions: Developing a conceptual framework' (2010) 30 *Environmental Impact Assessment Review* 1, 6; Stewart, Pullin, and Coles, above n 13, 9; Elizabeth A Masden et al, 'Renewable energy developments in an uncertain world: The case of offshore wind and birds in the UK' (2015) 51 *Marine Policy* 169, 170; Goodale and Milman, above n 9, 8 - 9.
[30] For example, refer to Chapter 3, section 3; and Chapter 4, section 2.2.
[31] For example, refer to Chapter 4, section 2.2; Chapter 5, sections 2.2 and 3.2, and Chapter 6, section 3.
[32] Stewart, Pullin, and Coles, above n 13, 8.
[33] Bergström et al, above n 12, 2.
[34] Masden et al (2015), above n 29, 170 – 171.
[35] Ibid. These categories are discussed in detail in Chapter 3, section 3.

Focusing on the uncertainty associated with incomplete knowledge, Masden et al explore the risk of decision-making that assumes an understanding of cumulative impacts is correct.[36] As Masden et al discuss, however, decisions are often made when the knowledge available is limited and there are limitations on understanding marine environmental impacts.[37] For example, the majority of OWF research that has occurred is focused around northern Europe. Thus extrapolation of these impacts to other locations presents difficulties.[38] Bergström et al argue that this OWF knowledge is limited as the studies are 'restricted in spatial and temporal scope'.[39] The studies tend to concentrate on an individual species, and rarely extend to include 'ecosystem and seascape scales.'[40] Having inadequate baseline data further compounds the problems of poor knowledge.[41] Goodale and Milman argue that baseline data is critical to an effective understanding of cumulative impacts.[42] Further, the risk of uncertainty can be compounded when there is an increasing number of projects.[43] This is because of the correlating increase in the lack of knowledge required to understand outcomes.[44]

As noted by Masden et al 'systematic uncertainty' exists within OWF proposals and needs to be considered by decision-makers.[45] Specific examples that need consideration include the human 'perception' about how species are impacted, the varied approaches to methods for data collection, and the data analysis.[46] The unpredictability of natural variations in marine environments is another factor that Masden et al identified as necessary to acknowledge when seeking to address issues of uncertainty.[47]

Wright et al discussed that uncertainty needs to be incorporated into the legal frameworks for decision-making about ocean energy (i.e. wave and tidal technology);[48] a conclusion that can be applied to all types of marine renewable energy. The application of the precautionary principle in decision-making, when combined with PAM, can assist with addressing the knowledge gaps associated with uncertainty.[49] In decision-making about marine use and development proposals (subject to EIA), the precautionary principle can be applied in an approval process that requires

[36] Masden et al (2015), above n 29, 170 – 171.
[37] Ibid.
[38] Bergström et al, above n 12, 5.
[39] Ibid.
[40] Ibid.
[41] See, eg, Bergström et al, above n 12, 5; Glen Wright et al, 'Establishing a legal research agenda for ocean energy' (2016) 63 *Marine Policy* 126, 128.
[42] Goodale and Milman, above n 9, 8.
[43] Masden et al (2015), above n 29, 170; Goodale and Milman, above n 9, 8 - 9.
[44] Masden et al (2015), above n 29, 170; Goodale and Milman, above n 9, 8 - 9.
[45] Masden et al (2015), above n 29, 170 - 171.
[46] Ibid.
[47] Ibid, 170.
[48] Wright et al, above n 41, 128.
[49] Refer to Chapter 3, section 3 for a detailed discussion on this.

the ongoing development of scientific methods. The outcomes from improved methods can also help with reducing uncertainty.

The following sections seek to further understand potential approaches to the assessment of cumulative and synergistic impacts within EIA and PAM associated with OWF approved and constructed in Denmark. This is achieved through an examination of Danish EIA examples (in section 4), and PAM examples (in section 5). The examination also includes an analysis of the approach to the issue of uncertainty.

4. Danish Offshore Wind Farms: Environmental impact assessments

Offshore wind power has been utilised in Denmark since the 1990s, with 12 OWF in operation, three awaiting construction, and additional proposals within the assessment and licensing process yet to be approved.[50] This section focuses on examples of the cumulative and synergistic impact assessments that have occurred as detailed within the EIA of two large-scale Danish offshore windfarms.[51] The selected EIA examples focus on publicly available reports concerning the operational Anholt OWF, and the proposed Kriegers Flak OWF.[52] The purpose of this section is to identify the issues raised in relation to cumulative and synergistic impact assessment as detailed within the selected EIA documents.[53] These issues are then analysed to determine potential benefits and shortcomings. This discussion also addresses the issue of uncertainty.

4.1 Cumulative and synergistic impacts within environmental impact assessments – Anholt Offshore Wind Farm

Anholt OWF (Anholt) is located within the Danish maritime area between the east coast of Jutland (the Danish mainland) and Anholt Island (refer to Figure 7-1: Anholt site location).[54] The wind farm encompasses an operational area of 88km^2,[55] and is constructed with 111 wind turbines providing for 400MW power capacity.[56] The Anholt EIA documents were available for

[50] Danish Energy Agency, above n 3; Danish Energy Agency (2017) above n 3 ; Danish Energy Agency (2019), above n 3.
[51] The EIA and PAM reports selected were publicly released by the Danish Energy Agency. Only those documents available in English were reviewed.
[52] Danish Energy Agency, *Environmental Reports for Specific Danish Projects,* above n 4. Only those available in English were reviewed. The reports were publicly available as at March 2016.
[53] It is acknowledged that due to the focus on documents published in English only, the analysis of publicly available information is more limited than had Danish language documents been reviewed as well.
[54] Energinet.dk and Ramboll Wind, *Anholt Offshore Wind Farm Project Description* (Ramboll Wind, January 2010) 1.
[55] Ibid.
[56] See, eg, Dong Energy, *The Anholt Offshore Wind Farm* <http://www.anholt-windfarm.com/en/the-wind-farm>; Danish Energy Agency, *Anholt Offshore wind farm – 400MW* <http://www.ens.dk/supply/renewable-energy/wind-power/offshore-wind-power/current-offshore-wind-farm-projects/anholt>.

public consultation in early 2010,[57] with the subsequent approval of the proposal resulting in commencement of operation in September 2013.[58]

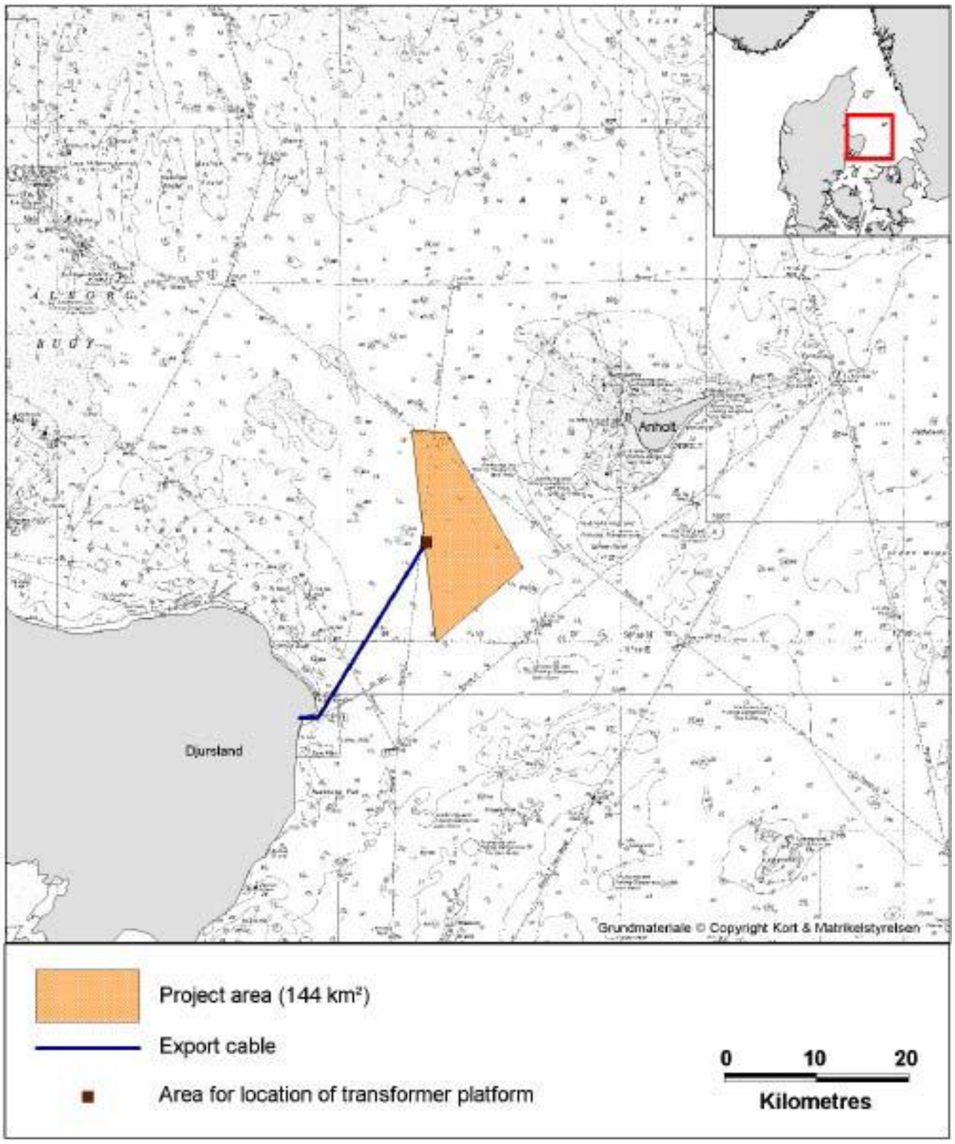

Figure 7-1: Anholt OWF site location (Source: Energinet.dk and Ramboll Wind)[59]

Only reports addressing natural environmental impacts on the marine environment were reviewed for the thesis analysis.[60] In addition to general project information and EIA

[57] See, eg, Danish Energy Agency, above n 56.
[58] See, eg, Dong Energy, above n 56.
[59] Energinet.dk and Ramboll Wind, above n 54, 1.
[60] Reports addressing non-natural environmental impacts, e.g. visual impacts, were not reviewed. See, eg, Ramboll Oil and Gas, *Anholt Offshore wind farm Visualization Report: Background memo for the environmental impact assessment of the Anholt Offshore Wind Farm Project* (Ramboll Oil and Gas, Rev 9, December 2009).

methodology,[61] the reports focused on: air emissions;[62] benthic fauna;[63] benthic habitat;[64] birds;[65] geotechnical investigations;[66] hydrography, sediment, water, and geomorphology;[67] marine mammals;[68] and noise.[69]

The *Anholt Offshore Wind Farm: Method for impact assessment* identified cumulative impacts as a type of impact to be assessed.[70] The definition provided was: '*Cumulative effects are here defined as combined effects of Anholt offshore Wind Farm and other man-made third structures/projects, of which the Universal Wind Park at Store Middelgrund is the most important*.'[71] This definition is narrow and limits cumulative impacts to those that are in combination with existing or future external impacts, and excludes those that could occur within the project area as a result of impact interactions caused solely by the Anholt activities.

The assessment of cumulative impacts concluded that detriment was not anticipated for the atmosphere,[72] benthic fauna[73], or hydrography, sediment, water, and geomorphology.[74] The assessment concluded that whilst there might be cumulative impacts on the benthic habitat, the extent of impact was not significant.[75] Similarly, whilst the potential for cumulative impacts on bird species (e.g. Red and Black Throated Divers) could result due to the combination of the Anholt impacts and those impacts from fisheries and ferry movements, relative to the population

[61] Energinet.dk and Ramboll Oil and Gas, *Anholt Offshore Wind Farm: Method for impact assessment* (Ramboll Oil and Gas, Ver 2, June 2009); Energinet.dk and Ramboll Wind, above n 54.
[62] Energinet.dk and Ramboll Oil and Gas, *Anholt Offshore Wind Farm: Background memo Air Emissions* (Ramboll Oil and Gas, November 2009).
[63] Energinet.dk and Jorgen Birklun (DHI Group), *Anholt Offshore Wind Farm: Benthic Fauna – Baseline Surveys and Impact Assessment* (DHI Group, Ver 5, October 2009).
[64] Energinet.dk and Fleming Møhlenberg (DHI Group), *Anholt Offshore Wind Farm: Benthic Habitats. Baseline Description and Impact Assessment* (DHI Group, Ver 3, September 2009); Energinet.dk and Ramboll Oil and Gas, *Anholt Offshore Wind Farm: Background Memo - Mapping of Substrates and Benthic Community Types* (Ramboll Oil and Gas, September 2009).
[65] Energinet.dk and DHI Group, *Anholt Offshore Wind Farm: Birds* (DHI Group, Ver 7, December 2009).
[66] GEO (Danish Geotechnical Institute), *Anholt/Djursland Offshore Wind Farm Geotechnical Investigations Wind Farm Area: Geotechnical Report – Consolidation tests, GEO project no 32490 Report 2* (GEO, October 2009); GEO (Danish Geotechnical Institute), *Anholt/Djursland Offshore Wind Farm Geotechnical Investigations Cable Corridors: Geotechnical Report – CPT tests and vibrocores, GEO project no 32490 Report 2* (GEO, August 2009); GEO (Danish Geotechnical Institute), *Anholt/Djursland Offshore Wind Farm Geotechnical Investigations Wind Farm Area: Geotechnical Report – Boreholes, GEO project no 42490 Report 1* (GEO, Rev 1, October 2009).
[67] Sanne Niemann et al, Energinet.dk and DHI Group, *Anholt Offshore Wind Farm: Hydrography, sediment spill, water quality, geomorphology and coastal morphology*, (DHI Group, Ver 6, October 2009); DHI Group, *Appendix ABCD: Details of numerical modelling of currents and stratification conditions* (DHI Group, August 2009).
[68] Energinet.dk, Ramboll Oil and Gas & DHI Group, *Anholt Offshore Wind Farm: Marine Mammals* (Ramboll Oil and Gas & DHI Group, Ver 7, December 2009).
[69] EMD International A/S, *Noise calculations for Anholt Offshore Wind Farm*, (3 July 2009) <http://www.ens.dk/sites/ens.dk/files/undergrund-fosyning/vedvarende-energi/vindkraft-vindmodeller/havvindmoeller/miljoepaavirkninger-2/Noise%20Calculations%20for%20Anholt%20Offshore%20Wind%20Farm.pdf>.
[70] Energinet.dk and Ramboll Oil and Gas, above n 61, 5.
[71] Ibid, 11.
[72] Energinet.dk and Ramboll Oil and Gas, above n 62, 14.
[73] Energinet.dk and Birklun (DHI Group), above n 63, 53, 71.
[74] Niemann et al, Energinet.dk and DHI Group, above n 67, 205, 254.
[75] Energinet.dk and Møhlenberg (DHI Group), above n 43, 30; Energinet.dk and Ramboll Oil and Gas, above n 64, 33, 50.

size the extent of impact was considered insignificant.[76]

Noise created by the construction of the Store Middelgrund OWF (Swedish maritime area) as well as Anholt was identified as a significantly detrimental cumulative impact to marine mammals, should both occur at the same time.[77] The need to ensure that pile driving for these projects occurred at different times to minimise impacts was emphasised.[78] Also focusing on the combination of multiple anthropogenic activities, the cumulative impacts from the combination of impacts from Anholt with those from existing commercial fishing and ferry services were deemed to be greater than ongoing impacts from the offshore cable and substation.[79] No recommendations were made for avoidance, minimisation or mitigation.

The assessment report that focused on the Anholt impacts on marine mammals indicated that no significant[80] impacts were anticipated for marine mammals as a result of noise during the operation or decommissioning of the turbines, or from the combination of suspended sediments, electromagnetic fields and traffic.[81] This assessment on the combination of suspended sediments, electromagnetic fields and traffic provides an example of cumulative impact assessment occurring within the Anholt project parameters. When the *Anholt Offshore Wind Farm: Method for impact assessment* definition for 'cumulative effects' (discussed above) is considered, the commentary demonstrates an inconsistency with the 'other project' approach identified within the EIA method.

The EIA reports were also analysed for discussion about synergistic impacts. Reference to 'synergistic impacts' was not found within the discussion on impact assessments. Nor was there any discussion on the definition of synergistic impacts as an impact type different to that of cumulative impacts. The approach to addressing synergistic impacts within EIA reports for Danish OWF has changed since the Anholt EIA. The subsequent EIA for the Kriegers Flak OWF (Kriegers Flak) demonstrates an example of the change in approach through the use of a definition with the potential to include 'synergistic' impacts as a type of 'cumulative' impact. [82] This is discussed in the next section.

[76] Energinet.dk and DHI Group, above n 65, 6, 86 – 87.
[77] Energinet.dk, Ramboll Oil and Gas & DHI Group, above n 68, 6, 58.
[78] Ibid, 58.
[79] Ibid, 65.
[80] Refer to the glossary for an explanation about the use of the term 'significant' as a term to describe the measurement of an impact.
[81] Energinet.dk, Ramboll Oil and Gas & DHI Group, above n 68, 4, 58.
[82] Danish Center for Environment and Energy (DCE) Aarhus University, DHI Group, and NIRAS, *Kriegers Flak Offshore Wind Farm Marine Mammals EIA – Technical Report June 2015* (DHI Group, Aarhus University and NIRAS, June 2015) 165.

4.2 Cumulative and synergistic impacts within environmental impact assessments – Kriegers Flak Offshore Wind Farm

Kriegers Flak is a 600MW offshore wind power installation,[83] proposed to be located between the Danish islands of Møn and Bornholm in the Baltic Sea (Danish maritime area) [84] (refer to Figure 7-2: Kriegers Flak site location). The EIA was published for public consultation in October 2015.[85]

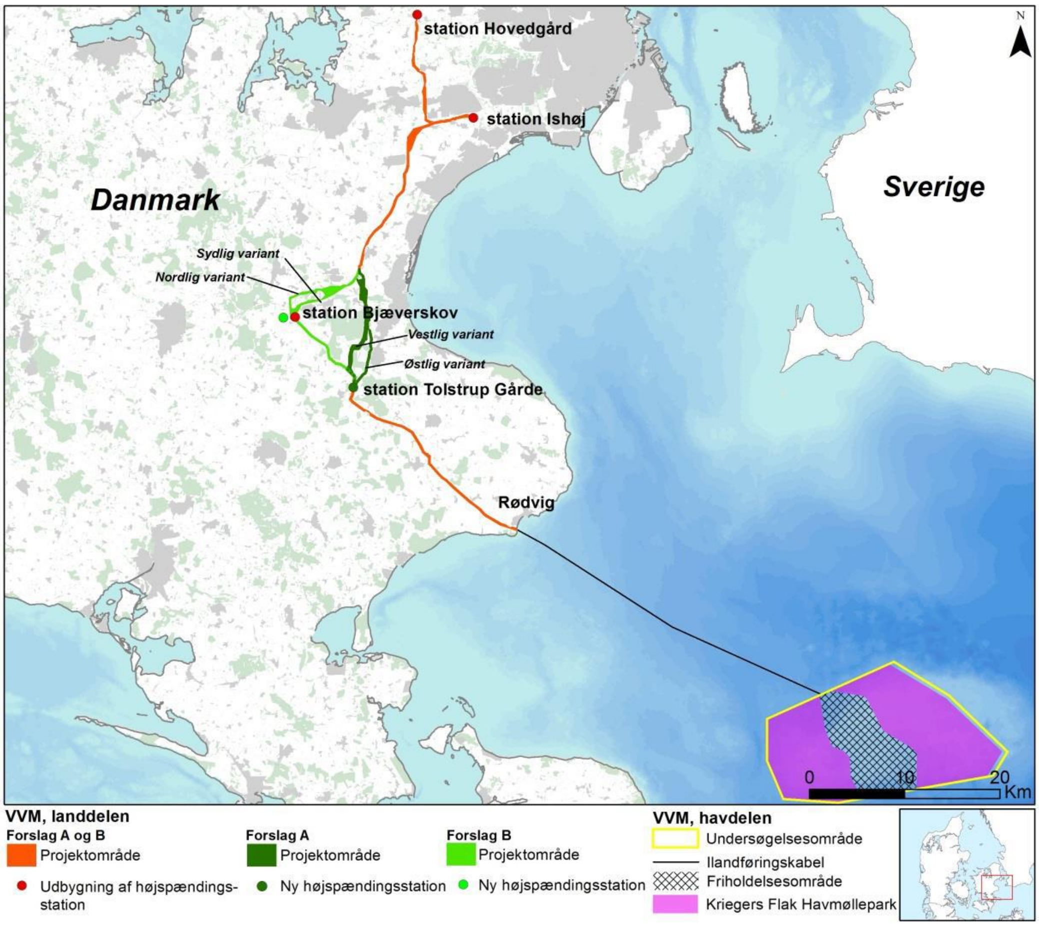

Figure 7-2: Kriegers Flak OWF site location (Source: NIRAS A/S and COWI A/S)[86]

The EIA process and subsequent public consultation provided feedback that was intended to be reflected within any approvals issued.[87] The EIA reports reviewed for this thesis included a

[83] Danish Energy Agency, above n 3. The information was current as of February 2016.
[84] NIRAS A/S and COWI A/S, *Kriegers Flak Offshore Wind Farm Environmental Statement, Part 1: Non-Technical Summary* (The Danish Energy Agency and the Danish Nature Agency, 2015) 3.
[85] Danish Energy Agency, *Large-scale offshore wind tenders* <http://www.ens.dk/en/supply/renewable-energy/wind-power/offshore-wind-power/large-scale-offshore-wind-tenders>. The information was current as of February 2016.
[86] NIRAS A/S and COWI A/S, above n 84, 6.
[87] Danish Energy Agency, above n 85. The information was current as of February 2016.

project description[88] and general environmental statement,[89] and reports relating to environmental impacts on marine mammals,[90] birds,[91] noise generation,[92] and benthic flora, fauna and habitat.[93]

In the reviewed documents, only one (the EIA for impacts on marine mammals) provided a definition for cumulative impacts. The definition was for the term 'cumulative effects' and was stated as 'the combined effects, larger than the simple sum of the individual effects on population level.'[94] The discussion about this definition emphasised the need to distinguish this definition from any discussion about 'cumulative effect of multiple (pile driving) strikes'. This distinction acknowledges the need to consider the cumulative impacts of repetitive action from construction activity (i.e. multiple strikes from pile driving), as well as those associated with anthropogenic activities other than the proposal being assessed. The definition provided for cumulative effects, in stating that the outcome is greater than the 'simple sum of the individual effects', also includes an element of the definition for synergistic impacts (refer to Chapter 2, section 7). Therefore, it could be concluded that definition intends to address both types of impacts. However, as demonstrated below, there is no explicit consideration given to synergistic impacts as a separate impact type assessment, or needing to be assessed, within the EIA reports.

The EIA reports reviewed acknowledged the need for the assessment of cumulative impacts, as they assess unanticipated impact types related to benthic habitats, flora and fauna.[95] To this extent, the assessment of cumulative impacts focused on the interaction of the Kriegers Flak proposal in combination with four other planned and existing projects.[96] These included three nearby OWF within the maritime areas of Denmark, Sweden and Germany and a sand extraction project within the Kriegers Flak Bank area.[97] Further, whilst the potential for cumulative impacts from 'sedimentation events' was acknowledged, the level of concern was stated as minimal because of the probability that there would be rapid recovery rates.[98]

[88] Energinet.dk, *Kriegers Flak Offshore Wind Farm Technical Project Description for the large-scale offshore wind farm (600 MW) at Kriegers Flak* (Energinet.dk October 2015).
[89] NIRAS A/S and COWI A/S, above n 84.
[90] Danish Center for Environment and Energy (DCE) Aarhus University, DHI Group, and NIRAS, above n 82.
[91] Danish Center for Environment and Energy (DCE) Aarhus University, DHI Group, and NIRAS, *Kriegers Flak Offshore Wind Farm Birds and Bats EIA – Technical Report* (DHI Group, Aarhus University and NIRAS, June 2015); Energinet.dk and NIRAS Consulting Ltd, *Kriegers Flak Wind Farm Report to Inform an Appropriate Assessment: Natura 2000 sites designated for migratory Common Crane in the west-central Baltic* (Energinet.dk, NIRAS Consulting Ltd, September 2015).
[92] Energinet.dk and NIRAS, *Kriegers Flak Offshore Wind Farm Underwater Noise Modelling EIA – Technical Report* (NIRAS, *January 2015*).
[93] NIRAS Consulting Ltd, Marilim, Energinet.dk, *Kriegers Flak Offshore Wind Farm Benthic Flora, Fauna and Habitats EIA – Technical Report* (NIRAS Consulting Ltd, Marilim, Energinet.dk, June 2015).
[94] Danish Center for Environment and Energy (DCE) Aarhus University, DHI Group, and NIRAS, above n 82, 165.
[95] See, eg, NIRAS Consulting Ltd, Marilim, Energinet.dk, above n 93, 8, 9, 44.
[96] NIRAS Consulting Ltd, Marilim, Energinet.dk, above n 93, 8, 93.
[97] Ibid, 8, 93.
[98] Ibid, 68.

Cumulative impacts as a result of the proposed electromagnetic cable interacting with external anthropogenic activities were also identified as inconsequential. [99]

Noise impacts on marine species, [100] and the impact of turbine locations on bird species, were seen as cumulative impacts that needed to be mitigated.[101] In relation to noise, during construction (pile driving) the potential for cumulative noise impact on marine mammals could be significant and would need mitigating to avoid marine mammal displacement behaviour.[102] The concerns raised focused on the potential for combined impacts due to the construction of multiple OWF within proximity (i.e. within the German and Swedish maritime areas[103]) if the timing of pile driving and other construction activities were simultaneous.[104] The EIA provided recommendations to mitigate these impacts including through the use of alternative foundations,[105] and/or reducing the temporal frequency and programme for pile strikes.[106] However, within the assessments the focus for noise modelling was restricted to that from OWF. Noise from other anthropogenic sources such as 'ships and cable installation' were not included as a source of cumulative impact.[107] Further, the need to address noise from existing onshore facilities (i.e. an existing substation), was also considered within the cumulative impact discussion.[108] The cumulative impacts of this noise, however, that might be had on the marine environment because of proximity of these onshore facilities were not discussed.

Uncertainty of modelling was identified in the discussion surrounding the accuracy of assessment for cumulative impacts, and was raised on the basis of limited data being available for population dynamics as well as the difficulty in gathering sufficient data to establish the requisite knowledge.[109] The concern was emphasised by a statement that the results for cumulative impacts of noise on marine mammals were effectively 'speculative'.[110] The issue of uncertainty with results was also raised in relation to cumulative impacts on birds due to the difficulty in estimating additional impact from planned OWF when the construction and layout details were unknown.[111]

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[99] NIRAS A/S and COWI A/S, above n 84, 39.
[100] See, eg, NIRAS A/S and COWI A/S, above n 84, 30, 59; Energinet.dk and NIRAS, above n 92, 21.
[101] See, eg, NIRAS A/S and COWI A/S, above n 84, 77.
[102] Danish Center for Environment and Energy (DCE) Aarhus University, DHI Group, and NIRAS, above n 82, 143, 169 - 170.
[103] Ibid, 7, 165 – 166, 171.
[104] See, eg, NIRAS A/S and COWI A/S, above n 84, 59.
[105] NIRAS A/S and COWI A/S, above n 84, 59.
[106] Danish Center for Environment and Energy (DCE) Aarhus University, DHI Group, and NIRAS, above n 82, 163.
[107] Energinet.dk and NIRAS, above n 92, 21.
[108] NIRAS A/S and COWI A/S, above n 84, 30.
[109] Danish Center for Environment and Energy (DCE) Aarhus University, DHI Group, and NIRAS, above n 82, 164, 165.
[110] Ibid, 164.
[111] Danish Center for Environment and Energy (DCE) Aarhus University, DHI Group, and NIRAS, above n 91, 160.

Poor knowledge and inadequate research methods were identified as prohibitive to the effective assessment of cumulative impacts caused by a combination of the Kriegers Flak and the German and Swedish proposals.[112] This uncertainty was also reflected in discussion that whilst there was potential for cumulative impacts from dredging in the area, information, however, about the dredging or associated noise impacts was unknown.[113] Further, it was stated that:

> Foreseeing and mitigating the ecological consequences of exploitation of the marine environment will require spatially and temporally explicit monitoring of physical drivers within and outside of wind farm areas. Until we improve our ability to quantify biological responses of communities to these drivers and their interactions, the cumulative impacts of wind farms on top of all other human induced pressures is not possible. The most informative studies for assessing the consequences of offshore installations are those that have monitored community changes in time and space prior to construction and decades into the life of the wind farm. Such monitoring will help to increase our 'post-EIA' audit to assess the accuracy of model predictions, and enhance the ability to make quantitative assessments of how ecological changes may develop….We also need to focus on new responses (e.g. habituation to stimuli) and track offshore developments with regard to larger turbines, larger farm areas, novel foundation types and in new locations.[114]

This commentary emphasises that limited knowledge can cause uncertainty about cumulative impacts and result in inadequate impact assessment for OWF. Further, it highlights the complexity of assessing cumulative (and synergistic impacts) and the importance of seeking continual efforts to improve assessment methods.

The EIA focused on the potential for a significant impact given the number of 'planned', 'existing' and 'permitted' OWF in the region (Denmark, Sweden and Germany).[115] In particular, the transboundary impacts for the cumulative risk from multiple OWF due to bird strikes and collision within the migratory path for birds such as the Common crane.[116] Primary concerns focused on the potential for an increased mortality that might detrimentally impact population maintenance.[117] Within a protected species and area legislative context, the potential impact to these birds from 'planned', 'existing' and 'permitted' OWF was deemed 'significant' as an impact on Natura 2000 sites[118] (refer to *Council Directive 92/43EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora*[119]). The assessment, however, also

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[112] Danish Center for Environment and Energy (DCE) Aarhus University, DHI Group, and NIRAS, above n 82, 7, 166.
[113] Ibid, 7.
[114] Ibid 165.
[115] NIRAS A/S and COWI A/S, above n 84, 59, 78; Danish Center for Environment and Energy (DCE) Aarhus University, DHI Group, and NIRAS, above n 91, 11, 161.
[116] See, eg, NIRAS A/S and COWI A/S, above n 84, 74; Danish Center for Environment and Energy (DCE) Aarhus University, DHI Group, and NIRAS, above n 91, 11.
[117] Danish Center for Environment and Energy (DCE) Aarhus University, DHI Group, and NIRAS, above n 91, 11, 161.
[118] See, eg, Energinet.dk and NIRAS Consulting Ltd, above n 91, 13.
[119] *Council Directive 92/43EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora*, [1992] OJ L 206/7; and amendments contained within *Regulation (EC) No 1882/2003 of the European Parliament and of the Council of 29 September 2003 adapting to Council Decision 1999/468/EC the provisions relating to*

demonstrated that the current cumulative impact when considering only those 'existing' and 'permitted' OWF was considered 'moderate'.[120] This raises the question of thresholds and when permissions should be limited. Importantly, it is noted that the conditions of, for example, operational windfarms in the area (German Baltic 1 and 2), and the impacts on bird populations from these windfarms formed part of the baseline assessment.[121]

The EIA also included discussion on methods to mitigate cumulative impacts for migrating cranes.[122] However, the mitigation of cumulative impacts was not considered possible and only methods for decreasing the risk of collision (i.e. aligning turbines 'with the direction of the migration corridor') could be achieved.[123] In relation to other bird species, a minor cumulative impact was identified,[124] with issues such as the barrier effect on migration (resulting in increased energy expenditure) not being identified as significant even when additional planned OWF were included in the assessment.[125]

4.3 Identifying the benefits and shortcomings of cumulative and synergistic impact assessment within the Anholt and Kriegers Flak EIAs

The review presented above of the Anholt and Kriegers Flak EIA documents demonstrates benefits and shortcomings in approaches to cumulative impact assessment. In reaching these conclusions it is noted that the Anholt OWF EIA 2010 and Kriegers Flak OWF EIA 2015 were prepared under different versions of the EU EIA Directive. The Anholt OWF EIA 2010 was prepared under the *EC Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment and the subsequent amending Directives 97/11/EC, 2003/35/EC & 2009/31/EC*.[126] The Kriegers Flak OWF EIA 2015 was prepared under the

committees which assist the Commission in the exercise of its implementing powers laid down in instruments subject to the procedure referred to in Article 251 of the EC Treaty, [2003] OJ L 284/1, *Council Directive 97/62/EC of 27 October 1997 adapting to technical and scientific progress Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora*, [1997] OJ L 305/42, *Council Directive 2006/105/EC of 20 November 2006 adapting Directives 73/239/EC, 74/557/EC and 2002/83/EC in the field of environment, by reason of the accession of Bulgaria and Romania*, [2006] OJ L 363/368.

120 NIRAS A/S and COWI A/S, above n 84, 59.

121 Danish Center for Environment and Energy (DCE) Aarhus University, DHI Group, and NIRAS, above n 91, 47.

122 NIRAS A/S and COWI A/S, above n 84, 77.

123 Ibid.

124 Danish Center for Environment and Energy (DCE) Aarhus University, DHI Group, and NIRAS, above n 91, 161.

125 Ibid, 153.

126 *EC Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment and the subsequent amending Directives 97/11/EC, 2003/35/EC & 2009/31/EC*, [2009] OJ L 140/114. It is noted that this has since been superseded by *Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification)*, [2012] OJ L 26/1 and *Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment*, [2014] OJ L 124/1.

current *Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification))*[127] and the amending *Directive 2014/52/EU on the assessment of the effects of certain public and private projects on the environment*.[128] When the different versions of the Directive are compared, however, the requirements for the assessment of cumulative and synergistic impacts do not differ significantly enough to explain any differences in the EIA approaches. The shortcomings and benefits are therefore discussed based on comparison of the Anholt and Kriegers Flak OWF EIA documents alone.

A clear shortcoming is that synergistic impacts are not explicitly considered. Three possible reasons for why synergistic impact assessments were not included are the complexity of assessing nonlinear impacts, a lack of consideration given to synergistic impacts as distinct from cumulative impacts, and/or that there is no legal requirement to assess. [129] If synergistic impacts are not considered as a separate impact type, as previously discussed, their omission from EIA can contribute to uncertainty and inadequacy within impact predictions.[130]

In addition to a lack of consideration given to synergistic impacts, both the Anholt EIA and Kriegers Flak EIA demonstrate shortcomings in approach to the use of definitions for cumulative impacts. The definition provided within the Anholt EIA is narrow and does not clearly address the cumulative impacts associated with the project itself. For the Kriegers Flak definition, whilst there is a focus on 'combined effects, larger than the simple sum of the individual effects'[131] between the project and other anthropogenic activities, and therefore the potential to consider synergistic impacts, there is insufficient clarity in the definition. This, as discussed above, is because cumulative and synergistic impacts are different types of impacts and should be defined (and assessed) separately. Further, the use of this definition is limited to the marine mammal EIA report.

The benefits identified as a result of the approaches to cumulative impact assessment include focus on site specific and regional issues, with both EIAs addressing the specific cumulative interactions with anthropogenic activities other than those associated with the proposal. For example, the Anholt EIA included a consideration of the planned Swedish construction of the Store Middelgrund OWF. Similarly, the Kriegers Flak EIA considered existing, approved and

[127] *Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification),* [2012] OJ L 26/1.
[128] *Directive 2014/52/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification),* [2014] OJ L 124/1.
[129] Refer to Chapters 2 and 3 for a general discussion on these issues.
[130] Refer to the discussion in Chapters 2 and 3.
[131] Danish Center for Environment and Energy (DCE) Aarhus University, DHI Group, and NIRAS, above n 82, 165.

planned windfarms within the Baltic and Kriegers Flak wider area (as associated with Germany and Sweden). Thus both assessments showed clear spatial considerations that extend beyond the individual project. This approach to cumulative impact assessment highlights the need for cumulative and synergistic impacts to be addressed within EIA as well as SEA. The acknowledgement of uncertainty surrounding the lack of information available for assessing cumulative impacts within the Kriegers Flak area, reinforces the need for assessment within both regional marine spatial area (e.g. SEA) and individual project (e.g. EIA) approaches. This is because scientific research at both the regional and project area scale can result in better knowledge outcomes, about cumulative and synergistic impacts, than a focus on scientific research limited to either scale. The Anholt and Kriegers Flak case studies also demonstrate that site specific measures to avoid, minimise or mitigate cumulative impacts can be appropriately determined. For example, the implementation of altered timing for pile driving or the use of different foundations can be recommended and applied as project conditions.

Within the Kriegers Flak analysis, the identification of a need to remedy substation noise was also discussed. This example demonstrates the benefit of assessing cumulative impacts and identifying existing impacts that may be beyond determined or preferred environmental thresholds. The discussion of baseline assessments as a foundation for understanding cumulative impacts – in relation to cumulative impacts on birds for Kriegers Flak – is also important in aiding the establishment of thresholds that are then used as benchmarks of subsequent impacts.[132] The importance of establishing appropriate environmental thresholds as a baseline is necessary for effective cumulative and synergistic impact assessment.

There are differences in the approach to cumulative impact assessment evident in the two EIAs. The Kriegers Flak EIA emphasised uncertainty and lack of access to adequate information to enable accurate predictions. The Anholt EIA did not discuss these topics. Another example of the difference in approach between the Anholt EIA and the Kriegers Flak EIA is that of the change in definition for cumulative impacts to include synergistic impacts. As discussed above, whilst the Anholt definition for ‘cumulative impacts’ does not address ‘synergistic impacts’, the Kriegers Flak EIA definition has the potential to include synergistic impacts as a type of cumulative impact. That said, the extent of change in approach is limited due to the definition’s use within the marine mammal EIA report only.

The different approaches taken in the Kriegers Flak EIA may be because of changes to Danish policy, an increase in knowledge, and/or the development of research methods occurring

[132] Refer to the discussion in Chapter 3, section 2.3.2.

between the EIA publication times of 2010 (Anholt) and 2015 (Kriegers Flak). An example of policy change was the publication in 2013 of the *Guidance Document on Environmental Impact Assessment: Danish Offshore Wind Farms*[133] (discussed in section 6 below). The increase in knowledge about cumulative impacts, and the development of research methods for the assessment of cumulative impacts, that has occurred in Denmark during this time frame, is supported by the scientific data and analysis associated with PAM undertaken for other Danish OWF. For example, the PAM programme undertaken for the Horns Rev and Nysted OWF. The next section examines these PAM programmes.

5. The Danish approach to the environmental monitoring of cumulative and synergistic impacts

Baseline and monitoring studies, and PAM, are procedures that can be utilised to improve scientific knowledge about cumulative and synergistic impacts and aid the EIA of OWF. This section examines the Danish environmental monitoring programme for the Horns Rev and Nysted OWF ('Horns Rev' and 'Nysted'), and demonstrates the integral role of baseline and monitoring studies, and PAM, as tools for identifying cumulative and synergistic impacts. The environmental monitoring programme documents reviewed for this thesis analysis are public documents, published in English.[134] These documents are listed in Appendix C - Horns Rev I & Nysted Offshore Wind Farms environmental monitoring programmes: list of documents reviewed (Appendix C).

5.1 Horns Rev and Nysted environmental monitoring programmes

The Danish approach to assessing marine environmental impacts from OWF has incorporated baseline environmental monitoring studies and PAM.[135] Significant environmental monitoring programmes were undertaken in two stages from 1999 – 2006 and then from 2007 – 2012.[136] The programmes incorporated baseline data gathering, monitoring against the baselines, monitoring of impacts during construction, and monitoring of impacts post-construction as caused by two large-scale OWF, Nysted and Horns Rev.[137] Nysted was constructed with 72 turbines and is located in the Baltic Sea near the Danish island of Lolland (refer to Figure 7-3:

[133] Danish Energy Agency, above n 5.
[134] Danish Energy Agency, *Environmental Reports for Specific Danish Projects*, above n 4. The documents reviewed were publicly available as at March 2016.
[135] See, eg, Danish Energy Agency, *Danish Offshore Wind. Key Environmental Issues – a Follow-up* (The Environmental Group: The Danish Energy Agency, The Danish Nature Agency, Dong Energy and Vattenfall, 2013); Danish Energy Agency, above n 4.
[136] Danish Energy Agency, above n 4.
[137] Ibid.

Horns Rev and Nysted (Rødsand) site location).[138] Horns Rev was constructed with 80 turbines and is located in the North Sea offshore from the mainland near Esbjerg (refer to Figure 7-3: Horns Rev and Nysted (Rødsand) site location).[139] Approval to undertake preliminary environmental impact investigations was given in 1999 and approval for construction was given in 2002 for both OWF.[140] Construction was completed for Horns Rev in 2002[141] and Nysted in 2003.[142]

Baseline environmental studies were undertaken until 2001 for Horns Rev[143] and 2002 for Nysted;[144] occurring across periods of up to two years.[145] These studies enabled comparative analysis of changes to species, habitats and ecosystems that were monitored during construction and operation.[146] For PAM, monitoring programmes occurred during the construction process and after the commencement of operation until 2012 (a period of 10 years).[147]

[138] Danish Energy Agency, above n 135, 25.
[139] Ibid.
[140] Ibid, 25.
[141] See, eg, Energi E2 A/S, *Review Report 2004. The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farm Environmental Impact Assessment and Monitoring. Report prepared for the environmental Committee of the Danish Offshore Wind Farm Demonstration Projects* (Energi E2 A/S, 2005) 2.
[142] See, eg, Energi E2 A/S, above n 141, 2.
[143] Ibid, 20, 22, 28, 32, 37.
[144] Ibid, 62, 67, 82, 89, 107.
[145] Ibid, 82, 107.
[146] Danish Energy Agency, above n 135, 26.
[147] Ibid, 18.

Figure 7-3: Horns Rev and Nysted (Rødsand) site location (Source: Danish Energy Authority)[148]

5.2 Identification of cumulative and synergistic impacts within the environmental monitoring programme for Horns Rev and Nysted

The review of Horns Rev and Nysted OWF environmental monitoring programme documents (Appendix C), as undertaken for this thesis, demonstrated that the monitoring programme

[148] Danish Energy Authority, *Offshore wind farms and the environment – Danish Experiences from Horns Rev and Nysted* (Danish Energy Authority, 2006) 5.

focused on cumulative and synergistic impacts for birds, marine mammals, fish, and benthic habitats and species. The environmental monitoring reports from 2005 and 2006 identified avoidance behaviour in birds and associated energy expenditure impacts on bird health. [149] Hence, the assessment of cumulative impacts affecting migratory birds was considered necessary when multiple OWF (and other anthropogenic structures) were likely to occur. [150] The concern about cumulative impacts from the combination of Horns Rev and Nysted OWF, however, was assessed as minimal because of the geographical separation from migratory bird flight paths.[151] It is evident from this that spatial scales have influenced the cumulative impact assessment. The lack of information about potential impacts on bird species, including population impacts, and the impacts as a result of bird collisions were also considered a potential, yet complex, cumulative impact to predict.[152] In this instance a lack of evidence is treated in a non-precautionary manner and an inconsistent approach is evident.

It was argued in Chapter 3[153] that there should be a consistent approach to assessment methods. This is discussed in these Danish case studies as a need for cumulative impact assessment methodology that enables effective assessments, and development of understanding of impacts, at both local and regional levels.[154] The EU legislative requirements to consider other projects beyond the proposal were highlighted.[155]

Building upon the earlier monitoring, 2011 monitoring discussions about cumulative impacts also focused on protected bird species, such as the Red-throated Divers; demonstrating reduced population numbers.[156] The discourse identified that due to species displacement concerns, mathematical modelling and evaluation was undertaken to assist in predicting population impacts.[157] The modelling indicated a potential higher impact on population levels associated

[149] See, eg, Vattenfall A/S, *Horns Rev Offshore Wind Farm, Annual Status Report for the Environmental Monitoring Programme, 2005* (The Environmental Committee of the Danish Offshore Wind Farm Demonstration Projects, November 2006) 44; DONG Energy and Vattenfall A/S, *Review Report 2005, The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farms – Environmental impact assessment and monitoring* (The Environmental Group of the Danish Offshore Wind Farm Demonstration Projects, 2006) 123 - 124; Ib Krag Petersen et al, *Final results of bird studies at the offshore wind farms at Nysted and Horns Rev, Denmark* (National Environmental Research Institute and Ministry of the Environment, 2006) 6, 19, 139, 152; Danish Energy Authority, above n 148, 32.
[150] See, eg, Vattenfall A/S, above n 149, 44; DONG Energy and Vattenfall A/S, above n 149, 123 - 124; Petersen et al, above n 149, 6, 19, 139, 152; Danish Energy Authority, above n 148, 32.
[151] Petersen et al, above n 149, 150.
[152] Mark Desholm, *TADS investigations of avian collision risk at Nysted offshore wind farm, autumn 2004* (National Environmental Research Institute/ Ministry of the Environment - Denmark, 2005), 7; Petersen et al, above n 149, 149 - 150.
[153] Refer to section 2.3.2.
[154] Petersen et al, above n 149, 16 – 17.
[155] Ibid, 16, 149.
[156] Chris Topping and Ib Krag Petersen, *Report on a Red-throated Diver Agent-based Model to assess cumulative impact from offshore wind farms* (Danish Centre for Environment and Energy (Aarhus University), 2011) 5 - 6.
[157] Ibid, 6.

with a higher level of OWF development. [158] Yet, the conclusions highlighted a number of complexities that had bearing on the efficacy of the modelling results, including limited knowledge about species biology, significant variations in 'density estimates', and a lack of consideration given to variation in habitats across time.[159]

The marine mammals cumulative impact monitoring was focused on harbour porpoises and harbour seals. For harbour porpoises, although the complexity of assessing cumulative impacts arising from a single OWF development was identified,[160] any future increase in the number of wind farms would require the consideration of cumulative impacts,[161] in order to avoid exceeding determined environmental thresholds.[162] At Horns Rev, the potential for cumulative impacts to affect harbour seals if multiple OWF were to be constructed was identified.[163]

Further, in considering the potential for negative cumulative impacts on harbour porpoises, potentially positive impacts (e.g. artificial habitat resulting in increased food availability), should also be assessed.[164] The negative impacts from OWF interacting with those of shipping, however, were considered to be of significant concern and it was recommended that increases in shipping should be carefully considered.[165] Again, the emphasis on knowledge limitations and the capacity to predict cumulative impacts with (then) current methodology was noted.[166] Consequently, predictive modelling was developed to forecast and assess cumulative impacts on porpoises inhabiting Danish waters to the north of Nysted.[167]

Fish monitoring identified that there were no negative cumulative impacts of concern.[168] Instead, however, improved habitat due to commercial fishing restrictions,[169] and increased habitat due to artificial structures,[170] were identified as positive cumulative outcomes. In relation

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[158] Ibid, 33.
[159] Ibid.
[160] Jakob Tougaard et al, *Harbour Porpoises on Horns Reef – Effects of the Horns Reef Wind Farm, Final Report to Vattenfall A/S*, (National Environmental Research Institute, November 2006) 61; Jonas Teilmann, Jakob Tougaard and Jacob Carstensen, *Summary on Harbour porpoise monitoring 1999 – 2006 around Nysted and Horns Rev Offshore Wind Farms: Report to Energi E2 A/S and Vattenfall A/S* (Ministry of the Environment, Denmark, 2006) 12.
[161] Nabe-Nielsen et al, Sveegaard, *Effects of wind farms on Harbour porpoise behaviour and population dynamics. Report commissioned by The Environmental Group under the Danish Environmental Monitoring Programme. Scientific Report from Danish Centre for Environment and Energy No. 1* (Danish Centre for Environment and Energy, Aarhus University, 2011) 7- 8; Teilmann, Tougaard and Carstensen, above n 160, 12; Tougaard et al, above n 160, 61;
[162] Nabe-Nielsen et al, above n 161, 7- 8.
[163] Tougaard et al, above n 5, 54.
[164] Nabe-Nielsen et al, above n 161, 32 – 33.
[165] Ibid, 32 – 34.
[166] Ibid, 7- 8.
[167] Ibid.
[168] Simon B Leonhard, Claus Stenberg and Jossiane Støttrup (eds), *Effect of the Horns Rev 1 Offshore Wind Farm on Fish Communities. Follow-up Seven Years after Construction* (Danish Energy Authority, 2011) 4, 55, 57.
[169] Ibid.
[170] Ibid.

to benthic habitat and species, as with fish, the restriction on commercial fisheries in wind farm areas was identified as being the cause of minimal cumulative impact, if not resulting in an overall improvement.[171]

Minimal reference to the assessment of synergistic impacts within the environmental monitoring programme reports was made, and those references that occurred related only to marine mammals. For harbour seals, the potential for significant impacts was also identified as resulting from nonlinear (or synergistic) interactions.[172] Thus, this is one of the few studies that have addressed synergistic impacts. In relation to both harbour seals and harbour porpoises, the definition of cumulative effects was similar to the definition of synergistic impacts;[173] being described as the 'combined effects of two or more factors (e.g. individual wind farms) larger than the simple sum of the individual effects'.[174] Further, comment was made about the complexity of assessing these impact types in relation to harbour porpoises when information for only one OWF is being considered.[175] Therefore, the spatial scale of cumulative impacts needs to be inclusive of multiple OWF due to the ability of these species to roam across large areas. The minimal focus on synergistic impacts could be due to the uncertainty and the lack of knowledge about these impact types, as well as a perceived lack of modelling capability to assist with impact predictions.

The outcomes of the Horns Rev and Nysted OWF environmental monitoring programme documents also included recommendations for improving cumulative impact assessment. These recommendations are discussed below.

5.3 Recommendations for future approaches

In addition to the Horns Rev and Nysted OWF environmental monitoring programme identifying whether cumulative and synergistic impacts were found to be detrimental, future approaches to the cumulative impact assessment of OWF within the marine environment were recommended. The recommendations were that:

- The PAM results focusing on cumulative impact assessment demonstrated a need for consideration to be given to the siting of future OWF (to avoid these impact types);[176]

[171] Simon B Leonhard and John Pedersen, *Benthic Communities at Horns Reef, before, during and after construction of Horns Rev Offshore Wind Farm. Final report Annual Report 2005* (Vattenfall, 2006) 9, 80 and 82.
[172] Tougaard et al, above n 5, 54.
[173] Refer to glossary. Also refer to the discussion about the definition of synergistic impacts in Chapter 2.
[174] Tougaard et al, above n 160, 60; Tougaard et al, above n 5, 54.
[175] Tougaard et al, above n 160, 60.
[176] See, eg, Danish Energy Authority, above n 148, 3, 7.

- That assessment of cumulative impacts, whilst complex, should occur over a long timeframe. [177] In the case of impacts on migratory birds, for example, this should encompass regional assessments with a common approach to methodology to enable a focus on population impacts as well as local habitat impacts; [178]
- More research and modelling was required to determine the impact on bird populations from multiple OWF;[179] and
- Future application of cumulative impact modelling developed to assess cumulative effects for Red-throated Divers, as well as further work and data provision/ analysis, should be incorporated into assessments.[180] Additional marine impact use, such as that of shipping, wind-turbine collisions, and the impact of alternative marine renewable energy should also be considered.[181]

These recommendations imply that spatial considerations are needed when assessing cumulative and synergistic impacts. The need to consider temporal scales is also raised as important to address seasonal changes, long term climate changes and changes resulting from anthropogenic activities in the marine environment. These types of considerations identified as necessary for cumulative and synergistic impact assessment are discussed throughout Chapter 2 (sections 2, 3, 4, 5, and 6). Furthering modelling and research will improve knowledge, assist with reducing data limitations, and assist to address uncertainty (as discussed above in section 3).

In 2013, a summary of conclusions from the environmental monitoring programme was published in the report *Danish Offshore Wind: Key Environmental Issues – a Follow-up*.[182] The report focused on comments about cumulative impact assessments and modelling methods made in relation to birds,[183] porpoises,[184] fish,[185] and in general.[186] Further, whilst the summary report highlighted the value of the extended monitoring period as an opportunity to develop assessment tools, including modelling,[187] there was also discussion of the limitations and uncertainties associated with knowledge gaps (leading to uncertainty) and methods.[188] The need to continually improve assessment approaches was highlighted.[189] Marine strategic planning was emphasised as a tool to minimise these impacts from the future development of multiple

[177] Petersen et al, above n 149, 17.
[178] Ibid.
[179] See, eg, Danish Energy Authority, above n 148, 41.
[180] Topping and Petersen, above n 156, 33 – 34.
[181] Ibid, 34.
[182] Danish Energy Agency, above n 135.
[183] Ibid, 17, 71, 82 – 83, 87.
[184] Ibid, 46, 64, 67, 69.
[185] Ibid, 16, 30, 43.
[186] Ibid, 15 – 17.
[187] Ibid, 15 – 17, 82 - 83.
[188] Ibid, 17.
[189] Danish Energy Agency, above n 135.

OWF in combination with other anthropogenic activities.[190] How best to assess the long term cumulative impacts occurring along a migratory bird flyway, when there is more than one country involved, was also noted by the International Advisory Panel of Experts on Marine Ecology (IAPEME) as needing to be resolved.[191]

5.4 Identifying the benefits and shortcomings of cumulative and synergistic impact assessment within the environmental monitoring programme for Horns Rev and Nysted

The review of the environmental monitoring programme at Horns Rev and Nysted demonstrated benefits and shortcomings in approach to cumulative and synergistic impact assessment. The benefits related to transboundary management, baseline assessments and studies and PAM, whilst shortcomings were in relation to definitions and assessment approaches.

The environmental monitoring reports demonstrated shortcomings through the limited and inconsistent use of approach and/or definitions for cumulative and synergistic impacts. As discussed in section 5.2, the same example definition was provided in reports for harbour porpoises and harbour seals, with the definition of cumulative impacts stated as the 'combined effects of two or more factors (e.g. individual wind farms) larger than the simple sum of the individual effects'.[192] This definition could reflect the definition for synergistic impacts but it does not identify the distinct elements of the two impact types (i.e. the additive nature of cumulative impacts, and the nonlinear nature of synergistic impacts). Examples of synergistic impacts were presented, yet there is insufficient clarity and identification of the impact type that enables a separation of cumulative from synergistic impacts. The lack of discussion about synergistic impacts, compared to cumulative impacts, is a shortcoming because without the assessment of both impact types the probability of errors in impact predictions is potentially greater and the chance of synergistic impacts being ignored is also greater. Resultant knowledge gaps and higher levels of uncertainty are also more likely.

The monitoring programmes did not disclose definitions and, therefore, it is difficult to determine the extent of inconsistency between definitions used for assessments, or the breadth of approaches. The discussion within monitoring programmes appears to focus on the multiplicity of OWF. Whilst this is critical, the limited consideration and assessment of cumulative and synergistic impacts that occurs between activities within the project itself, as

[190] Ibid, 21.
[191] Ibid, 27; International Advisory Panel of Experts on Marine Ecology, *General Outlook* (October 2013) 1 <http://www.ens.dk/en/node/2018>; Petersen et al, above n 149, 17.
[192] Tougaard et al, above n 160, 60; Tougaard et al, above n 5, 54.

well as with other types of anthropogenic activities, and the potential for environmental change, is evident of knowledge gaps. It is also evident of an inability to compare beyond the scope of the activity within a proposal area.

The need for a way to manage cumulative impacts as a transboundary issue has been identified.[193] A transboundary approach seeks to accommodate the impact assessment of multiple OWFs across biogeographic and political areas (e.g. the Baltic Sea). The acknowledged benefit of this approach stems from the need to manage environmental issues across multiple legal frameworks when, for example, it is challenging to achieve a consistent approach between different jurisdictions.

The duration of the PAM programmes across an extended time frame is also a beneficial approach. The use of baseline studies for periods, for example, of up to two years, enable greater understanding of the existing environmental conditions because information prior to impact is collected and established. Baselines also enable the ability to determine appropriate ecological thresholds and comparative analysis for impacts pre, during and post construction and operation of an OWF. When PAM programmes occur across an extended time frame, problematic impacts are identified. This can also aid in determining whether ecological thresholds have been, or are at risk of being, breached. Knowledge gained from the environmental monitoring programme results, provide opportunities for the development and improvement of methods to assess future impacts.

6. Danish guidelines for cumulative and synergistic impact assessment within the EIA of offshore wind farms

The Danish Energy Agency published the *Guidance Document on Environmental Impact Assessment: Danish Offshore Wind Farms* (*Guidance Document*),[194] as part of the Danish approval process for offshore windfarm development, and in addition to legislative requirements to undertake EIA for proposals,[195] for example, *Executive Order no. 68 of January 26th 2012*.[196] The *Guidance Document* was a policy developed after completion of the environmental

[193] See, eg, Danish Energy Agency, above n 135, 27; International Advisory Panel of Experts on Marine Ecology, above n 191, 1; Petersen et al, above n 149, 17.
[194] Danish Energy Agency, above n 5.
[195] See, eg, Danish Energy Agency, *Procedures and permits for offshore wind parks* <http://www.ens.dk/en/supply/renewable-energy/wind-power/offshore-wind-power/procedures-permits-offshore-wind-parks>.
[196] See, eg, Danish Energy Agency, above n 195; *Bekendtgørelse om vurdering af virkning på miljøet (VVM) ved projekter om etablering m.v. af elproduktionsanlæg på havet*, [Offshore Wind Energy Environmental Impact Assessment Act] (Denmark) BEK nr 68 af 26/01/2012, <http://www.retsinformation.dk/Forms/R0710.aspx?id=140308>.

monitoring programme. The document provides advice on the preparation of an EIA within the context of the marine natural environment,[197] and provides direction on the current approach for assessing cumulative impacts.[198] This section analyses the *Guidance Document* from a procedural perspective, and the legislation is analysed in section 7 of this chapter.

Within the *Guidance Document* cumulative impacts are defined as those impacts that 'result from incremental changes caused by other past, present or planned projects or activities in combination with the applied project.'[199] This assists in providing a connection between the Danish legal requirements for EIA and the preferred approach to cumulative impact assessment.[200] The definition of cumulative impacts provides a common approach to what is to be focused on, and the need for varying methodology within each EIA is acknowledged.[201] Project proponents are referred to the European Commission's *Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions* for information on different assessment methods.[202] That these guidelines were published in 1999 seems to indicate that there has been no substantive change in requirements for assessing cumulative impacts despite the 20 year timeframe; a period in which research and development around the assessment of cumulative and synergistic impacts has progressed.

The *Guidance Document* states that 'the maximum geographic range of impacts from the OWF can be used to determine the area for which assessment of cumulative impacts shall be covered.'[203] This approach means that the range (spatial scale) of impact assessment differs depending upon the species and impacts occurring. For example, the extent of noise impacts on mammals is dependent upon the proximity of other anthropogenic activities (e.g. offshore petroleum drilling activities).[204] Another example is that of the combined impacts of multiple OWF along a migratory bird route even when impacts are transboundary.[205]

Baseline assessments and studies typically are required as part of the OWF EIA process when there is a lack of existing knowledge.[206] The information obtained from such studies used to identify actual impacts when combined with PAM.[207] The *Guidance Document* also

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197 Danish Energy Agency, above n 5, 1.
198 See, eg, Danish Energy Agency, above n 5, 2, 5, 21- 22.
199 Danish Energy Agency, above n 5, 2, 21.
200 Ibid, 1 - 2.
201 Ibid, 21.
202 Ibid citing Hyder, *Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions* (European Communities, 1999) <https:www.ec.europa.eu/environment/archives/eia/eia-studies-and-reports/pdf/guidel.pdf>.
203 Danish Energy Agency, above n 5, 21.
204 Ibid.
205 Ibid, 22.
206 Ibid, 17.
207 Ibid, 22.

acknowledges that ‘prior knowledge’ from other OWF assessments (both baseline monitoring and PAM) should be used and is important for determining cumulative impacts.[208]

Although significant impacts must be addressed, the *Guidance Document* also focuses on cumulative impacts caused by the accumulation of insignificant or minor impacts.[209] The requirement within the *Guidance Document* for the determination of ‘ecological thresholds and criteria’ within an EIA, [210] could also be seen as fundamental to the need for understanding cumulative (or synergistic) impacts.[211] Finally, it is noted that the *Guidance Document* emphasises the need to assess the cumulative impacts on migratory birds, from both the local and regional perspective.[212]

The *Guidance Document* does not discuss synergistic impacts as a distinct impact type.[213] Whilst it could be assumed that these impact types are defined as a subset of cumulative impacts, the separate reference to synergistic impacts within *Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment* (*SEA Directive*)[214] provides a basis for part of Denmark’s environmental assessment legal framework (refer to section 7 below for more discussion). This suggests that there may be more justification for defining cumulative and synergistic impacts separately.

The procedural approach for cumulative impact assessment within the *Guidance Document* reflects both the benefits and shortcomings identified for the Anholt and Kriegers Flak EIA case studies and the environmental monitoring programmes undertaken for Horns Rev and Nysted. This occurs in relation to defining cumulative impacts inadequately with a limited approach, no discussion about synergistic impacts, and acknowledging the importance of baseline studies, ecological thresholds and PAM. The Guidance Document does not address the approach to cumulative (or synergistic) impact assessment when there is uncertainty.

The definition of cumulative impacts provided within the procedural approach appears to address an earlier identified shortcoming, that being the potential for inconsistency in the definition of cumulative impacts. As previously discussed in this thesis, however, definitions

[208] Ibid, 5.
[209] Ibid, 21.
[210] Ibid, 20.
[211] Refer to discussion in Chapter 3.
[212] See, eg, Danish Energy Agency, above n 5, 78, 90, 92.
[213] Danish Energy Agency, above n 5.
[214] *Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment*, [2001] OJ L 197/30, Article 5(1) and Annex 1(f) Footnote 1, and Article 3(5) and Annex II.

within policy do not necessarily ensure the same level of consistency as those provided within legislation. The procedural approach in the *Guidance Document* provides that geographical areas are not defined by pre-determined geographical coordinates, and instead are dependent upon the nature of an impact, the range of a species that may be impacted, and the proximity of other anthropogenic activities. Determination of this requires information with limitations or knowledge gaps filled where possible. This approach is supportive of effective cumulative impact assessment. The importance of such an approach has been identified by Masden, and Goodale and Milman, where it is discussed that when undertaking the assessment of cumulative impacts, the life cycle of a species, as well as its range, should influence parameters.[215]

Avoiding the pre-determination of geographical areas is also supported by commentary from Judd, Backhaus and Goodsir. [216] This was suggested as part of their recommendation to focus on the common elements of definitions as a way to reduce the uncertainty within marine cumulative impact assessments.[217] Within the context of applying the different approaches found within EU Directives, Judd, Backhaus and Goodsir stated that:

> … it is 'the combination and interaction of pressures that should be crux of environmental assessment and management measures. As such our proposed approach deals with the environmental response to single or multiple pressures (from single or multiple activities) rather than the traditional perspective of environmental impact assessments to determine which plans, projects or human activities should be included in the assessment of "cumulative", "in combination" or "collective" effects. This ensures that all cumulative effects assessments are based on an ecosystem based approach which provides a common structure, whether the impetus is the EU Environmental Impact Assessment, Habitats, Marine Strategy Framework Directives or any other legal or scientific driver.[218]

The benefit of taking an approach to defining and assessing 'cumulative' and 'synergistic' impacts that does not pre-determine a geographical area, is that a consistent approach within the marine environmental assessment legal frameworks of multiple jurisdictions is possible. This would be of assistance when dealing with environmental impacts that are transboundary.

7. The Danish legal framework for assessing the marine environmental effects of cumulative and synergistic impacts from offshore wind farms

The analysis undertaken for the Anholt and Kriegers Flak EIAs, and the Horns Rev and Nysted environmental monitoring programmes, demonstrates common benefits and shortcomings in

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[215] Masden et al, cited in Goodale and Milman, above n 9, 11; Masden et al (2010), above n 29, 4 – 5.
[216] A D Judd, T Backhaus and F Goodsir, 'An effective set of principles for practical implementation of marine cumulative effects assessment' (2015) 54 *Environmental Science and Policy* 254, 254 – 256.
[217] Ibid.
[218] Ibid, 255.

approach to the effective assessment of cumulative and synergistic impacts. The shortcomings focus on the definition of the terms, whilst the benefits focus on environmental assessment process and methodology. In relation to the definition of cumulative and synergistic impacts, these include the potential for inconsistency and an unclear approach, an absence of definition provided for synergistic impacts, non-differentiation of these impact types. A comparative inadequacy in the level of discussion about synergistic impacts is also identified as a shortcoming. Key beneficial approaches identified in relation to process and methodology include the importance of undertaking baseline assessments and studies to improve knowledge, the determination of ecological thresholds, and the emphasis on PAM programmes. Further, the acknowledgement of uncertainty within the scientific assessments was perceived as a beneficial approach.

This section investigates the Danish legal foundation for considering cumulative and synergistic impacts within the EIA of OWF development, and the way in which this framework can support the beneficial aspects and assist with addressing the shortcomings. [219] To achieve this the provisions for assessing cumulative and synergistic impacts within both the applicable Danish legal framework and the overarching EU Environmental Directives[220] are examined.[221] As discussed above, the EU Directives and Danish legislation reviewed were current as of March 2016. Further, whilst the Danish legislation review incorporated applicable amendments,[222] the amending legislation is only referred to when applicable to the matters being discussed.

The first part of this section addresses the legal requirements for cumulative and synergistic impacts within EU Directives and Danish legislation applicable to the EIA of OWF. In addition to EIA specific legislation, legislation that applies to general SEA, marine strategic planning (also SEA focused) and marine protection is considered to enable comparison. The discussion considers whether the terms have been defined, and the extent of adequacy associated with any definition, based on the identified legal requirements for cumulative and synergistic impacts.

The second part of this section involves further review of the legislation identified to contain

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[219] Given the language translation complexities, guidance as to the relevant selection of Danish legislation was taken from Danish Energy Agency, above n 5, 8 - 10. The Danish legislation translation was undertaken by Anna Grage. For information purposes only, within a translation of the relevant surrounding context, the following Danish search terms were used: '*kumulative*' (cumulative); '*synergistike*' (synergistic); '*forsighighedsprincippet*' (precautionary principle); '(*økologisk*) *bæredygtig udvikling'* ((ecologically) sustainable development); and *overvågning* (monitoring).

[220] Only EU Environmental Directives relevant to the environmental assessment of offshore wind farms were selected.

[221] In order to determine the relationship between the legislation selected and offshore wind farms, the legislation selected contained either a direct reference to the offshore wind farms or was capable of application to the environmental assessment of an offshore wind farm.

[222] The Danish legislation is not published in a consolidated form.

requirements for cumulative and/or synergistic impact assessment. The review also focuses upon the legislative provisions for baseline assessments and studies, and the determination of environmental thresholds within the context of EIA for development. Within a similar context, the third part addresses the legal requirements for PAM. The final part of this section considers the legislative capacity for managing uncertainty within decision-making through legal requirements for the application of the precautionary principle. The potential for iterative feedback within decision-making is also examined. Again, the review focuses on legislation containing requirements for cumulative and/or synergistic impact assessment.

7.1 The Danish legal framework for assessing cumulative and synergistic impacts associated with the construction and operation of offshore wind farms

The applicable EU Directives for requiring the consideration of cumulative and synergistic impacts for the environmental assessment of OWF are examined in this part. An equivalent discussion for the Danish legal framework is also provided.

7.1.1 European Union Environmental Directives

The EU environmental assessment framework relevant to OWF includes Directives relating to EIA that apply to projects proposed for the marine environment. There are also Directives that focus on SEA (general focus), protected areas and bird species, and the protection of the marine environment through the use of strategic marine planning, monitoring and assessment.

Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification))[223] and the amending *Directive 2014/52/EU on the assessment of the effects of certain public and private projects on the environment*[224] (collectively the '*EIA Directive*') enables the consideration of cumulative impacts from OWF development through a requirement to assess the significant effects of a project on the environment when preparing an EIA.[225] There is no requirement to assess synergistic impacts in the *EIA Directive*. As a comparison, the *SEA Directive* contains requirements to address both cumulative and synergistic impacts when

[223] *Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification)*, [2012] OJ L 26/1.
[224] *Directive 2014/52/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification)*, [2014] OJ L 124/1.
[225] See, eg, Articles 3(1), 4(3) and Annexes III(1)(b) and IV(5).

preparing programmes or plans for strategic planning purposes.[226] This Directive is similar to the *EIA Directive* in that it applies to both the marine and terrestrial environment, and that only 'significant' impacts need be assessed.[227]

The management of the marine environment and development of applicable legislation and policy in EU member countries is also guided by *EC Directive 2008/56/EC establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive).* [228] This Directive requires the consideration of both cumulative and synergistic impacts and applies to the assessment by EU member states of the environmental health of their marine waters.[229]

The *EIA Directive* also provides direct connection[230] with the *Council Directive 92/43EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora* (*Habitats Directive*).[231] Whilst the term 'cumulative' is not used, cumulative impacts are required to be considered,[232] when preparing an 'Appropriate Assessment'[233] on the impacts on listed species or habitat. The final EU Directive reviewed was the *EC Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (codified*

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[226] *Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment*, [2001] OJ L 197/30, Article 5(1) and Annex 1(f) Footnote 1, and Article 3(5) and Annex II.

[227] See, eg, *Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment*, [2001] OJ L 197/30, Article 5(1) and Annex 1(f) Footnote 1, and Article 3(5) and Annex II.

[228] *Directive 2008/56/EC of the European Parliament and of the Council of 17 June 208 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive) (Text with EEA relevance)*, [2008] OJ L 164/19.

[229] Ibid, Article 8(1)(b)(ii).

[230] Article 5(1) and Annex 1(f) Footnote 1.

[231] *Council Directive 92/43EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora*, [1992] OJ L 206/7, reviewed alongside amendments contained within *Regulation (EC) No 1882/2003 of the European Parliament and of the Council of 29 September 2003 adapting to Council Decision 1999/468/EC the provisions relating to committees which assist the Commission in the exercise of its implementing powers laid down in instruments subject to the procedure referred to in Article 251 of the EC Treaty*, [2003] OJ L 284/1, *Council Directive 97/62/EC of 27 October 1997 adapting to technical and scientific progress Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora*, [1997] OJ L 305/42, *Council Directive 2006/105/EC of 20 November 2006 adapting Directives 73/239/EC, 74/557/EC and 2002/83/EC in the field of environment, by reason of the accession of Bulgaria and Romania*, [2006] OJ L 363/368.

[232] *Council Directive 92/43EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora*, [1992] OJ L 206/7, Articles 1(e), 1(i), 6(3); reviewed alongside amendments contained within *Regulation (EC) No 1882/2003 of the European Parliament and of the Council of 29 September 2003 adapting to Council Decision 1999/468/EC the provisions relating to committees which assist the Commission in the exercise of its implementing powers laid down in instruments subject to the procedure referred to in Article 251 of the EC Treaty*, [2003] OJ L 284/1, *Council Directive 97/62/EC of 27 October 1997 adapting to technical and scientific progress Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora*, [1997] OJ L 305/42, *Council Directive 2006/105/EC of 20 November 2006 adapting Directives 73/239/EC, 74/557/EC and 2002/83/EC in the field of environment, by reason of the accession of Bulgaria and Romania*, [2006] OJ L 363/368.

[233] 'Appropriate Assessment' is a term used to describe the EIA process required under the *Habitats Directive* and is similar to an EIA. See, eg, *Council Directive 92/43EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora*, [1992] OJ L 206/7, Articles 6(3), 6(4).

version).[234] It does not contain explicit references to cumulative or synergistic impacts.[235]

7.1.2 Danish legal framework

The Offshore Wind Energy Environmental Impact Assessment Act (*Bekendtgørelse om vurdering af virkning på miljøet (VVM) ved projekter om etablering m.v. af elproduktionsanlæg på havet*) BEK nr 68 af 26/1/2012[236] provides requirements for the consideration of cumulative impacts within Annex 1(b). Specific to EIA for OWF development, this Act reflects the EIA requirements of the *EIA Directive* discussed above, and includes a requirement to assess the cumulative impacts of the particular proposal with other projects within EIA.[237] Further, this Act also requires cumulative impacts be identified as a significant environmental effect to be addressed within EIAs.[238]

As with the *SEA Directive*, the Act for the Environmental Assessment of Plans and Programmes (*Bekendtgørelse af lov om miljørvurdering af planer og programmer*) LBK nr 1398 af 22/10/2007[239] requires the consideration of significant cumulative impacts that arise from other programmes or plans when preparing strategic documents.[240] The Act requires the consideration of significant synergistic impacts,[241] which reflects the *SEA Directive*.

The Marine Strategy Framework Directive (discussed above) is implemented by the Marine Strategy Act (*Lov om havstrategi*) Lov nr No. 522 af 26/05/2010.[242] This Act provides that significant cumulative and synergistic impacts must be incorporated into the assessment of the

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[234] *EC Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (codified version)* [2010] OJ L 20/7.
[235] Ibid.
[236] *Bekendtgørelse om vurdering af virkning på miljøet (VVM) ved projekter om etablering m.v. af elproduktionsanlæg på havet*, [Offshore Wind Energy Environmental Impact Assessment Act] (Denmark) BEK nr 68 af 26/01/2012 <http://www.retsinformation.dk/Forms/R0710.aspx?id=140308>. Note analysis of Act is based on the author's translation.
[237] Annex 1(1)(b).
[238] Annex 2(5).
[239] *Bekendtgørelse af lov om miljørvurdering af planer og programmer* [Environmental Assessment of Plans and Programmes Act] (Denmark) LBK nr 1398 af 22/10/2007, <http://www.retsinformation.dk/Forms/R0710.aspx?id=113557>, as amended by *Bekendtgørelse af lov om miljørvurdering af planer og programmer* [Environmental Assessment of Plans and Programmes Act] (Denmark) LBK nr 1533 af 10/12/2015, http://www.retsinformation.dk/Forms/R0710.aspx?id=175265>. Note analysis of Act is based on the author's translation.
[240] *Bekendtgørelse af lov om miljørvurdering af planer og programmer* [Environmental Assessment of Plans and Programmes Act] (Denmark) LBK nr 1398 af 22/10/2007, as amended by *Bekendtgørelse af lov om miljørvurdering af planer og programmer* [Environmental Assessment of Plans and Programmes Act] (Denmark) LBK nr 1533 af 10/12/2015, Annex 1(f) Footnote 3, Annex 2(2).
[241] Ibid.
[242] *Lov om havstrategi* [Marine Strategy Act] (Denmark) Lov nr No. 522 af 26/05/2010, <http://www.retsinformation.dk/Forms/R0710.aspx?id=131991> as amended by *Bekendtgørelse af lov om havstrategi* (Denmark) Lov nr No. 1582 af 10/12/2015, <http://www.retsinformation.dk/Forms/R0710.aspx?id=175602. Note analysis of Act is based on the author's translation.

current marine environmental health status. [243]

The Act for the Appropriate Assessment of offshore energy installation projects (*Bekendtgørelse om konsekvensvurdering vedrørende international naturbeskyttelsesområder sant beskyttelse af vise arter ved projekter om etablering m.v. af elproduktionsanlæg og elforsyningsnet på havet*) Lov nr. 1476 af 13/ 12/ 2010, also contained reference to the term cumulative whereby there is a requirement to provide information on significant cumulative effects from a proposed OWF combined with other projects or plans. [244] In addition to its direct relationship with OWF development, this is a similar, albeit more explicit, approach to the *Habitats Directive* that it aims to implement.

7.2 Definitions for cumulative and synergistic impacts

Judd, Backhaus and Goodsir argue that the lack of cohesive approach to definitions and use of terms within EU Environmental Directives that require assessment of cumulative impacts within the marine environment limits the effective assessment and evolution of research methods.[245] This is similar to the opinions of Duinker et al,[246] and Bedford and Preston,[247] on the general challenges of defining cumulative impacts, which were discussed in Chapter 3. Further, these opinions are supported through the comments on uncertainty identified in the Kriegers Flak case study. These comments should be considered along with the conclusions drawn in earlier chapters that cumulative and synergistic impacts need to be defined separately. Providing this distinction might result in better clarity for assessment requirements. This might also result in the development of research and assessment methods that consistently focus on the specific characteristics of each impact type.

The *EIA Directive*, requires the consideration of cumulative impacts, but does not provide a clear definition of the term.[248] As a comparison, the *SEA Directive* provides for a similar

[243] *Lov om havstrategi* [Marine Strategy Act] (Denmark) Lov nr No. 522 af 26/05/2010 as amended by *Bekendtgørelse af lov om havstrategi* (Denmark) Lov nr No. 1582 af 10/12/2015, Section 6(2).
[244] *Bekendtgørelse om konsekvensvurdering vedrørende internationale naturbeskyttelsesområder sant beskyttelse af vise arter ved projekter om etablering m.v. af elproduktionsanlæg og elforsyningsnet på havet* [Act for the Appropriate Assessment of offshore energy installation projects] (Denmark) Lov nr. 1476 af 13/ 12/ 2010, Annex 1(3) <http://www.retsinformation.dk/Forms/R0710.aspx?id=134988>.
[245] Judd, Backhaus and Goodsir, above n 216, 254 – 256.
[246] Peter N Duinker et al, 'Scientific dimensions of cumulative effects assessment: toward improvements in guidance for practice' (2013) 21 *Environmental Reviews* 40, 42.
[247] Barbara L Bedford and Eric M Preston, 'Developing the Scientific Basis for Assessing Cumulative Effects of Wetland Loss and Degradation on Landscape Functions: Status, Perspectives, and Prospects' (1988) 12 (5) *Environmental Management* 751, 758.
[248] *Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification),* [2012] OJ L 26/1 and amending *Directive 2014/52/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification),* [2014] OJ L 124/1.

reference to the consideration of cumulative impacts.[249] Further, as with the *EIA Directive*, no definition is provided.[250] There is also no cumulative impact definition provided in the *Marine Strategy Framework Directive*.[251] Whilst not making a direct reference to the term 'cumulative', the *Habitats Directive* contributes to possible definitions of the term by providing for the assessment of cumulative impacts through its requirement that:

> Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site....[252]

Further, the *Habitats Directive* contains an indirect reference to cumulative impacts through the use of language such as 'sum of the influences'.[253]

The use of the term 'in combination', however, does not provide more clarity than the EU Directives that directly refer to the term 'cumulative' but without any definition. The use of alternative terms such as 'in combination' has been commented upon by Judd, Backhaus and Goodsir, where the uncertainty associated with terminology when using other terms to describe cumulative impacts within EU Environmental Directives was emphasised.[254] The need for a clear understanding of requirements was also highlighted by Masden et al.[255]

The need for clear and consistent requirements has been identified as significant within the EU context; particularly where there is the potential for different approaches amongst member countries. Busch describes this as 'different planning cultures', where the 'varying experiences and legislative differences between neighbouring states….are likely to generate opposing

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[249] *Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment*, [2001] OJ L 197/30.
[250] Ibid.
[251] D*irective 2008/56/EC of the European Parliament and of the Council of 17 June 208 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive) (Text with EEA relevance)*, [2008] OJ L 164/19.
[252] *Council Directive 92/43EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora*, [1992] OJ L 206/7, Articles 6(3); reviewed alongside amendments contained within *Regulation (EC) No 1882/2003 of the European Parliament and of the Council of 29 September 2003 adapting to Council Decision 1999/468/EC the provisions relating to committees which assist the Commission in the exercise of its implementing powers laid down in instruments subject to the procedure referred to in Article 251 of the EC Treaty*, [2003] OJ L 284/1, *Council Directive 97/62/EC of 27 October 1997 adapting to technical and scientific progress Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora*, [1997] OJ L 305/42, *Council Directive 2006/105/EC of 20 November 2006 adapting Directives 73/239/EC, 74/557/EC and 2002/83/EC in the field of environment, by reason of the accession of Bulgaria and Romania*, [2006] OJ L 363/368.
[253] *Council Directive 92/43EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora*, [1992] OJ L 206/7, Articles 1(e), 1(i); reviewed alongside amendments contained within *Regulation (EC) No 1882/2003 of the European Parliament and of the Council of 29 September 2003 adapting to Council Decision 1999/468/EC the provisions relating to committees which assist the Commission in the exercise of its implementing powers laid down in instruments subject to the procedure referred to in Article 251 of the EC Treaty*, [2003] OJ L 284/1, *Council Directive 97/62/EC of 27 October 1997 adapting to technical and scientific progress Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora*, [1997] OJ L 305/42, *Council Directive 2006/105/EC of 20 November 2006 adapting Directives 73/239/EC, 74/557/EC and 2002/83/EC in the field of environment, by reason of the accession of Bulgaria and Romania*, [2006] OJ L 363/368.
[254] Judd, Backhaus and Goodsir, above n 216, 255.
[255] Masden et al (2010), above n 29, 6.

priorities, goals, measurements and consequently assessments.'[256] Busch discusses this issue through consideration of the *Marine Strategy Framework Directive* within the context of OWF development, and highlights the transboundary difficulties when marine planning decisions about cumulative impacts apply to a maritime area controlled by several countries, with potentially different approaches.[257] Further, Busch demonstrates that studies in Europe, on the cumulative impacts on seabirds from OWF use and development within the North Sea, identify the need for more co-operation to overcome the lack of clarity and uncertainty.[258]

The Danish legislation reviewed is generally reflective of the EU Directives in terms of failing to provide a definition for cumulative impacts within the Offshore Wind Energy Environmental Impact Assessment Act BEK nr 68 af 26/1/2012,[259] the Act for the Environmental Assessment of Plans and Programmes LBK nr 1398 af 22/10/2007, [260] the Marine Strategy Act Lov nr No. 522 af 26/05/2010, [261]or the Act for the Appropriate Assessment of offshore energy installation projects Lov nr. 1476 af 13/ 12/ 2010.[262] The issues discussed above in relation to co-operation and consistency between neighbouring countries would need to be considered should the approach to requirement and definition be improved within the Danish context.

Judd, Backhaus and Goodsir comment further that an issue of inconsistency can also arise within methodology for cumulative impacts when there is a risk of assumption that legal requirements are to result in an EIA approach that focuses on the simplest approach.[263] This can result in the neglect of synergistic impacts in favour of linear assessment.[264] As discussed in Chapter 2, Halpern and Fujita stated that the benefits of policy frameworks that seek to reduce synergistic impacts can result in a greater environmental benefit than for cumulative impacts for the same amount of effort.[265] The analysis of the Anholt and Kriegers Flak EIAs, as well as the Horns Rev and Nysted PAM case studies are examples of the relative lack of attention given to

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[256] Busch et al, above n 6, 214.
[257] Ibid.
[258] Ibid, 222.
[259] *Bekendtgørelse om vurdering af virkning på miljøet (VVM) ved projekter om etablering m.v. af elproduktionsanlæg på havet*, [Offshore Wind Energy Environmental Impact Assessment Act] (Denmark) BEK nr 68 af 26/01/2012.
[260] *Bekendtgørelse af lov om miljørvurdering af planer og programmer* [Environmental Assessment of Plans and Programmes Act] (Denmark) LBK nr 1398 af 22/10/2007.
[261] *Lov om havstrategi* [Marine Strategy Act] (Denmark) Lov nr No. 522 af 26/05/2010 as amended by *Bekendtgørelse af lov om havstrategi* (Denmark) Lov nr No. 1582 af 10/12/2015.
[262] *Bekendtgørelse om konsekvensvurdering vedrørende international naturbeskyttelsesområder sant beskyttelse af vise arter ved projekter om etablering m.v. af elproduktionsanlæg og elforsyningsnet på havet* [Act for the Appropriate Assessment of offshore energy installation projects] (Denmark) Lov nr. 1476 af 13/ 12/ 2010.
[263] Judd, Backhaus and Goodsir, above n 216, 257.
[264] Crain et al (2009) and Halpern and Fujita (2013) cited in Judd, Backhaus and Goodsir, above n 216, 256; Caitlin M Crain et al, 'Understanding and Managing Human Threats to the Coastal Marine Environment', (2009) 1162 *The Year in Ecology and Conservation Biology 2009: Ann. N.Y. Acad. Sci* 39, 52; Benjamin S Halpern and Rod Fujita, 'Assumptions, challenges and future directions in cumulative impact analysis' (2013) 4 (10) 131 *Ecosphere* 1, 5, 8.
[265] Halpern and Fujita, above n 264, 8.

synergistic impacts when compared to cumulative impacts within EIA. Combined with a similar conclusion for the EU Directive and Danish legislative review, the potential problems identified by Judd, Backhaus and Goodsir, or Halpern and Fujita are difficult to argue against. The issues raised also indicate that the lack of attention given to synergistic impacts could result in a greater risk of environmental impact being identified than previously anticipated within assessment.

That the requirements to assess cumulative and synergistic impacts within the EU Directives and Danish legislation are limited to 'significant' impacts is a restriction of definition for these impact types. As discussed in Chapter 5, the use of 'significant' as a descriptor of magnitude means that many smaller, yet potentially insidious impacts, can be overlooked within an assessment process. This limitation on the definition occurs for cumulative impacts within the *EIA Directive*,[266] the *SEA Directive*,[267] the Offshore Wind Energy Environmental Impact Assessment Act,[268] the Act for the Environmental Assessment of Plans and Programmes,[269] and the Marine Strategy Act.[270] The limitation on definition occurs for synergistic impacts within the *SEA Directive*[271], the Act for the Environmental Assessment of Plans and Programmes,[272] and Marine Strategy Act.[273]

The approach taken by Denmark is also reflective of the EU in relation to synergistic impacts. Within both frameworks the legislation relating to SEA,[274] and the *Marine Strategy Framework*

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266 *Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification),* [2012] OJ L 26/1, and the amending *Directive 2014/52/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification),* [2014] OJ L 124/1, Articles 3(1), 4(3) and Annexes III(1)(b) and IV(5).
267 *Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment*, [2001] OJ L 197/30, Article 5(1) and Annex 1(f) Footnote 1, and Article 3(5) and Annex II.
268 *Bekendtgørelse om vurdering af virkning på miljøet (VVM) ved projekter om etablering m.v. af elproduktionsanlæg på havet*, [Offshore Wind Energy Environmental Impact Assessment Act] (Denmark) BEK nr 68 af 26/01/2012, Annex 1(1)(b) and Annex 2(5).
269 *Bekendtgørelse af lov om miljørvurdering af planer og programmer* [Environmental Assessment of Plans and Programmes Act] (Denmark) LBK nr 1398 af 22/10/2007, as amended by *Bekendtgørelse af lov om miljørvurdering af planer og programmer* [Environmental Assessment of Plans and Programmes Act] (Denmark) LBK nr 1533 af 10/12/2015, Annex 1(f) Footnote 3, Annex 2(2).
270 *Lov om havstrategi* [Marine Strategy Act] (Denmark) Lov nr No. 522 af 26/05/2010 as amended by *Bekendtgørelse af lov om havstrategi* (Denmark) Lov nr No. 1582 af 10/12/2015, Section 6(2).
271 See, eg, *Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment,* [2001] OJ L 197/30, Article 5(1) and Annex 1(f) Footnote 1, and Article 3(5) and Annex II.
272 *Bekendtgørelse af lov om miljørvurdering af planer og programmer* [Environmental Assessment of Plans and Programmes Act] (Denmark) LBK nr 1398 af 22/10/2007, as amended by *Bekendtgørelse af lov om miljørvurdering af planer og programmer* [Environmental Assessment of Plans and Programmes Act] (Denmark) LBK nr 1533 af 10/12/2015, Annex 1(f) Footnote 3, Annex 2(2).
273 *Lov om havstrategi* [Marine Strategy Act] (Denmark) Lov nr No. 522 af 26/05/2010 as amended by *Bekendtgørelse af lov om havstrategi* (Denmark) Lov nr No. 1582 af 10/12/2015, Section 6(2).
274 *Bekendtgørelse af lov om miljørvurdering af planer og programmer* [Environmental Assessment of Plans and Programmes Act] (Denmark) LBK nr 1398 af 22/10/2007; *Directive 2001/42/EC of the European Parliament and of*

Directive[275] provides for the consideration of synergistic impacts but does not define them. Sheate et al, contend that whilst synergistic impacts are given separate focus within the *SEA Directive* (and no reference within the *EIA Directive*), there is an assumption that as an impact type, they can still be interpreted as part of the cumulative impact definition.[276] Their reasoning for the provision of distinction is 'for the avoidance of doubt'.[277] As contended by this thesis,[278] however, the need for a distinct definition is based on cumulative and synergistic impacts having different characteristics (i.e. linear versus nonlinear). The concerns raised about uncertainty resulting from the absence of a clear approach for the definition of cumulative impacts, is therefore applicable in this context; as is the potential for failure to assess synergistic impacts.

Masden et al recommend that 'standardised vocabulary' is required to improve the efficacy and clarity of EIA terms.[279] When drafting appropriate requirements and definitions, consideration also needs to be given to the disparity between the regulatory approach which commences the assessment focus on the control of anthropogenic activities, and the scientific approach that begins with focus on the environmental effects.[280]

Further, as discussed in the Anholt and Kriegers Flak EIA case studies, the Horns Rev and Nysted environmental monitoring case studies and the *Guidance Document*, the focus of cumulative impact assessment is restricted to anthropogenic activities other than the proposal. The legislative basis for this can be seen within both the EU *EIA Directive*[281] and Denmark's Offshore Wind Energy Environmental Impact Assessment Act BEK nr 68 af 26/1/2012.[282] In relation to the case study analysis, this is a narrow approach as it does not address the impact interactions that can occur between the differing activities of the proposed project. The approach does not require consideration of those cumulative and synergistic impacts that can occur as a

the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment, [2001] OJ L 197/30.

[275] *Lov om havstrategi* [Marine Strategy Act] (Denmark) Lov nr No. 522 af 26/05/2010 and amendment *Bekendtgørelse af lov om havstrategi* (Denmark) Lov nr No. 1582 af 10/12/2015; *Directive 2008/56/EC of the European Parliament and of the Council of 17 June 208 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive) (Text with EEA relevance),* [2008] OJ L 164/19.

[276] William Sheate et al, *The Relationship between the EIA and SEA Directives: Final Report to the European Commission* (Imperial College London Consultants Ltd, August 2005) 6.

[277] Sheate et al, above n 276, 6.

[278] Refer to discussion in Chapters 2.

[279] Masden et al (2015), above n 29, 171.

[280] Judd, Backhaus and Goodsir, above n 216, 254.

[281] *Directive 2014/52/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification),* [2014] OJ L 124/1, Annex III(1)(b).

[282] *Bekendtgørelse om vurdering af virkning på miljøet (VVM) ved projekter om etablering m.v. af elproduktionsanlæg på havet,* [Offshore Wind Energy Environmental Impact Assessment Act] (Denmark) BEK nr 68 af 26/01/2012, Annex 1(1)(b).

result of environmental change (e.g. the effects of climate change).[283]

Whilst the legal frameworks discussed above could provide a foundation for achieving stronger requirements and definitions for cumulative and synergistic impacts, there are a number of complexities that would need to be overcome. These include the potential for insufficient implementation by EU member countries due to the complexity of adaptation to suit individual governance and legislative frameworks, as well as access to resources that higher standards of implementation would inevitably require.

7.3 Baseline studies and environmental thresholds in association with EIA

The literature demonstrates that baseline studies and the establishment of thresholds are critical to effective cumulative impact assessment.[284] As discussed in Chapter 3, attention to these elements within the environmental assessment context is also important for understanding not only the impacts from anthropogenic activities, but also those from environmental change.[285] This is reflected within the Horns Rev and Nysted case studies, and the *Guidance Document* analysis.

The undertaking of baseline assessments is a process required under the *EIA Directive*,[286] yet the determination of environmental thresholds as part of the EIA process is not.[287] In comparison, Denmark's Offshore Wind Energy Environmental Impact Assessment Act BEK nr 68 af 26/1/2012, does not provide direct requirements for either baseline assessments or environmental thresholds.[288] This is because the *EIA Directive* 2014 amendments have not yet been implemented.[289] Indirectly, however, baseline studies can be required through the general provision for the collection of data to enable the prediction of cumulative impacts.[290]

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[283] As discussed in Chapter 2, cumulative and synergistic impacts from environmental change should be considered in addition to those from anthropogenic activities.

[284] See, eg, Goodale and Milman, above n 9, 9 - 11. These elements are identified as part of a group of critical elements based on a review of the literature by Goodale and Milman.

[285] See, eg, John Court, Colin Wright and Alasdair Guthrie, 'Environmental Assessment and Sustainability: Are we ready for the challenge?' (1996) 3 *Australian Journal of Environmental Management* 42, 46; Jill Harriman Gunn and Bram F Noble, 'Integrating cumulative effects in regional strategic environmental assessment frameworks: lessons from practice' (2009) 11 (3) *Journal of Environmental Assessment Policy and Management* 267, 277.

[286] *Directive 2014/52/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification),* [2014] OJ L 124/1, para 31, Annex IV(3).

[287] Ibid, Article 4(3).

[288] *Bekendtgørelse om vurdering af virkning på miljøet (VVM) ved projekter om etablering m.v. af elproduktionsanlæg på havet,* [Offshore Wind Energy Environmental Impact Assessment Act] (Denmark) BEK nr 68 af 26/01/2012.

[289] When noted that the legislation was reviewed in March 2016.

[290] Ibid, Section 3(3).

Both the Danish and EU EIA provisions could be used to address cumulative and synergistic impacts from environmental change in addition to anthropogenic activities. Issues surrounding environmental change, such as biodiversity changes and climate change, resulted in the inclusion of reference to the need to consider environmental changes within the 2014 amendment to the *EIA Directive*.[291] This was not subsequently reflected by the Danish Offshore Wind Energy Environmental Impact Assessment Act BEK nr 68 af 26/1/2012.[292] Further, given the intention that EU member country legislation should reflect EU legislation, the influence of any amendments on Danish EIA process to reflect the changes is yet to be seen.[293]

With a direct influence on the strategic planning of OWF, and therefore any future decisions about location, the *Marine Strategy Framework Directive*,[294] and the Marine Strategy Act (*Lov om havstrategi*) Lov nr No. 522 af 26/05/2010[295] both focus on the measurement of environmental change and have the capacity to address the shortcomings of the EIA legislation. Within the *Marine Strategy Framework Directive* this is aided through the provision of baseline analysis requirements for the 'initial assessment' of marine environmental conditions,[296] and requirements for the determination of environmental thresholds through the setting of environmental targets and inclusion of objectives for achieving 'good environmental status'.[297] Further, the importance of acknowledging environmental change is also recognised within this Directive.[298] Within Denmark's Marine Strategy Act similar provisions for 'initial assessments',[299] environmental targets [300] and achieving 'good environmental status'[301] are also present.

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[291] *Directive 2014/52/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification),* [2014] OJ L 124/1, para 7, para 13.
[292] *Bekendtgørelse om vurdering af virkning på miljøet (VVM) ved projekter om etablering m.v. af elproduktionsanlæg på havet,* [Offshore Wind Energy Environmental Impact Assessment Act] (Denmark) BEK nr 68 af 26/01/2012.
[293] When noted that the legislation was reviewed in March 2016.
[294] See, eg, *Directive 2008/56/EC of the European Parliament and of the Council of 17 June 208 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive) (Text with EEA relevance),* [2008] OJ L 164/19, Article 1.
[295] See, eg, *Lov om havstrategi* [Marine Strategy Act] (Denmark) Lov nr No. 522 af 26/05/2010 as amended by *Bekendtgørelse af lov om havstrategi* (Denmark) Lov nr No. 1582 af 10/12/2015, Section 6.
[296] D*irective 2008/56/EC of the European Parliament and of the Council of 17 June 208 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive) (Text with EEA relevance),* [2008] OJ L 164, 25, Article 10.
[297] See, eg, D*irective 2008/56/EC of the European Parliament and of the Council of 17 June 208 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive) (Text with EEA relevance)*, [2008] OJ L 164, 25, Article 9.
[298]Ibid, para 34, Article 3(5)(a).
[299] *Lov om havstrategi* [Marine Strategy Act] (Denmark) Lov nr No. 522 af 26/05/2010 as amended by *Bekendtgørelse af lov om havstrategi* (Denmark) Lov nr No. 1582 af 10/12/2015, Section 6.
[300] See, eg, *Lov om havstrategi* [Marine Strategy Act] (Denmark) Lov nr No. 522 af 26/05/2010, as amended by *Bekendtgørelse af lov om havstrategi* (Denmark) Lov nr No. 1582 af 10/12/2015, Section 5.
[301] Ibid, Sections 1, 5, 7, Annex 2.

7.4 Post-approval monitoring requirements associated with EIA

The Horns Rev and Nysted environmental monitoring programme demonstrated that instead of relying on the assumptions associated with predicted impacts, the capacity to determine actual impacts is dependent upon effective PAM. To avoid the risk of monitoring failing to occur, or occurring with an inconsistent approach, the monitoring of cumulative and synergistic impacts can be supported through legislation.

The 2014 amendments to the *EIA Directive* incorporated monitoring requirements through the stipulation that any approval must contain conditions with appropriately prescribed 'monitoring measures'.[302] The Directive also enables the efficient use of resources through the use of monitoring programmes associated with other EU Directives, or the legislation of a member country. [303] Alternative EU Directives that could facilitate the general environmental monitoring of OWF include the *SEA Directive*[304] and the *Marine Strategy Framework Directive*.[305] Importantly, the *EIA Directive* provides direct reference to the consideration of the *Habitats Directive*. Although focused on the conservation of selected species and areas, this Directive also provides opportunities for monitoring when appropriate.[306]

Within the Danish legislative framework, the capacity to provide for PAM is focused within the alternative provisions under the Act for the Environmental Assessment of Plans and Programmes LBK nr 1398 af 22/10/2007,[307] and the Marine Strategy Act Lov nr No. 522 af 26/05/2010.[308] This occurs due to a delay in the implementation of the 2014 *EIA Directive*

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[302] *Directive 2014/52/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification),* [2014] OJ L 124/1, Article 8a(1)(b).
[303] Ibid, Article 8a(4).
[304] *Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment*, [2001] OJ L 197/30, Article 10.
[305] See, eg, *Directive 2008/56/EC of the European Parliament and of the Council of 17 June 208 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive) (Text with EEA relevance),* [2008] OJ L 164/19, para 21, para 23, para 26, para 38, para 48, Article 5(2) (a) (iv), Article 11, Article 19.
[306] *Council Directive 92/43EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora*, [1992] OJ L 206/7, Article 12(4); reviewed alongside amendments contained within *Regulation (EC) No 1882/2003 of the European Parliament and of the Council of 29 September 2003 adapting to Council Decision 1999/468/EC the provisions relating to committees which assist the Commission in the exercise of its implementing powers laid down in instruments subject to the procedure referred to in Article 251 of the EC Treaty*, [2003] OJ L 284/1, *Council Directive 97/62/EC of 27 October 1997 adapting to technical and scientific progress Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora*, [1997] OJ L 305/42, *Council Directive 2006/105/EC of 20 November 2006 adapting Directives 73/239/EC, 74/557/EC and 2002/83/EC in the field of environment, by reason of the accession of Bulgaria and Romania,* [2006] OJ L 363/368.
[307] *Bekendtgørelse af lov om miljørvurdering af planer og programmer* [Environmental Assessment of Plans and Programmes Act] (Denmark) LBK nr 1398 af 22/10/2007, as amended by *Bekendtgørelse af lov om miljørvurdering af planer og programmer* [Environmental Assessment of Plans and Programmes Act] (Denmark) LBK nr 1533 af 10/12/2015, Sections 9(3), 11, Annex 1(i).
[308] See, eg, *Lov om havstrategi* [Marine Strategy Act] (Denmark) Lov nr No. 522 af 26/05/2010, as amended by *Bekendtgørelse af lov om havstrategi* (Denmark) Lov nr No. 1582 af 10/12/2015, Sections 9,12,13,14,16,21, Annex 3(7), Annex 4.

amendments within the Offshore Wind Energy Environmental Impact Assessment Act BEK nr 68 af 26/1/2012.[309] The Act for the Appropriate Assessment of offshore energy installation projects Lov nr. 1476 af 13/ 12/ 2010, which implements the *Habitats Directive*, also provides that conditions requiring monitoring can be included as part of an approval. [310]

7.5 Reducing uncertainty

Decision-making needs to acknowledge uncertainty in process and the limitations of knowledge and theories need to be identified qualitatively or quantitatively.[311] This should occur either as assumptions or caveats to the methods/ approaches used. The role of the precautionary principle as a mechanism for the management of uncertainty, associated with cumulative and synergistic impacts, is discussed within Chapter 3.[312] In brief, application of the precautionary principle assists through the acknowledgement within decision-making that cumulative and synergistic impacts are not well understood,[313] and facilitation of opportunities to increase knowledge about these impact types.[314] The legislative extent of capacity for the application of the precautionary principle is discussed further below.

Decision-making that incorporates iterative feedback processes can facilitate an increase in the understanding of cumulative and synergistic impacts from baseline studies and PAM. The knowledge gained, where appropriate, should be applied within future decision-making processes. The potential for this as a result of the legislative reviews undertaken is discussed.

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309 As a result of the EIA assessment under the *Bekendtgørelse om vurdering af virkning på miljøet (VVM) ved projekter om etablering m.v. af elproduktionsanlæg på havet*, [Offshore Wind Energy Environmental Impact Assessment Act] (Denmark) BEK nr 68 af 26/01/2012, license conditions can be incorporated into approvals. See, eg, Danish Energy Agency, above n 5, 32. It is noted that The Offshore Wind Energy Impact Assessment Act was abolished on 16th May 2017 by *Bekendtgørelse om ophævelse af Bekendtgørelse om vurdering af virkning på miljøet (VVM) ved projekter om etablering m.v. af elproduktionsanlæg på havet* BEK nr 446 af 09/05/2017 <http://www.retsinformation.dk/Forms/R0710.aspx?id=189972>.

310 See, eg, *Bekendtgørelse om konsekvensvurdering vedrørende international naturbeskyttelsesområder sant beskyttelse af vise arter ved projekter om etablering m.v. af elproduktionsanlæg og elforsyningsnet på havet* [Act for the Appropriate Assessment of offshore energy installation projects] (Denmark) Lov nr. 1476 af 13/ 12/ 2010, Annex 1(1).

311 Masden et al (2015), above n 29, 171.

312 Refer to section 3.

313 See, eg, Jaye Ellis and Stepan Wood, 'International Environmental Law' in Benjamin J Richardson & Stepan Wood (eds) *Environmental Law for Sustainability* (Hart Publishing, 2006) 343, 361 – 362; Joel A Tickner and Ken Geiser, 'The precautionary principle stimulus for solutions – and alternatives – based environmental policy' (2004) 24 *Environmental Impact Assessment Review* 801, 807; David Kriebel et al, 'The Precautionary Principle in Environmental Science' (2001) 109 (9) *Environmental Health Perspectives* 871, 873, 874.

314 See, eg, Rozalyn Daniell, 'To what extent do land use planning controls and policy in South Australia facilitate sustainable development' (1998) (1)(2) AELN 50, 51; Derek V Ellis, 'The precautionary principle and environmental monitoring' (2003) 46 *Marine Pollution Bulletin* 933, 933; Charmain Barton, 'The Status of the Precautionary Principle in Australia: its emergence in legislation and as a common law doctrine' (1998) *22 Harvard Environmental Law Review* 509, 513; Kriebel et al, above n 313, 873, 874.

7.5.1 Applying the precautionary principle

The Treaty of the European Union states that all European Union environmental policy is 'based on the precautionary principle'.[315] Of the EU Environmental Directives that include requirements for the consideration of cumulative and/or synergistic impacts, explicit reference to the precautionary principle can be found within the *EIA Directive*,[316] the *SEA Directive*[317], and the *Marine Strategy Framework Directive*.[318] Each of these Directives states, within the preamble, that the application of the precautionary principle is fundamental to the decision-making process. Whilst there is no direct reference to the requirement to apply the precautionary principle within the *Habitats Directive,* the preamble identifies the importance of achieving the goals of sustainable development.[319] As discussed within Chapters 3 and 4,[320] Ecologically Sustainable Development (known as 'sustainable development' (SD) in Denmark and the EU) incorporates the precautionary principle. Further, as discussed within the *Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC*, the precautionary principle is critical to decision-making under Articles 6(3) and 6(4).[321]

Within the Danish legislation containing requirements for the assessment of cumulative and/or synergistic impact, there are no explicit references to the application of the precautionary principle.[322] Further, the potential for the precautionary principle to be required within

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315 *Consolidated version of the Treaty of the European Union,* [2016] OJ C 202/132, Article 191.
316 *Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification),* [2012] OJ L 26/1, para 2; and amending *Directive 2014/52/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification),* [2014] OJ L 124/1, para 15.
317 *Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment*, [2001] OJ L 197/30, para 1.
318 *Directive 2008/56/EC of the European Parliament and of the Council of 17 June 208 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive) (Text with EEA relevance),* [2008] OJ L 164/19, paras 27, 44.
319 *Council Directive 92/43EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora,* [1992] OJ L 206/7, 206/7; reviewed alongside amendments contained within *Regulation (EC) No 1882/2003 of the European Parliament and of the Council of 29 September 2003 adapting to Council Decision 1999/468/EC the provisions relating to committees which assist the Commission in the exercise of its implementing powers laid down in instruments subject to the procedure referred to in Article 251 of the EC Treaty*, [2003] OJ L 284/1, *Council Directive 97/62/EC of 27 October 1997 adapting to technical and scientific progress Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora*, [1997] OJ L 305/42, *Council Directive 2006/105/EC of 20 November 2006 adapting Directives 73/239/EC, 74/557/EC and 2002/83/EC in the field of environment, by reason of the accession of Bulgaria and Romania,* [2006] OJ L 363/368.
320 Refer to Chapter 3, section 2.1, and Chapter 4, section 2.
321 European Commission, *Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC* (January 2007), 3 – 4 http://www.ec.europa.eu/environmental/nature/natura2000/management/guidance_en.
322 *Bekendtgørelse om vurdering af virkning på miljøet (VVM) ved projekter om etablering m.v. af elproduktionsanlæg på havet*, [Offshore Wind Energy Environmental Impact Assessment Act] (Denmark) BEK nr 68 af 26/01/2012; *Bekendtgørelse af lov om miljørvurdering af planer og programmer* [Environmental Assessment of Plans and Programmes Act] (Denmark) LBK nr 1398 af 22/10/2007, as amended by *Bekendtgørelse af lov om miljørvurdering af planer og programmer* [Environmental Assessment of Plans and Programmes Act] (Denmark) LBK nr 1533 af 10/12/2015; *Lov om havstrategi* [Marine Strategy Act] (Denmark) Lov nr No. 522 af 26/05/2010, as amended by *Bekendtgørelse af lov om havstrategi* (Denmark) Lov nr No. 1582 af 10/12/2015; *Bekendtgørelse om konsekvensvurdering vedrørende international naturbeskyttelsesområder sant beskyttelse af vise arter ved projekter*

assessment procedures as a principle of SD ('*bæredygtig udvikling'*) is limited within this suite of legislation. There are no direct references to the application of the SD principles. It is acknowledged that the precautionary principle can still be applied as a matter of procedural policy;[323] with the imperative for this approach strengthened when the precautionary principle and/ or SD are referred to within the relevant EU Directive. Given, however, the importance of applying principles for the assessment of uncertainty to ensure achievable goals for assessing cumulative (and synergistic) impacts,[324] an improved legal foundation for applying the precautionary principle either explicitly or through reference to SD may be of benefit to Danish EIA processes for OWF development. The effectiveness of this approach should also be supported through the provision of clear requirements for both cumulative and synergistic impact assessment.

Within the EU Directives and Danish legislation reviewed there are examples that, although not containing express requirements for the consideration of cumulative and/or synergistic impacts, do contain reference to the precautionary principle and/or SD.[325] Whilst the inclusion of these references alone could justify an implied need for cumulative and synergistic impact assessment, as discussed throughout this thesis, the absence of specific requirements means that an effective approach to consideration and/or assessment cannot be guaranteed.

7.5.2 The role of iterative feedback

Ensuring the flow of information between EIA, PAM and decision-making is critical for gaining insight to improve both scientific assessments and decision-making. Focusing on the role of iterative feedback, the importance of improving understanding of both the science and regulatory requirements to ensure that cumulative impact assessment is undertaken effectively has been highlighted by Goodale and Milman.[326] Discussing these challenges, Goodale and Milman also emphasise the need for effective knowledge sharing between decision-making and authorities.[327] Further, the value of knowledge sharing about cumulative and synergistic impacts between decision-making processes is emphasised. As an example, Sheate et al comment that when comparing decision-making processes, quantitative impact predictions associated with EIA can provide a lower 'level of uncertainty' than when compared with the qualitative impact

om etablering m.v. af elproduktionsanlæg og elforsyningsnet på havet [Act for the Appropriate Assessment of offshore energy installation projects] (Denmark) Lov nr. 1476 af 13/ 12/ 2010.

[323] See, eg, Danish Energy Agency, above n 5, 29.

[324] Judd, Backhaus and Goodsir, above n 216, 261.

[325] See, eg, *EC Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (codified version)* [2010] OJ L 20/7 para 5.

[326] Goodale and Milman, above n 9, 2.

[327] Ibid, 13 - 14.

predictions associated with SEA.[328]

It is acknowledged that valuable information about cumulative and synergistic impacts can be derived under the marine environmental assessment legislation discussed. Yet the capacity for knowledge sharing between statutory and strategic planning processes, as well as scientific assessment, appears to be limited in requirement. This is evident when comparing the impact assessment requirements within the EIA legislation (*EIA Directive*[329]and the Offshore Wind Energy Environmental Impact Assessment Act BEK nr 68 af 26/1/2012,[330]), the SEA legislation (*SEA Directive*[331] and the Act for the Environmental Assessment of Plans and Programmes LBK nr 1398 af 22/10/2007[332]) and the Marine Strategy Frameworks legislation (*Marine Strategy Framework Directive*[333] and the Marine Strategy Act Lov nr No. 522 af 26/05/2010[334]). The provision of requirements for more integration between legislative requirements at both the EU and Danish levels would improve the potential for knowledge sharing.

The absence of requirement for synergistic impact assessment within the EIA legislation and the subsequent inconsistency in approach undermines the potential for integrating the outcomes, and increases the complexity of knowledge sharing between decision-making processes. In addition, there is a need for provisions that facilitate not only the transfer of knowledge about synergistic impacts (and from a general perspective), but also the consideration of prior knowledge from other sources within any decision-making process. Given the link between EIA and strategic planning for the marine environment, the capacity for iterative feedback is a critical element. This has also been demonstrated for OWF within the United Kingdom and Germany, with the transfer of knowledge from EIA to SEA critiqued by Phylip-Jones and Fischer as being in need of 'mechanisms' to 'improve the use of data collected from previous

[328] Sheate et al, above n 276, 16.
[329]See, eg, *Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification),* [2012] OJ L 26/1, and amending *Directive 2014/52/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification),* [2014] OJ L 124/1, Annex III.
[330] See, eg, *Bekendtgørelse om vurdering af virkning på miljøet (VVM) ved projekter om etablering m.v. af elproduktionsanlæg på havet*, [Offshore Wind Energy Environmental Impact Assessment Act] (Denmark) BEK nr 68 af 26/01/2012, Annexes 1 and 2.
[331] See, eg, *Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment,* [2001] OJ L 197/30, Annexes 1 and II.
[332] See, eg, *Bekendtgørelse af lov om miljørvurdering af planer og programmer* [Environmental Assessment of Plans and Programmes Act] (Denmark) LBK nr 1398 af 22/10/2007, Section 7, Annex 1, Annex 2 as amended by *Bekendtgørelse af lov om miljørvurdering af planer og programmer* [Environmental Assessment of Plans and Programmes Act] (Denmark) LBK nr 1533 af 10/12/2015.
[333] See, eg, *Directive 2008/56/EC of the European Parliament and of the Council of 17 June 208 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive) (Text with EEA relevance)*, [2008] OJ L 164/19, Article 8.
[334] See, eg, *Lov om havstrategi* [Marine Strategy Act] (Denmark) Lov nr No. 522 af 26/05/2010, amendment *Bekendtgørelse af lov om havstrategi* (Denmark) Lov nr No. 1582 af 10/12/2015, Section 6.

EIA and SEA applications.'[335] Phylip-Jones and Fischer also emphasised the need for improved approaches to cumulative impact assessment within SEA for OWF.[336] The combination of these findings stress the role for cumulative and synergistic impact assessment in both EIA and SEA.

The role of PAM as a mechanism for iterative feedback is discussed within Chapter 3.[337] Provisions have been included within the EU Directives that facilitate the use of PAM programmes required under alternative Directives or legislation.[338] Excluding the Offshore Wind Energy Environmental Impact Assessment Act,[339] this is also reflected within the Danish legislation demonstrated to contain explicit and potential requirements for cumulative and synergistic impact assessment.[340] To facilitate effective iterative feedback for improving cumulative and synergistic impact knowledge the need for stronger requirements that directly link monitoring and these impact types should be considered.

8. Conclusion

The Anholt and Kriegers Flak EIA demonstrate several issues about effective cumulative and synergistic impact assessment. They include concerns with the narrow and inconsistent approach to definitions and inadequate attention to synergistic impacts as a distinct impact type.

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[335] J Phylip-Jones and T B Fischer, 'Strategic environmental assessment (SEA) for wind energy planning: Lessons from the United Kingdom and Germany' (2015) 50 *Environmental Impact Assessment Review* 203, 212.
[336] Ibid, 211.
[337] Refer to section 3.2.
[338] See, eg, *Directive 2014/52/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification),* [2014] OJ L 124/1, Article 8a(4); *Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment*, [2001] OJ L 197/30, Article 10; *Directive 2008/56/EC of the European Parliament and of the Council of 17 June 208 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive) (Text with EEA relevance)*, [2008] OJ L 164/19, para 21, para 23, para 26, para 38, para 48, Article 5(2)(a)(iv), Article 11, Article 19; *Council Directive 92/43EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora*, [1992] OJ L 206/7, Article 12(4); reviewed alongside amendments contained within *Regulation (EC) No 1882/2003 of the European Parliament and of the Council of 29 September 2003 adapting to Council Decision 1999/468/EC the provisions relating to committees which assist the Commission in the exercise of its implementing powers laid down in instruments subject to the procedure referred to in Article 251 of the EC Treaty*, [2003] OJ L 284/1, *Council Directive 97/62/EC of 27 October 1997 adapting to technical and scientific progress Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora*, [1997] OJ L 305/42, *Council Directive 2006/105/EC of 20 November 2006 adapting Directives 73/239/EC, 74/557/EC and 2002/83/EC in the field of environment, by reason of the accession of Bulgaria and Romania*, [2006] OJ L 363/368.
[339] *Bekendtgørelse om vurdering af virkning på miljøet (VVM) ved projekter om etablering m.v. af elproduktionsanlæg på havet*, [Offshore Wind Energy Environmental Impact Assessment Act] (Denmark) BEK nr 68 af 26/01/2012.
[340] See, eg, *Bekendtgørelse af lov om miljørvurdering af planer og programmer* [Environmental Assessment of Plans and Programmes Act] (Denmark) LBK nr 1398 af 22/10/2007 as amended by *Bekendtgørelse af lov om miljørvurdering af planer og programmer* [Environmental Assessment of Plans and Programmes Act] (Denmark) LBK nr 1533 af 10/12/2015 Sections 9(3), 11, Annex 1(i); *Lov om havstrategi* [Marine Strategy Act] (Denmark) Lov nr No. 522 af 26/05/2010, as amended by *Bekendtgørelse af lov om havstrategi* (Denmark) Lov nr No. 1582 af 10/12/2015, Sections 9,12,13,14,16,21, Annex 3(7), Annex 4*; Bekendtgørelse om konsekvensvurdering vedrørende international naturbeskyttelsesområder sant beskyttelse af vise arter ved projekter om etablering m.v. af elproduktionsanlæg og elforsyningsnet på havet* [Act for the Appropriate Assessment of offshore energy installation projects] (Denmark) Lov nr. 1476 af 13/ 12/ 2010, Annex 1(1).

Further, uncertainty about impacts is pervasive. The importance of undertaking baseline assessment and studies was also evident. These matters were also emphasised within the Danish environmental monitoring programme for Horns Rev and Nysted, with focus placed on the value of baseline assessment and studies, and PAM. The beneficial approaches identified in the Danish EIA and PAM programmes were also addressed in the *Guidance Document on Environmental Impact Assessment: Danish Offshore Wind Farms* through acknowledgement of the need to determine environmental thresholds.

It is clear that not all relevant EU Directives and Danish legislation refers to cumulative and synergistic impacts. The inclusion of requirements to assess cumulative and synergistic impacts as distinct impact types needs to be considered. This will assist in ensuring a consistent approach and the potential for iterative feedback. The analysis demonstrates the importance of ensuring consistent approaches that support the effective integration of legal frameworks for both statutory (e.g. EIA) and strategic (e.g. SEA) planning processes within the OWF developments. This can also be achieved through the use of more specific PAM provisions.

Clear definitions should be provided in legislation to support consistent approaches to assessment method. A more consistent approach to the inclusion of baseline assessments, and determining environmental thresholds, and direct connection to cumulative and synergistic impacts across the legislation would assist the achievement of EU Environmental Directives and Danish legislation objectives. The management of transboundary cumulative impacts is also needed. Transboundary impact management for both cumulative and synergistic impacts, when multiple legislative frameworks are involved, needs to be addressed or improved. The impacts from environmental change and anthropogenic activities should also be given attention within any revised requirements. Finally, provisions for the precautionary principle and use of iterative feedback as approaches for reducing the uncertainty surrounding cumulative and synergistic impacts could be improved within all legislative examples reviewed. Given the conclusions derived from the analysis, it is also suggested that a re-evaluation of the EU and Danish legislative frameworks for a point in time more recent than March 2016, whilst not undertaken for this thesis, may provide additional insight as to how legal requirements for cumulative and synergistic impacts can be improved.

The issues raised above within the Danish OWF case studies and legislative review are also important for informing the reform of other legal framework approaches to effective cumulative and synergistic impact assessments for general large-scale use and development within the marine environment. When the legal requirements for the EIA of cumulative and synergistic impacts for OWF within EU and Danish legislative frameworks is compared to those within the legislation analysed for the Otways Marine Area case study,[341] the potential for improving the approach within the Australian legislation reviewed is clear. This is because requirements for assessing cumulative and/or synergistic impacts within the EU and Danish legislative frameworks were identified more often, and with more specific focus on assessment requirements within the EIA processes. In contrast, the capacity to consider cumulative and synergistic impacts within the Australian legislation is limited by a pervasive absence of explicit requirement and therefore cohesive approach to defining and assessing these impact types.[342]

When the analysis within this chapter is compared to that undertaken for legislation in Chapter 5 Otways Marine Area, there are also similarities in shortcomings for the approach to defining cumulative and/ or synergistic impacts. One example is the limitation of approach to assessment that can be caused by a definition that is restricted through the use of the descriptor term 'significant'. As discussed in this chapter and Chapter 5, this can mean that smaller, yet potentially problematic, cumulative and synergistic impacts are overlooked within an EIA process.[343] That this is a common issue identifies the importance of considering this issue when incorporating requirements and defining terms within legislative frameworks.

The shortcomings and benefits identified within this chapter also provide insight into ways the shortcomings identified within the Victorian Port Phillip Bay Channel Deepening Project case study analysis could be addressed.[344] As an example, if the *Environmental Effects Act 1978* (Vic) contained requirements to assess cumulative and synergistic impacts, as well provided for definitions, then these requirements could be used alongside processes and management tools (e.g. baseline monitoring, environmental thresholds and PAM) to increase knowledge about cumulative and synergistic impacts within Victorian marine environments. When these processes and management tools are utilised, and the precautionary principle is applied, decision-making processes change and EIA becomes more effective as a tool for predicting impacts.

Any law reform should consider the issues raised through the case study and legislative analysis undertaken in this chapter to provide for a more cohesive approach. This is discussed within the recommendations contained in the next chapter.

[341] Refer to Chapter 5.
[342] Refer to Chapters 5 for further discussion and examples.
[343] Refer to Chapter 5, section 2.2.2 and 3.2, and Section 7.2 of this Chapter.
[344] Refer to Chapters 6 for further discussion and examples.

CHAPTER 8 – CONCLUSIONS AND RECOMMENDATIONS

'What is the argument on the other side? Only this, that no case has been found in which it has been done before. That argument does not appeal to me in the least. If we never do anything which has not been done before, we shall never get anywhere. The law will stand still whilst the rest of the world goes on: and that will be bad for both.' [1]

Chapter outline

[1] *Packer v Packer* [1953] 2 All ER 127, 129 [H] (Denning LJ)

1. Introduction

The scientific assessment of cumulative and synergistic impacts can assist in increasing knowledge about the effects of anthropogenic activities and environmental change in the marine environment. Assessments can inform approaches and management strategies to improve the ability to avoid or mitigate detrimental impacts. Thus, it is imperative that requirements to provide information and data about cumulative and synergistic impacts are included in Australian legislation for marine environmental impact assessment (EIA). This will improve the protection of the marine environment by ensuring that anthropogenic activities occur in an environmentally sustainable manner. The provision of requirements within Australian legislation for the consideration and assessment of these impact types can influence the method for assessment, and extent of consideration given, within EIA and statutory decision-making processes.

This thesis has identified that cumulative and synergistic impacts are a problem for Australia's marine environment.[2] That cumulative impacts are continuing to cause detriment to Australia's marine environment is evidenced in the 2017 release of the *Australia state of the environment report 2016* (SoE16).[3] The causes being anthropogenic activities (e.g. shipping and dredging, and the introduction and spread of invasive species)[4] and environmental change (e.g. natural variability climate change and establishment of invasive species).[5]

SoE16 contains more extensive discussion about cumulative impacts in the marine environment than earlier Australia state of the environment reports (SoE) (discussed in Chapter 4).[6] The

[2] Refer to Chapter 4, section 1.2.
[3] See, eg, W J Jackson et al, *Australia state of the environment 2016: overview*, independent report to the Australian Government Minister for the Environment and Energy (Australian Government Department of the Environment and Energy, 2017) viii, x,16, 39, 61, 63, 66, 81; G F Clark and E L Johnston, *Australia state of the environment 2016: coasts*, independent report to the Australian Government Minister for the Environment and Energy (Australian Government Department of the Environment and Energy, 2017) iv, 107, 112; K Evans, N Bax and D C Smith, *Australia state of the environment 2016: marine environment*, independent report to the Australian Government Minister for the Environment and Energy (Australian Government Department of the Environment and Energy, 2017) 34 – 35, 46, 68, 69, 86, 113, 130, 140, 146, 165, 167, 174, 176, 184, 186; I D Creswell and H T Murphy, *Australia state of the environment 2016: biodiversity*, independent report to the Australian Government Minister for the Environment and Energy (Australian Government Department of the Environment and Energy, 2017) v, vi, 37, 94;
[4] See, eg, Clark and Johnston, above n 3, 13, 38.
[5] See, eg, Evans, Bax and Smith, above n 3, 64; Clark and Johnston, above n 3, iv, 44, 102.
[6] See, eg, State of the Environment Advisory Council, *Australia State of the Environment 1996* (Commonwealth of Australia, 1996) <http://www.environment.gov.au/soe/1996/publications/report/index.html>; Australian State of the Environment Committee 2001, *Australian State of the Environment Report 2001: Independent Report to the Commonwealth Minister for the Environment and Heritage*, (CSIRO Publishing on behalf of the Department of the Environment and Heritage, 2001) ; Beeton RJS (Bob) et al, Australian State of the Environment Committee, *Australian State of the Environment Report 2006: Independent Report to the Commonwealth Minister for the Environment and Heritage* (Department of the Environment and Heritage, 2006); State of the Environment 2011 Committee, *Australia State of the Environment 2011, Independent report to the Australian Government Minister for Sustainability, Environment, Water, Population and Communities*, (DSEWPaC 2011). Refer to Chapter 4, section 1.2 for detailed analysis of the cumulative and synergistic impacts discussion in the SoE reports.

greater focus on cumulative impacts as a key challenge in areas such as environmental management and planning,[7] decision-making,[8] and the need for effective post-approval monitoring[9] (PAM) and adaptive governance,[10] indicates that their consideration is gaining increasing importance. Concern is also raised about the complexity for predicting these types of marine environmental impacts[11] and limitations for using risk assessments as a means of assessing cumulative impacts.[12] This combined with focus placed on the lack of knowledge about complex interactions and impacts within the marine environment,[13] recognises the potential implications of uncertainty for environmental assessments and decision-making.

That the direction of SoE reporting is becoming more focused on cumulative impacts shows promise that their assessment is increasingly integral to marine environmental protection. Despite the increased attention given to these impact types, however, Clark and Johnston stated in the SoE16 coasts report that:

> The outlook for cumulative impact management in the short and long term is poor, unless all levels of government adopt effective frameworks backed by strong incentives and regulations. Effective cumulative impact management requires the development of approaches to facilitate realistic and respectful interactions between managers, researchers, government advisers, stakeholders and communities.[14]

The direction taken for the consideration and assessment of synergistic impacts is less encouraging. The need to consider synergistic impacts is acknowledged in SoE16 as necessary for cumulative impact management in coastal areas.[15] However, the overall level of attention given to synergistic impacts is not significantly different to that given in the earlier SoE reports.[16] Further, the concerns identified in this thesis about the ambiguity that can result from an inadequate distinction between cumulative and synergistic impacts, are also evident in the SoE16 references to synergistic impacts. These references highlight the existing trend that does not acknowledge the differences between cumulative and synergistic impacts. The SoE16 marine report contributes to the confusion about definition and assessment through reference to

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[7] See, eg, Jackson et al, above n 3, viii, x; Clark and Johnston, above n 3, 107, 112; Evans, Bax and Smith, above n 3, 167, 174, 176, 184, 186.
[8] See, eg, Jackson et al, above n 3, 53, 56, 58, 67; Clark and Johnston, above n 3, 64, 100, 102, 105, 106, 107; Evans, Bax and Smith, above n 3, 115, 148, 149, 164, 175.
[9] See, eg, Creswell and Murphy, above n 3, 43; Jackson et al, above n 3, 81; Evans, Bax and Smith, above n 3, xi, 150.
[10] See, eg, Shultz et al (2015) in Evans, Bax and Smith, above n 3, 166; Evans, Bax and Smith, above n 3, 166.
[11] Evans, Bax and Smith, above n 3, 16, 17, 46.
[12] Ibid, x.
[13] See, eg, Clark and Johnston, above n 3, iv, viii, 107; Evans, Bax and Smith, above n 3, x, 62, 148, 172; Jackson et al, above n 3, xiii, 3, 4, 20, 21, 53, 81;
[14] Clark and Johnston, above n 3, 107.
[15] Ibid, 100, 106.
[16] See, eg, State of the Environment Advisory Council, *Australia State of the Environment 1996* (Commonwealth of Australia, 1996), Chapter 4-10, Chapter 4 -21 <http://www.environment.gov.au/soe/1996/publications/report/index.html>; J Williams et al, *Biodiversity, Australian State of the Environment Report 2001 (Theme Report)*, (CSIRO Publishing on behalf of the Department of the Environment and Heritage, 2001) 102.

synergistic impacts as providing a beneficial nonlinear outcome.[17] The term is then used to describe potential detrimental impacts within coastal areas,[18] and for land based biodiversity threats.[19] The use of the term in two different ways is inconsistent and causes confusion as to the intended meaning of synergistic impacts.

Efforts to improve the assessment of cumulative impacts as part of EIA is evident in other countries. As an example, Willsteed et al evaluated the cumulative impact assessment (CIA) methods undertaken for multiple large-scale offshore wind farms in United Kingdom waters.[20] Their research has provided insightful analysis of the shortcomings of each CIA, and the results can be used to improve consistency in approach to consideration within future assessments.[21] Whilst research such as this is important, Willsteed et al have not addressed synergistic impacts and this emphasises that modern research needs to take a more holistic approach. As discussed in this thesis, both cumulative and synergistic impacts need to be considered and assessed in environmental assessment, and their difference requires that they are addressed separately. One way of achieving separate consideration and assessment is through changes to legislation for EIA (and strategic environmental assessment (SEA)) that result in the inclusion of clear and consistent requirements.

The purpose of this thesis is to determine whether Australian legal requirements for marine environmental assessment (in particular EIA) are adequate to ensure the effective consideration and assessment of cumulative and synergistic impacts. The literature and case study analyses undertaken demonstrate that whilst there is a trend toward improving the Australian legal requirements for assessing cumulative and synergistic impacts in the marine environment, they are generally inadequate. Based upon these findings, recommendations for improving the Australian legal approach to cumulative and synergistic impact consideration and assessment in marine EIA can be made.

In Australia, there are examples of recent reform to legislation that demonstrate missed opportunities to improve the approach to cumulative and synergistic marine EIA has not been taken. One example is the *Planning, Development and Infrastructure Act 2016* (SA), the Act that is incrementally replacing the *Development Act 1986* (SA).[22] The *Development Act 1986*

[17] Evans, Bax and Smith, above n 3, 148.
[18] Clark and Johnston, above n 3, vi, 100, 106.
[19] Creswell and Murphy, above n 3, 36.
[20] Edward A Willsteed et al, 'Obligations and aspirations: A critical evaluation of offshore wind farm cumulative impact assessments' (2018) 82 *Renewable and Sustainable Energy Reviews* 2332, 2338 – 2344.
[21] Ibid.
[22] On the 1st April 2017. From this date the *Development Act 1993* (SA) is being repealed/ replaced by in stages.

(SA) was assessed within the Otways Marine Area case study.[23] Whilst identifying the need to consider cumulative impacts, the approach is limited to consideration about determining the appropriate authority, and based on 'the cumulative effect of the development, when considered in conjunction with any other development, project or activity.'[24] There is no requirement to assess cumulative or synergistic impacts within the EIA processes associated with this new legislation.

The second example is the *Marine and Coastal Act 2018* (Vic), the Act that replaced the *Coastal Management Act 1995* (Vic);[25] also an Act assessed within the Otways Marine Area case study.[26] This Act references the need for an ecosystem-based management approach for the marine and coastal environment that includes 'avoiding detrimental cumulative or incremental ecosystem impacts'.[27] There is no direct requirement for the consideration of cumulative impacts in associated EIA processes, and there is no reference to synergistic impacts.

This thesis demonstrates that there are problems with the assessment of cumulative and synergistic impacts in marine EIA in Australia. These shortcomings are evident when cumulative and synergistic impacts are not defined as separate impact types, or explicitly required to be assessed (as separate impact types) within legislation. Instead, the approaches of identifying synergistic impacts as a type of cumulative impact, or not assessing synergistic impacts at all, are often used and can result in inadequate assessment. Legal requirements for the consideration and assessment of cumulative and synergistic impacts that include clear and distinct definitions for both these impact types can be used to improve the effectiveness of scientific assessment for marine EIA.

The key findings that lead to these conclusions about cumulative and synergistic impact assessment approaches are discussed in the next section. The section following addresses recommendations for reforming Australian marine EIA legislation to resolve inadequacies. The final section includes suggestions for further research.

2. Key findings

This thesis examined the benefits and shortcomings associated with the consideration and assessment of cumulative and synergistic impacts. The literature review provided a general

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[23] Refer to Chapter 5, Appendix A: Otways Marine Area legislation analysis.
[24] *Planning, Development and Infrastructure Act 2016* (SA), s 94 (2)(a)(iii).
[25] On the 1st August 2018.
[26] Refer to Chapter 5, Appendix A: Otways Marine Area legislation analysis.
[27] Marine and Coastal Act 2018 (Vic), s 9(2)(a).

discussion on these benefits and shortcomings. The case study methods and analysis sought to address the aims of this thesis from three different perspectives. The results identify shortcomings and benefits of the approach to cumulative and synergistic impact consideration and assessment within Australian marine EIA legal frameworks that are particular to each case study. A review of the case study analyses show similarities between the identified shortcomings and benefits. These similarities can be summarised as key findings about the inadequacies of the Australian legal approach to the assessment of cumulative and synergistic impacts within marine EIA. The key findings address the shortcomings and benefits generally. They also address how the Otways Marine Area and Victorian Port Phillip Bay Channel Deepening Project (CDP) case studies demonstrate challenges that can occur when there is an inadequate Australian approach. The case study example focusing on offshore wind farms in Denmark (Danish OWF case study) provides for comparison and additional guidance as to how similar challenges can be overcome.

2.1 Defining and assessing cumulative and synergistic impacts separately

The thesis examined the characteristics of cumulative and synergistic impacts, and demonstrates that these impact types are different (linear versus nonlinear).[28] The approach to defining 'synergistic impact' as a subset of the 'cumulative impact' definition was considered in Chapter 2. Part of this discussion focused on the concerns of Duinker et al that ambiguous definitions were inhibiting improvements in cumulative effects assessment (CEA),[29] and that a more proactive approach was necessary if CEA was to be evolved. [30] A similar argument can be applied to synergistic impacts.

Cumulative and synergistic impacts have different characteristics, and because of this each term needs to be defined, and the impact types considered and assessed separately.[31] As concluded in Chapter 2, the separate consideration and assessment of these impact types would result in increased knowledge and the identification of ways to avoid or mitigate the detriment caused in marine environments. If they are not addressed separately, then in instances where cumulative impacts are assessed, there is a higher chance of synergistic impacts being neglected. The need for clear definitions for these impact types is emphasised through the continued demonstration of a poor focus on synergistic impacts.[32] When the definitions of cumulative and synergistic

[28] Refer to Chapter 2, sections 2, 3, 4 & 7; Chapter 6, section 3.3; Chapter 7, sections 5.2 & 7.2.
[29] Peter N Duinker et al, 'Scientific dimensions of cumulative effects assessment: toward improvements in guidance for practice' (2013) 21 *Environmental Reviews* 40, 42.
[30] Ibid.
[31] Refer to Chapter 2, sections 2, 3 & 4.
[32] Refer to Chapter 3, section 2; Chapter 4, sections 2 & 3; Chapter 5, sections 2, 3 & 4; Chapter 6, sections 2, 3, 4 & 5; Chapter 7, sections 4, 5, 6 & 7.

impacts are unclear, this can lead to ambiguity in the understanding of how assessments should be done.[33]

Improved clarity to reduce the ambiguity associated with the definitions of cumulative and synergistic impacts is therefore recommended. This can be achieved in environmental assessment frameworks when cumulative and synergistic impacts are clearly defined, considered and assessed as separate impact types. To assist with the process of understanding the distinction and provide clarity, distinct definitions are provided in the conclusion to Chapter 2:

- **Cumulative impact:** impacts/effects that result from interactions between stressors and that are demonstrated to have linear characteristics. They result from the accumulation of impacts/effects that interact within spatial areas and/or time periods.[34]

- **Synergistic impact:** impacts/effects that result from interactions between stressors and that are demonstrated to have nonlinear characteristics. The resultant impact/effect is of a greater magnitude than the expected sum of the combined impacts/effects. They can occur as a result of interactions across defined spatial areas as well as defined time periods.[35]

Discussed in Chapter 2, Duinker et al have raised concerns that the use of short definitions contribute to the confusion about how to assess cumulative impacts.[36] However, as rebutted in the Chapter 2 conclusion, short definitions are useful inclusions in primary legislation (i.e. Acts), and provide an important framework for more detailed definitions in delegated legislation and/or policy guidelines.

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[33] Refer to Chapter 2, sections 2, 4 & 5; Chapter 3, sections 2.3 & 3.

[34] This definition is based on elements found in multiple references. See, eg, L M Cooper and W R Sheate, 'Cumulative Effects Assessment: A review of UK Environmental Impact Statements' (2002) 22 *Environmental Impact Assessment Review* 415, 416, 422 - 423; Benjamin S Halpern et al, 'Managing for cumulative impacts in ecosystem-based management through ocean zoning' (2008) 51 *Ocean and Coastal Management* 203, 205; Samuli Korpinen, Manuel Meidinger and Maria Laamanen, 'Cumulative impacts on seabed habitats: An indicator for assessments of good environmental status' (2013) 74 *Marine Pollution Bulletin* 311,313; Great Barrier Reef Marine Park Authority, *Great Barrier Reef Region Strategic Assessment: Strategic assessment report* (Great Barrier Reef Marine Park Authority, 2014) XIII; Natalie C Ban, Hussein M Alidina and Jeff A Ardron, 'Cumulative impact mapping: Advances, relevance and limitations to marine management and conservation, using Canada's Pacific Waters as a case study' (2010) 34 *Marine Policy* 876, 883; Murray Raff, 'Ten Principles of Environmental Impact Assessment' (1997) 14 EPLJ 207, 210; Harry Spaling and Barry Smit, 'Cumulative Environmental Change: Conceptual Frameworks, Evaluation Approaches, and Institutional Perspectives' (1993) 17 (5) *Environmental Management* 587, 589.

[35] This definition is based on elements found in multiple references. See, eg, Raff, above n 34, 210; C L Folt et al, 'Synergism and antagonism among multiple stressors' (1999) 44(3)(2) *Limnology and Oceanography* 864,864; J D Court, C J Wright, and A C Guthrie, *Assessment of cumulative impacts and strategic assessment in environmental impact assessment: prepared for the Commonwealth Environment Protection Agency*, (Commonwealth of Australia, 1994) Appendix I.3; Great Barrier Reef Marine Park Authority, above n 34, 10-3; Ban, Alidina and Ardron, above n 34, 883; Spaling and Smit, above n 34, 587, 592; the definition is also supported within a different context in Daniel Simberloff and Betsy Von Holle, 'Positive Interactions of nonindigenous species: invasional meltdown?' (1999) 1 *Biological Invasions* 21, 22.

[36] Duinker et al, above n 29, 42, 49.

When cumulative and synergistic impacts are accurately defined, the definitions can be used to enable consistency within and between environmental assessment processes. An increase in the frequency of assessment of cumulative and synergistic impacts is also warranted. This is discussed below.

2.2 Increasing the focus on assessing cumulative and synergistic impacts from anthropogenic activities and environmental change in EIA

The thesis discussed in Chapter 2 that cumulative and synergistic impacts are being caused by both anthropogenic activities and environmental change in the marine environment.[37] As discussed, scholars have emphasised the importance of assessing cumulative[38] and synergistic[39] impacts to improve knowledge about these impact types, reduce detrimental impacts on habitat, ecosystem, or species,[40] and minimise causes of environmental change.[41]

The appropriateness of EIA and SEA as tools for the assessment of cumulative and synergistic impacts was focused on in Chapter 3. In this chapter it was established that whilst there is a current trend toward a preference for considering cumulative impacts within SEA, there is a need to change the preference toward consideration in both EIA and SEA.[42] Discussed in Chapter 3, the importance of assessing cumulative and synergistic impacts in both SEA and EIA was emphasised by scholars, including Harriman and Noble,[43] Cooper and Sheate,[44] and Duinker et al.[45]

Using both SEA and EIA is necessary because the assessment frameworks and outcomes, whilst different, each provide important benefits for the understanding of cumulative and synergistic

[37] Refer to Chapter 2, section 6.
[38] Jill A E Harriman and Bram F Noble, 'Characterizing Project and Strategic Approaches to Regional Cumulative Effects Assessment in Canada' (2008) 10(1) *Journal of Environmental Assessment Policy and Management* 25, 27; Jeremy B C Jackson, 'Ecological extinction and evolution in the brave new ocean' (2008) 105 (Suppl. 1) *Proceedings of the National Academy of Sciences* 11458, 11464 <http//:www.pnas.org/cgi/doi/10/1073/pnas.0802812105>.
[39] See, eg, National Research Council, *Understanding Marine Biodiversity A Research Agenda for the Nation* (National Academy Press, 1995) 25, 34; A D Rogers and D d'A Laffoley, *International Earth System expert workshop on ocean stresses and impacts* (IPSO Oxford, 2011) 8 – 9; Jackson, above n 38, 11458.
[40] See, eg, Laura J Falkenberg, Sean D Connell and Bayden D Russell, 'Disrupting the effects of synergies between stressors: improved water quality dampens the effects of future CO_2 on a marine habitat' (2013) 50 *Journal of Applied Ecology* 51, 52, 56; Elizabeth R Selig et al, 'Global Priorities for Marine Biodiversity Conservation' (2014) 9(1) *PloS One*: e82898, 9 <http://doi:10.1371/journal.pone.0082898>.
[41] Harriman and Noble, above n 38, 27.
[42] Refer to Chapter 3, section 2.
[43] Harriman and Noble, above n 38, 44 - 45.
[44] Lourdes M Cooper and William R Sheate, 'Integrating cumulative effects assessment into UK strategic planning: implications of the European Union SEA Directive' (2004) 22 (5) *Impact Assessment and Project Appraisal* 5, 10.
[45] Duinker et al, above n 29, 49.

impacts. Example arguments of the SEA benefits can be found where Court, Wright and Guthrie stated that it is better for understanding the indicators of environmental change,[46] and where Masden et al stated that the SEA framework provides for the more consistent and overarching approach.[47] An example of the EIA benefits was found in Hegmann and Yarranton's argument that smaller assessment areas result in lower levels of uncertainty associated with predicting cumulative (and synergistic) impacts.[48] Fidler and Noble added to this by identifying that EIA is better for managing the operational and construction 'specifics' of a project.[49]

Further, as discussed in Chapter 3, both impact types need to be considered and assessed within EIA and SEA, with commentators such as Duinker and Greig having recommended that improvements in cumulative and synergistic impact assessments are needed for both EIA and SEA.[50] It was concluded in Chapter 3 that this requires an increased focus on assessing cumulative and synergistic impacts as part of EIA processes. The provision of better integration between EIA and SEA frameworks is therefore recommended. However, with SEA considered to provide better consistency in its overarching approach, if the function of EIA is better aligned in structure and foundation then there is greater potential for successful integration with SEA.

Both the Otways Marine Area and CDP case studies demonstrate that attention needs to be given to the assessment of cumulative and synergistic impacts in EIA in Australian legal frameworks for environmental assessment. The Otways Marine Area case study (Chapter 5) included a review of environmental assessment legislation for the Commonwealth, South Australian, Tasmanian and Victorian jurisdictions. The results showed that very few of the Acts and regulations contained EIA (or SEA) provisions with reference to cumulative or synergistic impacts.

The CDP case study (Chapter 6) emphasised that without legal requirements for the assessment of cumulative and synergistic impacts in EIA, the effective assessment of these impact types can be compromised. The analysis showed that there was inadequate consideration given to cumulative and synergistic impacts in the EIA assessment, reporting, and decision-making documents. In particular, the analysis of the CDP Supplementary Environmental Effects

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[46] John Court, Colin Wright and Alasdair Guthrie, 'Environmental Assessment and Sustainability: Are we ready for the challenge?' (1996) 3 *Australian Journal of Environmental Management* 42, 46.
[47] Elizabeth A Masden et al, 'Cumulative impact assessments and bird/wind farm interactions: Developing a conceptual framework' (2010) 31 *Environmental Impact Assessment Review* 1, 4.
[48] George Hegmann and G A (Tony) Yarranton, 'Alchemy to reason: Effective use of Cumulative Effects Assessment in resource management' (2011) 31 *Environmental Impact Assessment Review* 484, 486.
[49] Courtney Fidler and Bram Noble, 'Advancing strategic environmental assessment in the offshore oil and gas sector: Lessons from Norway, Canada, and the United Kingdom' (2012) 34 *Environmental Impact Assessment Review* 12, 16.
[50] Peter N Duinker and Lorne A Greig, 'The Impotence of Cumulative Effects Assessment in Canada: Ailments and Ideas for Redeployment' (2006) 37 (2) *Environmental Management* 153, 158.

Statement (SEES) showed that there was an underestimation of the potential for cumulative and synergistic impacts to occur.

The discussion in Chapters 2 and 3 identifies that there are other challenges associated with effective assessment, whether as part of EIA or SEA, that need to be addressed. These challenges are in addition to the definition concerns and include those related to the time lags for cumulative and synergistic impacts to become apparent, and the extent of geographical area potentially impacted (regional).[51] For example, as discussed in Chapter 2, Spaling and Smit have noted that cumulative impacts occur over time periods that are not often accounted for in strategic policy and planning decisions.[52] Another example is that provided in the Chapter 7 discussion about the complexity of determining geographical areas when, because of the range of a species, boundaries are difficult to pre-determine.[53]

Challenges also include those related to fragmented regulatory and decision-making approaches, the limitations of scientific methods, inadequacies in regulatory frameworks, and limitations to knowledge sharing and collaboration.[54] Whilst some of these challenges can be addressed within regulatory frameworks and decision-making processes, providing recommendations for improvements in all of these areas is beyond the scope of this thesis. The thesis focus on how legal requirements can be used to help resolve concerns about the way cumulative and synergistic impacts are assessed is addressed next.

2.3 Legal requirements for assessing cumulative and synergistic impacts: an explicit and consistent approach

The discussion in this thesis focused on the risks of missing cumulative and/ or synergistic impacts when legal requirements for the assessment of these impact types in EIA is inadequate. For example, the discussion in Chapter 7 included Busch's comments that clear and consistent legal requirements are necessary to account for different approaches amongst jurisdictions.[55]

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[51] Refer to Chapter 3, section 2.3.
[52] Spaling and Smit, above n 34, 587.
[53] Danish Energy Agency, *Guidance Document on Environmental Impact Assessment: Danish Offshore Wind Farms* (Danish Energy Agency, NIRAS, February 2013) 21; Masden et al, cited in M Wing Goodale and Anita Milman, 'Cumulative adverse effects of offshore wind energy development on wildlife' (2016) 59 (1) *Journal of Environmental Planning and Management* 1, 11; Elizabeth A Masden et al, 'Cumulative impact assessments and bird/ wind farm interactions: Developing a conceptual framework' (2010) 30 *Environmental Impact Assessment Review* 1, 4 – 5.
[54] Refer to Chapter 3, section 2.3.
[55] Malte Busch et al, 'Consequences of a cumulative perspective on marine environmental impacts: Offshore wind farming and seabirds at North Sea scale in context of the EU Marine Strategy Framework Directive' (2013) 71 *Ocean & Coastal Management* 213, 214.

Also an example discussed in Chapter 7, Judd, Backhaus and Goodsir have commented that EIA legal requirements for CIA are necessary to minimise the chance of inconsistency.[56] This can occur when there are no requirements and EIA practitioners are able to choose a simple assessment approach.[57] Allowing 'simpler' approaches to EIA can also result in assessments that overlook synergistic impacts.[58] As discussed in Chapter 2, Halpern and Fujita have explained that the environmental benefits are significantly greater when policy seeks to reduce synergistic impacts as well as cumulative impacts.[59]

The thesis identified areas in which Australian legal requirements for the consideration and assessment of cumulative and synergistic impacts were found to be inadequate and how this situation could be improved. The research questions focused on the extent of explicit requirements in marine environmental assessment legislation to consider and assess cumulative and synergistic impacts. The discussion in Chapter 4 establishes that there are non-explicit requirements for cumulative and synergistic impact assessment in Australian legislation. Chapter 4 details that these requirements relate to general environmental assessment, individual sector management, and marine environmental protection. There is, however, little to indicate that synergistic impacts are to be treated as distinct from cumulative impacts. The chapter also focused on the utilisation of SEA, EIA, the precautionary principle and PAM, for cumulative and synergistic impact assessment when there are requirements to use these tools within legislation.

The Otways Marine Area case study (Chapter 5) analysed the legislative requirements for the assessment of cumulative and synergistic impacts.[60] This study demonstrates that there is an absence of express requirements for the consideration of these impact types in four Australian jurisdictions. Further, the examination of the law reform reports focusing on the *Environmental Effects Act 1978* (Vic) and the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) showed limited intention to improve the approach to cumulative and synergistic impact requirements and assessment within EIA.

The results of the Otways Marine Area case study show that provisions requiring CIA within the legislation assessed were found to be minimal and there were no explicit requirements for

[56] A D Judd, T Backhaus and F Goodsir, 'An effective set of principles for practical implementation of marine cumulative effects assessment' (2015) 54 *Environmental Science and Policy* 254, 257.
[57] Judd, Backhaus and Goodsir, above n 56, 257.
[58] Crain et al (2009) and Halpern and Fujita (2013) cited in Judd, Backhaus and Goodsir, above n 56, 256; Caitlin M Crain et al, 'Understanding and Managing Human Threats to the Coastal Marine Environment', (2009) 1162 *The Year in Ecology and Conservation Biology 2009: Ann. N.Y. Acad. Sci* 39, 52; Benjamin S Halpern and Rod Fujita, 'Assumptions, challenges and future directions in cumulative impact analysis' (2013) 4 (10) 131 *Ecosphere* 1, 5, 8.
[59] Halpern and Fujita, above n 58, 8.
[60] July 2015 currency.

synergistic impact assessments (as a distinct impact type). [61] When the legislation did contain requirements for the consideration of cumulative impacts, for example the *Marine Parks Act 2007* (SA),[62] the language used lead to ambiguous interpretations (e.g. requirements for a 'general duty of care' that 'a person' must apply when considering the extent of environmental 'harm' that may be caused by anthropogenic activities within a marine park).[63] As concluded in this case study, when there is no definitive requirement for the consideration and assessment of cumulative and synergistic impacts, the ambiguity undermines the potential effectiveness of environmental assessment outcomes.

The Otways Marine Area case study also re-emphasises the need to provide specific terminology and definitions for cumulative and synergistic impacts. The analysis shows that the use of general terminology in legislation should not be relied on as an alternative reference to cumulative and synergistic impacts (i.e. 'significant', 'adverse', 'indirect', 'impact' and 'effect'). [64] This is because of the potential for poor clarity in understanding for the impacts required to be assessed and the potential for inconsistent application. Further, this case study showed that where provisions for environmental assessment were discretionary, the risk of not assessing cumulative and synergistic impacts could be exacerbated. This occurred when discretionary terms such as 'may' were found in the provisions,[65] and suggests that the assessment of cumulative impacts is not always necessary. The use of phrases that are ambiguous as to the extent of consideration (e.g. the use of phrases such as 'regard must be had') can also impede effective assessment.

The Otways Marine Area case study analysis demonstrated inadequate consideration given to environmental change, as caused by cumulative and synergistic impacts. The analysis of the legislative provisions shows that whilst there were examples of ecologically sustainable development (ESD) objectives or a focus on the protection of areas or species, there were no explicit requirements for assessing the effects of environmental change.

Adequate definitions are needed if legislation is to effectively require the consideration and assessment of cumulative and synergistic impacts. The CDP case study (Chapter 6) demonstrates that EIA and decision-making need to incorporate a consistent approach to cumulative and synergistic impact consideration and assessment. The CDP case study did not identify significant concerns about cumulative impacts, and synergistic impacts are not

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[61] Refer to Chapter 5, section 2.
[62] Section 37(2)(f).
[63] *Marine Parks Act 2007* (SA) s 37(2)(f).
[64] Refer to Chapter 5, section 2 & 3.
[65] See, eg, *Development Act 1993* (SA) s 46(1a).

identified as distinct from cumulative impacts in the legislation, guidelines or decision-making documents. For the decision-making documents, synergistic impacts were not discussed. This shows that the absence of legal requirements and definitions for cumulative and synergistic impacts can result in inadequate and inconsistent approaches to their assessment. Further, the CDP case study analysis demonstrates a tendency to avoid nonlinear assessment methods (and therefore synergistic impacts).

The CDP case study further demonstrates that the use of alternative terms such as ‘indirect’, ‘combined effects’ and ‘interactions’ terms can cause ambiguity when used in place of reference to cumulative and synergistic impacts. The analysis showed that the use of alternative terms does not ensure consideration and assessment, or a consistent approach when there is assessment of these impact types. The analysis also identifies that the use of specific mandatory language would benefit the efficacy of legal requirements for the assessment of cumulative and synergistic impacts. The CDP case study demonstrates this through the use of guidelines (instead of legislation) that contain discretionary assessment requirements. Overall, the CDP case study is an illustrative example of inconsistent consideration and assessment approach to cumulative and synergistic impacts within an EIA, decision-making and PAM process, when there is an absence of adequate requirement in the EIA legislation (i.e. *Environmental Effects Act 1978* (Vic)).

The Danish OWF case study (Chapter 7) was examined to provide insight into how cumulative and synergistic impacts are addressed within EIA and PAM, when environmental assessment legislation incorporates requirements to consider and assess cumulative and synergistic impacts. The Danish OWF case study demonstrates that legal requirements for the consideration of cumulative impacts result in their consideration and assessment, as well as the identified need for ongoing research and development into appropriate scientific assessment methods. This case study, however, also demonstrates that when less attention is given to synergistic impacts (as a distinct impact type), the subsequent approach to their assessment is inadequate. Inconsistency between the legal requirements for synergistic impact assessment in SEA and EIA was also shown, with only the SEA-focused legislation found to include such requirements.

The Danish OWF case study demonstrated that even though there was no common definition or approach to the assessment of synergistic impacts within the EIA and PAM reports, these impact types were still discussed. For cumulative impacts, the analysis showed that whilst there are legal requirements for CIA in EIA-specific and other associated environmental assessment legislation, an absence of common definition can result in ambiguity and inconsistency in the approach taken within the EIA and PAM reports.

The inadequate consideration and assessment requirements for cumulative and synergistic impacts needs to be addressed by marine EIA legislation. As evidenced by the case study examples, more provisions requiring cumulative and synergistic impact consideration and assessment are needed. Legal requirements that address cumulative and synergistic impacts should be specific and ensure that these impact types are clearly defined, and considered and assessed as separate impact types. The reliance upon alternative terminology to capture these impact types should be avoided. Legal provisions should also aim to predicate the use of nonlinear assessment methods (and therefore the assessment of synergistic impacts).
When legislation requires and defines cumulative and synergistic impact consideration and assessment, there are still limitations to effective assessment. To assist in overcoming these limitations, legislative requirements should focus on a multi-faceted approach. One approach is to consider and acknowledge uncertainty, which is discussed further below.

2.4 The uncertainty of cumulative and synergistic impact predictions

A common concern regarding inadequate assessment and data for cumulative and synergistic impacts is that the inadequacies are caused by, and contribute to, the problem of insufficient knowledge about the effect of impacts in the marine environment. As discussed in Chapters 2 and 7, a paucity of information and data can result in uncertainty about the prediction of cumulative and synergistic impacts.[66] Uncertainty about predictions made for environmental assessments cause uncertainty in the decision-making process.[67] When this occurs, and use and development approvals are granted, there is a greater potential for unexpected detrimental environmental outcomes. As identified in Chapter 3, Darling and Côté, and Pavlickova and Vsykupova have discussed that uncertainty about the future behaviour of cumulative and synergistic impacts is also a challenge to the accuracy of predictions.[68]

Through comparison of the SEES risk assessment, and analysis of the identified predictions for

[66] See, eg, Fidler and Noble, above n 49, 16; Hegmann and Yarranton, above n 48, 486; Larry Canter and Bill Ross, 'State of practice of cumulative effects assessment and management: the good, the bad and the ugly' (2010) 28 (4) *Impact Assessment and Project Appraisal* 261, 263 – 264; Jacqueline Peel, *The Precautionary Principle in Practice: Environmental Decision-Making and Scientific Uncertainty,* (The Federation Press, 2005) 143; Måns Nilsson and Holger Dalkmann, 'Decision making and strategic environmental assessment' (2001) 3(3) *Journal of Environmental Assessment Policy and Management* 305, 323; Elizabeth A Masden et al, 'Renewable energy developments in an uncertain world: The case of offshore wind and birds in the UK' (2015) 51 *Marine Policy* 169, 170 – 171; Lena Bergström et al, 'Effects of offshore wind farms on marine wildlife – a generalized impact assessment' (2014) 9 *Environmental Research Letters* 1, 5 <http://doi:10.1088/1748-9326/9/3/034012>.
[67] Nilsson and Dalkmann, above n 66, 323.
[68] See, eg, Emily S Darling and Isabelle M Côté, 'Quantifying the evidence for ecological synergies' (2008) 11 *Ecology Letters* 1278, 1284; Katarina Pavlickova and Monika Vsykupova, 'A method proposal for cumulative environmental impact assessment based on landscape vulnerability evaluation' (2015) 50 *Environmental Impact Assessment Review* 74, 75.

cumulative and synergistic impact assessment by contributing experts, the CDP case study (Chapter 6) demonstrates that there was the potential for unidentified (or unreported) cumulative and synergistic impacts. This case study also demonstrates the potential for uncertainty through the thesis analysis of the SEES risk assessment. The analysis indicated that there is greater potential for cumulative and synergistic impacts to occur than acknowledged within the SEES risk assessment. Theoretically this results in a greater level of uncertainty about environmental impacts, and a greater level of unidentified uncertainty within the decision-making process. In contrast, the Danish OWF case study (Chapter 7) demonstrates the importance of acknowledging uncertainty about predicted impacts; thus enabling consideration to be given to the potential for unidentified impacts in decision-making.

Uncertainty about predicted impacts needs to be acknowledged and addressed in EIA (and SEA) and associated decision-making processes. A greater focus on the uncertainty of cumulative and synergistic impact consideration and assessment needs to occur, and, as discussed below, mechanisms that can be used for this include the precautionary principle and PAM.

2.5 The benefit of applying the precautionary principle and PAM within EIA and decision-making

The assessment of cumulative and synergistic impacts is discussed in Chapter 3 as important for achieving effective application of the precautionary principle in decision-making.[69] Chapter 6 identified an important statement by Jessup about the application of ESD (and the ESD principles) that 'the challenge is for law-makers to establish a legal regime that sets out protection requirements…and prevents decision-makers from deviating from those conservation requirements'.[70] In Chapter 3, this challenge is also emphasised in the discussion on Gullett's warning against the absence of explicit legislative direction for the precautionary principle's application.[71]

That the precautionary principle and PAM can be used to improve the assessment and understanding of cumulative and synergistic impacts is emphasised throughout this thesis. This includes discussion in Chapters 4 and 7 that legal requirements for decision-making that address

[69] See, eg, Court, Wright and Guthrie, above n 46, 44; D Santillo et al, 'The Precautionary Principle: Protecting Against Failures of Scientific Method and Risk Assessment' (1998) 36(12) *Marine Pollution Bulletin* 939, 942.
[70] Brad Jessup, 'The Port Phillip Channel Deepening Project and Environmental Law: A model for ecologically sustainable development?' in Warwick Gullett, Clive Schofield and Joanna Vince, *Marine Resources Management* (LexisNexis Butterworths, 2011) 309.
[71] See, Warwick Gullett, 'Environmental Impact Assessment and the Precautionary Principle: Legislating Caution in Environmental Protection' (1998) 5 *Australian Journal of Environmental Management* 146, 155.

ESD, and therefore the precautionary principle, should be incorporated into environmental assessment legislation. This is particularly important if these mechanisms are to be relied on to assist cumulative and synergistic impact consideration and assessment. As concluded in Chapter 3, the precautionary principle should be applied in a way that enables the onus of the 'burden of proof' to be shared between proponents and statutory decision-makers. This should occur in a manner that improves the response to the challenges of effective cumulative and synergistic impact assessment. Sharing the 'burden of proof' about cumulative and synergistic impacts would help to alleviate situations where it is inappropriate to allow the burden to remain solely with a project proponent (because of the limitations associated with scientific method), and there is a concurrent need for increased accountability and responsibility on the part of the decision-maker. However, as also discussed in Chapter 3, there is a need for this shared responsibility to be clearly defined before an assessment and decision-making process commences.

The discussion in Chapter 3 also emphasises that whilst the precautionary principle is a theoretical mechanism, it is dependent upon integration with practical mechanisms, such as PAM, to be effective. PAM should be undertaken to increase the understanding of 'actual' cumulative and synergistic impacts. The information should be used as iterative feedback for impact remediation (if possible), and predictions associated with future environmental assessments and decision-making.[72] As discussed in Chapter 3, Dubé and Munkittrick have emphasised that to achieve this it is important to ensure that PAM operates within an integrated and iterative framework that includes EIA, SEA, baseline studies and assessments.[73]

The CDP case study (Chapter 6) demonstrates the need for cumulative and synergistic impacts to be focused on with more consistency and to a greater extent within the assessments. The case study also shows that if the precautionary principle had been applied to the consideration of these impact types in decision-making, then there would have been reason to acknowledge uncertainty about the accuracy of impact predictions. Further, the CDP case study reveals that there was minimal consideration given to cumulative and synergistic impacts in the environmental management and monitoring documents. However, the conditions of approval facilitating a comprehensive monitoring programme, with an independent environmental monitor, is a beneficial approach that ensures accountability by the project proponent and oversees decision-making about remedial action requirements.

[72] Refer to Chapter 3, section 3; Chapter 4, section 3; Chapter 7, section 7.
[73] Monique Dubé and Kelly Munkittrick, 'Integration of Effects-Based and Stressor-Based Approaches into a Holistic Framework for Cumulative Effects Assessment in Aquatic Ecosystems' (2001) 7 (2) *Human and Ecological Risk Assessment: An International Journal* 247, 248 - 257.

The need for more legislative provisions that apply the precautionary principle in decision-making, and PAM, when there are concerns about cumulative and synergistic impacts, was also identified in the Danish OWF case study (Chapter 7). The Danish OWF monitoring programmes (Horns Rev and Nysted) demonstrate a beneficial approach to cumulative impacts, but shortcomings in terms of the focus on synergistic impacts. The absence of distinction between these impact types in the PAM phase emphasised the importance of providing consistent definitions between EIAs and PAM. The Danish OWF case study also identifies important elements of PAM, including the need for baseline assessments and studies, long-term monitoring for cumulative impacts, and management of transboundary environmental impacts and environmental thresholds. This case study also shows that PAM is a valuable tool for enabling iterative feedback for future EIA preparation and decision-making.

To improve the application of the precautionary principle and the use of PAM, it is necessary to have legislative requirements that focus on these mechanisms, as a way of addressing cumulative and synergistic impacts in decision-making processes. The precautionary principle should be applied so that there is explicit acknowledgement of the uncertainty surrounding cumulative and synergistic impacts. There also needs to be more frequent use of PAM to improve understanding of ‘actual’ cumulative and synergistic impacts. The information resulting from PAM should be used as iterative feedback for impact remediation (if possible), predictions, and future environmental assessments (both EIA and SEA).

Legislative requirements for the role of the precautionary principle and PAM in the assessment of cumulative and synergistic impacts, should be provided in conjunction with a consistent approach to the assessment requirements for, and definitions of, these impact types. To consolidate an improved approach, it is also important to ensure that there is a consistent approach amongst legal jurisdictions and across legislation. The need to reduce fragmentation of legal frameworks and decision-making is addressed next.

2.6 Reducing fragmentation of legal frameworks and decision-making

The thesis examined the consequences of inconsistent approaches to the consideration and assessment of cumulative and synergistic impacts among legal jurisdictions and across legislation. The fragmentation of legal frameworks occurs because of multiple jurisdictions, and poor integration between legislation. As evidenced by the Chapter 4 discussion on the Great Barrier Reef region, fragmentation can inhibit effective consideration and assessment of, and decision-making about, cumulative and synergistic impacts.[74] This is compounded when there is the potential for environmental impacts due to interactions from multiple different marine uses and development within close proximity. As part of the example discussed in Chapter 4, Marsden highlighted concern about fragmentation of the approach to SEA (because of multiple jurisdictions),[75] and the concerns about EIA were highlighted in the discussion about the *Abbot Point Cumulative Impact Assessment*.[76] The EIA problems were caused by the involvement of multiple jurisdictions and different legislative and policy approaches.

The Otways Marine Area case study (Chapter 5) demonstrates that the potential for fragmentation between Australian legal frameworks for marine environmental assessment - because of multiple jurisdictions – should be minimised to assist with consistent approaches to the consideration and assessment of cumulative and synergistic impacts. The potential for fragmentation in the consideration and assessment for cumulative and synergistic impacts is emphasised when, within the same jurisdiction, there are multiple Acts to manage different sectors, species or area specific protection of the marine environment and general environmental assessment frameworks.

Similarly, fragmented decision-making can occur when multiple pieces of legislation are applicable to different elements of the same project. Yet, the Danish OWF case study (Chapter 7) provides an example of the way the use of consistent legislative provisions between multiple jurisdictions can enable the consideration and management of cumulative (and synergistic) impacts that are transboundary and affect the marine and other environments in a wide region. As shown in this case study, this consistency of approach is facilitated by the minimum legislative standards set by the European Union (EU) Environmental Directives.

When resolving regulatory fragmentation and addressing transboundary issues, it is also important to ensure the integration of, and a consistent approach between, legal frameworks to support iterative feedback across environmental assessment and decision-making. As discussed below, an important element of the iterative feedback process is understanding existing environmental conditions and the thresholds critical to maintaining the resilience and health of an environment.

[74] Refer to Chapter 4, section 4; Chapter 5, section 3; Chapter 7, sections 4, 5, 6 & 7.
[75] Simon Marsden, 'Australian World Heritage in danger' (2014) 31 *Environmental and Planning Law Journal* 192, 202 – 209.
[76] Eco Logical Australia Pty Ltd and Open Lines Consulting Pty Ltd, *Abbot Point Cumulative Impact Assessment* (2013), 1- 1, 1-8, 4-3, 4-4, 1-13 – 1-14 <http//:www.nqbp.com.au>.

2.7 The benefits of using baseline assessments and studies, and setting environmental thresholds

In Chapters 2 and 3 it is discussed that understanding the environmental thresholds of a marine habitat or ecosystem is an important aspect of understanding and managing cumulative and synergistic impacts and the uncertainty associated with these impact types.[77] It is also discussed that the consideration and assessment of cumulative and synergistic impacts within the marine environment is important for understanding environmental resilience and avoiding the breach of an environmental threshold (whether science or policy based).[78]

Scholars such as Dubé and Munkittrick have discussed the need to gain an understanding of how cumulative (and synergistic) impacts have affected the environment prior to any new activity being considered; for example, through the use of baseline monitoring.[79] The Danish OWF case study (Chapter 7) demonstrates that the determination of environmental thresholds and baseline assessments and studies is important to support an effective approach to the assessment of cumulative and synergistic impacts. The case study also demonstrates this through the Danish EIA requirements to use baseline assessments as a foundation for understanding cumulative impacts for OWFs (e.g. the Kriegers Flak, Nysted and Horns Rev OWFs). The discussions on this case study also showed that the use of baseline studies and monitoring can provide information that reduces the level of uncertainty between predicted impacts and actual impacts.

Legal requirements that include the determination of environmental thresholds, and undertaking of baseline data collection and utilisation of PAM, are therefore necessary to assist with the minimisation of uncertainty between predicted impacts and actual impacts.

All of the key findings identified should be addressed within any legal framework reform suggested to increase the consideration and assessment of cumulative and synergistic impacts. Recommendations provided in response to the question of how this can occur are discussed in the next section.

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[77] See, eg, Duinker et al, above n 29, 47; Thomas G Dickert and Andrea E Tuttle, 'Cumulative Impact Assessment in Environmental Planning: A Coastal Wetland Watershed Example' (1985) 5 *Environmental Impact Assessment Review* 37, 39; Duinker and Greig, above n 50, 157- 158; Jesper H Anderson et al, 'Baltic Sea biodiversity status vs. cumulative human pressures' (2015) 161 *Estuarine, Coastal and Shelf Science* 88, 90 – 91.

[78] See, eg, Carle Folke et al, 'Regime Shifts, Resilience, and Biodiversity in Ecosystem Management' (2004) 35 *Annual Review of Ecology, Evolution and Systematics* 557, 573; Also see the discussion surrounding Folke et al in Richard Curtin and Raúl Prellezo, 'Understanding marine ecosystem based management: A literature review', (2010) 34 *Marine Policy* 821, 822; Great Barrier Reef Marine Park Authority, above n 34, 10-6; Ban, Alidina and Ardron, above n 34, 883.

[79] Dubé and Munkittrick, above n 73, 250 – 251.

3. Recommendations

> It is when hidden decisions are made explicit that the arguments begin. The problem for the years ahead is to work out an acceptable theory of weighting. Synergistic effects, nonlinear variation, and difficulties in discounting the future make the intellectual problem difficult, but not (in principle) insoluble.[80]

There is an increasing focus on emerging and future large-scale marine use and development (e.g. offshore wind energy production in Australia), and its construction and operation will contribute to the complexity of impact interactions within the marine environment. Therefore, proactive improvement of legislative approaches to address cumulative and synergistic impacts in future environmental assessment and decision-making is needed. The recommendations provided focus on improving the assessment of these impact types within EIA through the reform of legislative requirements and the establishment of minimum standards. The recommendations for greater consideration of cumulative and synergistic impacts in decision-making focus on changes to process and approach. This can also be achieved through legislative reform.

The recommendations provide general guidance, however, where appropriate, the example of offshore wind farms (OWF) are used to illustrate how these recommendations can be implemented. The recommendations are not aimed at developing scientific methods of assessment for cumulative and synergistic impacts. The complexity of achieving improvement for scientific approaches to consideration, methods and assessment is, however, acknowledged.

3.1 Assessing cumulative and synergistic impacts – refocusing on the role of EIA

There are benefits of legal requirements for the assessment of cumulative and synergistic impacts in both EIA and SEA. The use of express and clear legal requirements and definitions translate into scientific assessment. With greater focus on requirements to assess cumulative and synergistic impacts, the need to further develop scientific methods for the assessment of these impact types will increase.

The contention of this thesis is that there should be consideration and assessment of cumulative and synergistic impacts within EIA. This differs from a current trend that risks the consideration of cumulative impacts in SEA alone. To avoid this isolated approach, the recommendations focus on reforming the EIA process. At a general level, it is acknowledged that marine environmental assessment frameworks need to ensure the provision of better integration

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[80] G Hardin, 'The Tragedy of the Commons' (1968) 162 *Science* 1243, 1244.

between EIA and SEA frameworks. This integration should be achieved through the use of a framework that enables an iterative approach. Reform to legislation, increased application of the precautionary principle, PAM, baseline assessments and studies, and the determination of environmental thresholds, can be used to enable the iterative feedback of information. Although the following recommendations refer to the subsequent integration of EIA with SEA, the detail provided is not intended to improve the SEA method beyond integration with EIA and greater focus on synergistic impact assessment.

3.2 Legislative reform

Legislative requirements and legal frameworks for the consideration and assessment of cumulative and synergistic impacts can be improved through the reform of legislative provisions. The following recommendations provide guidance as to the content of legal requirements, including the need for clear definitions, and the ways in which minimum standards for the consideration and assessment of these impact types can be implemented to facilitate consistency.

3.2.1 Express requirements and clear definitions

Reform of legal requirements needs to result in an increased capacity of Australian legal frameworks for marine environmental assessment (e.g. EIA and SEA) to consider and assess cumulative and synergistic impacts. Increased focus on legal requirements for the consideration and assessment of cumulative impacts has been recognised as an element of The Australian Panel of Experts on Environmental Law's recommendation that 'Design principles should guide the drafting of the next generation of Australian environmental law'.[81] Whilst an increase in cumulative impact focused requirements is necessary, it is essential to ensure that there is similar focus on synergistic impacts. This can be achieved through express provisions.

The potential for ambiguous outcomes because of inconsistency in environmental assessment methods and approach means that legislative reform needs to aim for consistency in approach to consideration and assessment. This can be achieved through the use of common definitions. Definitions of cumulative and synergistic impacts must be explicitly provided for in legal

[81] Australian Panel of Experts on Environmental Law, *The Foundations of Environmental Law: Goals, Objects, Principles and Norms* (Technical Paper 1, 2017) 4, Recommendation 1.3; Australian Panel of Experts on Environmental Law, *Blueprint for the Next Generation of Australian Environmental Law* (2017) 2, Recommendation 1.3.

requirements, and the definitions used should remain consistent between the different acts and regulations/ statutory instruments applicable to marine EIA. The definitions used must clearly distinguish cumulative and synergistic impacts. For example, definitions such as those identified in the conclusion to Chapter 2 (and section 2.1 above).

Legal provisions should be drafted with the aim of reducing assumptions about the extent of consideration and assessment required to be given (details can be included within delegated legislation or mandatory guidelines). The use of specific mandatory language (e.g. avoiding the use of phrases such as 'have regard to') in provisions requiring the assessment of cumulative and synergistic impacts also needs to occur. This is because mandatory assessment requirements can reduce the likelihood of inconsistent approaches to whether these impact types are assessed.

Reliance on the use of alternative terminology, as a substitute for describing cumulative and synergistic impacts, should be avoided. In instances where general terms (e.g. indirect, significant or adverse) are used for impact assessment requirements, cumulative and synergistic should be expressly included (and defined) as part of the definitions for the general term. Further, if the term 'significant' is to be used, decision-makers and project proponents need to address the likely transition of impacts from those that are seemingly 'insignificant' to those that become 'significant' due to the interaction of many small impacts (i.e. not just those from a 'major project'). That this issue was raised within the Otways Marine Area case study (Chapter 5) and Danish OWF case study (Chapter 7) emphasises the need to address this concern.

The need to assess cumulative and synergistic impacts from both anthropogenic activities and environmental change (e.g. climate change and natural variations) should form part of the requirements. The reform should achieve consistency within EIA (and SEA), and associated decision-making and PAM processes. Legislative requirements relating to decision-making, with a focus on the application of the precautionary principle, PAM, fragmentation, baseline assessments and studies, and environmental thresholds should also be included. These matters are discussed in more detail below.

3.2.2 Minimum standards

The application of minimum standards when reforming legislation can assist with reducing inconsistency and ambiguity. The benefits of having minimum standards include the encouragement of a consistent approach between jurisdictions; with the consistency providing for better facilitation of transboundary environmental impact management. The Danish OWF case study (Chapter 7) provides an example of this, and details that the Danish legislative requirements for considering cumulative and synergistic impacts are derived from the minimum standards set out in the EU Environmental Directives applicable to environmental assessment.

Minimum standards should address the need for express requirements to consider and assess cumulative and synergistic impacts, as caused by anthropogenic activities and environmental change, and associated definitions. Further, the minimum requirements should reflect the recommendations (discussed above and below) in relation to the precautionary principle, PAM, fragmentation, transboundary management, baseline assessments and studies, and environmental thresholds. Minimum standards also need to provide for adaptive governance mechanisms and, therefore, enable appropriate responses to the iterative feedback provided from the collection of information about a marine environmental area and any detrimental impacts found.

There are two possible pathways recommended to achieve minimum standards for the future EIA (and SEA) of offshore wind farm use and development in Australian marine waters. The first is to amend the existing Australian *Intergovernmental Agreement on the Environment* (IGAE).[82] As discussed in Chapter 4, the IGAE includes a decision-making framework for use and development in the marine environment.[83] The existing IGAE structure could be reformed to include a suite of schedules that provide for minimum standards on different environmental topics. The EU Environmental Directives could be used as a model example. One schedule should be specifically aimed at detailing the minimum standards for the assessment of marine environment impacts with a detailed focus on cumulative and synergistic impacts. The schedule should detail the recommended legal requirements discussed above, as well as address the consideration and assessment of cumulative and synergistic impacts in EIA and the integration of information into SEA.

The content of the IGAE would need to include an agreement that this schedule be incorporated into legislation by all Australian governments. This should happen in a way that ensures that the minimum standards would be used to develop a framework for any environmental assessment or PAM associated with offshore wind farms. Whilst reform of the IGAE would have the benefit of influencing other elements of Australian legal frameworks (e.g. policy/ guidelines and judicial decisions), there are also shortcomings that would need to be addressed. Examples of concerns about the use of the IGAE as a pathway include the complexities around timelines for

[82] Council of Australian Governments, *Intergovernmental Agreement on the Environment*, 1 May 1992 <http//:www.environment.gov.au/about-us/publications/intergovernmental-agreement>.
[83] Refer to Chapter 4, section 2.

reforming the IGAE, and subsequent timelines for translation into legislative standards by each government.

The need for revision and development of minimum standard content within the IGAE is emphasised through the example of the IGAE already being used to provide for national standards for the National Environment Protection Measures (NEPMs). Discussed in Chapter 5,[84] NEPMs were established as a result of the IGAE and via The 'National Environment Protection Council' suite of legislation.[85] As also discussed in Chapter 5, the analysis of this legislative framework also identified that, whilst there was reference to cumulative impact assessments for NEPMs, [86] there was no guidance for establishing a general framework and processes for environmental assessment. It was further established in Chapter 5 that the legislative objectives associated with the NEPMs do not focus on compatible approaches between jurisdictions.[87] Therefore, the use of the IGAE, and any subsequent common legislative framework, would need to ensure consistent application for assessment requirements associated with cumulative and synergistic impacts.

The second pathway is to develop a suite of legislation that is parallel between the States, Northern Territory and Commonwealth jurisdictions that applies to the environmental assessment (i.e. both EIA and SEA) of offshore wind farm use and development. The minimum standards for cumulative and synergistic impact assessment would need to be reflected within the legislative requirements and definitions, as well as in any delegated legislation. The legislation would also need to address general decision-making processes and broader issues applicable to environmental assessment. An industry specific example of this pathway can be found in the legislation for the environmental management of offshore petroleum in Commonwealth, Tasmanian, Victorian, and Western Australian marine waters.[88] The benefit of this approach would be a focus on the development of legislation, but as with the IGAE pathway, agreement between all jurisdictions would be necessary to ensure consistency.

[84]Refer to Chapter 5, sections 2.1, 2.2, 3.1 and 3.3.

[85] *National Environment Protection Council (South Australia) Act 1995* (SA) s 7, s 15; *National Environment Protection Council (Victoria) Act 1995* (Vic) s7, s 15; *National Environment Protection Council Act 1994* (Cth) s 7, s 15; *National Environment Protection Council (Tasmania) Act 1995* (Tas) s 7, s 15.

[86] Council of Australian Governments, *Intergovernmental Agreement on the Environment*, 1 May 1992, Schedule 2(3)(ii) <http//:www.environment.gov.au/about-us/publications/intergovernmental-agreement>.

[87] *National Environment Protection Council (South Australia) Act 1995* (SA) s 3(b); *National Environment Protection Council (Victoria) Act 1995* (Vic) s 3(b); *National Environment Protection Council (Tasmania) Act 1995* (Tas) s 3(b); *National Environment Protection Council Act 1994* (Cth) s 3(b).

[88] See, eg, *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (Cth) Part 6.4; Sch 2A, Pt 2; *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) Part 2; *Petroleum (Submerged Lands) (Management of Environment) Regulations 2012* (Tas); *Petroleum (Submerged Lands) (Environment) Regulations 2012* (WA); *Offshore Petroleum and Greenhouse Gas Storage Act 2010* (Vic) pt 6.4; *Offshore Petroleum and Greenhouse Gas Storage Regulations 2011* (Vic) ch 2.

It is acknowledged that both pathways need further research to determine their appropriateness. It is also acknowledged that the pathways could be designed to encompass the marine environmental impact assessment for all large-scale offshore use and development. The risk of this approach is the potential for conflict with existing legislative frameworks applicable to specific industries (e.g. offshore petroleum).

3.3 Decision-making

Improved consideration and assessment of cumulative and synergistic impacts in legal frameworks can also be approached through the provision of recommendations that address environmental assessment decision-making processes, mechanisms and tools. In particular, the way the processes, mechanism and tools are used for the consideration and assessment of cumulative and synergistic impacts, and integrated into legal frameworks (Figure 8-1). The recommendations in this part address some of the ways in which the consideration and assessment of cumulative and synergistic impacts could be improved within the decision-making processes associated with EIA. The recommendations relate to the reform of legal requirements in the areas of the application of the precautionary principle, PAM, fragmentation, baseline assessments and studies, and environmental thresholds.

Figure 8-1: Assessment and knowledge cycle - cumulative and synergistic impacts in EIA

3.3.1 Precautionary principle – requiring its application and sharing the burden of proof

The precautionary principle should be applied in a way that assists with identifying and acknowledging uncertainty and improve the understanding of cumulative and synergistic impacts in decision-making. The absence of legal requirements for the application of the precautionary principle and the problems associated with attributing the burden of proof to a project proponent, when there are risks of inaccuracy in scientific assessments, should be addressed.

The application of the precautionary principle in decision-making should form part of legislative requirements associated with any future EIA framework applicable to the marine environment. This can be achieved through specific requirements for the discussion of the precautionary principle's implications when EIAs address cumulative and synergistic impacts, as well as for the application of the precautionary principle by decision-makers throughout the decision-making process.

The requirements also need to provide for a shared 'burden of proof' between both the project proponent and the decision-making authority. This should occur in a manner that ensures adequate response to the challenges of effective cumulative and synergistic impact assessment. The practical aspects of this (i.e. the roles of the proponent and decision-making authority) should be detailed within assessment and decision-making guidelines, as well as via conditions imposed for an approved project.

When addressing uncertainty, the precautionary principle should be used in a manner that requires both decision-makers and project proponents to consider whether there is a need to undertake further research into cumulative and/or synergistic impacts before a decision is made. Requirements should also focus on whether any of the information required for assessment and decision-making includes the identification of uncertainty, and whether the extent of uncertainty is acceptable.

3.3.2 Post-approval monitoring conditions

PAM is necessary to monitor the actual impacts occurring during and after the development of a project (including when a use is in operation), and the information can be used to determine whether remedial action is necessary.

It is recommended that the consideration and assessment of cumulative and synergistic impacts within PAM be addressed through legislative requirements. This entails provisions for conditions to be included in any approval that would require their assessment. The legislation should set minimum requirements for these conditions. It is suggested that these include reference to legislative requirements within conditions so as to ensure there is consistency with the definitions of cumulative and synergistic impacts, as well as any direction previously provided as to assessment methods (e.g. guidelines). Legal requirements should ensure that PAM conditions enable a consistent approach to the use of baseline assessments and studies, and procedures for addressing breaches of environmental conditions or thresholds and associated adaptive management measures/ remediation. They should also address knowledge feedback systems. Legal requirements for PAM should also provide for adaptive management to the point that the original conditions of approval can be changed retrospectively if deemed necessary to stop detrimental cumulative and/ or synergistic impacts.[89] In terms of knowledge feedback, systems should be put in place so that provision to an environmental monitoring authority of the information gathered is required. Legal requirements should ensure the accessibility and use of information for future decisions involving both EIA and SEA.

An example of recent legislative reform for increasing the consideration of cumulative impacts in association with PAM can be seen in the *Planning, Development and Infrastructure Act 2016* (SA). The Act contains a provision that would enable a broader consideration of cumulative impacts within the decision-making framework. This is achieved with requirements that the knowledge about cumulative impacts, as gained from 'monitoring, benchmarking and evaluation programs' be incorporated into policy frameworks.[90] Based on the arguments in this thesis, although a step in a better direction, this example is not considered sufficiently progressive. This is because it is limited to 'principles of good planning' that seek to use knowledge about cumulative impacts from monitoring within policy frameworks. The information is not required to be obtained in relation to a PAM programme as a result of a specific approval and EIA process, and therefore the provision could not be used to address the conditions of a specific OWF approval in South Australian waters. The provision also neglects synergistic impacts.

Further, as emphasised in the Danish OWF case study (Chapter 7), for PAM to be successful, it needs to be linked to other environmental assessment requirements including baseline assessments and studies, long-term monitoring, and the need to manage transboundary environmental impacts and environmental thresholds. To ensure this happens it is recommended that legislation include requirements that result in environmental assessment and decision-making that is both iterative and connective.

Finally, the International Best Practice Principles for 'EIA follow-up' should be implemented to ensure that knowledge gained about cumulative and synergistic impacts (from both baseline monitoring and PAM) is effectively evaluated, managed, and communicated.[91] Whilst EIA

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[89] Refer to Chapter 4, section 3.2. A general example of this can be found in the *Environmental Protection Act 1986* (WA) sections 46, 48.

[90] *Planning, Development and Infrastructure Act 2016* (SA) s 14(a)(ii).

[91] A Morrison-Saunders, R Marshall and J Arts (2007) *EIA Follow-Up International Best Practice Principles*, Special Publication Series No. 6, (International Association for Impact Assessment, 2007) 1; Angus Morrison-Saunders et al, 'Towards Sustainability Assessment Follow-up' (2014) 45 *Environmental Impact Assessment Review* 38, 39. Refer to glossary.

follow-up should be undertaken by both the decision-making authority and the proponent,[92] the use of independent EIA follow-up verifiers is recommended to ensure transparency and accountability.[93]

3.3.3 Fragmentation (multiple jurisdictions, multiple and different Acts, and transboundary issue management)

Recommendations for resolving issues caused by fragmentation need to address multiple elements. Three of these elements are the management of transboundary environmental issues, the potential for incongruence between regulatory requirements associated with different jurisdictions (i.e. those that are neighbouring), and the different environmental assessment requirements and decision-making processes that exist because of different legislation governing the same project.

Legislative requirements that provide for a consistent and clear approach to cumulative and synergistic impact assessment and definitions are needed to assist in minimising fragmentation issues when the regulatory frameworks of multiple jurisdictions are a part of a decision-making process. As also discussed above, the use of minimum legislative standards would help achieve this within an Australian context. Situations should also be avoided where environmental assessment legislation is not explicitly and directly tied to a decision-making process (for example, the situation for the *Environmental Effects Act 1978* (Vic) and the CDP case study). When frameworks are dependent upon multiple pieces of legislation for environmental assessment and decision-making, then the requirements need to be consistent in approach. This would assist in avoiding any potential loss of accountability, when the environmental assessment process is subject to one set of requirements, and the decision-maker subject to another.

Further, as discussed within the Danish OWF case study (Chapter 7), when there is congruence between legal approaches it is better to focus on the environmental impacts of complex interactions without ‘pre-determined geographical areas’. Taking this approach can make it simpler to evaluate and decide upon appropriate environmental outcomes for an area using an ‘ecosystem based approach’. Therefore, in addition to recommending consistency in legal requirements, it is also recommended that legal requirements within neighbouring jurisdictions

[92] Morrison-Saunders, Marshall and Arts, above n 91, 2; Morrison-Saunders et al, above n 91, 40.
[93] Jan-Albert Wessels, Francois Retief and Angus Morrison-Saunders, ‘Appraising the value of independent EIA Follow-Up Verifiers’ (2015) 50 *Environmental Impact Assessment Review* 178, 187 – 188.

seek collaborative programmes that identify ecosystem requirements and parameters that can provide information for future cumulative and synergistic consideration and assessment.

3.3.4 Baseline assessments and studies, and environmental thresholds

Determining the scientific threshold of impacts is more robust if baseline assessments and studies specific to a marine area are undertaken. Further, supporting the need for environmental thresholds with appropriate policy is essential if thresholds are to assist with protecting the marine environment. The use of baseline assessments and studies, and environmental thresholds, were demonstrated as beneficial approaches within the Horns Rev and Nysted OWF case studies; although the requirement to undertake the scientific assessments was set by policy and not legislation.

It is recommended that any future EIA framework for the use and development of OWF in Australia is guided by legislative requirements for baseline assessments and studies of site-specific areas. As also required by legislation, the data collection could, as in the Danish OWF example, occur for periods of up to two years prior to final decisions being made about a proposal. 'Shifting baseline'[94] issues caused by changes in the environment across generations should also be considered.

The information collected from baseline assessments and studies should be required to be used to assist with determining environmental thresholds. Legislative provisions should set out the processes for determining these thresholds (i.e. scientific thresholds), decision-making processes for the application of these thresholds (i.e. would the threshold be breached if an approval is granted?), and conditions for compliance with set thresholds (i.e. conditions for PAM and adaptive governance should a threshold be found to be breached). Requirements associated with decision-making processes should also address the need to establish environmental thresholds (both scientific and regulatory) as set in neighbouring jurisdictions (i.e. transboundary impact consideration and assessment).

[94] See, eg, D Pauly (1995) cited in Willsteed et al, above n 20, 2342; Daniel Pauly, 'Anecdotes and the shifting baseline syndrome of fisheries' (1995) 10 *Trends in Ecology & Evolution* 430, 430.

4. Suggestions for further research

Further research is needed for all of the recommendation areas discussed above. Research is also suggested in a number of areas that have not been focused on in the recommendations, but that are integral to developing better approaches to the consideration and assessment of cumulative and synergistic impacts in marine EIA. This should occur whether or not it is for Australia's future and emerging industry of OWF. These areas include issues such as:

- The need for improved scientific methods to assess synergistic impacts;
- The time taken to assess cumulative and synergistic impacts and the effect that this would have on the duration of a decision-making process;
- The economic costs of assessing cumulative and synergistic impacts, and the equitable allocation of these costs;
- The way in which environmental thresholds affect future use and development proponents;
- Environmental thresholds from a scientific perspective;
- Consideration within the Australian context as to the site-specific nature of assessments as opposed to the benefits and shortcomings associated with desktop studies that rely on scientific data gathered for other areas (and are applied to the impact assessment area);
- Knowledge sharing and collaboration (beyond PAM and iterative feedback mechanisms);
- The potential for shared accountability between government and project proponents for the assessment of cumulative and synergistic impacts as required to be undertaken within baseline assessments and studies, EIA and PAM;
- How to ensure that decision-making processes and frameworks are adaptive enough to address issues raised in PAM;
- The practical application for the potential to share the burden of proof (i.e. application of the precautionary principle) between government and project proponents;
- Cooperative governance;
- Research and development into scientific methods for assessing cumulative and synergistic impacts, as well as the associated limitations;
- Whether the statutory decision-making processes associated with marine environmental impact assessment are appropriate as is, or need to be reformed in general to enable effective consideration and assessment of cumulative and synergistic impacts (i.e. do we need to reconsider the way decisions are made?);
- The management of transboundary environmental impacts, including the implications for assessing cumulative and synergistic impacts within EIAs that affect multiple state and federal (international) jurisdictions;

- Further research that monitors progressive changes in the legal requirements for the assessment of cumulative and synergistic impacts within alternative jurisdictions (e.g. EU and Denmark), as well as the approach to determining 'significant' cumulative and synergistic impacts within the screening/scoping phase of EIA;
- The role of case law within the Australian context should future legal requirements result in an increase in the consideration and assessment of cumulative and synergistic impacts; and
- The role of local government in considering and assessing cumulative and synergistic environmental impacts, and the implications of local regulation of land based activities that can impact on the marine environment.

5. Concluding remarks

This chapter has provided recommendations for reforming the Australian marine EIA legal framework to improve the approach to the consideration and assessment of cumulative and synergistic impacts. Based on the recommendations provided in this chapter, research needs have been identified that focus on the direction that future reform and improvements could take.

Any changes in legal frameworks need to consider the subsequent changes in science. Reform should also challenge some of the existing perceptions within law and science that it is difficult enough to assess cumulative impacts let alone address the complex interactions associated with synergistic impacts. Assessing cumulative and synergistic impacts is complex, and the development of methods for assessing cumulative and synergistic impacts might be slow. However, the arguments for avoiding the assessment of complex nonlinear impacts because of the difficulties associated with assessments and the concerns that it is difficult enough to assess cumulative impacts (linear outcomes) should, instead, be used to motivate research and development.

The decision-making approach to cumulative and synergistic impact consideration and assessment needs fundamental change. To achieve this, environmental assessment legislation that was formulated in the 1980s should be reviewed in depth on the basis that the complexity and extent of information being assessed has increased significantly since this time. Further, original decision-making frameworks should be reviewed to ensure that this complexity can be addressed within regulatory timeframes and decision-making parameters (e.g. if legislation contains requirements to address relevant matters). The legislative objectives of decision-making should also be reviewed. Finally, if the status quo remains, and there is no change within legal requirements toward a better approach to the assessment of cumulative and synergistic impacts, there is a risk that the resulting increases in detriment to Australia's marine environment might be too great.

Glossary

Adaptive management – a process where the data and information gathered from the post-approval monitoring of an anthropogenic activity's impact on the environment can be used to improve environmental outcomes. The modifications can include those associated with the original decision (e.g. changes to approval decisions and/ or environmental management practices), as well as future decisions (e.g. policy and practices).[1]

Adverse impact/ effect – For the purpose of this thesis the term 'adverse' is used to identify the detrimental characteristics of an environmental impact/ effect.

Anthropogenic activities – uses and/or associated development within an environment as undertaken by humans. Anthropogenic activities can be stressors within an environment. For the purpose of this thesis, the term 'use and development' is interchangeable but is more commonly used in relation to a proposed or approved anthropogenic activity (within the context of environmental assessment).

Baseline data/information/ environmental data/ studies – information about the environmental characteristics of an area as existing prior to the commencement of a use and/or development, for example 'geological, physical, chemical and biological characteristics'.[2]

Cumulative impact/ effect – impacts/effects that result from interactions between stressors and that are demonstrated to have linear characteristics. They result from the accumulation of impacts/effects that interact within spatial areas and/or time periods. [3]

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[1] See, eg, K Evans, N Bax and D C Smith, *Australia state of the environment 2016: marine environment*, independent report to the Australian Government Minister for the Environment and Energy (Australian Government Department of the Environment and Energy, 2017) 189; Larry Canter and Bill Ross, 'State of practice of cumulative effects assessment and management: the good, the bad and the ugly' (2010) 28 (4) *Impact Assessment and Project Appraisal* 261, 265; Rachel Walmsley and Anna Lashko, 'Are our marine biodiversity laws climate ready?' (2011) 2 *National Environmental Law Review* 37, 42, 43, 45; Jan Barton, Adam Pope and Steffan Howe, *Marine Natural Values Study Vol 2: Marine Protected Areas of the Otway Bioregion. Parks Victorian Technical Series Number 75* (Parks Victoria, 2012) iv – v, 25 – 26.

[2] Gordon E Beanlands and Peter N Duinker, 'Lessons from a Decade of Offshore Environmental Impact Assessment' (1984) 9 *Ocean Management* 157, 168.

[3] This definition is based on elements found in multiple references. See, eg, L M Cooper and W R Sheate, 'Cumulative Effects Assessment: A review of UK Environmental Impact Statements' (2002) 22 *Environmental Impact Assessment Review* 415, 416, 422 - 423; Benjamin S Halpern et al, 'Managing for cumulative impacts in ecosystem-based management through ocean zoning' (2008) 51 *Ocean and Coastal Management* 203, 205; Samuli Korpinen, Manuel Meidinger and Maria Laamanen, 'Cumulative impacts on seabed habitats: An indicator for assessments of good environmental status' (2013) 74 *Marine Pollution Bulletin* 311,313; Great Barrier Reef Marine Park Authority, *Great Barrier Reef Region Strategic Assessment: Strategic assessment report* (Great Barrier Reef Marine Park Authority, 2014) XIII; Natalie C Ban, Hussein M Alidina and Jeff A Ardron, 'Cumulative impact mapping: Advances, relevance and limitations to marine management and conservation, using Canada's Pacific Waters as a case study' (2010) 34 *Marine Policy* 876, 883; Murray Raff, 'Ten Principles of Environmental Impact Assessment' (1997) 14 EPLJ 207, 210; Harry Spaling and Barry Smit, 'Cumulative Environmental Change: Conceptual Frameworks, Evaluation Approaches, and Institutional Perspectives' (1993) 17 (5) *Environmental Management* 587, 589.

Cumulative impact assessment (CIA) – a methodological framework used to assess cumulative (and synergistic) impacts. For the purpose of this thesis the term is interchangeable with CEA.[4]

Cumulative effects assessment (CEA) - a methodological framework used to assess cumulative (and synergistic) impacts. For the purpose of this thesis the term is interchangeable with CIA.[5]

Ecologically Sustainable Development – 'using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased'.[6]

Effect - both the causes and consequences of stressors in an environment. The term is interchangeable with 'impact'.[7]

Effects-based approach – an approach oriented toward assessing the actual environmental effects and change within the environment.[8]

Environmental Assessment – process of assessment using scientific tools and methods for the purpose of measuring and predicting the impact of stressors on the natural environment.[9] The tools can include environmental impact assessment[10] and strategic environmental assessment.[11]

Environmental Impact Assessment (EIA) - a tool used to facilitate the assessment of environmental impacts predicted to occur as a result of proposed use and/or development at a

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4 See, eg, Andrew J Wright and Line A Kyhn, 'Practical management of cumulative anthropogenic impacts with working marine examples' (2014) 29 (2) *Conservation Biology* 333, 334.

5 See, eg, See, eg, Peter N Duinker et al, 'Scientific dimensions of cumulative effects assessment: toward improvements in guidance for practice' (2013) 21 *Environmental Reviews* 40, 41.

6 Ecologically Sustainable Development Steering Committee, *National Strategy for Ecological Sustainable Development*, (Australian Government Publishing Service, 1992), Part 1 <http://www.environment.gov.au/about/esd/publications/national-esd-strateg-part1>.

7 Refer to discussion in Chapter 2 for justification.

8 Monique Dubé and Kelly Munkittrick, 'Integration of Effects-Based and Stressor-Based Approaches into a Holistic Framework for Cumulative Effects Assessment in Aquatic Ecosystems' (2001) 7 (2) *Human and Ecological Risk Assessment: An International Journal* 247, 248, 251.

9 See, eg, Keijiang Zhang, Yuansheng Pei and Changjing Lin, 'An investigation of correlations between different environmental assessments and risk assessment' (2010) 2 *Procedia Environmental Sciences* 643, 643.

10 See, eg, Peter N Duinker et al, 'Scientific dimensions of cumulative effects assessment: toward improvements in guidance for practice' (2013) 21 *Environmental Reviews* 40, 41.

11 See, eg, Ulrike Weiland, 'Strategic Environmental Assessment in Germany – Practice and open questions' (2010) 30 *Environmental Impact Assessment Review* 211, 211.

particular site.[12]

EIA follow-up – a best practice approach to ensure that PAM occurs after an EIA, and that the information gained from the PAM is then evaluated, managed, and communicated.[13] The data from post-approval monitoring is evaluated alongside baseline monitoring, the predicted impacts and actual impacts/ environmental outcomes are evaluated, and the necessary decisions are made to respond to any environmental issues identified. The information is then communicated to as feedback about a project, as well as feedback for future EIA processes.[14]

Environmental change – encompasses changes that occur as a result of both natural variability e.g. seasonal and/or salinity variations,[15] as well as those changes that may have occurred indirectly and over a long period of time due to anthropogenic activities e.g. climate change[16] and changes in presence/ abundance of species.[17] Environmental change can be a stressor within the environment.

Impact - both the causes and consequences of stressors in an environment. The term is interchangeable with 'effect'.[18]

Indirect impact/ effect – 'Impacts on the environment, which are not a direct result of the project, often produced away from or as a result of a complex pathway.'[19]

Linear - when impacts accumulate in a linear nature, the quantified impact can be graphically represented in a straight line that shows the value increasing in increments that are directly

[12] See, eg, Simon Marsden, 'Strategic environmental assessment in Australian land-use planning' (2013) *Environmental and Planning Law Journal* 422, 422; Anna McLauchlan and Elsa João, 'The inherent tensions arising from attempting to carry out strategic environmental assessments on all policies, plans and programmes' (2012) 36 *Environmental Impact Assessment Review* 23, 23; George Hegmann and G A (Tony) Yarranton, 'Alchemy to reason: Effective use of Cumulative Effects Assessment in resource management' (2011) 31 *Environmental Impact Assessment Review* 484, 484.

[13] A Morrison-Saunders, R Marshall and J Arts (2007) *EIA Follow-UP International Best Practice Principles,* Special Publication Series No. 6, (International Association for Impact Assessment, 2007) 1; Angus Morrison-Saunders et al, 'Towards Sustainability Assessment Follow-up' (2014) 45 *Environmental Impact Assessment Review* 38, 39.

[14] Morrison-Saunders, Marshall and Arts, above n 13, 2; Morrison-Saunders et al, above n 13, 40.

[15] See, eg, Thomas H Suchanek, 'Oil Impacts on Marine Invertebrate Populations and Communities' (1993) 33 (6) *American Zoologist* 510, 516; D L Johnson et al, 'Meanings of Environmental Terms' (1997) 26 (3) *Journal of Environmental Quality* 581, 582 – 583.

[16] See, eg, T P Hughes et al, 'Climate Change, Human Impacts, and the Resilience of Coral Reefs' (2003) 301 *Science* 929, 930.

[17] See, eg, National Research Council, *Understanding Marine Biodiversity A Research Agenda for the Nation* (National Academy Press, 1995) 25, 59; Amélie Lescoröl et al, 'Seeing the ocean through the eyes of seabirds: A new path for marine conservation?' (2016) 68 *Marine Policy* 212, 213; Paul Adam, 'Ecological Communities – The context for biodiversity conservation or a source of confusion?' (2009) 13 (1) *The Australasian Journal of Natural Resources Law and Policy* 7, 17.

[18] Refer to discussion in Chapter 2, section 2.1 Cumulative impacts defined for justification.

[19] Hyder, *Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions* (European Communities, 1999), iii <https:www.ec.europa.eu/environment/archives/eia/eia-studies-and-reports/pdf/guidel.pdf>.

proportional to the value added.[20]

Marine environmental protection – For the purpose of this thesis, marine environmental protection is inclusive of marine environmental health, and all facets of conservation, targeted protection e.g. areas and species, and sustainable resource management e.g. environmental assessment. [21]

Nonlinear – when impacts are nonlinear in nature, they are the opposite of 'linear' and the quantified impact can be graphically represented through the use of a curved or non-straight line.

Post-approval monitoring (PAM) - Post-approval monitoring is the process of monitoring an anthropogenic activity's impact on the environment after a decision to approve a particular use and/or development has been granted and/or the activity or group of activities have been commenced.[22]

Precautionary principle – See, eg, the Australian definition of the precautionary principle: 'Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.'[23]

Resilience – the ability of a species or ecosystem to recover (to a previous condition) after being impacted upon by negative stressors.[24]

Scoping – an initial phase of EIA used for determining the type and extent of impacts and associated matters to be investigated.[25] The term is interchangeable with 'screening'.

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[20] See, eg, Benjamin S Halpern et al, 'Managing for cumulative impacts in ecosystem-based management through ocean zoning' (2008) 51 *Ocean and Coastal Management* 203, 207.
[21] Refer to discussion in Chapter 1 for justification.
[22] See, eg, International Association for Impact Assessment (IAIA) in cooperation with Institute of Environmental Assessment (IEA), UK, *Principles of Environmental Impact Assessment Best Practice,* (1999), 4 <http//:www.iaia.org/publicdocuments/special-publications/Principles%20of%201A_web.pdf>: IAIA and IEA cited in Ian Thomas and Mandy Elliot, *Environmental Impact Assessment in Australia: theory and practice* (The Federation Press, 4th ed, 2005) 18 – 19.
[23] Council of Australian Governments, *Intergovernmental Agreement on the Environment*, 1 May 1992, Section 3.5.1 <http//:www.environment.gov.au/about-us/publications/intergovernmental-agreement>.
[24] See, eg, C S Holling, 'Understanding the Complexity of Economic, Ecological and Social Systems' (2001) 4 *Ecosystems* 390, 394; Jeremy S Collie, Katherine Richardson and John H Steel, 'Regime shifts: can ecological theory illuminate the mechanisms?' (2004) 60 *Progress in Oceanography* 281, 289, 300.
[25] See, eg, Thomas and Elliot, above n 22, 149; John Glasson, Riki Therivel and Andrew Chadwick (1999) cited in Tim Snell and Richard Cowell, 'Scoping in environmental impact assessment: Balancing precaution and efficiency?' (2006) 26 *Environmental Impact Assessment Review* 359, 359 – 360; Environment and Natural Resources Committee, Parliament of Victoria, *Inquiry into the Environmental Effects Statement Process in Victoria* (2011), xvii.

Significant impact/ effect – For the purpose of this thesis the term ‘significant’ is used to identify a measure of magnitude/ severity/ intensity/ duration or extent for environmental impacts.[26] As an example, discussed in the Australian Government’s *Matters of National Environmental Significance: Significant impact guidelines 1.1, Environment Protection and Biodiversity Conservation Act* 1999, ‘significant’ impacts are considered to be ‘important, notable, or of consequence’.[27] It is noted that within different disciplines the meaning of ‘significant’ can differ (for example, in biological science the term can be used within the context of statistical significance (i.e. associated with the 95th percentile)).

Strategic Environmental Assessment (SEA) - a tool used to facilitate assessment of the environmental impacts that could be created by the implementation of policies, plans, and programmes that affect an environmental area or region.[28]

Stressor-based approach – the prediction of impacts as they arise from anthropogenic activities.[29]

Synergistic impact/ effect -impacts/effects that result from interactions between stressors and that are demonstrated to have nonlinear characteristics. The resultant impact/effect is of a greater magnitude than the expected sum of the combined impacts/effects. They can occur as a result of interactions across defined spatial areas as well as defined time periods. [30]

Thresholds – environmental quality status levels identified and set to assist with measuring the extent of impact and change considered to be the limit before indicators in a receiving

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[26] See, eg, Australian Government (Department of the Environment), *Matters of National Environmental Significance: Significant impact guidelines 1.1, Environment Protection and Biodiversity Conservation Act 1999* (Department of the Environment, 2013) 2.
[27] Australian Government (Department of the Environment), above n 26, 2.
[28] See, eg, Simon Marsden and John Ashe, ‘Strategic Environmental Assessment in Australian States and Territories’ (2006) 13 (4) *Australasian Journal of Environmental Management* 205, 205; Simon Marsden, ‘Strategic environmental assessment of Australian offshore oil and gas development: Ecologically sustainable development or deregulation?’ (2016) 32 *Environmental and Planning Law Journal* 21, 21; Marsden, above n 12, 422; McLauchlan and João, above n 12, 23; Jill Gunn and Bram F Noble, ‘Conceptual and methodological challenges to integrating SEA and cumulative effects assessment’ (2011) 31 *Environmental Impact Assessment Review* 154, 154.
[29] See, eg, Dubé and Munkittrick, above n 8, 248, 251.
[30] This definition is based on elements found in multiple references. See, eg, Raff, above n 3, 210; C L Folt et al, ‘Synergism and antagonism among multiple stressors’ (1999) 44(3)(2) *Limnology and Oceanography* 864,864; J D Court, C J Wright, and A C Guthrie, *Assessment of cumulative impacts and strategic assessment in environmental impact assessment: prepared for the Commonwealth Environment Protection Agency*, (Commonwealth of Australia, 1994) Appendix I.3; Great Barrier Reef Marine Park Authority, above n 3, 10-3; Ban, Alidina and Ardron, above n 3, 883; Spaling and Smit, above n 3, 587, 592; the definition is also supported within a different context in Daniel Simberloff and Betsy Von Holle, ‘Positive Interactions of nonindigenous species: invasional meltdown?’ (1999) 1 *Biological Invasions* 21, 22.

environment show that function in the same state can no longer be maintained.[31]

Use and development – For the purpose of this thesis, this phrase refers to the use (e.g. operation) and development (e.g. construction) elements of an anthropogenic activity.[32]

Valued Ecosystem Components (VECs) – those ecosystem components determined to be of value by set criteria, for example, ecosystem functions, habitats or species.[33]

[31] See, eg, Monique G Dubé, 'Cumulative effect assessment in Canada: a regional framework for aquatic ecosystems' (2003) 23 *Environmental Impact Assessment Review* 723, 730, 731; Benjamin S Halpern and Rod Fujita, 'Assumptions, challenges and future directions in cumulative impact analysis' (2013) 4 (10) 131 *Ecosphere* 1, 9.
[32] This is a phrase commonly used within Australian environmental planning.
[33] See, eg, Gordon E Beanlands and Peter N Duinker, *An Ecological Framework for Environmental Impact Assessment in Canada* (Institute for Resource and Environmental Studies Dalhousie University and Federal Environmental Assessment Review Office, 1983) 8.

List of References

Books

Bates, Gerry, *Environmental Law in Australia*, (LexisNexis Butterworths, 7th ed, 2010)

Canter, L W, *Environmental Impact Assessment* (McGraw – Hill Book Co, 1996)

Cooney, R and B Dickson (eds) *Biodiversity and the Precautionary Principle, Risk and Uncertainty in Conservation and Sustainable Use* (Earthscan, 2005)

Evans, Robert L, *Fueling our Future: An introduction to Sustainable Energy*, (Cambridge University Press, 2007)

Fisher, D E, *Australian Environmental Law: norms, principles and rules* (Thompson Reuters, 2010)

Glasson, John, Riki Therivel and Andrew Chadwick, *Introduction to Environmental Impact Assessment*, (Routledge, 3rd ed, 2005)

Godden, Lee and Jacqueline Peel, *Environmental Law: Scientific, Policy & Regulatory Dimensions* (Oxford University Press, 2010)

Marsden, Simon, *Strategic Environmental Assessment in International and European Law: A Practitioner's Guide* (Earthscan, 2008)

Meffe, Gary K, C Ronald Carroll and contributors, *Principles of Conservation Biology*, (Sinaur Associates Inc., 2nd ed, 1997)

Larcombe, J et al, *Marine Matters – Atlas of marine activities and coastal communities in Australia's South-East Marine Region* (Bureau of Rural Sciences, 2002)

Peel, Jacqueline, *The Precautionary Principle in Practice: Environmental decision-making and scientific uncertainty* (The Federation Press, 2005)

Port of Melbourne Corporation, *Main Volume Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007a)

Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b)

Richardson, Benjamin J & Stepan Wood (eds) *Environmental Law for Sustainability* (Hart Publishing, 2006)

Thomas, Ian and Mandy Elliot, *Environmental Impact Assessment in Australia: theory and practice* (The Federation Press, 4th ed, 2005)

Wood, Christopher, *Environmental Impact Assessment: A Comparative Review*, (Pearson Education Limited, 2nd ed, 2003)

Book chapters

Ambrose, Richard F, Russell J Schmitt and Craig W Osenberg, 'Predicted and Observed Environmental Impacts: Can we Foretell Ecological Change?' in Russell J Schmitt and Craig W Osenberg (eds), *Detecting ecological impacts: concepts and applications in coastal habitats* (Academic Press, 1996) 345

Applied Ecology Solutions Pty Ltd, 'Marine Mammals and Penguins' in Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) Technical Appendix 56

Breitburg, Denise L and Gerhardt F Riedel, 'Multiple Stressors in Marine Systems' in Elliot A Norse and Larry B Crowder (eds), *Marine Conservation Biology – The Science of Maintaining the Sea's Biodiversity* (Island Press, 2005) 167

Brett Lane & Associates Pty Ltd, 'Report No. 6036 (1.10) December 2006 in Port of Melbourne Corporation', *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) Technical Appendix 55

Buckley, R, 'Cumulative environmental impacts' in Alan J Porter and John J Fittipaldi (eds), *Environmental Methods Review: Retooling Impact Assessment for the New Century*, (The Press Club, 1998) 95

CEE Consultants Pty Ltd, 'Channel Deepening Project Overview Impact Assessment Plankton Communities' in Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) Technical Appendix 48

CEE Consultants Pty Ltd, 'Channel Deepening Project Overview Impact Assessment Seagrass' Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) Technical Appendix 50

CEE Consultants Pty Ltd, 'Channel Deepening Project Overview Impact Assessment Sessile Soft Seabed Communities' in Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) Technical Appendix 49

CEE Consultants Pty Ltd, 'Overview Impact Assessment Shallow Rocky Reef Communities' in Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) Technical Appendix 51

Cooper, Dr Dale F, Broadleaf Capital International Pty Ltd, 'Risk Management Peer Review' in Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) Technical Appendix 7

Dovers, Stephen, Tony Norton and John Handmer, 'Ecology and Policy' in J W Handmer, T W Norton and S R Dovers (eds), *Ecology, Uncertainty and Policy: Managing Ecosystems for Sustainability* (Pearson Education Ltd, 2001) 10

Edmunds M et al (Australian Marine Ecology), 'Port Phillip Bay Channel Deepening Project Supplementary Environmental Effects Statement – Marine Ecology Specialist Studies Volume

7: Water Column' in Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) Technical Appendix 47

Edmunds, M et al (Australian Marine Ecology), 'Port Phillip Bay Channel Deepening Project Supplementary Environmental Effects Statement – Marine Ecology Specialist Studies Volume 8: Shallow Reefs' in Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) Technical Appendix 47

Edmunds, M, P Pickett and A Judd (Australian Marine Ecology), 'Port Phillip Bay Channel Deepening Project Supplementary Environmental Effects Statement – Marine Ecology Specialist Studies Volume 10: Ecological Processes and Inventory' in Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) Technical Appendix 47

Ellis, Jaye and Stepan Wood, 'International Environmental Law' in Benjamin J Richardson & Stepan Wood (eds) *Environmental Law for Sustainability* (Hart Publishing, 2006) 343

Gullett, Warwick and Gregory Rose, 'Australia's marine jurisdiction under international and domestic law' in Warwick Gullett, Clive Schofield and Joanna Vince (eds), *Marine Resources Management* (LexisNexis Butterworths, 2011) 25

Hale, Jennifer, 'Supplementary Environment Effects Statement, Head Technical Report: Nutrient-cycling- Appendix 1 Phytoplankton Blooms December 2006' in Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) Technical Appendix 43

Irvine, Dr Ian, 'Peer Review, South and North Channels Supplementary EES Channel Deepening Project 1/3/2007' Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) Technical Appendix 37

Jenkins, Gregory P and Lachlan McKinnon, 'Aquaculture and Fisheries SEES' in Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) Technical Appendix 57

Jessup, Brad, 'The Port Phillip Channel Deepening Project and Environmental Law: A model for ecologically sustainable development?' in Warwick Gullett, Clive Schofield and Joanna Vince, *Marine Resources Management* (LexisNexis Butterworths, 2011)

Kent, C Salgado and R D McCauley, 'Underwater Noise Impacts CDP Report 2006' Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) Technical Appendix 64

Longmore, Andrew R, 'SEES Head Technical report: Nutrient Cycling' in Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) Technical Appendix 43

Mustoe, Simon and Nathan Waugh AES Applied Ecology Solutions Pty Ltd, 'Marine Mammals and Penguins' Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) Technical Appendix 56

O'Brien Consulting Greenhouse, 'Energy, Environment, Greenhouse Gas Emissions and Climate Change Head Technical Report - Final 2007' in Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) Technical Appendix 65

Parsons Brinckerhoff, 'Dredged Material Ground: Assessment of Optimal Location for Material to be Dredged in the South of the Bay' in Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) Technical Appendix 30

Port of Melbourne Corporation, 'Appendix 67' in Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) Appendix 67

Sinclair Knight Merz, 'Peer Review of Channel Design Report' in Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) Technical Appendix 18

URS Australia Pty Ltd, 'Channel Deepening Project Risk Assessment for SEES' in Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) Technical Appendix 6

URS Australia Pty Ltd, 'Section 5 Risk Assessment – Identification of Risks' in Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) Technical Appendix 6

URS Australia Pty Ltd, 'Section 6 Risk Assessment – Analysis of Risks' in Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) Technical Appendix 6

URS Australia Pty Ltd, 'Section 7 Risk Assessment – Evaluation of Outputs' in Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) Technical Appendix 6

Journal articles

Adam, Paul, 'Ecological Communities – The context for biodiversity conservation or a source of confusion?' (2009) 13 (1) *The Australasian Journal of Natural Resources Law and Policy* 7

Agbayani, Selina, Candace M Picco and Hussein M Alidina, 'Cumulative impact of bottom fisheries on benthic habitats: A quantitative spatial assessment in British Columbia, Canada' (2015) 116 *Ocean and Coastal Management* 423

Ahammed A K M R and B M Nixon, 'Environmental impact monitoring in the EIA process of South Australia', (2006) 26 *Environmental Impact Assessment Review* 426

Anderson, Jesper H et al, 'Baltic Sea biodiversity status vs. cumulative human pressures' (2015) 161 *Estuarine, Coastal and Shelf Science* 88

Antonson, Hans, ‘The treatment of landscape in a Swedish EIA process’ (2011) 31 (3) *Environmental Impact Assessment Review* 195

Ateweberhan, Mebrahtu et al, ‘Climate change impacts on coral reefs: Synergies with local effects, possibilities for acclimation, and management implications’ (2013) 74 *Marine Pollution Bulletin* 526

Ban, Natalie C, Hussein M Alidina and Jeff A Ardron, ‘Cumulative impact mapping: Advances, relevance and limitations to marine management and conservation, using Canada’s Pacific Waters as a case study’ (2010) 34 *Marine Policy* 876

Bao, Vivien W W, et al, ‘Synergistic toxic effects of zinc pyrithione and copper to three marine species: implications on setting appropriate water quality criteria’ (2008) 57 *Marine Pollution Bulletin* 616

Barker, Adam and Carys Jones, ‘A critique of the performance of EIA within the offshore oil and gas sector’ (2013) 43 *Environmental Impact Assessment Review* 31

Barton, Charmain, ‘The Status of the Precautionary Principle in Australia: its emergence in legislation and as a common law doctrine’ (1998) 22 *Harvard Environmental Law Review* 509

Batista, Marisa I et al, ‘Assessment of cumulative human pressures on a coastal area: Integrating information for MPA planning and management’ (2014) 102 *Ocean & Coastal Management* 248

Bax, Nicholas et al, ‘Marine invasive alien species: A threat to global biodiversity’ (2003) 27 *Marine Policy* 313

Beanlands, Gordon E and Peter N Duinker, ‘Lessons from a Decade of Offshore Environmental Impact Assessment’ (1984) 9 *Ocean Management* 157

Bedford, Barbara L and Eric M Preston, ‘Developing the Scientific Basis for Assessing Cumulative Effects of Wetland Loss and Degradation on Landscape Functions: Status, Perspectives, and Prospects’ (1988) 12 (5) *Environmental Management* 751

Bell, Justine et al, ‘Legal frameworks for unique ecosystems – how can the EPBC Act offsets policy address the impact of development on seagrass’ (2014) 31 *Environmental and Planning Law Journal* 34

Bergström, Lena et al, ‘Effects of offshore wind farms on marine wildlife – a generalized impact assessment’ (2014) 9 *Environmental Research Letters* 1, 8 - 9 <http://doi:10.1088/1748-9326/9/3/034012>

Bidstrup, Morten and Anne Merrild Hansen, ‘The paradox of strategic environmental assessment’ (2014) 47 *Environmental Impact Assessment Review* 29

Billick, Ian and Ted J Case, ‘Higher Order Interactions in Ecological Communities: What are they and how can they be detected?’ (1994) 75 (6) *Ecology* 1529

Bina, Olivia, ‘A critical review of the dominant lines of argumentation on the need for strategic environmental assessment’ (2007) 27 *Environmental Impact Assessment Review* 585

Bradbrook, Adrian J and Alexandra S Wawryk, ‘The Legal Regime Governing the Exploitation of Offshore Wind Energy in Australia’ (2001) 18 (1) *Environmental and Planning Law Journal* 30

Briffa, Mark, Kate de la Haye, Philip L Munday, ‘High CO_2 and marine animal behaviour: Potential mechanisms and ecological consequences’ (2012) 64 *Marine Pollution Bulletin* 1519

Brodie, J E et al, ‘Terrestrial pollutant runoff to the Great Barrier Reef: An update of issues, priorities and management responses’ (2012) 65 *Marine Pollution Bulletin* 81

Brunton, Nicholas, ‘Environmental Regulation: The Challenge Ahead’ (1999) (24)3 *Alternative Law Journal* 137

Buckley, Ralf, ‘Strategic Environmental Assessment’ (1997) 14 *Environmental and Planning Law Journal* 174

Buckley, Ralf, ‘Notes, Commentary and Reviews - Cumulative Environmental Impacts: Problems, Policy and Planning Law’ (1994) 11 *Environmental and Planning Law Journal* 344

Burthe, Sarah J et al, ‘Assessing the vulnerability of the marine bird community in the western North Sea to climate change and other anthropogenic impacts’ (2014) 507 *Marine Ecology Progress Series* 277

Busch, Malte et al, ‘Consequences of a cumulative perspective on marine environmental impacts: Offshore wind farming and seabirds at North Sea scale in context of the EU Marine Strategy Framework Directive’ (2013) 71 *Ocean & Coastal Management* 213

Buschke, Falko T and Bram Vanschoenwinkel, ‘Mechanisms for the inclusion of cumulative impacts in conservation decision-making are sensitive to vulnerability and irreplaceability in a stochastically simulated landscape’ (2014) 22 *Journal for Nature Conservation* 265

Buschmann, Alejandro H et al, ‘Salmon aquaculture and coastal ecosystem health in Chile: Analysis of regulations, environmental impacts and bioremediation systems’ (2009) 52 *Ocean and Coastal Management* 243

Campagna, Claudio et al, ‘Gulf of Mexico Oil Blowout Increases Risks to Globally Threatened Species’ (2011) 61(5) *BioScience* 393

Campbell, Marnie L and Charmaine Gallagher, ‘Assessing the relative effects of fishing on the New Zealand marine environment through risk analysis’ (2007) 64 *ICES Journal of Marine Science* 256

Canter, L W, and S F Atkinson, ‘Multiple uses of indicators and indices in cumulative effects assessment and management’ (2011) 31 *Environmental Impact Assessment Review* 491

Canter, Larry, and Bill Ross, ‘State of practice of cumulative effects assessment and management: the good, the bad and the ugly’ (2010) 28(4) *Impact Assessment and Project Appraisal* 261

Carter, R W (Bill) and Helen Ross, ‘Broadening of environmental concerns: insights from management of the Great Barrier Reef’ (2015) 22 (3) *Australasian Journal of Environmental Management* 265

Cashmore, Matthew et al, ‘The interminable issue of effectiveness: substantive purposes, outcomes and research challenges in the advancement of environmental impact assessment theory’ (2004) 22 (4) *Impact Assessment and Project Appraisal* 295

Chaker, A et al, ‘A review of strategic environmental assessment in 12 selected countries’, (2006) 26 *Environmental Impact Assessment Review* 15

Chapple, Sophie, ‘The *Environment Protection and Biodiversity Conservation Act 1999* Cth: one year later’ (2001) 18 *Environmental and Planning Law Journal* 523

Christian Alva-Basurto, Jorge and Jesús Ernesto Arias-González, ‘Modelling the effects of climate change on a Caribbean coral reef food web’ (2014) 289 *Ecological Modelling* 1

Clark, Dana et al, ‘Validation and limitations of a cumulative impact model for an estuary’ (2016) 120 *Ocean & Coastal Management* 88

Clarke Murray, Cathryn et al, ‘Advancing marine cumulative effects mapping: An update in Canada’s Pacific waters’ (2015) 58 *Marine Policy* 71

Cocklin, Chris, Sharon Parker and John Hay, ‘Notes on Cumulative Environmental Change I: Concepts and Issues’ (1992) 35 *Journal of Environmental Management* 31

Coleby, Alastor ‘Assessment of Marine Renewable Energy Industry Stakeholder Requirements in North Scotland’ (2010) 12(1) *Journal of Environmental Assessment Policy and Management* 29

Collie, Jeremy S, Katherine Richardson and John H Steel, ‘Regime shifts: can ecological theory illuminate the mechanisms?’ (2004) 60 *Progress in Oceanography* 281

Connelly, Robert (Bob), ‘Canadian and international EIA frameworks as they apply to cumulative effects’ (2011) 31 *Environmental Impact Assessment Review* 453

Connolly, Isabelle and Martin Falding, ‘Biocertification of local environmental plans – promise and reality’ (2009) 26 *Environmental and Planning Law Journal* 128

Contant, Cheryl K and Lyna L Wiggins, ‘Defining and analyzing cumulative environmental impacts’ (1991) 11 *Environmental Impact Assessment Review* 297

Cooper, Lourdes M , ‘CEA in policies and plans: UK case studies’ (2011) 31 *Environmental Impact Assessment Review* 465

Cooper, Lourdes M, and William R Sheate, ‘Integrating cumulative effects assessment into UK strategic planning: implications of the European Union SEA Directive’ (2004) 22 (5) *Impact Assessment and Project Appraisal* 5

Cooper, L M and W R Sheate, ‘Cumulative Effects Assessment: A review of UK Environmental Impact Statements’ (2002) 22 *Environmental Impact Assessment Review* 415

Cooper, Lourdes M, and William R Sheate, ‘Cumulative Effects Assessment: A review of UK environmental impact statements’ (2002) 22 *Environmental Impact Assessment Review* 415

Cormier, Susan M, and Glenn W Suter II, ‘A Framework for Fully Integrating Environmental Assessment’ (2008) 42 *Environmental Management* 543

Court, John, Colin Wright and Alasdair Guthrie, ‘Environmental Assessment and Sustainability: Are We Ready for the Challenge?’ (1996) 3 *Australian Journal of Environmental Management* 42

Crain, Caitlin M et al, ‘Understanding and Managing Human Threats to the Coastal Marine Environment’, (2009) 1162 *The Year in Ecology and Conservation Biology 2009: Ann. N.Y. Acad. Sci* 39

Crain, Caitlin Mullan, Kristy Kroeker and Benjamin S Halpern, ‘Interactive and cumulative effects of multiple stressors in marine systems’ (2008) 11 *Ecology Letters* 1304

Crosby, M P, G Brighouse and M Pichon, ‘Priorities and strategies for addressing natural and anthropogenic threats to coral reefs in Pacific Island Nations’ (2002) 45 *Ocean and Coastal Management* 121

Curtin, Richard, and Raúl Prellezo, ‘Understanding marine ecosystem based management: A literature review’, (2010) 34 *Marine Policy* 821

Dahlstrom Davidson, Alisha and Chad L Hewitt, ‘How often are invasion-induced ecological impacts missed?’ (2014) 16 *Biological Invasions* 1165

Dahlstrom Davidson, Alisha, Marnie L Campbell and Chad L Hewitt, ‘The role of uncertainty and subjective influences on consequence assessment by aquatic biosecurity experts’ (2013) 127 *Journal of Environmental Management* 103

Daniell, Rozalyn, ‘To what extent do land use planning controls and policy in South Australia facilitate sustainable development’ (1998) (1)(2) *Australian Environmental Law News* 50

Darling, Emily S and Isabelle M Côté, ‘Quantifying the evidence for ecological synergies’ (2008) 11 *Ecology Letters* 1278

Davidson, Alisha D, Chad L Hewitt and Donna R Kashian, ‘Understanding Acceptable Level of Risk: Incorporating the Economic Cost of Under-Managing Invasive Species’ (2015) *PloS ONE* 10(11) 3/12 <http://e0141958.doi:10.1371/journal.pone.0141958>

Day, Jon, 'The need and practice of monitoring, evaluating and adapting marine planning and management – lessons from the Great Barrier Reef' (2008) 32 *Marine Policy* 823

Dickert, Thomas G, and Andrea E Tuttle, 'Cumulative Impact Assessment in Environmental Planning: A Coastal Wetland Watershed Example' (1985) 5 *Environmental Impact Assessment Review* 37

Dixon, Jennifer and Burrell E Montz, 'From Concept to Practice: Implementing Cumulative Impact Assessment in New Zealand' (1995) 19 (3) *Environmental Management* 445

Dolman, Sarah and Mark Simmonds, 'Towards best environmental practice for cetacean conservation in developing Scotland's marine renewable energy' (2010) 34 *Marine Policy* 1021

Douvere, Fanny and Charles N Ehler, 'New Perspectives on sea use management: Initial findings from European experience with marine spatial planning' (2009) 90 *Journal of Environmental Management* 77

Dubé, Monique et al, 'Development of a new approach to cumulative effects assessment: a northern river ecosystem example' (2006) 113 *Environmental Monitoring and Assessment* 87

Dubé, Monique G, 'Cumulative effect assessment in Canada: a regional framework for aquatic ecosystems' (2003) 23 *Environmental Impact Assessment Review* 723

Dubé, Monique, and Kelly Munkittrick, 'Integration of Effects-Based and Stressor-Based Approaches into a Holistic Framework for Cumulative Effects Assessment in Aquatic Ecosystems' (2001) 7(2*) Human and Ecological Risk Assessment: An International Journal,* 247

Duinker, Peter N et al, 'Scientific dimensions of cumulative effects assessment: toward improvements in guidance for practice' (2013) 21 *Environmental Reviews* 40

Duinker, Peter N and Lorne A Greig, 'Forum: The Impotence of Cumulative Effects Assessment in Canada: Ailments and Ideas for Redeployment' (2006) 37(2) *Environmental Management* 153

Duinker, Peter N and Gordon E Beanlands, 'The significance of environmental impacts: an exploration of the concept' (1986) 10 (1) *Environmental Management* 1

Dwyer, Guy J and Mark P Taylor, 'Moving from consideration to application: The uptake of principles of ecologically sustainable development in environmental decision-making in New South Wales' (2013) 30 *Environmental and Planning Law Journal* 185

Edwards, Martin, 'Interactions between petroleum operations and carbon capture and storage operations' (2009) 26 *Environmental and Planning Law Journal* 152

Ellis, Derek V, 'The precautionary principle and environmental monitoring' (2003) 46 *Marine Pollution Bulletin* 933

Erftemeijer, Paul L A and Roy R Robin Lewis III, 'Environmental impacts of dredging on seagrasses: A review' (2006) 52 *Marine Pollution Bulletin* 1553

Fabry, Victoria J et al, 'Impacts of ocean acidification on marine fauna and ecosystem processes' (2008) 65 *ICES Journal of Marine Science* 414

Fairweather, Peter G, 'Where is the Science in EIA?' (1989) 20 (5) *Search* 142

Falkenberg, Laura J, Sean D Connell and Bayden D Russell, 'Disrupting the effects of synergies between stressors: improved water quality dampens the effects of future CO_2 on a marine habitat' (2013) 50 *Journal of Applied Ecology* 51

Fallon, Liza D, and Lorne K Kriwoken, 'Environmental Impact Assessment under the Protocol on Environment Protection to the Antarctic Treaty and Australian Legislation' (2005) 2 *Macquarie Journal of International and Comparative Environmental Law* 67

Fidler, Courtney and Bram Noble, 'Advancing strategic environmental assessment in the offshore oil and gas sector: Lessons from Norway, Canada, and the United Kingdom' (2012) 34 *Environmental Impact Assessment Review* 12

Fisher, D E, 'Dams, Irrigation and World Heritage Areas – The Nathan Dam Case' (2004) 21 *Environmental and Planning Law Journal* 85

Fisher, D E, 'Editorial Commentary: The meaning of impacts – The Nathan Dam Case on Appeal' (2004) 21 *Environmental and Planning Law Journal* 325

Foden, Jo, Stuart I Rogers and Andrew P Jones, 'Human pressures on UK seabed habitats: a cumulative impact assessment' (2011) 428 *Marine Ecology Progress Series* 33

Foden, Jo, Stuart I Rogers and Andrew P Jones, 'Recovery of UK seabed habitats from benthic fishing and aggregate extraction – towards a cumulative impact assessment' (2010) 411 *Marine Ecology Progress Series* 259

Foley, Melissa M et al, 'Guiding ecological principles for marine spatial planning' (2010) 34 *Marine Policy* 955

Folke, Carl et al, 'Regime Shifts, Resilience, and Biodiversity in Ecosystem Management' (2004) 35 *Annual Review of Ecology, Evolution and Systematics* 557

Folkeson, Lennart, Hans Antonson, and J O Helldin, 'Planners' views on cumulative effects. A focus-group study concerning transport infrastructure planning in Sweden' (2013) 30 *Land Use Policy* 243

Folt, C L et al, 'Synergism and antagonism among multiple stressors' (1999) 44(3)(2) *Limnology and Oceanography* 864

Fox, A D et al, 'Information needs to support environmental impact assessment of the effects of the European marine offshore wind farms on birds' (2006) *Ibis* 129

Franks, Daniel M, David Brereton and Chris J Moran, 'Managing the cumulative impacts of coal mining on regional communities and environments in Australia' (2010) 28 (4) *Impact Assessment and Project Appraisal* 299

Franks, Daniel M, David Brereton and Chris J Moran, ‘Managing the cumulative impacts of coal mining on regional communities and environments in Australia’ (2010) 28 (4) *Impact Assessment and Project Appraisal* 299

Fraser, G S, J Ellis and L Hussain, ‘An international comparison of governmental disclosure of hydrocarbon spills from offshore oil and gas installations’ (2008) 56 *Marine Pollution Bulletin* 9

Gilliland, Paul M and Dan Laffoley, ‘Key elements and steps in the process of development ecosystem-based marine spatial planning’ (2008) 32 *Marine Policy* 32 (2008) 787

Goberville, Eric et al, ‘Climate-driven changes in coastal marine systems of western Europe’ (2010) 408 *Marine Ecology Progress Series* 129

Goodale, M Wing and Anita Milman, ‘Cumulative adverse effects of offshore wind energy development on wildlife’ (2016) 59 (1) *Journal of Environmental Planning and Management* 1

González, Ainhoa et al, ‘Current practice in biodiversity impact assessment and prospects for developing an integrated process’ (2014) 32 (1) *Impact Assessment and Project Appraisal* 31

Grech, A, R Coles, and H Marsh, ‘A broad scale assessment of the risk to coastal seagrasses from cumulative threats’, (2011) 35 *Marine Policy* 560

Greig, Lorne, and Peter Duinker, ‘Strengthening impact assessment: what problems do integration and focus fix?’ (2014) 32 (1) *Impact Assessment and Project Appraisal* 23

Griffith, Gary P, Elizabeth A Fulton and Anthony J Richardson, ‘Effects of fishing and acidification-related benthic mortality on the southeast Australian marine ecosystem’ (2011) 17 *Global Change Biology* 3058

Gullett, Warwick, ‘Contesting the merits of aquaculture development: Port Stephens Pearls Pty Ltd v Minister for Infrastructure and Planning [2005] NSWLEC 426’ (2006) 11 (1) *The Australasian Journal of Natural Resources Law and Policy* 109

Gullett, Warwick, ‘Environmental Impact Assessment and the Precautionary Principle: Legislating Caution in Environmental Protection’ (1998) 5 *Australian Journal of Environmental Management* 146

Gullett, Warwick, ‘Environmental Protection and the “Precautionary Principle”: A Response to Scientific Uncertainty in Environmental Management’ (1997) 14 *Environmental and Planning Law Journal* 52

Gumley, Wayne, ‘An update on the EPBC Act Reviews’ (2009) 3 *National Environmental Law Review* 39

Gunn, Jill and Bram F Noble, ‘Conceptual and methodological challenges to integrating SEA and cumulative effects assessment’ (2011) 31 *Environmental Impact Assessment Review* 154

Haigh, David J, ‘Hinchinbrook – in defence of world heritage’ (1999) 6 (1) *The Australasian Journal of Natural Resources Law and Policy* 47

Halpern, B S and R Fujita, 'Assumptions, challenges and future directions in cumulative impact analysis' (2013) *Ecosphere* 4(10): 131, 1 <http//:dx.doi.org/10.1890/ES-13-00181.1>

Halpern, Benjamin S, and Rod Fujita, 'Assumptions, challenges and future directions in cumulative impact analysis' (2013) 4 (10) 131 *Ecosphere* 1

Halpern, Benjamin S et al (2008) cited in Dana Clark et al, 'Validation and limitations of a cumulative impact model for an estuary' (2016) 120 *Ocean & Coastal Management* 88

Halpern, Benjamin S et al, 'A Global Map of Human Impact on Marine Ecosystems' (2008) 319 *Science* 948

Halpern, Benjamin S et al, 'Managing for cumulative impacts in ecosystem-based management through ocean zoning' (2008) 51 *Ocean & Coastal Management* 203

Halpern, Benjamin S et al, Supporting Online Material for 'A Global Map of Human Impact on Marine Ecosystems' (2008) 319 *Science*, SOM 7 <https://www.sciencemag.org/cgi/comtent/full/319/5865/948/DC1>

Hardin G, 'The Tragedy of the Commons' (1968) 162 *Science* 1243

Harriman Gunn, Jill and Bram F Noble, 'A conceptual basis and methodological framework for regional strategic environmental assessment (R-SEA)' (2009) 27 (4) *Impact Assessment and Project Appraisal* 258

Harriman Gunn, Jill and Bram F Noble, 'Integrating cumulative effects in regional strategic environmental assessment frameworks: lessons from practice' (2009) 11 (3) *Journal of Environmental Assessment Policy and Management* 267

Harriman, Jill A E and Bram F Noble, 'Characterizing Project and Strategic Approaches to Regional Cumulative Effects Assessment in Canada' (2008) 10 (1) *Journal of Environmental Assessment Policy and Management* 25

Harrington, Lindsay et al, 'Synergistic effects of diuron and sedimentation on photosynthesis and survival of crustose coralline algae' (2005) 51 *Marine Pollution Bulletin* 415

Harris, Linda et al, 'Quantifying cumulative threats to sandy beach ecosystems: A tool to guide ecosystem-based management beyond coastal reserves' (2015) 110 *Ocean & Coastal Management* 12

Harvey, Nick, 'The Relationship Between Ecologically Sustainable Development and Environmental Impact Assessment in Australia: A Critique of Recent National Reports' (1992) 9 *Environmental and Planning Law Journal* 265

Havemann, Paul et al, 'Traditional use of marine resources agreements and dugong hunting in the Great Barrier Reef World Heritage Area' (2005) 22 *Environmental and Planning Law Journal* 258

Hegmann, George and G A (Tony) Yarranton, 'Alchemy to reason: Effective use of Cumulative Effects Assessment in resource management' (2011) 31 *Environmental Impact Assessment Review* 484

Hering, Daniel et al, 'Managing aquatic ecosystems and water resources under multiple stress – An introduction to the MARS project' (2015) 503 – 504 *Science of the Total Environment* 10

Hernández-Delgado, E A, 'The emerging threats of climate change on tropical coastal ecosystem services, public health, local economies and livelihood sustainability of small island: Cumulative impacts and synergies' (2015) 101 *Marine Pollution Bulletin* 5

Hiddink, J G et al, 'Cumulative impacts of seabed trawl disturbance on benthic biomass, production, and species richness in different habitats' (2006) 63 *Canadian Journal of Fisheries and Aquatic Sciences* 721

Holling, C S, 'Understanding the Complexity of Economic, Ecological and Social Systems' (2001) 4 *Ecosystems* 390

Hughes, T P and J H Connell, 'Multiple stressors on coral reefs: A long-term perspective' (1999) 44 (3, part 2) *Limnology and Oceanography* 932

Hughes, T P et al, 'Climate Change, Human Impacts, and the Resilience of Coral Reefs' (2003) 301 *Science* 929

Iverson, Terrence and Charles Perrings, 'Precaution and proportionality in the management of global environmental change' (2012) 22 *Global Environmental Change* 161

Jackson, Jeremy B C 'Ecological extinction and evolution in the brave new ocean' (2008) 105 suppl. 1 *PNAS* 11458 <http//:www.pnas.org/cgi/doi/10/1073/pnas.0802812105>

James, David 'Environmental Impact Assessment: Improving Processes and Techniques' (1995) 2 *Australian Journal of Environmental Management* 78

Jenkins, Rhian E, Raymond D H Brown, Michael R Phillips, 'Harbour porpoise (Phocoena phocoena) conservation management: A dimensional approach' (2009) 33 *Marine Policy* 744

Johnson, Dallas et al, 'Improving cumulative effects assessment in Alberta: Regional strategic assessment' (2011) 31 *Environmental Impact Assessment Review* 481

Johnson, D L et al, 'Meanings of Environmental Terms' (1997) 26 (3) *Journal of Environmental Quality* 581

Johnson, J E et al, 'Quantitative methods for analysing cumulative effects on fish migration success: a review' (2012) 81 *Journal of Fish Biology* 600

Johnson, Maggie D, and Robert C Carpenter, 'Ocean acidification and warming decrease calcification in the crustose coralline alga *Hydrolithon onkodes* and increased susceptibility to grazing', (2012) 434 – 435 *Journal of Experimental Marine Biology and Ecology* 94

Judd, A D, T Backhaus and F Goodsir, ‘An effective set of principles for practical implementation of marine cumulative effects assessment’ (2015) 54 *Environmental Science and Policy* 254

Katsnevakis, Stelios et al, ‘Ecosystem-based marine spatial management: Review of concepts, policies, tools, and critical issues’ (2011) 54 *Ocean and Coastal Management* 807

Keen, Meg and Marjorie Sullivan, ‘Aiding the environment: the Australian Development Agency’s experience of implementing an environmental management system’ (2005) 25 *Environmental Impact Assessment Review* 628

Kelly, Christina et al, ‘Investigating options on how to address cumulative impacts in marine spatial planning’ (2014) 102 *Ocean & Coastal Management* 139

King, Sarah C and Ronald Pushchak, ‘Incorporating cumulative effects into environmental assessments of mariculture: Limitations and failures of current siting methods’ (2008) 28 (8) *Environmental Impact Assessment Review* 572

Kirby, Richard R, Gregory Beaugrand and John A. Lindley, ‘Synergistic Effects of Climate and Fishing in a Marine Ecosystem’ (2009) 12 *Ecosystems* 548

Korpinen, Samuli, Manuel Meidinger and Maria Laamanen, ‘Cumulative impacts on seabed habitats: An indicator for assessments of good environmental status’ (2013) 74 *Marine Pollution Bulletin* 311

Kriebel, David et al, ‘The Precautionary Principle in Environmental Science’ (2001) 109 (9) *Environmental Health Perspectives* 871

Lacmuth, Cara L et al, ‘Estimation of southern killer whale exposure to exhaust emissions from whale-watching vessels and potential adverse health effects and toxicity thresholds’ (2011) 62 *Marine Pollution Bulletin* 792

Langston, R H W and J D Pullan (2003) cited in Gavin B Stewart, Andrew S Pullin, and Christopher F Coles, ‘Poor evidence-base assessment of windfarm impacts on birds’ (2007) 34 (1) *Environmental Conservation* 1, 9 <http://doi.10.1017/S0376892907003554>

Latteman, Sabine and Gary Amy, ‘Marine monitoring surveys for desalination plants – a critical review’ (2013) 51 (1 – 3) *Desalination and Water Treatment* 233

Lawrence, David P, ‘Impact significance determination – Pushing the boundaries’ (2007) 27 *Environmental Impact Assessment Review* 770

Lescoröl, Amélie et al, ‘Seeing the ocean through the eyes of seabirds: A new path for marine conservation?’ (2016) 68 *Marine Policy* 212

Lewis, Stephen E et al, ‘Assessing the additive risks of PSII herbicide exposure to the Great Barrier Reef’ (2012) 65 *Marine Pollution Bulletin* 280

Lindeboom, Han et al, ‘Offshore wind park monitoring programmes, lessons learned and recommendations for the future’ (2015) 756 *Hydrobiologia* 169

Lotze, Heike K and Boris Worm, ‘Complex interactions of Climatic and Ecological Controls of Macroalgal Recruitment’ (2002) 47(6) *Limnology and Oceanography* 1734

MacDonald, Lee H, ‘Evaluating and Managing Cumulative Effects: Process and Constraints’ (2000) 26 (3) *Environmental Management* 299

Macintosh, Andrew and Debra Wilkinson, ‘EPBC Act – The case for reform’ (2005) 10(1) *The Australasian Journal of Natural Resources Law and Policy* 139

Macintosh, Andrew, ‘The Environment Protection and Biodiversity Conservation Act 1999 (Cth) – An evaluation of its cost effectiveness’ (2009) 26 *Environmental and Planning Law Journal* 337

Macintosh, Andrew, ‘Why the Environment Protection and Biodiversity Conservation Act’s referral, assessment and approval process is failing to achieve its environmental objectives’ (2004) 21 *Environmental and Planning Law Journal* 288

Madsen, P T et al, ‘Wind turbine underwater noise and marine mammals; implications of current knowledge and data needs’ (2006) 309 *Marine Ecology Progress Series* 279

Maguire, Rowena and Angela Phillips, ‘The role of property law in environmental management: An examination of environmental markets’ (2011) 28 *Environmental and Planning Law Journal* 215

Mapstone, Bruce D, ‘Scalable decision rules for environmental impact studies: effect size, Type 1 and Type II errors’ (1995) 5(2) *Ecological Applications* 401

Maragos, J E, M P Crosby and J W McManus ‘Coral reefs and biodiversity: A critical and threatened relationship’ (1996) 9(1) *Oceanography* 83 <http://dx.doi.org/10.5670k/oceanog.1996.31>

Marcotte, Danielle, Samuel K Hung and Sébastien Caquard, ‘Mapping cumulative impacts on Hong Kong’s pink dolphin population’ (2015) 109 *Ocean & Coastal Management* 51

Marr, Simon, ‘The Southern Bluefin Tuna Cases: The Precautionary Approach and Conservation and Management of Fish Resources’ (2000) 11 *European Journal of International Law* 815

Marsden, Simon ‘Strategic environmental assessment of Australian offshore oil and gas development: Ecologically sustainable development or deregulation?’ (2016) 32 *Environmental and Planning Law Journal* 21

Marsden, Simon ‘Australian World Heritage in danger’ (2014) 31 *Environmental and Planning Law Journal* 192

Marsden, Simon, ‘Strategic environmental assessment in Australian land-use planning’ (2013) *Environmental and Planning Law Journal* 422

Marsden, Simon, ‘An international overview of strategic environmental assessment, with reference to world heritage areas globally and in Australian coastal zones’ (2002) 4 (1) *Journal of Environmental Assessment Policy and Management,* 31

Marsden, Simon, ‘Applying EIA to legislative proposals: practical solutions to advance ESD in Commonwealth and State policy-making’ (1997) 14 *Environmental and Planning Law Journal* 159

Marsden, Simon and John Ashe, ‘Strategic Environmental Assessment in Australian States and Territories’ (2006) 13 (4) *Australasian Journal of Environmental Management* 205

Masden, Elizabeth A et al, ‘Renewable energy developments in an uncertain world: The case of offshore wind and birds in the UK’ (2015) 51 *Marine Policy* 169

Masden, Elizabeth A et al, ‘Cumulative impact assessments and bird/wind farm interactions: Developing a conceptual framework’ (2010) 31 *Environmental Impact Assessment Review* 1

McGrath, Dr Chris, ‘One stop shop for environmental approvals a messy backward step for Australia’ (2014) 31 *Environmental and Planning Law Journal* 164

McGrath, Chris, ‘Swirls in the stream of Australian environmental law: Debate on the EPBC Act’ (2006) 23 *Environmental and Planning Law Journal* 165

McGrath, Chris, ‘Avoiding the legal pitfalls in the EPBC Act by understanding its key concepts’ (2005) 3 *National Environmental Law Review* 32

McGrath, Chris, ‘Key Concepts of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth)’ (2005) 22 *Environmental and Planning Law Journal* 20

McGrath, Chris, ‘Editorial commentary: Minister Appeals the Nathan Dam Case’ (2004) 21 *Environmental and Planning Law Journal* 85

McIntyre, Owen and Thomas Mosedale, ‘The Precautionary Principle as a norm of customary international law’ (1997) 9 (2) *Journal of Environmental Law* 221

McLauchlan, Anna and Elsa João, ‘The inherent tensions arising from attempting to carry out strategic environmental assessments on all policies, plans and programmes’ (2012) 36 *Environmental Impact Assessment Review* 23

Micheli, Fiorenza, et al, ‘A risk-based framework for assessing the cumulative impact of multiple fisheries’ (2014) 176 *Biological Conservation* 224

Morris, Mary Lou, ‘In the evolution of environmental impact assessment – a time of change for Australia’ (1987) 4 *Environmental and Planning Law Journal* 295

Morrison-Saunders, Angus et al, ‘Towards Sustainability Assessment Follow-up’ (2014) 45 *Environmental Impact Assessment Review* 38

Myers, Norman, ‘Environmental Unknowns’ (1995) 269 *Science* 358

Naser, Humood A, ‘The role of environmental impact assessment in protecting coastal and marine environments in rapidly developing islands: The case of Bahrain, Arabian Gulf’ (2015) 104 *Ocean & Coastal Management* 159

Negri, Andrew P et al, ‘Herbicides increase the vulnerability of corals to rising sea surface temperature’ (2011) 56 (2) *Limnology and Oceanography* 471

New, Leslie F, et al, ‘The modelling and assessment of whale watching impacts’ (2015) 115 *Ocean & Coastal Management* 10

Nilsson, Måns, and Holger Dalkmann, ‘Decision making and strategic environmental assessment’ (2001) 3(3) *Journal of Environmental Assessment Policy and Management* 305

O’Boyle, Robert, and Glen Jamieson, ‘Observations on the implementation of ecosystem-based management: Experiences on Canada’s east and west coasts’ (2006) 79 *Fisheries Research* 1

O’Hara, Patrick D and Lora A Morandin, ‘Effects of sheens associated with offshore oil and gas development on microstructure of pelagic seabirds’ (2010) 60 *Marine Pollution Bulletin* 672

Ocean Affairs Board National Research Council, ‘Petroleum in the Marine Environment’ (1975) 56 (1) *Bulletin of the Ecological Society of America* 4

Ojaveer, Henn et al, ‘Classification of Non-Indigenous Species Based on their Impacts: Considerations for Application in Marine Management’ (2015), 5/13, *PloS Biol* 13(4): e1002130.doi:10.1371/journal.pbio.1002130.

Olds, Andrew et al, ‘Synergistic effects of reserves and connectivity on ecological resilience’ (2012) 49 *Journal of Applied Ecology* 1195

Olagunju, Ayodele Omoniyi and Jill A E Gunn, ‘Selection of valued ecosystem components in cumulative effects assessment: lessons from Canadian road construction projects’ (2015) 33 (3) *Impact Assessment and Project Appraisal* 207

Paine, Robert T, Mia J Tegner and Edward A Johnson, ‘Compounded Perturbations Yield Ecological Surprises’ (1998) *Ecosystems* 1 (6) 535

Paul L Stein, The Hon Justice, ‘Are Decision-makers too Cautious with the Precautionary Principle’ (2000) 17 *Environmental and Planning Law Journal* 3

Pauly, Daniel et al, ‘Fishing down marine food webs’ (1998) 279 *Science* 860.

Pauly, Daniel, ‘Anecdotes and the shifting baseline syndrome of fisheries’ (1995) 10 *Trends in Ecology & Evolution* 430, 430.

Pavlickova, Katarina and Monika Vsykupova, ‘A method proposal for cumulative environmental impact assessment based on landscape vulnerability evaluation’ (2015) 50 *Environmental Impact Assessment Review* 74

Peel, Jacqueline, ‘Ecologically Sustainable Development: More than Mere Lip Service?’ (2008) 12 (1) *The Australasian Journal of Natural Resources Law and Policy* 1

Perdicoúlis, Anastássios and Jake Piper, ‘Network and system diagrams revisited: Satisfying CEA requirements for causality analysis’ (2008) 28 *Environmental Impact Assessment Review* 455

Perkol-Finkel, Shimrit and Laura Airoldi, ‘Loss and Recovery Potential of Marine Habitats: An Experimental Study of Factors Maintaining Resilience in Subtidal Algal Forests at the Adriatic Sea’, (2010) 5 (5) *PLoS One* e107911 <http://doi:10.1371/journal.pone.001079>

Peterman, Randall M, ‘The importance of reporting statistical power: the forest decline and acidic deposition example’ (1990) 71 (5) *Ecology* 2074

Phylip-Jones, J and T B Fischer, ‘Strategic environmental assessment (SEA) for wind energy planning: Lessons from the United Kingdom and Germany’ (2015) 50 *Environmental Impact Assessment Review* 203

Pine, Matthew K, Andrew G Jeffs and Craig A Radford, ‘The cumulative effect on sound levels from multiple underwater anthropogenic sound sources in shallow coastal waters’ (2014) 51 *Journal of Applied Ecology* 23

Pitcher, Tony J and William W L Cheung, ‘Fisheries: Hope or despair?’ (2013) 74 *Marine Pollution Bulletin* 506

Porter, Madeline, Daniel M Franks and Jo-Anne Everingham, ‘Cultivating collaboration: Lessons from initiatives to understand and manage cumulative impacts in Australian resource regions’ (2013) 38 *Resources Policy* 657

Preston, A and P C Wood, ‘Monitoring the Marine Environment’ (1971) 177 *Proceedings of the Royal Society of London B: Biological Sciences* 451

Preston, The Hon Justice Brian J, ‘Biodiversity offsets: Adequacy and efficacy in theory and practice’ (2016) 33 *Environmental and Planning Law Journal* 93

Preston, Hon Justice Brian J, ‘Adapting to the impacts of climate change: The limits and opportunities of law in conserving biodiversity’ (2013) 30 *Environmental and Planning Law Journal* 375

Preston, Brian J, ‘The environmental impact statement threshold test: when is an activity likely to significantly affect the environment?’ (1990) 7 *Environmental and Planning Law Journal* 147

Preston, Eric M and Barbara L Bedford, ‘Evaluating Cumulative Effects on Wetland Functions. A Conceptual Overview and Generic Framework’ (1988) 12 (5) *Environmental Management* 565

Przeslawski, R, A R Davis and K Benkendorff, ‘Synergistic effects associated with climate change and the development of rocky shore molluscs’ (2005) 11 (3) *Global Change Biology*, 515

Raff, Murray, ‘Ten Principles of Environmental Impact Assessment’ (1997) 14 *Environmental and Planning Law Journal* 207

Randall, Allan, ‘Coal Seam Gas – Toward a risk management framework for a novel intervention’ (2012) 29 *Environmental and Planning Law Journal* 152

Randall, Bess and Ramana Rallapudi, ‘Spatial conflicts in New Zealand Fisheries: The rights of fishers and protection of the marine environment’ (2007) 31 *Marine Policy* 719

Regan, Helen M, Mark Colyvan, and Mark A Burgman, ‘A taxonomy and treatment of uncertainty for ecology and conservation biology’ (2002) 12(2) *Ecological Applications* 618

Rice, Jake et al, *Science dimensions of an Ecosystem Approach to Management of Biotic Ocean Resources (SEAMBOR)* (Marine Board – ESF Position Paper 14, 2010) 70

Rico-Martínez, Roberto, Terry W Snell and Tonya L Shearer, ‘Synergistic toxicity of Macondo crude oil and dispersant Corexit 9500A® to the Brachionus plicatilis species complex (Rotifera)’ (2013) 173 *Environmental Pollution* 5

Ripple, William J et al, ‘‘World Scientists’ Warning to Humanity: A second notice’ (2017) 67 (3) *BioScience* 197

Risser, Paul G, ‘General Concepts for Measuring Cumulative Impacts on Wetland Ecosystems’ (1988) 12 (5) *Environmental Management* 585

Roberts, David A, Emma L Johnston, Nathan A Knott, ‘Impacts of desalination plant discharges on the marine environment: A critical review of published studies’ (2010) 44 *Water Research* 5117

Robertson, Sarah, ‘Local Government and Sustainable Development: Its Recent Evolution in Australia and New Zealand’ (1996) 1 *Local Government Law Journal* 227

Robinson, Brian and Rosemary Martin, ‘Protection of the Environment: A new age of enlightenment’ (1996) 3 *Australian Environmental Law News* 32

Robinson, David, ‘Strategic planning for biodiversity in New South Wales’ (2009) 26 *Environmental and Planning Law Journal* 213

Rockström, Johan, et al, ‘A safe operating space for humanity’ (2009) 461 *Nature* 472

Rogers, Alex D and Dan Laffoley, ‘Editorial - Introduction to the special issue: The global state of the ocean; interactions between stresses, impacts and some potential solutions. Synthesis papers from the International Programme on the State of the Ocean 2011 and 2012 workshops’ (2013) 74 *Marine Pollution Bulletin* 491

Ross, Helen and R W (Bill) Carter, ‘Reflection on our system of environmental instruments’ (2012) 9 (2) *Australasian Journal of Environmental Management* 75

Rothwell, Donald R and Stuart B Kaye, ‘A legal framework for Integrated Oceans and Coastal Management’ (2001) 18 (3) *Environmental and Planning Law Journal* 278

Russell, Bayden D et al, ‘Synergistic effects of climate change and local stressors: CO_2 and nutrient –driven change in subtidal rocky habitats’ (2009) 15 (9) *Global Change Biology*, 2153

Sala, Enric and Nancy Knowlton, ‘Global Marine Biodiversity Trends’, (2006) 31 *Annual Review of Environment and Resources*) 93

Sala, Osvaldo E et al, ‘Global Biodiversity Scenarios for the Year 2100’ (2000) 287 *Science* 1770

Sale, Peter F, ‘Management of coral reefs: Where have we gone wrong and what can we do about it’ (2008) 56 *Marine Pollution Bulletin* 805

Salo, Tiina and Morten Foldager Pedersen, ‘Synergistic effects of altered salinity and temperature on estuarine eelgrass (*Zostera marina)* seedlings and clonal shoots’ (2014) 457 *Journal of Experimental Marine Biology and Ecology* 143

Sánchez, F et al, ‘Monitoring the *Prestige* oil spill impacts on some key species of the Northern Iberian Shelf’ (2006) 53 *Marine Pollution Bulletin* 332

Santillo, D et al, ‘The Precautionary Principle: Protecting Against Failures of Scientific Method and Risk Assessment’ (1998) 36(12) *Marine Pollution Bulletin* 939

Schaffelke, Britta, Jane Mellors and Norman C Duke, ‘Water quality in the Great Barrier Reef region: responses of mangroves, seagrass and macro algal communities’ (2005) 51 *Marine Pollution Bulletin* 279

Scheffer, Marten et al, ‘Anticipating Critical Transitions’ (2012) 338 *Science* 344

Scheffer, Marten et al, ‘Catastrophic shifts in ecosystems’ (2001) 413 *Nature* 591

Schifter, I et al, ‘Long-term effects of discharges of produced water the marine environment from petroleum-related activities at Sonda de Campeche, Gulf of Mexico’ (2015) 187 *Environmental Monitoring and Assessment* 723

Schippers, Peter, Miquel Lurling and Marten Scheffer, ‘Increase of atmospheric CO_2 promotes phytoplankton productivity’ (2004) 7 *Ecology Letters* 446

Seitz, Nicole E , Cherie J Westbrook and Bram F Noble, ‘Bringing Science into river systems cumulative effects assessment practice’ (2011) 31 *Environmental Impact Assessment Review* 172

Selig, Elizabeth R et al, ‘Global Priorities for Marine Biodiversity Conservation’ (2014) 9(1) *PloS One*: e82898, 9 <http://doi:10.1371/journal.pone.0082898>

Senner, Robert, ‘Appraising the sustainability of project alternatives: An increasing role for cumulative effects assessment’ (2011) 31 *Environmental Impact Assessment Review* 502

Shepherd, Anne, and Leonard Ortolano, ‘Strategic Environmental Assessment for Sustainable Urban Development’, (1996) 16 *Environmental Impact Assessment Review* 321

Simberloff, Daniel and Betsy Von Holle, ‘Positive Interactions of nonindigenous species: invasional meltdown?’ (1999) 1 *Biological Invasions* 21

Sinclair, A J et al, ‘Looking up, down and sideways: Reconceiving cumulative effects assessment as a mindset’ (2017) 62 *Environmental Impact Assessment Review* 183

Sivayoganathan, Shashi, ‘Forestry Tasmania v Brown: Biodiversity Protection – An Empty Promise?’ (2007) 3 *National Environmental Law Review* 21

Smart, Duncan Ewan, Timothy A. Stojanovic and Charles R. Warren, ‘Is EIA part of the wind power planning problem?’ (2014) 49 *Environmental Impact Assessment Review* 13

Snell, Tim and Richard Cowell, ‘Scoping in environmental impact assessment: Balancing precaution and efficiency?’ (2006) 26 *Environmental Impact Assessment Review* 359

Sommer, Nicole, ‘Editorial Note: Queensland Conservation Council Inc v Minister for the Environment and Heritage’ [2003] FCA 1463 (‘Nathan Dam Case’)’ (2004) 9(1) *The Australasian Journal of Natural Resources Law and Policy* 145

Spaling, Harry and Barry Smit, ‘Cumulative Environmental Change: Conceptual Frameworks, Evaluation Approaches, and Institutional Perspectives’ (1993) 17(5) *Environmental Management* 587

Spaling, Harry and Janelle Zwier, ‘Managing regional cumulative effects of oil sands development in Alberta, Canada’ (2000) 2 (4) *Journal of Environmental Assessment Policy and Management* 501

Stamoulis, Kostantinos A, and Jade M S Delevaux, ‘Data requirements and tools to operationalize marine spatial planning in the United States’ (2015) 116 *Ocean & Coastal Management* 214

Stelzenmüller, V et al, ‘Quantifying cumulative impacts of human pressures on the marine environment: a geospatial modelling framework’ (2010) 398 *Marine Ecology Progress Series* 19

Stewart, Gavin B, Andrew S Pullin, and Christopher F Coles, ‘Poor evidence-base assessment of windfarm impacts on birds’ (2007) 34 (1) *Environmental Conservation* 1 <http://doi.10.1017/S0376892907003554>;

Suchanek, Thomas H, ‘Oil Impacts on Marine Invertebrate Populations and Communities’ (1993) 33 (6) *American Zoologist* 510

Sullivan, Rory and Amanda R Hunt, ‘Commentary (cont): Risk assessment: the myth of scientific objectivity’ (1999) 16 *Environmental and Planning Law Journal* 522

Taylor, Mark Patrick and Christopher Ives, ‘Legislative and policy challenges for the protection of biodiversity and bushland habitats: An evidence-based approach’ (2009) 26 *Environmental and Planning Law Journal* 35

Therivel, Riki and Bill Ross, ‘Cumulative effects assessment: Does scale matter?’ (2007) 27 *Environmental Impact Assessment Review* 365

Tickner, Joel A, and Ken Geiser, ‘The precautionary principle stimulus for solutions – and alternatives – based environmental policy’ (2004) 24 *Environmental Impact Assessment Review* 801

Tornambè, Andrea et al, ‘Toxicity evaluation of diethylene glycol and its combined effects with produced waters of offshore gas platforms in the Adriatic Sea (Italy): Bioassays with marine/ estuarine species’ (2012) 77 *Marine Environmental Research* 141

Vanderzwaag, David, ‘The Precautionary Principle and Marine Environmental Protection: Slippery Shores, Rough Seas, and Rising Normative Tides’ (2010) 33(2) *Ocean Development and International Law* 165

Verlaan, Philomène A, ‘Experimental activities that intentionally perturb the marine environment: Implications for the marine environmental protection and marine scientific research provisions of the 1982 United Nations Convention on the Law of the Sea' (2007) 31 (2) *Marine Policy* 210

Vernon, J E N et al, 'The Coral Reef Crisis: The Critical Importance of < 350 ppm CO_2' (2009) 58 *Marine Pollution Bulletin* 1428

Vitousek, Peter M et al, 'Human Domination of Earth's Ecosystems' (1997) 277 *Science* 494

von Seht, Hauke, 'Requirements of a comprehensive strategic environmental assessment system' (1999) 45 *Landscape and Urban Planning* 1

Walmsley, Rachel and Anna Lashko, 'Are our marine biodiversity laws climate ready?' (2011) 2 *National Environmental Law Review* 37

Wawryk, Dr Alexandra S, 'Legislating for offshore wind energy in South Australia' (2011) 28 *Environmental and Planning Law Journal* 265

Wärnbäck, Antoinette and Tuija Hilding-Rydevik, 'Cumulative effects in Swedish EIA practice – difficulties and obstacles' (2009) 29 *Environmental Impact Assessment Review* 107

Weiland, Ulrike, 'Strategic Environmental Assessment in Germany – Practice and open questions' (2010) 30 *Environmental Impact Assessment Review* 211

Weilgart, L S, 'The impacts of anthropogenic ocean noise on cetaceans and implications for management' (2007) 85 (11) *Canadian Journal of Zoology* 1091

Wells, Katherine and Amanda Cornwall, 'Managing Australia's ocean resources: the next step' (2012) 2 *National Environmental Law Review* 37

Wernberg, Thomas et al, 'Impacts of climate change in a global hotspot for temperate marine biodiversity and ocean warming' (2011) 400 *Journal of Experimental Marine Biology and Ecology* 7

Wessels, Jan-Albert, Francois Retief and Angus Morrison-Saunders, 'Appraising the value of independent EIA Follow-Up Verifiers' (2015) 50 *Environmental Impact Assessment Review* 178

Wilhelmsson, Dan, Torleif Malm and Marcus C Öhman, 'The influence of offshore windpower on demersal fish' (2006) 63 *ICES Journal of Marine Science* 775

Wilkinson, Clive and Bernard Salvat, 'Coastal resource degradation in the tropics: Does the tragedy of the commons apply for coral reefs, mangrove forests and seagrass beds' (2012) 64 *Marine Pollution Bulletin* 1096

Willers, Bill, 'Sustainable Development: A New World Deception' (1994) 8 *Conservation Biology* 1146

Williams, Caroline, 'Combating Marine Pollution from land-based activities: Australian initiatives' (1996) 33 (1 – 3) *Ocean and Coastal Management* 87

Willsteed , Edward A et al, 'Obligations and aspirations: A critical evaluation of offshore wind farm cumulative impact assessments' (2018) 82 *Renewable and Sustainable Energy Reviews* 2332

Wing Goodale, M, and Anita Milman, 'Cumulative adverse effects of offshore wind energy development on wildlife' (2016) 59 (1) *Journal of Environmental Planning and Management* 1

Wooldridge, Scott A and Terence J Done. 'Improved water quality can ameliorate effects of climate change on corals' (2009) 19 (6) *Ecological Applications* 1492

Wooldridge, Scott A, 'Water quality and coral bleaching thresholds: Formalising the linkage for the inshore reefs of the Great Barrier Reef, Australia' (2009) 58 *Marine Pollution Bulletin* 745

Wooldridge, Scott Andrew et al, 'Safeguarding coastal coral communities on the central Great Barrier Reef (Australia) against climate change: realizable local and global actions' (2012) 112 *Climatic Change* 945

Worm, B et al, 'Impacts of Biodiversity Loss on Ocean Ecosystem Services' (2006) 314 *Science* 787

Wright, Andrew J and Line A Kyhn, 'Practical management of cumulative anthropogenic impacts with working marine examples' (2014) 29 (2) *Conservation Biology* 333

Wright, Glen et al, 'Establishing a legal research agenda for ocean energy' (2016) 63 *Marine Policy* 126

Wulf, Peter, 'Diffuse land base pollution and the Great Barrier Reef World Heritage Area: The Commonwealth's responsibilities and implications for the Queensland sugar industry' (2004) 21 *Environmental and Planning Law Journal* 424

Wulf, Peter, 'Offshore Petroleum and the *Environment Protection and Biodiversity Conservation Act 1999* (Cth): Consideration of all adverse impacts' (2005) 22 *Environmental and Planning Law Journal* 296

Wyman, Lisa, 'Acceptance of the Precautionary Principle – Australian v International Decision-makers' 18 (4) *Environmental and Planning Law Journal* 395

Xiongzhi Xue, Huasheng Hong and Anthony T Charles, 'Cumulative environmental impacts and integrated coastal management: the case of Xiamen, China' (2004) 71 *Journal of Environmental Management* 271

Zhang, Keijiang, Yuansheng Pei and Changjing Lin, 'An investigation of correlations between different environmental assessments and risk assessment' (2010) 2 *Procedia Environmental Sciences* 643

Zhao Ma, Dennis R Becker and Michael A Kilgore, 'Assessing cumulative impacts within state environmental review frameworks in the United States' (2009) 29 *Environmental Impact Assessment Review* 390

Reports

Australian Government Department of the Environment, *Matters of National Environmental Significance: Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth of Australia, 2013)

Australian Government Great Barrier Reef Marine Park Authority, *Great Barrier Reef Region Strategic Assessment Terms of Reference* (Great Barrier Reef Marine Park Authority, 2012)

Australian Government National Oceans Office, *South-East Regional Marine Plan: Implementing Australia's Oceans Policy in the South-East Marine Region* (National Oceans Office, 2004)

Australian Government Productivity Commission, *Review on Regulatory Burden on Upstream Petroleum (Oil and Gas) Sector: Productivity Commission Research Report* (Commonwealth of Australia, 2009)

Australian Government, *Australian Government Response to the Senate Standing Committee on Environment, Communications and the Arts Committee Report: Operations of the Environment Protection and Biodiversity Conservation Act 1999 (First, Second and Final Reports)* (Commonwealth of Australia, September 2011)

Australian State of the Environment Committee 2001, *Australian State of the Environment Report 2001: Independent Report to the Commonwealth Minister for the Environment and Heritage,* (CSIRO Publishing on behalf of the Department of the Environment and Heritage, 2001)

Australian State of the Environment Committee 2001, *Coasts and Oceans, Australian State of the Environment Report 2001 (Theme Report),* (CSIRO Publishing on behalf of the Department of the Environment and Heritage, 2001)

Australian Panel of Experts on Environmental Law, *Blueprint for the Next Generation of Australian Environmental Law* (2017)

Australian Panel of Experts on Environmental Law, *The Foundations of Environmental Law: Goals, Objects, Principles and Norms* (Technical Paper 1, 2017)

Australian Panel of Experts on Environmental Law, *Marine and Coastal Issues* (Technical Paper 4, 2017)

Barton, Jan, Adam Pope and Steffan Howe, *Marine Natural Values Study Vol 2: Marine Protected Areas of the Otway Bioregion. Parks Victorian Technical Series Number 75* (Parks Victoria, 2012)

Beanlands, G E et al (eds), The Canadian Environmental Assessment Research Council (CEARC) and the United States National Research Council (NRC), *Cumulative Environmental Effects: A Binational Perspective,* (CEARC, NRC, 1986)

Beanlands, Gordon E and Peter N Duinker, *An Ecological Framework for Environmental Impact Assessment in Canada* (Institute for Resource and Environmental Studies Dalhousie University and Federal Environmental Assessment Review Office, 1983)

Beeton RJS (Bob) et al, Australian State of the Environment Committee), *Australian State of the Environment Report 2006: Independent Report to the Commonwealth Minister for the Environment and Heritage* (Department of the Environment and Heritage, 2006)

Bio/consult as, *Horns Rev Offshore Wind Farm, Environmental Impact Assessment of Sea Bottom and Marine Biology* (I/S Elsam, 2000)

Canadian Environmental Assessment Agency, *Cumulative Effects Assessment Practitioners' Guide* (2014) <http//:www.ceaa-acee.gc.ca/default.asp?lang=En&n=43952694-1&offset=6&toc=hide>

Clark, G F, and E L Johnston, *Australia state of the environment 2016: coasts*, independent report to the Australian Government Minister for the Environment and Energy (Australian Government Department of the Environment and Energy, 2017)

Commonwealth Government, *Reef 2050 Long-Term Sustainability Plan* (Commonwealth of Australia, 2015)

Commonwealth of Australia, *Independent Review of the Environment Protection and Biodiversity Conservation Act 1999: Interim Report* (Commonwealth of Australia, 2009)

Commonwealth of Australia, *Australia's Oceans Policy: caring, understanding, using wisely (Volume 1),* (Environment Australia, 1998)

Commonwealth of Australia, *Australia's Oceans Policy: Specific Sectoral Measures - Caring, understanding, using wisely (Volume 2),* (Environment Australia, 1998)

Cooper, L M, *Guidelines for Cumulative Effects Assessment in SEA of Plans,* (EMPG Occasional Paper 04/LMC/CEA, Imperial College London, 2004)

Council on Environmental Quality, *Guidance on the Consideration of Past Actions in Cumulative Effects Analysis* (2005) <http//:www.ceq.hss.doe.gov/nepa/regs/Guidance_on_CE.pdf>

Council on Environmental Quality, *Considering Cumulative Effects Under the National Environmental Policy Act* (1997) <http//:www.ceq.hss.doe.gov/publications/cumulative_effects.html>

Creswell, I D, and H T Murphy, *Australia state of the environment 2016: biodiversity*, independent report to the Australian Government Minister for the Environment and Energy (Australian Government Department of the Environment and Energy, 2017)

CSIRO Australia, Port Phillip Bay Environmental Study Final Report June 1996 in CSIRO Australia, *Port Phillip Bay Environmental Study Technical Reports* (CSIRO Publishing, 1999)

Danish Center for Environment and Energy (DCE) Aarhus University, DHI Group, and NIRAS, *Kriegers Flak Offshore Wind Farm Marine Mammals EIA – Technical Report June 2015* (DHI Group, Aarhus University and NIRAS, June 2015)

Danish Center for Environment and Energy (DCE) Aarhus University, DHI Group, and NIRAS, *Kriegers Flak Offshore Wind Farm Birds and Bats EIA – Technical Report* (DHI Group, Aarhus University and NIRAS, June 2015)

Danish Energy Agency, *Danish Offshore Wind. Key Environmental Issues – a Follow-up* (The Environmental Group: The Danish Energy Agency, The Danish Nature Agency, Dong Energy and Vattenfall, 2013)

Danish Energy Agency, *Danish Experiences from Offshore Wind Development,* (Danish Energy Agency, 2017)

Danish Energy Agency, *Guidance Document on Environmental Impact Assessment: Danish Offshore Wind Farms* (Danish Energy Agency, NIRAS, February 2013)

Danish Energy Authority, *Offshore wind farms and the environment – Danish Experience from Horns Rev and Nysted* (Danish Energy Authority, 2006)

Danish Institute for Fisheries Research, Department of Marine Fisheries, *Sandeels in the wind farm area at Horns Reef, report to Elsam August 2004, Final Report,* (Department of Marine Fisheries, 2004)

Danish Institute for Fisheries Research, Department of Marine Fisheries, *Sandeels and clams (Spisula sp.) in the wind turbine park at Horns Reef, report to Techwise April 2003, Preliminary Report* (Department of Marine Fisheries, 2003)

Danish Institute for Fisheries Research, Department of Marine Fisheries, *Effects of marine windfarms on the distribution of fish, shellfish and marine mammals in the Horns Rev area, Report to Elsamprojekt* A/S (Department of Marine Fisheries, 2000)

Department of Sustainability, Environment, Water, Population and Communities, *Australian Government Response to the Report of the Independent Review of the Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth of Australia, 2011)

Desholm, Mark, *Preliminary investigations of bird-turbine collisions at Nysted offshore wind farm and final quality control of Thermal Animal Detection Systems (TADS), Autumn 2003 and Spring 2004* (National Environmental Research Institute/ Ministry of the Environment (Denmark), 2005)

Desholm, Mark, *TADS investigations of avian collision risk at Nysted offshore wind farm, autumn 2004* (National Environmental Research Institute/ Ministry of the Environment - Denmark, 2005)

Desholm, Mark, *TADS investigations of avian collision risk at Nysted offshore wind farm, autumn 2004* (National Environmental Research Institute/ Ministry of the Environment - Denmark, 2005).

Desholm, Mark et al, *Base-line investigations of birds in relation to an offshore wind farm at Rødsand: results and conclusions, 2002* (National Environmental Research Institute & Ministry of Environment and Energy (Denmark), 2003)

Desholm, Mark, *Thermal Animal Detection System (TADS). Development of a method for estimating collision frequency of migrating birds at offshore wind turbines. NERI Technical Report No 440* (National Environmental Research Institute, 2003)

Desholm, Mark et al, *Base-line investigations of birds in relation to an offshore wind farm at Rødsand: results and conclusions, 2000* (National Environmental Research Institute, Ministry of Environment and Energy (Denmark), 2001)

Desholm, Mark, *First phase of the project 'Development of a method for estimating collision frequency of migrating birds and offshore wind turbines' – the choice of equipment* (National Environmental Research Institute, 2001)

DHI Group, *Appendix ABCD: Details of numerical modelling of currents and stratification conditions* (DHI Group, August 2009)

DONG Energy and Vattenfall A/S, *Review Report 2005, The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farms – Environmental impact assessment and monitoring* (The Environmental Group of the Danish Offshore Wind Farm Demonstration Projects, 2006)

Eco Logical Australia Pty Ltd and Open Lines Consulting Pty Ltd, *Abbot Point Cumulative Impact Assessment* (2013) <http//:www.nqbp.com.au>.

Ecologically Sustainable Development Steering Committee, *National Strategy for Ecological Sustainable Development*, (Australian Government Publishing Service, 1992) Part 1 <http://www.environment.gov.au/about/esd/publications/national-esd-strateg-part1>

Elsam Engineering A/S, *Elsam Offshore Wind Turbines – Horns Rev: Annual status report for the environmental monitoring programme, 1 January 2004 – 31 December 2004, Report July 2005* <http://www.ens.dk/en/node/2018>

Elsam Engineering and ENERGI E2, *Review Report 2004, The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farms – Environmental impact assessment and monitoring, prepared for The Environmental Group of the Danish Offshore Wind Farm Demonstration Projects* (Elsam Engineering and ENERGI E2, 2004)

Elsam Engineering and ENERGI E2, *Review Report 2003, The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farms – Environmental impact assessment and monitoring* (The Environmental Group, September 2004)

EMD International A/S, *Noise calculations for Anholt Offshore Wind Farm*, (3 July 2009) <http://www.ens.dk/sites/ens.dk/files/undergrund-fosyning/vedvarende-energi/vindkraft-vindmodeller/havvindmoeller/miljoepaavirkninger-2/Noise%20Calculations%20for%20Anholt%20Offshore%20Wind%20Farm.pdf>

Energi E2 A/S, *Review Report 2004. The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farm Environmental Impact Assessment and Monitoring. Report prepared for the environmental Committee of the Danish Offshore Wind Farm Demonstration Projects* (Energi E2 A/S, 2005)

ENERGI E2 and Tech-Wise, *Review Report, The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farms – Environmental impact assessment and monitoring, prepared for The Environmental Group*, (The Environmental Group, 2003)

Energi E2, *Annual Status Report Nysted Offshore Wind Farm, Environmental Monitoring Program 2004, January 1st 2004 – December 31st 2004* (Energi E2, 2005)

Energi E2, *Annual Status Report Nysted Offshore Wind Farm, Environmental Monitoring Program 2003, January 1st 2003 – December 31st 2003* (Energi E2, 2004)

Energie2, *Annual Status Report Nysted Offshore Wind Farm, Environmental Monitoring Program 2002* (Energie E2, 2002)

Energinet.dk and DHI Group, *Anholt Offshore Wind Farm: Birds* (DHI Group, Ver 7, December 2009)

Energinet.dk and Fleming Møhlenberg (DHI Group), *Anholt Offshore Wind Farm: Benthic Habitats. Baseline Description and Impact Assessment* (DHI Group, Ver 3, September 2009)

Energinet.dk and Jorgen Birklun (DHI Group), *Anholt Offshore Wind Farm: Benthic Fauna – Baseline Surveys and Impact Assessment* (DHI Group, Ver 5, October 2009)

Energinet.dk and NIRAS Consulting Ltd, *Kriegers Flak Wind Farm Report to Inform an Appropriate Assessment: Natura 2000 sites designated for migratory Common Crane in the west-central Baltic* (Energinet.dk, NIRAS Consulting Ltd, September 2015)

Energinet.dk and NIRAS, *Kriegers Flak Offshore Wind Farm Underwater Noise Modelling EIA – Technical Report* (NIRAS, *January 2015*)

Energinet.dk and Ramboll Oil and Gas, *Anholt Offshore Wind Farm: Background memo Air Emissions* (Ramboll Oil and Gas, November 2009)

Energinet.dk and Ramboll Oil and Gas, *Anholt Offshore Wind Farm: Background Memo - Mapping of Substrates and Benthic Community Types* (Ramboll Oil and Gas, September 2009)

Energinet.dk and Ramboll Oil and Gas, *Anholt Offshore Wind Farm: Method for impact assessment* (Ramboll Oil and Gas, Ver 2, June 2009)

Energinet.dk and Ramboll Wind, *Anholt Offshore Wind Farm Project Description* (Ramboll Wind, January 2010)

Energinet.dk, *Kriegers Flak Offshore Wind Farm Technical Project Description for the large-scale offshore wind farm (600 MW) at Kriegers Flak* (Energinet.dk October 2015)

Energinet.dk, Ramboll Oil and Gas & DHI Group, *Anholt Offshore Wind Farm: Marine Mammals* (Ramboll Oil and Gas & DHI Group, Ver 7, December 2009)

Environment and Natural Resources Committee, Parliament of Victoria, *Inquiry into the Environmental Effects Statement Process in Victoria* (2011)

Environmental Protection Authority Western Australia, *Review of the Environmental Impact Assessment Process in Western Australia*, (EPA, 2009) <https//:www.epa.wa.gov.au/abouttheepa/eiareview/Pages/default.aspx>

European Commission, *Guidelines for the Assessment of Indirect And Cumulative Impacts And Impact Interactions* (Office for Official Publications of the European Communities, 1999)

European Ocean Energy Association, *Industry Vision Paper 2013* (European Ocean Energy, 2013), 5 <http://www.oceanenergy-europe.eu/images/Publications/European_Ocean_Energy_Industry_Vision_Paper_2013.pdf>

European Wind Energy Association, *The European offshore wind industry – key trends and statistics 1st half 2015* (European Wind Energy Association, July 2015)

Evans K, N Bax and D C Smith, *Australia state of the environment 2016: marine environment*, independent report to the Australian Government Minister for the Environment and Energy (Australian Government Department of the Environment and Energy, 2017)

Fisheries and Maritime Museum, Ornis Consult A/S, Zoological Museum (University of Copenhagen), *Environmental Impact Assessment*, *Investigation of marine mammals in relation to the establishment of a marine wind farm on Horns Reef*, (Fisheries and Maritime Museum, Ornis Consult A/S, Zoological Museum (University of Copenhagen, 2000)

Fisheries Victoria, DPI, *Guidelines for Environmental Baseline Surveys and Ongoing*

Monitoring of Aquaculture Fisheries Reserves in Port Phillip and Western Port: Fisheries Victoria DPI Management Report Series No. 35 (Department of Primary Industries, 2006) <http//:www.depi.vic.gov.au/fishing-and-hunting/aquaculture/aquaculture-management/guideines-and-ongoing-management-of-aquaculture-fisheries-reserves>

GEO (Danish Geotechnical Institute), *Anholt/Djursland Offshore Wind Farm Geotechnical Investigations Wind Farm Area: Geotechnical Report – Consolidation tests, GEO project no 32490 Report 2* (GEO, October 2009)

GEO (Danish Geotechnical Institute), *Anholt/Djursland Offshore Wind Farm Geotechnical Investigations Cable Corridors: Geotechnical Report – CPT tests and vibrocores, GEO project no 32490 Report 2* (GEO, August 2009)

GEO (Danish Geotechnical Institute), *Anholt/Djursland Offshore Wind Farm Geotechnical Investigations Wind Farm Area: Geotechnical Report – Boreholes, GEO project no 42490 Report 1* (GEO, Rev 1, October 2009)

GESAMP (Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection), *Assessment and Communication of Environmental Risks in Coastal Aquaculture: Reports and Studies No 76* (FAO, 2008)

Government of Canada, Canadian Environmental Assessment Agency *Cumulative Effects Assessment Practitioners' Guide,* 2.2.2 <https://www.ceaa-acee.gc.ca/default.asp?landg=EN&n=43952694-1&offset=6&toc=hide>

Government of South Australia, *Lower South East Marine Park: Management Plan Summary* (Department of Environment, Water and Natural Resources, 22nd November 2012) <http://marine-park-management-summary-19-lower-south-east-plan.pdf>

Government of South Australia, *Transforming our Planning System: Response of the South Australian Government to the final report and recommendations of the Expert Panel on Planning Reform* (Government of South Australia, 2015)

Government of Western Australia Department of Fisheries, *Guidance statement on undertaking seismic surveys in Western Australian waters* (Department of Fisheries, 2013)

Great Barrier Reef Marine Park Authority, *Great Barrier Reef Outlook Report 2014,* (Great Barrier Reef Marine Park Authority, 2014)

Great Barrier Reef Marine Park Authority, *Great Barrier Reef Region Strategic Assessment: Strategic assessment report* (Great Barrier Reef Marine Park Authority, 2014)

Great Barrier Reef Marine Park Authority, *Great Barrier Reef Region Strategic Assessment: Program report* (Great Barrier Reef Marine Park Authority, 2014)

Hawke, Allan, *The Australian Environment Act - Report of the Independent Review of the Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth of Australia, 2009)

Hawke, Dr Allan, Ms Kathryn Mitchell and Dr Mike Lisle-Williams, *Environment Effects Act 1978 Port Phillip Bay Channel Deepening Supplementary Environmental Effects Statement Report of the Inquiry* (1st October 2007) (2007a)

Hawke, Dr Allan, Ms Kathryn Mitchell and Dr Mike Lisle-Williams, *Environment Effects Act 1978 Port Phillip Bay Channel Deepening Supplementary Environmental Effects Statement Appendix to the Report of the Inquiry Environmental Assessment Report* (1st October 2007) (2007b)

Hegmann, G C et al, *Cumulative Effects Assessment Practitioners Guide* (AXYS Environmental Consulting Ltd, CEA Working Group for the Canadian Environmental Assessment Agency, 1999)

House of Representatives Standing Committee on Environment, Recreation, and the Arts, Parliament of the Commonwealth of Australia, *The Injured Coastline: Protection of the Coastal Environment* (1991)

Hubbard, Pamela, *Cumulative effects assessment and regional planning in Southern Ontario: A manuscript prepared for the Canadian Environmental Assessment Research Council* (Canadian Environmental Assessment Research Council, 1990)

Hvidt, Christian B et al, *Hydroacoustic Monitoring of Fish Communities at Offshore Wind Farms, Horns Rev Offshore Wind Farm, Annual Report 2005*, (Vattenfall, 2006)

Hvidt, Christian B, Lars Brünner and Frank Reier Knudsen, *Hydroacoustic Monitoring of Fish Communities in Offshore Wind Farms, Annual Report 2004, Horns Rev Offshore Wind Farm* (Elsam Engineering, 2005)

Hyder, *Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions* (European Communities, 1999)

International Advisory Panel of Experts on Marine Ecology, *General Outlook* (October 2013)

International Risk Consultants Pty Ltd prepared for the Department of the Environment Water, Heritage and the Arts, *Petroleum and minerals industries in the North-west Marine Region: A Report to the Department of the Environment, Water, Heritage and the Arts* (2007) <http://www.environment.gov.au/resource/petroleum-and-minerals-industries-north-west-marine-region>

Jackson, W J et al, *Australia state of the environment 2016: overview*, independent report to the Australian Government Minister for the Environment and Energy (Australian Government Department of the Environment and Energy, 2017)

John D Court, Colin J Wright, Alasdair C Guthrie, *Assessment of cumulative impacts and strategic assessment in environmental impact assessment: prepared for the Commonwealth Environment Protection Agency* (Commonwealth of Australia, 1994)

K R N Anthony et al, *A framework for understanding cumulative impacts, supporting environmental decisions and informing resilience-based management of the Great Barrier Reef World Heritage Area: Final Report to the Great Barrier Reef Marine Park Authority and Department of the Environment* (Great Barrier Reef Marine Park Authority, 2013), 15, 21 <http://www.environment.gov.au/resource/framework-understanding-cumulative-impacts-supporting-environmental-decisions-and-informing>

Kahlert, Johnny et al, *Investigations of birds during construction and operation at Nysted offshore wind farm at Rødsand, Annual status report 2003* (National Environmental Research Institute, Ministry of the Environment, 2004)

Kahlert, Johnny et al, *Base-line investigations of birds in relation to an offshore wind farm at Rødsand: results and conclusions, 2001* (National Environmental Research Institute & Ministry of Environment and Energy (Denmark), 2002)

Kahlert, Johnny, Mark Desholm and Ib Clausager, Department of Wildlife Ecology and Biodiversity, NERI Note 2004 (commissioned by Energi E2), Investigations of migratory birds during operation of Nysted offshore wind farm at Rødsand: Preliminary analysis of data from spring 2004 (Energi E2, 2004)

Langston, R H W and J D Pullan, *Windfarms and Birds: An analysis of the effects of windfarms on birds, and guidance on environmental assessment criteria and site selection issues. Report T-PVS/Inf (2003) 12, by Birdlife International to the Council of Europe, Bern Convention on the Conservation of European Wildlife and Natural Habitats. RSPB/Birdlife in the UK* (Secretariat Memorandum prepared by the Directorate of Culture and of Cultural and Natural Heritage, 2003)

Leonhard, Simon B and Henrik Skov (eds), *Food Resources for Common Scoter: Horns Reef Monitoring 2009 – 2010. Orbicon, DHI, Wageningen IMARES. Report commissioned by the Environmental Group through contract with DONG Energy* (The Danish Energy Authority, 2012)

Leonhard, Simon B and John Pedersen, *Benthic Communities at Horns Reef, before, during and after construction of Horns Rev Offshore Wind Farm. Final report Annual Report 2005* (Vattenfall, 2006)

Leonhard, Simon B and John Pedersen, *Benthic Communities at Horns Reef, before, during and after construction of Horns Rev Offshore Wind Farm. Final report Annual Report 2005* (Vattenfall, 2006)

Leonhard, Simon B, Claus Stenberg and Jossiane Støttrup (eds), *Effect of the Horns Rev 1 Offshore Wind Farm on Fish Communities. Follow-up Seven Years after Construction* (Danish Energy Authority, 2011)

Leonhard, Simon B, Claus Stenberg and Jossiane Støttrup (eds), *Effect of the Horns Rev 1 Offshore Wind Farm on Fish Communities. Follow-up Seven Years after Construction* (Danish Energy Authority, 2011)

Marine Biodiversity Decline Working Group, *A National Approach to Addressing Marine Biodiversity Decline – Report to the Natural Resource Management Ministerial Council Marine* (Marine and Coastal Committee of the Natural Resource Management Ministerial Council, 2008)

Millenium Ecosystem Assessment, *Ecosystems and Human Well-Being: Biodiversity Synthesis* (World Resources Institute, 2005)

Ministry of the Environment, Denmark, *Monitoring effects of offshore windfarms on harbour porpoises using PODS (porpoise detectors): Technical Report* (Ministry of the Environment, Denmark 2002)

Mitchell, Graham, et al, *Advice on the Channel Deepening Project Supplementary Environmental Effects Statement, Independent Expert Group, May 2007, to the Secretary Department of Sustainability and Environment*, (Department of Sustainability and Environment, May 2007)

<http://www.dtpli.vic.gov.au/_assets/pdf_file/0017/233090/FINAL_IEG_Advice_on_CDP_SEES_1_May_2007.pdf>

Morrison-Saunders, A, R Marshall and J Arts (2007) *EIA Follow-Up International Best Practice Principles,* Special Publication Series No. 6, (International Association for Impact Assessment, 2007)

Nabe-Nielsen, Jacob, Jakob Tougard, Jonas Teilmann, and Signe Sveegaard, *Effects of wind farms on harbour porpoise behaviour and population dynamics. Report commissioned by The Environmental Group under the Danish Environmental Monitoring Programme. Scientific Report from Danish Centre for Environment and Energy No. 1* (Danish Centre for Environment and Energy, Aarhus University, 2011)

Nabe-Nielsen, Sveegaard et al, *Effects of wind farms on Harbour porpoise behaviour and population dynamics. Report commissioned by The Environmental Group under the Danish Environmental Monitoring Programme. Scientific Report from Danish Centre for Environment and Energy No. 1* (Danish Centre for Environment and Energy, Aarhus University, 2011)

National Biodiversity Strategy Review Task Group, *Australia's Biodiversity Conservation Strategy 2010 – 2020, Consultation Draft* (Australian Government (Department of the Environment Water Heritage and the Arts, 2009) <http://www.environment.gov.au/system/files/pages/50e1085f-1ef9-4b25-8275-08808133c346/files/biodiversity-conservation-strategy2010-2020.pdf>

National Research Council, *Understanding Marine Biodiversity A Research Agenda for the Nation* (National Academy Press, 1995)

Natural and Cultural Heritage, Department for Environment and Heritage, *Marine Planning Network for South Australia,* (Government of South Australia, 2006)

Natural Resource Management Ministerial Council 2010, *Australia's Biodiversity Conservation Strategy 2010 – 2030* (Australian Government (Department of Sustainability, Environment, Water, Population and Communities, 2010) <http://www.environment.gov.au/system/files/pages/58321950-f8b6-4ef3-bb68-6f892420d601/files/biodiversity-conservation-strategy-2010.pdf>

New South Wales Government (Fisheries, Compliance and Regional Regulations Division), *Guidelines for Environmental Assessment of Fishing Related Activities,* (Industry and Investment NSW, 2009)

Niemann, Sanne et al, Energinet.dk and DHI Group, *Anholt Offshore Wind Farm: Hydrography, sediment spill, water quality, geomorphology and coastal morphology*, (DHI Group, Ver 6, October 2009)

NIRAS A/S and COWI A/S, *Kriegers Flak Offshore Wind Farm Environmental Statement Part 1: Non-Technical Summary* (The Danish Energy Agency and the Danish Nature Agency, 2015)

NIRAS Consulting Ltd, Marilim, Energinet.dk, *Kriegers Flak Offshore Wind Farm Benthic Flora, Fauna and Habitats EIA – Technical Report* (NIRAS Consulting Ltd, Marilim, Energinet.dk, June 2015)

NSW Government Marine Parks Authority, *NSW Marine Parks Strategic Research Framework 2010 – 2015* (Marine Parks Authority) <http//:www.mpa.nsw.gov.au/pdf/Marine-Parks-Strategic-Framework-2010-2015>

Oceans Policy Science Advisory Group/Marine Science Steering Committee, *A Marine Nation: National Framework for Marine Research and Innovation* (Australian Government, 2009) <https://www.imos.org.au/fileadmin/user_upload/shared/IMOS%General/documents/external_reports/opsag-marine-nation-01.pdf>

Office of the Deputy Prime Minister, *A Practical Guide to the Strategic Environmental Assessment Directive: Practical Guidance on applying European Directive 2001/42/EC "on the assessment of the effects of certain plans and programmes on the environment"* (Scottish Executive, Welsh Assembly Government, Department of the Environment, Northern Ireland, 2005)

Office of the Environmental Monitor, *Channel Deepening Project Closeout of Environmental Approvals – June 2012* (Victorian Government Office of the Environmental Monitor, 2012)

Office of the Environmental Monitor, *Annual Review No. 1 – March 2009, Reporting period: 8 February 2008 to 31 March 2009* (Victorian Government Office of the Environmental Monitor, 2009)

Office of the Environmental Monitor, *Annual Review No. 2 – January 2010, Reporting period: 8 February 2008 to 28 January 2010* (Victorian Government Office of the Environmental Monitor, 2010)

Office of the Environmental Monitor, *Annual Review No. 3 – January 2011, Reporting period: 8 February 2008 to 31 December 2010* (Victorian Government Office of the Environmental Monitor, 2011)

Office of the Environmental Monitor, *Annual Review No. 4 – January 2012, Reporting period: 1 January to 31 December 2011* (Victorian Government Office of the Environmental Monitor, 2012)

Office of the Environmental Monitor, *Quarterly Review No. 1 – June 2008, Reporting Period: 8 February to 31 May 2008* (Victorian Government Office of the Environmental Monitor, 2008)

Office of the Environmental Monitor, *Quarterly Review No. 2 – September 2008, Reporting Period: 1 June 2008 to 31 August 2008* (Victorian Government Office of the Environmental Monitor, 2008)

Office of the Environmental Monitor, *Quarterly Review No. 3 – December 2008, Reporting Period: 1 September to 30 November 2008* (Victorian Government Office of the Environmental Monitor, 2008)

Office of the Environmental Monitor, *Quarterly Review No. 4 – March 2009, Reporting Period: 1 December 2008 to 28 February 2009* (Victorian Government Office of the Environmental Monitor, 2009)

Office of the Environmental Monitor, *Quarterly Review No. 5 – June 2009, Reporting Period: 1 March 2009 to 31May 2009* (Victorian Government Office of the Environmental Monitor, 2009);

Office of the Environmental Monitor, *Quarterly Review No. 6 – September 2009, Reporting Period: 1 June to 31 August 2009* (Victorian Government Office of the Environmental Monitor, 2009)

Office of the Environmental Monitor, *Quarterly Review No. 7 – December 2009, Reporting Period: 1 September to 30 November 2009* (Victorian Government Office of the Environmental Monitor, 2009)

Office of the Environmental Monitor, *Quarterly Review No. 8 – March 2010, Reporting Period: 1 December 2009 to 28 February 2010* (Victorian Government Office of the Environmental Monitor, 2010)

Office of the Environmental Monitor, *Quarterly Review No. 9 – June 2010, Reporting Period: 1 March 2010 to 31 May 2010* (Victorian Government Office of the Environmental Monitor, 2010)

Office of the Environmental Monitor, *Quarterly Review No. 10 – September 2010, Reporting Period: 1 June 2010 to 31 August 2010* (Victorian Government Office of the Environmental Monitor, 2010)

Office of the Environmental Monitor, *Quarterly Review No. 11 – December 2010, Reporting Period: 1 September 2010 to 30 November 2010* (Victorian Government Office of the Environmental Monitor, 2010)

Office of the Environmental Monitor, *Quarterly Review No. 12 – March 2011, Reporting Period: 1 December 2010 to 28 February 2011* (Victorian Government Office of the Environmental Monitor, 2011)

Office of the Environmental Monitor, *Quarterly Review No. 13 – June 2011, Reporting Period: 1 March 2011 to 31 May 2011* (Victorian Government Office of the Environmental Monitor, 2011)

Office of the Environmental Monitor, *Quarterly Review No. 14 – September 2011, Reporting Period: 1 June 2011 to 31 August 2011* (Victorian Government Office of the Environmental Monitor, 2011)

Office of the Environmental Monitor, *Quarterly Review No. 15 – December 2011, Reporting Period: 1 September 2011 to 30 November 2011* (Victorian Government Office of the Environmental Monitor, 2011)

Office of the Environmental Monitor, *Report on the implementation of the Environmental Management Plan for the Entrance – February 2009* (Office of the Environmental Monitor, 16 February 2009)

Office of the Environmental Monitor, *Post Construction Requirements – Report on the Implementation of the Environmental Management Plan for the Entrance – September 2009* (Office of the Environmental Monitor, 18 September 2009)

Office of the Environmental Monitor, *Report on the implementation of the Environmental Management Plan for the Management of Contaminated Sediment – September 2009* (Office of the Environmental Monitor, 18 September 2009)

Office of the Environmental Monitor, *Report and Advice on Environmental Incident – a partial non-conformance with the Project Delivery Standard No.24 in South Channel on 19 April 2009* (Office of the Environmental Monitor, 21 June 2009)

Office of the Environmental Monitor, *Report and Advice on Environmental Incident – a partial non-conformance with Project Delivery Standard No.34 in North of the Bay 3 August 2009* (Office of the Environmental Monitor, 26 August 2009)

Office of the Environmental Monitor, *Report and Advice on Environmental Incident at the Entrance on 20 July 2008* (Office of the Environmental Monitor, 20 August 2008)

Office of the Environmental Monitor, *Report and Advice on Environmental Incident – Oil Spill at the Entrance on 30 August 2008* (Office of the Environmental Monitor, 11 September 2008)

Office of the Environmental Monitor, *Report on dredging management in the south of Port Phillip Bay to protect seagrass – December 2009* (Office of the Environmental Monitor, 21 December 2009)

OPSAG/Marine Science Steering Committee, *A Marine Nation: National Framework for Marine Research and Innovation* (March 2009)

Petersen, Ib Krag, 2007, *Modelling total numbers and distribution of Common Scoter Melanitta nigra at Horns Rev 2007* (National Environmental Research Institute, University of Aarhus, 2007)

Petersen, Ib Krag et al, *Final results of bird studies at the offshore wind farms at Nysted and Horns Rev, Denmark* (National Environmental Research Institute and Ministry of the Environment, 2006)

Petersen, Ib Krag, and Anthony D Fox, *Changes in bird habitat utilisation around the Horns Rev 1 offshore wind farm, with particular emphasis on Common Scoter: Report request. Commissioned by Vattenfall A/S*, (National Environmental Research Institute, 2007)

Peterson, E B et al (Canadian Environmental Assessment Research Council), *Cumulative Effects Assessment in Canada: An Agenda for Action and Research*, (Ministry of Supply and Services Canada, 1987)

Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan SEMSO5-08 Rev 12* (Port of Melbourne Corporation, 17/5/2011)

Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan SEMSO5-08 Rev 11* (Port of Melbourne Corporation, 29/3/2010)

Port of Melbourne Corporation, *EMP Close-out Report –February 2010 Channel Deepening Project – Construction* (Port of Melbourne Corporation, 2010)

Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan SEMSO5-08 Rev 10* (Port of Melbourne Corporation, 9/3/2010)

Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan CDP_IMS_PL_004 Rev 6* (Port of Melbourne Corporation, 23/1/2009)

Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan CDP_IMS_PL_004 Rev 7* (Port of Melbourne Corporation, 27/5/2009)

Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan CDP_IMS_PL_004 Rev 8* (Port of Melbourne Corporation, 5/6/2009)

Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan CDP_IMS_PL_004 Rev 9* (Port of Melbourne Corporation, 14/7/2009)

Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan CDP_IMS_PL_004 Rev 1* (Port of Melbourne Corporation, 30/1/2008)

Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan CDP_IMS_PL_004 Rev 2* (Port of Melbourne Corporation, 11/4/2008)

Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan CDP_IMS_PL_004 Rev 3* (Port of Melbourne Corporation, 22/7/2008)

Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan CDP_IMS_PL_004 Rev 4* (Port of Melbourne Corporation, 2/9/2008)

Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan CDP_IMS_PL_004 Rev 5* (Port of Melbourne Corporation, 3/11/2008)

Port of Melbourne Corporation, *Channel Deepening Project Environmental Management Plan CDP_IMS_PL_004 Rev 0* (Port of Melbourne Corporation, 13/12/2007)

Properzi, Scott and Helle Herk-Hansen (Energi E2), *Life Cycle Assessment of a 150MW Offshore Wind Turbine Farm at Nysted Rødsand, Denmark, Presented at European Wind Energy Conference and Exhibition, Copenhagen, Denmark. 4 July 2001*) <http://www.ens.dk/en/node/2018>

Ramboll Oil and Gas, *Anholt Offshore wind farm Visualization Report: Background memo for the environmental impact assessment of the Anholt Offshore Wind Farm Project* (Ramboll Oil and Gas, Rev 9, December 2009)

Rogers, A D and D d'A Laffoley, *International Earth System expert workshop on ocean stresses and impacts* (IPSO Oxford, 2011)

Rynd Smith et al, *Port Phillip Bay Channel Deepening Environmental Effects Statement Volume 1 Panel Report* (11 February 2005)

SEAS Wind Energy Centre, *Nysted Offshore Wind Farm and Rødsand. Annual Status Report for the Environmental Monitoring Program 1st January 1st 2001 – 31st December 2001* (SEAS Wind Energy Centre, 2002)

SEAS Wind Energy Centre, *Review Report, The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farms – Environmental impact assessment and monitoring* (The Environmental Group, 2002)

Sheate, William et al, *The Relationship between the EIA and SEA Directives: Final Report to the European Commission* (Imperial College London Consultants Ltd, August 2005)

Skov, Henrik et al, *Investigations of harbour porpoises at the planned site for wind turbines at Horns Reef. Status report: 1/1/2001 – 1/4/2002. Technical report for Tech-wise A/S* (Ornis Consult A/S, 2002)

South Australia's Expert Panel on Planning Reform, *The Planning System We Want*, (Government of South Australia, 2014)

State of the Environment 2011 Committee, *Australia state of the environment 2011. Independent report to the Australian Government Minister for Sustainability, Environment, Water, Population and Communities* (DSEWPaC, 2011)

State of the Environment Advisory Council, *Australia State of the Environment 1996* (Commonwealth of Australia,1996)

Steve Howett, *Fact Sheet: Environmental Management and Pollution Control Amendment Bill 2012* (Environment Protection Authority Tas, 2012) <http//:www.epa.tas.gov.au/documents/empca_amendment_2012_fact_sheet.pdf>

Techwise A/S, Basic Study/ Surveillance of Porpoises at Horns Rev (February 2002) <http://www.ens.dk/en/node/2018>

Techwise, *Elsam. Offshore Wind Farm. Horns Rev. Annual Status Report for the Environmental Monitoring Programme, 1st January 2001 – 31st December 2001 (Replace Report)* (October 2002) <http://www.ens.dk/en/node/2018>

Techwise, *Report: Seals using the Areas of Horns Rev, Satellite Tracking of Seals* (February 2002) <http://www.ens.dk/en/node/2018>

Teilmann, Jonas et al, *Summary on seal monitoring 1999 – 2005 around Nysted and Horns Rev Offshore Wind Farms: Technical report to Energi E2 A/S and Vattenfall A/S* (Ministry of the Environment, Denmark, 2006)

Teilmann, Jonas, Jakob Tougaard and Jacob Carstensen, *Summary on Harbour porpoise monitoring 1999 – 2006 around Nysted and Horns Rev Offshore Wind Farms: Report to Energi E2 A/S and Vattenfall A/S* (Ministry of the Environment, Denmark, 2006)

Teilmann, Jonas, Jakob Tougaard and Jacob Carstensen, *Summary on harbour porpoise monitoring 1999 – 2006 around Nysted and Horns Rev Offshore Wind Farms: Report to Energi E2 A/S and Vattenfall A/S* (Ministry of the Environment, Denmark, 2006)

The United States National Research Council (NRC), *Cumulative Environment Effects: A Binational Perspective* (CEARC, NRC, 1986)

Topping, Chris and Ib Krag Petersen, *Report on a Red-throated Diver Agent-based Model to assess cumulative impact from offshore wind farms* (Danish Centre for Environment and Energy (Aarhus University), 2011)

Tougaard, Jakob et al, *Harbour Porpoises on Horns Reef – Effects of the Horns Reef Wind Farm, Final Report to Vattenfall A/S*, (National Environmental Research Institute, November 2006)

Tougaard, Jakob et al, *Harbour Porpoises on Horns Reef – Effects of the Horns Reef Wind Farm, Final Report to Vattenfall A/S*, (National Environmental Research Institute, November 2006)

Tougaard, Jakob et al, *Harbour seals on Horns Reef, before, during and after construction of Horns Rev Offshore Wind Farm. Final report to Vattenfall A/S. Biological Papers from the*

Fisheries and Maritime Museum No. 5, Esbjerg, Denmark (Fisheries and Maritime Museum, October 2006)

Tougaard, Jakob et al, *Harbour Porpoises on Horns Reef – Effects of the Horns Reef Wind Farm, Annual Status Report 2004 to Elsam Engineering* (National Environmental Research Institute, 2005)

Tougaard, Jakob et al, *Harbour Porpoises on Horns Reef – Effects of the Horns Reef Wind Farm: Annual Status Report 2003 to Elsam Engineering A/S, NERI Technical Report Final version June 2004* (National Environmental Research Institute, 2004)

Tougaard, Jakob et al, *Satellite tracking of Harbour Seals on Horns Reef: Use of the Horns Reef wind farm area and the North Sea, report to Techwise A/S, Biological Papers from the Fisheries and Maritime Museum, Esberg. No. 3* (Fisheries and Maritime Museum, 2003)

Tougaard, Jakob et al, *Short-term effects of the construction of wind turbines on harbour porpoises at Horns Reef. Technical report to TechWise A/S* (Techwise, 2002)

Tougaard, Jakob, Jonas Teilmann, and Jacob Rye Hansen, *Effects of the Horns Reef Wind Farm on harbour porpoises – Interim report to Elsam Engineering A/S for the harbour porpoise monitoring programme* (National Environmental Research Institute, Ministry of the Environment, 2004).

Tougaard, Svend and Jakob Tougaard, *Use of the North Sea by Harbour Seal with special emphasis on the Horns Reef area – Test of prototype GPS/GSM – transmitter on harbour seals in the Sealarium, Esbjerg. Annual Status Report for 2003 to Elsam Engineering A/S* (Elsam Engineering, 2004)

Tougaard, Svend, *Interim Report on Harbour seal satellite monitoring program, Horns Reef, North Sea*, (Fiskeri- og Søfarsmuseet, 2002) <http://www.ens.dk/sites/ens.dk/files/undergrund-forsyning/vedvarende-energi/vindkraft-vindmoeller/havvindmoeller/miljoepaavirkninger/hornsrev1/harbour20seal20satellite20monitoring20program.pdf>

U Cubasch et al, *Introduction. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group 1 to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Stocker et al (eds) (Cambridge University Press, 2013)

Vattenfall A/S, *Horns Rev Offshore Wind Farm, Annual Status Report for the Environmental Monitoring Programme, 2005* (The Environmental Committee of the Danish Offshore Wind Farm Demonstration Projects, November 2006)

Vattenfall A/S, *Horns Rev Offshore Wind Farm, Annual Status Report for the Environmental Monitoring Programme, 2005* (The Environmental Committee of the Danish Offshore Wind Farm Demonstration Projects, November 2006)

Victorian Government, *Government Response to the ENRC Inquiry into the Environmental Effects Statement Process in Victoria* (1 March 2012) <http//:www.parliament.vic.gov.au/images/stories/committees/enrc/EES/Govt_Response_to_the_ENRC_Inquiry_into_the_Environment_Effects_Statement_Process_in_Victoria_1_March_2012.pdf>

Williams, J et al, *Biodiversity, Australian State of the Environment Report 2001 (Theme Report)*, (CSIRO Publishing on behalf of the Department of the Environment and Heritage, 2001)

World Commission on Environment and Development (WCED), *Report of the World Commission on Environment and Development: Our Common Future* (1987) <http//:www.un-documents.net/our-common-future.pdf>

World Heritage Committee, Fanny Douvere (UNESCO World Heritage Centre) and Tim Badman (IUCN), *Mission Report Great Barrier Reef (Australia) (154),* United Nations Education Scientific and Cultural Organization, Convention concerning the Protection of the World Cultural and Natural Heritage, World Heritage Committee (24^{th} June – 6^{th} July 2012)

Cases

Brown v Forestry Tasmania, Commonwealth of Australia and State of Tasmania (No 4) (2006) 157 FCR 1

Environment Protection Authority v Pancorp Australia Pty Ltd [2002] NSWLEC 38

Environment Protection Authority v Rail Infrastructure Corporation (2002) 119 LGERA 409

Hoxton Park Residents Action Group Inc v Liverpool City Council and Others (2011) 81 NSWLR 638

Minister for the Environment and Heritage v Queensland Conservation Council Inc (2004) 139 FCR 24

Nufarm Australia Ltd v Monsanto Technology LLC [2013] APO 66

Packer v Packer [1953] 2 All ER 127

Port Stephens Pearls Pty Ltd v Minister for Infrastructure and Planning [2005] NSWLEC 426

Prineas v Forestry Commission of New South Wales (1983) 49 LGRA 402

Queensland Conservation Council Inc v Minister for the Environment and Heritage [2003] FCA 1463 (19 December 2003)

Tarkine National Coalition Incorporated v Minister for the Environment [2014] FCA 468

Telstra Corporation Limited v Hornsby Shire Council [2006] NSWLEC 133

Valhalla Village Pty Ltd v Wyong Shire Council, [2008] NSWLEC 1476 [109]

Legislation – Australia

Aquaculture Act 2001 (SA)

Aquaculture Regulations 2005 (SA)

Australian Heritage Council Act 2003 (Cth)

Australian Heritage Council Regulations 2003 (Cth)

Biodiversity Conservation Act 2016 (NSW)

Coastal Management Act 1995 (Vic)

Coast Protection Act 1972 (SA)

Coast Protection Regulations 2015 (SA)

Coastal Protection and Management Act 1995 (Qld)

Coastal Waters (Northern Territory Powers) Act 1980 (Cth)

Coastal Waters (Northern Territory Title) Act 1980 (Cth)

Coastal Waters (State Powers) Act 1980 (Cth)

Coastal Waters (State Title) Act 1980 (Cth)

Commonwealth of Australia Constitution Act

Development Act 1993 (SA)

Development Regulations 2008 (SA)

Environmental Assessment Act 2013 (NT)

Environment and Heritage Legislation Amendment Act (No.1) 2006 (Cth)

Environment Effects Act 1978 (Vic)

Environment Management and Pollution Control Act 1994 (Tas)

Environmental Management and Pollution Control Act 1994 (Tas)

Environmental Management and Pollution Control (Waste Management) Regulations 2010 (Tas)

Environmental Planning and Assessment Act 1979 (NSW)

Environmental Planning and Assessment Regulation 2000 (NSW)

Environment Protection (Sea Dumping) Act 1981 (Cth)

Environment Protection (Sea Dumping) Regulations 1983 (Cth)

Environment Protection (Ships' Ballast Water) Regulations 2006 (Vic)

Environment Protection Act 1970 (Vic)

Environment Protection and Biodiversity Conservation Act 1999 (Cth)

Environment Protection and Biodiversity Conservation Regulations 2000 (Cth)

Environmental Protection Act 1986 (WA)

Environment Protection Act 1993 (SA)

Environment Protection Regulations 2009 (SA)

Fisheries (Abalone) Rules 2009 (Tas)

Fisheries (Aquatic Reserves) Regulations 2008 (SA)

Fisheries Act 1994 (Qld)

Fisheries Act 1995 (Vic)

Fish Resources Management Act 1994 (WA)

Fisheries Management Act 1994 (NSW)

Fisheries Management (Aquaculture) Regulation 2012 (NSW)

Fisheries Management (General) Regulations 2007 (SA)

Fisheries Management (Miscellaneous Fishery) Regulations 2000 (SA)

Fisheries Management (Miscellaneous Research Fishery) Regulations 2013 (SA)

Fisheries Management (Southern Bluefin Tuna Fishery) Regulations 1995 (Cth)

Fisheries Management Act 1991 (Cth)

Fisheries Management Act 2007 (SA)

Fisheries Management Regulations 1992 (Cth)

Fisheries Regulations 2009 (Vic)

Fisheries Rules 2009 (Tas)

Flora and Fauna Guarantee Act 1988 (Vic)

Flora and Fauna Guarantee Regulations 2011 (Vic)

Great Barrier Reef Marine Park Act 1975 (Cth).

Hazardous Waste (Regulation of Exports and Imports) (OECD Decision) Regulations 1996 (Cth)

Hazardous Waste (Regulation of Exports and Imports) Act 1989 (Cth)

Hazardous Waste (Regulation of Exports and Imports) Regulations 1996 (Cth)

Heritage (General) Regulations 2015 (Vic)

Heritage Act 1995 (Vic)

Heritage Act 2017 (Vic)

Living Marine Resources Management Act 1995 (Tas)

Local Government Act 1989 (Vic)

Marine and Coastal Act 2018 (Vic)

Marine (Drug, Alcohol and Pollution Control) Act 1988 (Vic)

Marine (Drug, Alcohol and Pollution Control) Regulations 2012 (Vic)

Marine and Safety Authority Act 1997 (Tas)

Marine Estate Management Act 2014 (NSW)

Marine Farming Planning Act 1995 (Tas)

Marine Farming Planning Regulations 2006 (Tas)

Marine Order 91 (Marine pollution prevention – oil) 2014 (Cth)

Marine Order 93 (Marine Pollution Prevention – noxious liquid substances) 2014 (Cth)

Marine Order 94 (Marine pollution prevention – packaged harmful substances) 2014 (Cth)

Marine Order 95 (Marine pollution prevention – garbage) 2013 (Cth)

Marine Order 96 (Marine pollution prevention – sewage) 2013 (Cth)

Marine Order 97 (Marine pollution prevention – air pollution) 2013 (Cth)

Marine Order 98 (Marine pollution – anti-fouling systems) 2013 (Cth)

Marine Park (Zoning) Regulations 2012 (SA)

Marine Park Act 2007 (SA)

Marine Park Regulations 2008 (SA)

Marine Parks Regulations 2006 (Qld)

Marine Parks Regulations 2017 (Qld)

Marine Parks Act 2004 (Qld)

Marine Parks Act 2007 (SA)

Marine Pollution Act 2012 (NSW)

Mineral Resources Development Act 1995 (Tas)

Mineral Resources Development Regulations 2006 (Tas)

National Environment Protection Council (South Australia) Act 1995 (SA)

National Environment Protection Council (Tasmania) Act 1995 (Tas)

National Environment Protection Council (Victoria) Act 1995 (Vic)

National Environment Protection Council Act 1994 (Cth)

National Environment Protection Measures (Implementation) Act 1998 (Cth)

National Environment Protection Measures (Implementation) Regulations 1999 (Cth)

National Parks Act 1975 (Vic)

National Parks (Park) Regulations 2013 (Vic)

National Parks and Reserved Land Regulations 2009 (Tas)

National Parks and Reserves Management Act 2002 (Tas)

National Parks and Wildlife (National Parks) Regulations 2001 (SA)

National Parks and Wildlife (Protected Animals – Marine Mammals) Regulations 2010 (SA)

National Parks and Wildlife Act 1972 (SA)

Natural Resource Management Act 2002 (Tas)

Natural Resources Management (General) Regulations 2005 (SA)

Natural Resources Management Act 2004 (SA)

Nature Conservation Act 2002 (Tas)

Navigation Act 2012 (Cth)

Offshore Minerals (Data Lodging and Reporting) Regulations 1996 (Cth)

Offshore Minerals Act 1994 (Cth)

Offshore Minerals Act 2000 (SA)

Offshore Minerals Regulations 2002 (SA)

Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cth)

Offshore Petroleum and Greenhouse Gas Storage Act 2010 (Vic)

Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth)

Offshore Petroleum and Greenhouse Gas Storage (Greenhouse Gas Injection and Storage) Regulations 2011 (Cth)

Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011 (Cth)

Offshore Petroleum and Greenhouse Gas Storage Regulations 2011 (Vic)

Planning, Development and Infrastructure Act 2016 (SA)

Petroleum (Submerged Lands) (Environment) Regulations 2012 (WA)

Petroleum (Submerged Lands) (Management of Environment) Regulations 2012 (Tas)

Petroleum (Submerged Lands) Act 1982 (SA)

Petroleum (Submerged Lands) Act 1982 (Tas)

Petroleum (Submerged Lands) Management of Environment Regulations 2012 (Tas)

Petroleum (Submerged Lands) Regulations 2005 (SA)

Petroleum and Geothermal Energy Act 2000 (SA)

Petroleum and Geothermal Energy Regulations 2013 (SA)

Planning and Environment Act 1987 (Vic)

Planning and Environment Regulations 1998 (Vic)

Planning and Environment Regulations 2015 (Vic)

Planning, Development and Infrastructure Act 2016 (SA)

Pollution of Waters by Oil and Noxious Substances Act 1986 (Vic)

Pollution of Waters by Oil and Noxious Substances Act 1987 (Tas)

Pollution of Waters by Oil and Noxious Substances Regulations 2002 (Vic)

Pollution of Waters by Oil and Noxious Substances Regulations 2007 (Tas)

Port Management (Local Ports) Regulations 2004 (Vic)

Port Management Act 1995 (Vic)

Protection of Marine Waters (Prevention of Pollution from Ships) Act 1987 (SA)

Protection of Marine Waters (Prevention of Pollution from Ships) Regulations 2013 (SA)

Protection of the Environment Administration Act 1991 (NSW)

Protection of the Sea (Harmful Anti-Fouling Systems) Act 2006 (Cth)

Protection of the Sea (Powers of Intervention) Act 1981 (Cth)

Protection of the Sea (Powers of Intervention) Regulations 1983 (Cth)

Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Orders) Regulations 1994 (Cth)

Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Cth)

Seas and Submerged Lands Act 1973 (Cth)

State Government Victoria, *Stonnington Planning Scheme: Victorian Planning Provisions* (2014)

State Policies and Projects Act 1993 (Tas)

State Policies and Projects Regulations 2014 (Tas)

Sustainable Ports Development Act 2015 (Qld)

Threatened Species Protection Act 1995 (Tas)

Transport Operations (Marine Pollution) Act 1995 (Qld)

Victorian Environmental Assessment Council Act 2001 (Vic)

Whales Protection Act 1988 (Tas)

Wilderness Protection Act 1992 (SA)

Wilderness Protection Regulations 2006 (SA)

Wildlife (Marine Mammals) Regulations 2009 (Vic)

Wildlife Act 1975 (Vic)

Wildlife Regulations 2002 (Vic)

Legislation – Denmark

Bekendtgørelse af lov om miljørvurdering af planer og programmer [Environmental Assessment of Plans and Programmes Act] (Denmark) LBK nr 1398 af 22/10/2007, <http://www.retsinformation.dk/Forms/R0710.aspx?id=113557>

Bekendtgørelse af lov om miljørvurdering af planer og programmer [Environmental Assessment of Plans and Programmes Act] (Denmark) LBK nr 1533 af 10/12/2015, http://www.retsinformation.dk/Forms/R0710.aspx?id=175265>

Bekendtgørelse om konsekvensvurdering vedrørende internationale naturbeskyttelsesområder sant beskyttelse af vise arter ved projekter om etablering m.v. af elproduktionsanlæg og elforsyningsnet på havet [Act for the Appropriate Assessment of offshore energy installation projects] (Denmark) Lov nr. 1476 af 13/ 12/ 2010, <http://www.retsinformation.dk/Forms/R0710.aspx?id=134988>

Bekendtgørelse om ophævelse af Bekendtgørelse om vurdering af virkning på miljøet (VVM) ved projekter om etablering m.v. af elproduktionsanlæg på havet BEK nr 446 af 09/05/2017 <http://www.retsinformation.dk/Forms/R0710.aspx?id=189972>

Bekendtgørelse om vurdering af virkning på miljøet (VVM) ved projekter om etablering m.v. af elproduktionsanlæg på havet, [Offshore Wind Energy Environmental Impact Assessment Act] (Denmark) BEK nr 68 af 26/01/2012, <http://www.retsinformation.dk/Forms/R0710.aspx?id=140308>

Lov om havstrategi [Marine Strategy Act] (Denmark) Lov nr No. 522 af 26/05/2010, <http://www.retsinformation.dk/Forms/R0710.aspx?id=131991> as amended by *Bekendtgørelse af lov om havstrategi* (Denmark) Lov nr No. 1582 af 10/12/2015, <http://www.retsinformation.dk/Forms/R0710.aspx?id=175602

European Union Directives

Consolidated version of the Treaty of the European Union, [2016] OJ C 202/132

Council Directive 92/43EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, [1992] OJ L 206/7; and amendments contained within *Regulation (EC) No 1882/2003 of the European Parliament and of the Council of 29 September 2003 adapting to Council Decision 1999/468/EC the provisions relating to committees which assist the Commission in the exercise of its implementing powers laid down in instruments subject to the procedure referred to in Article 251 of the EC Treaty*, [2003] OJ L 284/1, *Council Directive 97/62/EC of 27 October 1997 adapting to technical and scientific progress Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora*, [1997] OJ L 305/42, *Council Directive 2006/105/EC of 20 November 2006 adapting Directives 73/239/EC, 74/557/EC and 2002/83/EC in the field of environment, by reason of the accession of Bulgaria and Romania,* [2006] OJ L 363/368

Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment, [2001] OJ L 197/30

Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive) (Text with EEA relevance), [2008] OJ L 164/19

Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification), [2012] OJ L 26/1 and amending *Directive 2014/52/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification),* [2014] OJ L 124/1

EC Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (codified version) [2010] OJ L 20/7

EC Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment and the subsequent amending Directives 97/11/EC, 2003/35/EC & 2009/31/EC, [2009] OJ L 140/114

Legislation – Other

Canadian Environmental Assessment Act 2012

CEQ, Regulations for implementing NEPA [40 CFR Parts 1500 – 15081]. Washington DC: Council on Environmental Quality; 1978

Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 (UK)

Marine Works (Environmental Impact Assessment) Regulations 2007 (UK)

Resource Management Act 1991 (NZ)

Treaties

Convention Concerning the Protection of the World Cultural and Natural Heritage opened for signature 16 November 1972, 1037 UNTS 151 (entered into force 17 December 1975)

Convention for the Conservation of Southern Bluefin Tuna, opened for signature 10 May 1993, [1994] ATS 16 (entered into force 20 May 1994)

Convention on Biological Diversity, opened for signature 5 June 1992, 1760 UNTS 79 (entered into force 29 December 1993)

Convention on Environmental Impact Assessment in a Transboundary Context, opened for signature 25 February 1991, 1989 UNTS 309 (entered into force 10 September 1997)

Convention on Wetlands of International Importance Especially as Waterfowl Habitat opened for signature 2 February 1971, 996 UNTS 245 (entered into force 21 December 1975)

United Nations Convention on the Law of the Sea, opened for signature 10 December 1982, 183 UNTS 3 (entered into force 16 November 1994)

United Nations Documents

United Nations Education Scientific and Cultural Organization, World Heritage Committee, *Decision 35 COM 7B.10,* 35th Session, , Convention concerning the Protection of the World Cultural and Natural Heritage, World Heritage Committee (19 – 29th June 2011)

United Nations Education Scientific and Cultural Organization, World Heritage Committee, *Decision 36 COM 7B.8,* 36th Session, Convention concerning the Protection of the World Cultural and Natural Heritage, World Heritage Committee (24th June – 6th July 2012)

United Nations Education Scientific and Cultural Organization, World Heritage Committee, *Decision 37 COM 7B.10*, 37th Session, Convention concerning the Protection of the World Cultural and Natural Heritage, World Heritage Committee (16th - 27th June 2013)

United Nations Education Scientific and Cultural Organization, World Heritage Committee, *Decision 38 COM 7B.63*, 38th Session, Convention concerning the Protection of the World Cultural and Natural Heritage, World Heritage Committee (15th - 25th June 2014)

United Nations Education Scientific and Cultural Organization, World Heritage Committee, *Decision 39 COM 7B.7*, 39th Session, Convention concerning the Protection of the World Cultural and Natural Heritage, World Heritage Committee (28th June – 8th July 2015)

United Nations General Assembly, *Report of the United Nations Conference on Environment and Development: Annex 1 Rio Declaration on Environment and Development* UN Doc A:CONF.151:26(Vol.1) (3 – 14 June 1992) <http//:www.un.org/documents/ga/conf151/aconf15126-1annex1.htm>

Other

Attorney General's Department, *Offshore Constitutional Settlement: A milestone in co-operative federalism* (Australian Government Publishing Service, 1980)

Australian Environmental Law Digest (National Environmental Law Association, 2014)

Australian Environmental Law News (National Environmental Law Association, 1995 – 2001)

Australian Journal of Maritime and Ocean Affairs (Taylor & Francis, 2009 - 2014)

Australian Broadcasting Corporation, *Great Barrier Reef: Dredge spoil in marine park to be banned under draft federal laws proposed by Environment Minister Greg Hunt*, 16 March 2015 <http://abc.net.au/news/2015-03-16/greg-hunt-introduces-draft-laws-ban-dumping-of-dredge-spoil/6322136>

Australian Government (Department of the Environment), *Matters of National Environmental Significance: Significant impact guidelines 1.1, Environment Protection and Biodiversity Conservation Act 1999* (Department of the Environment, 2013)

Australian Government Department of the Environment, Water, Heritage and the Arts, *Approval Port Phillip Bay Channel Deepening (EPBC 2002/576)*, (20 December 2007) <http://www.environment.gov.au/epbc/notices/assessments/2002/576/approval-decision.pdf>

Australian Government Department of the Environment, Water, Heritage and the Arts, *Notification of Variation to Approval Decision*, (3 July 2008) <http://www.environment.gov.au/cgi-bin/epbc/epbc_app.pl?name=current_referral_detail&proposal_id=576>

Australian Government Department of the Environment, Water, Heritage and the Arts, *Statement of Reasons for Grant of approval under the Environment Protection and Biodiversity Conservation Act 1999* (18 January 2008) <http://www.environment.gov.au/epbc/notices/assessments/2002/576/statement-reasons.pdf>

Australian Government Department of the Prime Minister and Cabinet, *Legislation Proposed for Introduction in the 2012 Winter Sittings* (2012)

Australian Government Department of the Prime Minister and Cabinet, *Legislation Proposed for Introduction in the 2013 Autumn Sittings* (2013)

Commonwealth of Australia and The State of Western Australia, *Draft Approval Bilateral Agreement made under Sections 44 and 45 of the Environment Protection and Biodiversity Conservation Act 1999 (Cth)*, Clause 4.2 <http://www.environment.gov.au/system/files/pages/69324f7e-a815-485e-aafe-552a7b787a37/files/wa-draft-bilateral-agreeement.pdf>

Commonwealth of Australia, *Environment Protection and Biodiversity Conservation Act 1999 Decision on Assessment Approach*, (21 May 2002) <http://www.environment.gov.au/cgi-bin/epbc/epbc_app.pl?name=current_referral_detail&proposal_id=576>

Council of Australian Governments, *Council of Australian Governments Meeting Canberra 19 August 2011 Communique* <http://www.coag.gov.au/coag_meeting_outcome/2011-08-19/index.cfm>

Council of Australian Governments, *Heads of agreement on Commonwealth and State roles and responsibilities for the Environment*, November 1997, Clause 5 <http//:www.environment.gov.au/resources/heads-agreement-commonwealth-and-state-roles-and-responsibilities-environment>

Council of Australian Governments, *Intergovernmental Agreement on the Environment*, 1 May 1992 <http//:www.environment.gov.au/about-us/publications/intergovernmental-agreement>

Department of Planning and Development, Government of Victoria, *Guidelines for Environmental Impact Assessment and the Environment Effects Act*, (Government of Victoria, 6th ed, 1995)

Department of Transport, Planning and Local Infrastructure, *Port Phillip Bay Channel deepening proposal* (7 October 2014) <http://www.dpli.vic.gov.au/planning/environmental-assessment/projects/port-phillip-bay-channel-deepening-proposal>

Environment Protection and Heritage Legislation Amendment Bill (No.1), No 53 of 2006-07, 22 November 2006

Environmental and Planning Law Journal (Thomson Reuters, 1995 to 2014)
European Commission, *Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC* (January 2007), http://www.ec.europa.eu/environmental/nature/natura2000/management/guidance_en

Explanatory Memorandum, Environment and Heritage Legislation Amendment Bill (No.1) 2006 (Cth)

Explanatory Memorandum, Environment Protection and Biodiversity Conservation Bill 1998 (Cth)

Macquarie Journal of International and Comparative Environmental Law (Macquarie University, Macquarie Law School, 2004 – 2013)

Maritime Studies (Taylor and Francis, 1995 – 2008)

Minister for Planning, Government of Victoria, *Assessment Guidelines Issued by the Minister for Planning for Port Phillip Bay Channel Deepening Supplementary Environmental Effects Statement, Proponent: Port of Melbourne Corporation* (Victorian Government, October 2005)

Minister for Planning, Government of Victoria, *Assessment Guidelines for the Port Phillip Bay Channel Deepening Environmental Effects Statement – Proponent: Victorian Channels Authority,* (Government of Victoria, October 2002)

Minister for Planning, Government of Victoria, *Minister's Statement Port Phillip Bay Channel Deepening Supplementary Environmental Effects Statement* (Victorian Government, July 2005)

Minister for Planning, Government of Victoria, *Port Phillip Bay Channel Deepening Project Assessment under Environment Effects Act 1978*, (Victorian Government, November 2007)

Minister for Planning, Government of Victoria, *Statement by the Minister for Planning: Current Status of assessment process under the Environment Effects Act 1978 for the proposed Port Phillip Bay Channel Deepening Project* (Victorian Government, 2005)

Minister for the Environment and Climate Change, *Section 40 Coastal Management Act 1995 Consent for Use and Development of Coastal Crown Land* (14th December 2007)

National Environmental Law Review (National Environmental Law Association, 2002 - 2013)

The Australasian Journal of Natural Resources Law and Policy (University of New South Wales, Faculty of Law, 1995 to 2014)

Victorian Government Department of Sustainability and Environment, *Ministerial Guidelines for the Assessment of Environmental Effects under the Environmental Effects Act 1978* (Victorian Government, 7th ed, 2006)

Websites

Alcocks, M B, and N J Taffs, *Australia's Maritime Zones Edition 5* (Geoscience Australia, 5th ed, 2014) <http://www.ga.gov.au/corporate_data/81859/Australias_Maritime_Zones_Edition_5.pdf>

Australian Fisheries Management Authority, *Southern Bluefin Tuna Fishery (SBTF) at a glance* (2014) <http://www.afma.gov.au/managing-our-fisheries/fisheries-a-to-z-index/southern-bluefin-tuna/at-a-glance/

Australian Government (Approvals and Wildlife Division), Woodside Energy Ltd (EPBC 2002/621) *Final Approval Instrument 14/4/04*, Condition 1 <http://www.environment.gov.au/cgi-bin/epbc/epbc_ap.pl?name=current_referral_detail&proposal_id=621>

Australian Government (Department of the Environment), *State of the Environment (SoE) reporting* <http://www.environment.gov.au/science/soe>

Australian Government Department of Industry and Science, *Acreage Release Areas VIC14-GHG-1, VIC14-GHG-2 and VIC14-GHG-3, Gippsland Basin, offshore Victoria* <http://www.industry.gov.au/resource/LowEmissionsFossilFuelTech/Greenhouse-Gas-Storage-Acreage-Release/Pages/Acreage-Release-Areas.aspx>

Australian Government Department of Sustainability, Environment, Water, Population and Communities, *Ramsar wetlands of Australia,* (Environmental Resources Information Network, Australian Government, Department of Sustainability, Environment, Water, Population and Communities, January 2013) <http://www.environment.gov.au/water/topics/wetlands/database/maps/pubs/ramsar-sites-australia.pdf>

Australian Government Department of the Environment Water Heritage and the Arts, *Independent Review of the Environment Protection and Biodiversity Conservation Act 1999 (Cth): Interim Report* (Commonwealth of Australia, 2009)<https:www.environment.gov.au/epbc/review>

Australian Government Department of the Environment, *Australia's World Heritage List* <http://www.environment.gov.au/heritage/places/world-heritage-list>

Australian Government Department of the Environment, *Australian Capital Territory Bilateral Agreement Information* <http://www.environment.gov.au/protection/environment-assessments/bilateral-agreements/act>

Australian Government Department of the Environment, *New South Wales Bilateral Agreement Information* <http://www.environment.gov.au/protection/environment-assessments/bilateral-agreements/nsw>

Australian Government Department of the Environment, *Northern Territory Bilateral Agreement Information* <http://www.environment.gov.au/protection/environment-assessments/bilateral-agreements/nt>

Australian Government Department of the Environment, *One stop shop for environmental approvals* <http://www.environment.gov.au/epbc/one-stop-shop>

Australian Government Department of the Environment, *Tasmania Bilateral Agreement Information* <http://www.environment.gov.au/protection/environment-assessments/bilateral-agreements/tas>

Australian Government Department of the Environment, *Queensland Bilateral Agreement Information* <http://www.environment.gov.au/protecction/environment-assessments/bilateral-agreements/qld>

Australian Government Department of the Environment, *South Australia Bilateral Agreement Information* <http://www.environment.gov.au/protection/environment-assessments/bilateral-agreements/sa>

Australian Government Department of the Environment, *Western Australia Bilateral Agreement Information* <http://www.environment.gov.au/protection/environment-assessments/bilateral-agreements/wa>

Australian Government Department of the Environment, *Victoria Bilateral Agreement Information* <http://www.environment.gov.au/protection/environment-assessments/bilateral-agreements/vic>

Australian Government Department of the Environment, *Independent review of the Environment Protection and Biodiversity Conservation Act 1999* <http//:www.environment.gov.au/legislation/environment-protection-and-biodiversity-conservation-act/epbc-review-2008>

Australian Government Department of the Environment, *Strategic assessment of the Browse Basin liquefied natural gas precinct* <http://www.environment.gov.au/node/18603>

Australian Government Geoscience Australia, *Geoscience Australia Greenhouse Gas Storage Projects* (Commonwealth of Australia, 2012) <http://www.ga.gov.au/corporate_data/74730/74730.pdf>

Australian Government, Department of Sustainability, Environment, Water, Population and Communities, *A guide to undertaking strategic assessments: Environment Protection and Biodiversity Conservation Act 1999* (2013) <http//:www.environment.gov.au/resource/guide-undertaking-strategic-assessments>

Clean Energy Finance Corporation, 'Statement from the CEFC on receipt of updated Investment Mandate', (Statement, 23/12/15) <http://www.cleanenergyfinancecorp.com.au/media/releases-and-announcements/files/statement-from-the-cefc-on-receipt-of-the-updated-investment-mandate.aspx>

Danish Energy Agency, *Anholt Offshore wind farm – 400MW* <http://www.ens.dk/supply/renewable-energy/wind-power/offshore-wind-power/current-offshore-wind-farm-projects/anholt>

Danish Energy Agency, *Current Offshore Wind Farm Projects* <http://www.ens.dk/en/supply/renewable-energy/wind-power/offshore-wind-power/current-offshore-wind-farm-projects>

Danish Energy Agency, *Environmental Impacts* <http://www.ens.dk/en/supply/renewable-energy/wind-power/offshore-wind-power/environmental-impacts>

Danish Energy Agency, *Large-scale offshore wind tenders* <http://www.ens.dk/en/supply/renewable-energy/wind-power/offshore-wind-power/large-scale-offshore-wind-tenders>

Danish Energy Agency, *Procedures and permits for offshore wind parks* <http://www.ens.dk/en/supply/renewable-energy/wind-power/offshore-wind-power/procedures-permits-offshore-wind-parks>

Danish Energy Agency, *Environmental Reports for Specific Danish Projects* <http://www.ens.dk/supply/renewable-energy/wind-power/offshore-wind-power/environmental-impacts/environmental-reports>

Danish Energy Agency, *Table of wind power facilities (end of March 2019)* < http://www.ens.dk/our-services/statistics-data-key-figures-and-energy-maps/overview-energy-sector>

Dong Energy, *The Anholt Offshore Wind Farm* <http://www.anholt-windfarm.com/en/the-wind-farm>

ERIN, Department of the Environment and Heritage, Australian Government, *Map 2 IMCRA 4.0: Meso-scale Bioregions* (Commonwealth of Australia, 2006) <http://www.environment.gov.au/system/files/resources/2660e2d2-7623-459d-bcab-1110265d2c86/files/map2-msb.pdf>

Hunt MP Minister for the Environment, The Hon. Greg, *Orders given to ban dumping of capital dredge material in Marine Park*, 24 January 2015 <http://www.environment.gov.au/minister/hunt/2015/mr20150124.html>

International Association for Impact Assessment in cooperation with Institute of Environmental Assessment, UK, *Principles of Environmental Impact Assessment Best Practice,* (1999) <http//:www.iaia.org/publicdocuments/special-publications/Principles%20of%201A_web.pdf>

Stevenson, Angus (ed), *Oxford Dictionary of English* (Oxford University Press, 3rd ed, 2014) <http://www.oxfordreferenc.com.ezproxy.uow.edu.au/view/10.1093/...ef/9780199571123.001.0001/m_en_gb019790?rskey=niUP60&result=1>

Appendices

Appendix A - Otways Marine Area legislation analysis (June 2015)

Summary of findings from environmental assessment legislation framework review (Legend: ● = Present, *CI* = cumulative impacts, *SI* = synergistic impacts, M = mandatory assessment requirement, D = discretionary assessment requirement, *Def* = definition, Def diff = definition differentiation, Indirect = indirect impact, Incl. = expressly included, S = 'significant' (e.g. associated with impact/effect), A = 'adverse' (e.g. associated with impact/ effect), I = 'impact', E = 'effect', Excl. = expressly excludes, Blank space = absence of search term/ not applicable)

Legislation	***CI***	**M/ D**	***Def***	***SI***	**M/ D**	***Def***	**Def diff - *CI* and *SI***	**Indirect**	**Indirect Excl. *CI* or *SI***	**S, A, I, &/or E?**	**S, A, I &/or E Excl. *CI* or *SI***
Commonwealth											
Australian Heritage Council Act 2003 (Cth)										I	
Australian Heritage Council Regulations 2003 (Cth)											
Environment Protection and Biodiversity Conservation Act 1999 (Cth)								●		S, A, I, E	
Environment Protection and Biodiversity Conservation Regulations 2000 (Cth)	●	M & D								S, A, I, E	
Environment Protection (Sea Dumping) Act 1981 (Cth)										E	
Environment Protection (Sea Dumping) Regulations 1983 (Cth)											
Fisheries Management Act 1991 (Cth)										S, A, I, E	

Legislation	***CI***	**M/ D**	***Def***	***SI***	**M/ D**	***Def***	**Def diff - *CI* and *SI***	**Indirect**	**Indirect Excl. *CI* or *SI***	**S, A, I, &/or E?**	**S, A, I &/or E Excl. *CI* or *SI***
Fisheries Management Regulations 1992 (Cth)										I	
Hazardous Waste (Regulation of Exports and Imports) Act 1989 (Cth)										S, A, I, E	
Hazardous Waste (Regulation of Exports and Imports) Regulations 1996 (Cth)											
Hazardous Waste (Regulation of Exports and Imports) (OECD Decision) Regulations 1996 (Cth)										S, A, I , E	
National Environment Protection Council Act 1994 (Cth)	●	D								S, A, I, E	
National Environment Protection Measures (Implementation) Act 1998 (Cth)								●		I , E	
National Environment Protection Measures (Implementation) Regulations 1999 (Cth)											
Navigation Act 2012 (Cth)										*Pollution/ damage/ harm within the marine environme-nt*	
Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cth)										S, A, I, E	

Legislation	***CI***	**M/ D**	***Def***	***SI***	**M/ D**	***Def***	**Def diff - *CI* and *SI***	**Indirect**	**Indirect Excl. *CI* or *SI***	**S, A, I, &/or E?**	**S, A, I &/or E Excl. *CI* or *SI***
Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth)								●		S, A, I	
Offshore Petroleum and Greenhouse Gas Storage (Greenhouse Gas Injection and Storage) Regulations 2011 (Cth)										A, I, E	
Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011 (Cth)										S	
Offshore Minerals Act 1994 (Cth)										E	
Offshore Minerals (Data Lodging and Reporting) Regulations 1996 (Cth)											
Protection of the Sea (Powers of Intervention) Act 1981 (Cth)										E	
Protection of the Sea (Powers of Intervention) Regulations 1983 (Cth)											
Protection of the Sea (Harmful Anti-Fouling Systems) Act 2006 (Cth)											
Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Cth)										S	
Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Orders) Regulations 1994 (Cth)											

Legislation	*CI*	M/ D	*Def*	*SI*	M/ D	*Def*	Def diff - *CI* and *SI*	Indirect	Indirect Excl. *CI* or *SI*	S, A, I, &/or E?	S, A, I &/or E Excl. *CI* or *SI*
Marine Order 91 (Marine pollution prevention – oil) 2014 (Cth)											
Marine Order 93 (Marine Pollution Prevention – noxious liquid substances) 2014 (Cth)											
Marine Order 94 (Marine pollution prevention – packaged harmful substances) 2014 (Cth)											
Marine Order 95 (Marine pollution prevention – garbage) 2013 (Cth)											
Marine Order 96 (Marine pollution prevention – sewage) 2013 (Cth)											
Marine Order 97 (Marine pollution prevention – air pollution) 2013 (Cth)											
Marine Order 98 (Marine pollution – anti-fouling systems) 2013 (Cth)											
Victoria											
Coastal Management Act 1995 (Vic)											
Environmental Effects Act 1978 (Vic)										S, E	
Environment Protection Act 1970 (Vic)	*Section 1J 'Principles of Integrated Manageme-nt'*									S, A, I, E	

Legislation	***CI***	**M/ D**	***Def***	***SI***	**M/ D**	***Def***	**Def diff - *CI* and *SI***	**Indirect**	**Indirect Excl. *CI* or *SI***	**S, A, I, &/or E?**	**S, A, I &/or E Excl. *CI* or *SI***
Environment Protection (Ships' Ballast Water) Regulations 2006 (Vic)											
Fisheries Act 1995 (Vic)										I, E	
Fisheries Regulations 2009 (Vic)											
Flora and Fauna Guarantee Act 1988 (Vic)										S, A, E	
Flora and Fauna Guarantee Regulations 2011 (Vic)											
Heritage Act 1995 (Vic)	●	M								A, I	
Heritage (General) Regulations 2015 (Vic)											
Marine (Drug, Alcohol and Pollution Control) Act 1988 (Vic)										E	
Marine (Drug, Alcohol and Pollution Control) Regulations 2012 (Vic)											
National Environment Protection Council (Victoria) Act 1995 (Vic)	●	D								S, A, I, E	
National Parks Act 1975 (Vic)										A, I	
National Parks (Park) Regulations 2013 (Vic)											
Offshore Petroleum and Greenhouse Gas Storage Act 2010 (Vic)										S, A, I, E	
Offshore Petroleum and Greenhouse Gas Storage Regulations 2011 (Vic)								●		S, A, I, E	

Legislation	***CI***	**M/ D**	***Def***	***SI***	**M/ D**	***Def***	**Def diff - *CI* and *SI***	**Indirect**	**Indirect Excl. *CI* or *SI***	**S, A, I, &/or E?**	**S, A, I &/or E Excl. *CI* or *SI***
Pollution of Waters by Oil and Noxious Substances Act 1986 (Vic)										E	
Pollution of Waters by Oil and Noxious Substances Regulations 2002 (Vic)											
Port Management Act 1995 (Vic)										I	
Port Management (Local Ports) Regulations 2004 (Vic)											
Victorian Environmental Assessment Council Act 2001 (Vic)											
Wildlife Act 1975 (Vic)										A, E	
Wildlife Regulations 2002 (Vic)											
Wildlife (Marine Mammals) Regulations 2009 (Vic)	●	M									
Tasmania											
Environmental Management and Pollution Control Act 1994 (Tas)	'combined effects'			'combined effects'				●		A, I, E	
Environmental Management and Pollution Control (Waste Management) Regulations 2010 (Tas)								●		A	
Living Marine Resources Management Act 1995 (Tas)										S, A, I, E	
Fisheries Rules 2009 (Tas)										I	
Mineral Resources Development Act 1995 (Tas)										I	
Mineral Resources Development Regulations 2006 (Tas)											

Legislation	***CI***	**M/ D**	***Def***	***SI***	**M/ D**	***Def***	**Def diff - *CI* and *SI***	**Indirect**	**Indirect Excl. *CI* or *SI***	**S, A, I, &/or E?**	**S, A, I &/or E Excl. *CI* or *SI***
Marine Farming Planning Act 1995 (Tas)										S, A, I, E	
Marine Farming Planning Regulations 2006 (Tas)											
Marine and Safety Authority Act 1997 (Tas)											
Natural Resource Management Act 2002 (Tas)										A, E	
Nature Conservation Act 2002 (Tas)										A, E	
National Environment Protection Council (Tasmania) Act 1995 (Tas)	●	D								S, A, I, E	
National Parks and Reserves Management Act 2002 (Tas)										A, I, E	
National Parks and Reserved Land Regulations 2009 (Tas)										I	
Petroleum (Submerged Lands) Act 1982 (Tas)										E	
Petroleum (Submerged Lands) Management of Environment Regulations 2012 (Tas)								●		S, A, I	
Pollution of Waters by Oil and Noxious Substances Act 1987 (Tas)											
Pollution of Waters by Oil and Noxious Substances Regulations 2007 (Tas)											
State Policies and Projects Act 1993 (Tas)										S, A, I, E	
State Policies and Projects Regulations 2014 (Tas)											

Legislation	***CI***	**M/ D**	***Def***	***SI***	**M/ D**	***Def***	**Def diff - *CI* and *SI***	**Indirect**	**Indirect Excl. *CI* or *SI***	**S, A, I, &/or E?**	**S, A, I &/or E Excl. *CI* or *SI***
Threatened Species Protection Act 1995 (Tas)										S, A, E	
Whales Protection Act 1988 (Tas)										A	
South Australia											
Aquaculture Act 2001 (SA)										S, A, E	
Aquaculture Regulations 2005 (SA)										A, I	
Coast Protection Act 1972 (SA)										I	
Coast Protection Regulations 2015 (SA)											
Development Act 1993 (SA)	●	D								S, A, I, E	
Development Regulations 2008 (SA)								●		S, A, I, E	
Environment Protection Act 1993 (SA)	'combined effects'			'combined effects'				●		S, A, I, E	
Environmental Protection Regulations 2009 (SA)											
Fisheries Management Act 2007 (SA)										A, I, E	
Fisheries Management (General) Regulations 2007 (SA)											
Fisheries Management (Miscellaneous Fishery) Regulations 2000 (SA)											
Fisheries (Aquatic Reserves) Regulations 2008 (SA)											

Legislation	***CI***	**M/ D**	***Def***	***SI***	**M/ D**	***Def***	**Def diff - *CI* and *SI***	**Indirect**	**Indirect Excl. *CI* or *SI***	**S, A, I, &/or E?**	**S, A, I &/or E Excl. *CI* or *SI***
Fisheries Management (Miscellaneous Research Fishery) Regulations 2013 (SA)											
Marine Park Act 2007 (SA)	●	D								S, A, I, E	
Marine Park Regulations 2008 (SA)											
Marine Park (Zoning) Regulations 2012 (SA)											
National Parks and Wildlife Act 1972 (SA)										A, I, E	
National Parks and Wildlife (National Parks) Regulations 2001 (SA)											
National Parks and Wildlife (Protected Animals – Marine Mammals) Regulations 2010 (SA)											
Natural Resources Management Act 2004 (SA)	●	D								A, I, E	
Natural Resources Management (General) Regulations 2005 (SA)										I	
National Environment Protection Council (South Australia) Act 1995 (SA)	●	D								S, A, I, E	
Offshore Minerals Act 2000 (SA)										E	
Offshore Minerals Regulations 2002 (SA)											
Protection of Marine Waters (Prevention of Pollution from Ships) Act 1987 (SA)										E	

Legislation	***CI***	**M/ D**	***Def***	***SI***	**M/ D**	***Def***	**Def diff - *CI* and *SI***	**Indirect**	**Indirect Excl. *CI* or *SI***	**S, A, I, &/or E?**	**S, A, I &/or E Excl. *CI* or *SI***
Protection of Marine Waters (Prevention of Pollution from Ships) Regulations 2013 (SA)											
Petroleum (Submerged Lands) Act 1982 (SA)										E	
Petroleum (Submerged Lands) Regulations 2005 (SA)											
Petroleum and Geothermal Energy Act 2000 (SA)	●	M								S, A, I, E	
Petroleum and Geothermal Energy Regulations 2013 (SA)										I	
Wilderness Protection Act 1992 (SA)											
Wilderness Protection Regulations 2006 (SA)											

Appendix B – CDP Supplementary Environmental Effects Statement: Stated predictions for cumulative, synergistic, indirect, combined and interactive effects

(Legend: *Y* = impact type assessed and predicted as problematic; *N* = impact type assessed and predicted as non-problematic; *blank space* = impact type not assessed)

	Cumulative		**Synergistic**		**Indirect**		**Combined**		**Interactive**	
Values/ Assets/ Activities[1]	**Y**	**N**	**Y**	**N**	**Y**	**N**	**Y**	**N**	**Y**	**N**
Landform Bathymetry (geomorphology and bathymetry)										
Hydrodynamic										
Sediment transport and coastal processes										
Nitrogen cycle										
Nutrient cycle		N[2]								
Water quality (turbidity, nutrients, contaminant mobilisation etc.)										
Biological/ ecological processes (seabed water column habitat, primary production & food web)		N[3]			Y[4]					
Seabed and water column habitat										
Fish (unspecified)		N[5]			Y[6]					
Bream		N[7]								

[1] The 'Values/Assets/ Activities' have been selected based on a combination of the environmental values and assets, and anthropogenic activities identified in: URS Australia Pty Ltd, 'Section 7 Risk Assessment – Evaluation of Outputs' in Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) 7- 1; Table 6-1 List of Asset Categories and Definitions in URS Australia Pty Ltd, 'Section 6 Risk Assessment – Analysis of Risks' in Port of Melbourne Corporation, *Technical Appendices Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007b) 6- 1; the environmental value and assets associated with cumulative/synergy terms etc. when found in text. Values and assets related to property, social, economic and public health and safety matters are not included.

[2] Andrew R Longmore, 'SEES Head Technical report: Nutrient Cycling' in Port of Melbourne Corporation 2007b, above n 1, 102 – 104.

[3] Port of Melbourne Corporation ,'Appendix 67' in Port of Melbourne Corporation 2007b, above n 1, 21.

[4] M Edmunds, P Pickett and A Judd (Australian Marine Ecology), 'Port Phillip Bay Channel Deepening Project Supplementary Environmental Effects Statement – Marine Ecology Specialist Studies Volume 10: Ecological Processes and Inventory' in Port of Melbourne Corporation 2007b, above n 1, 41; Brett Lane & Associates Pty Ltd, 'Report No. 6036 (1.10) December 2006' in Port of Melbourne Corporation 2007b, above n 1, 210, 216, 218 – 220, 234, 265, 271 (note: impact on seabirds: photosynthesis – reduced light from suspended sediment, clogging of organisms, food production).

[5] Port of Melbourne Corporation, *Main Volume Supplementary Environmental Effects Statement Channel Deepening Project* (Port of Melbourne Corporation, 2007) (2007a) 14-40; Gregory P Jenkins and Lachlan McKinnon, 'Aquaculture and Fisheries SEES' in Port of Melbourne Corporation 2007b, above n 1, 214.

[6] Port of Melbourne Corporation 2007a, above n 5, 9-22; Jenkins and McKinnon, above n 5, 20, 136 – 137, 143.

[7] Port of Melbourne Corporation 2007a, above n 5, 12-49.

	Cumulative		Synergistic		Indirect		Combined		Interactive	
Values/ Assets	**Y**	**N**	**Y**	**N**	**Y**	**N**	**Y**	**N**	**Y**	**N**
Anchovy		N[8]			Y[9]					
Seabirds (unspecified)	Y[10]	N[11]			Y[12]					
Penguins		N[13]								
Pied Cormorant		N[14]			Y[15]					
Sygnathids		N[16]			Y[17]					
Nutrient cycling										
Plankton		N[18]			Y[19]					
Seagrass										
Marine Mammals (unspecified)		N[20]			Y[21]	N[22]				
Dolphins					Y[23]					
Marine protected areas		N[24]								
Sessile soft sediment communities	Y[25]	N[26]					Y[27]			

[8] Port of Melbourne Corporation 2007a, above n 5, 12-49 - 12-50, 13-79.
[9] Jenkins and McKinnon, above n 5, 174. (note: light reduction)
[10] Brett Lane & Associates Pty Ltd, above n 4, 289. (Note: potential for greater impact in particular circumstances).
[11] Port of Melbourne Corporation 2007a, above n 5, 13-103.
[12]Brett Lane & Associates Pty Ltd, above n 4, 191, 210, 216, 218 – 220, 234, 265, 271, 283 (note: impact on seabirds: photosynthesis – reduced light from suspended sediment, clogging of organisms, food production).
[13] Port of Melbourne Corporation 2007a, above n 5, 12-62; Simon Mustoe and Nathan Waugh, AES Applied Ecology Solutions Pty Ltd, Marine Mammals and Penguins, in Port of Melbourne Corporation 2007b, above n 1, 144, 154, 166, 174. (Note: CE unlikely).
[14] Port of Melbourne Corporation 2007a, above n 5, 12-56, 13-93.
[15] Ibid, 12-53; Brett Lane & Associates Pty Ltd, above n 4, 219-220, 236. (note: minor)
[16] Port of Melbourne Corporation 2007a, above n 5, 14-31.
[17] Ibid, 9-9.
[18] CEE Consultants Pty Ltd, 'Channel Deepening Project Overview Impact Assessment Plankton Communities' in Port of Melbourne Corporation 2007b, above n 1, 25 – 26, 38.
[19] M Edmunds et al (Australian Marine Ecology), 'Port Phillip Bay Channel Deepening Project Supplementary Environmental Effects Statement – Marine Ecology Specialist Studies Volume 7: Water Column' in Port of Melbourne Corporation 2007b, above n 1, 23, 27; CEE Consultants Pty Ltd, above n 18, 37.
[20] Mustoe and Waugh AES Applied Ecology Solutions Pty Ltd, above n 13, 144, 154, 166, 174. (note: CE unlikely)
[21] Ibid, 124. (note: marine pests cause potential)
[22] Ibid, 3.
[23] Port of Melbourne Corporation 2007a, above n 5, 13-87, 13-88.
[24] Ibid, 14-52.
[25] CEE Consultants Pty Ltd, 'Channel Deepening Project Overview Impact Assessment Sessile Soft Seabed Communities' in Port of Melbourne Corporation 2007b, above n 1, 53 (note: minimal impact).
[26] CEE Consultants Pty Ltd, above n 25, 39.
[27] Ibid, 86, 87. (note: short term impact)

	Cumulative		Synergistic		Indirect		Combined		Interactive	
Values/ Assets	**Y**	**N**	**Y**	**N**	**Y**	**N**	**Y**	**N**	**Y**	**N**
Shallow reef habitat					Y[28]					
Deep reef habitat										
Protected marine fauna (unspecified)										
Ramsar Wetlands (including bird species, flora, fauna (seagrass) and ecological features etc.)					Y[29]	N[30]				
Listed Threatened Species & Communities										
Terrestrial Ecology		N[31]								
General ecosystem/ ecological impacts					Y[32]					
Cumulative effect of noise	Y[33]	N[34]								
Rock fall					Y[35]					
Dredging										
Plumes/ suspended sediment					Y[36]					
Contaminants		N[37]								
Algal Blooms						N[38]				
Oil Spills						N[39]				

[28] M Edmunds et al (Australian Marine Ecology), above n 19, 117.
[29] Port of Melbourne Corporation 2007a, above n 5, 15-12. (note: insignificant)
[30] Ibid, 15-12, 15-13.
[31] Brett Lane & Associates Pty Ltd, above n 4, 14, 288.
[32] Port of Melbourne Corporation 2007a, above n 5, 16-24. (note: short term one- two years)
[33] Ibid, 14-35 (not specified – on noise levels); Mustoe and Waugh, AES Applied Ecology Solutions Pty Ltd, above n 13, 117. (note: dredge plumes)
[34] C Salgado Kent and R D McCauley, 'Underwater Noise Impacts CDP Report 2006' in Port of Melbourne Corporation 2007b, above n 1, 92 (note: 'in addition to that already assessed for individual project areas').
[35] Port of Melbourne Corporation 2007a, above n 5, 14-35. (note: impact on fish)
[36] Ibid, 13-87, 13-88 (note: dolphins); Brett Lane & Associates Pty Ltd, above n 4, 210, 216, 218 – 220, 234, 265 (note: impact on seabirds: photosynthesis – reduced light from suspended sediment, clogging of organisms, food production); Mustoe and Waugh, AES Applied Ecology Solutions Pty Ltd, above n 13, 117 (note: impact on dolphins); Jenkins and McKinnon, above n 5, 174.
[37] Port of Melbourne Corporation, above n 3, 21. (note: food chain)
[38] Brett Lane & Associates Pty Ltd, above n 4, 193. (note: impact on seabirds)
[39] Ibid, 194, 271, 283 (note: impact on seabirds); Brett Lane & Associates Pty Ltd, above n 4, 283 (note: potential major impact on fish).

Appendix C - Horns Rev I & Nysted Offshore Wind Farms environmental monitoring programmes: list of documents reviewed

Wind farm	Document
Horns Rev	*Hydroacoustic Registration of Fish Abundance at Offshore Wind Farms, Annual Report 2004, Horns Rev Offshore Wind Farm*[1]
Nysted	*Annual Status Report Nysted Offshore Wind Farm, Environmental Monitoring Program 2002*[2]
Horns Rev	*Environmental Impact Assessment, Investigation of marine mammals in relation to the establishment of a marine wind farm on Horns Reef, February 2000*[3]
Horns Rev	*Horns Rev Offshore Wind Farm, Environmental Impact Assessment of Sea Bottom and Marine Biology, 2000*[4]
Horns Rev	*Effects of marine windfarms on the distribution of fish, shellfish and marine mammals in the Horns Rev area, May 2000*[5]
Horns Rev	*Basic Study/ Surveillance of Porpoises at Horns Rev* [6]
Horns Rev	*Harbour seal satellite monitoring program, Horns Reef, North Sea*[7]
Horns Rev	*Effects of the Horns Reef Wind Farm on harbour porpoises – Interim report to Elsam Engineering A/S for the harbour porpoise monitoring programme*[8]
Horn Rev	*Elsam Offshore Wind Turbines – Horns Rev: Annual status report for the environmental monitoring programme, 1 January 2004 – 31 December 2004, Report July 2005*[9]
Horns Rev	*Investigations of harbour porpoises at the planned site for wind turbines at Horns Reef: Status report 1/1/2001 – 31/12/2001*[10]

[1] Christian B Hvidt, Lars Brünner and Frank Reier Knudsen, *Hydroacoustic Monitoring of Fish Communities in Offshore Wind Farms, Annual Report 2004, Horns Rev Offshore Wind Farm* (Elsam Engineering, 2005).
[2] Energie2, *Annual Status Report Nysted Offshore Wind Farm, Environmental Monitoring Program 2002* (Energie E2, 2002).
[3] Fisheries and Maritime Museum, Ornis Consult A/S, Zoological Museum (University of Copenhagen), *Environmental Impact Assessment, Investigation of marine mammals in relation to the establishment of a marine wind farm on Horns Reef*, (Fisheries and Maritime Museum, Ornis Consult A/S, Zoological Museum (University of Copenhagen, 2000).
[4] Bio/consult as, *Horns Rev Offshore Wind Farm, Environmental Impact Assessment of Sea Bottom and Marine Biology* (I/S Elsam, 2000).
[5] Danish Institute for Fisheries Research, Department of Marine Fisheries, *Effects of marine windfarms on the distribution of fish, shellfish and marine mammals in the Horns Rev area, Report to Elsamprojekt A/S* (Department of Marine Fisheries, 2000).
[6] Techwise A/S, Basic Study/ Surveillance of Porpoises at Horns Rev (February 2002) <http://www.ens.dk/en/node/2018>.
[7] Svend Tougaard, *Interim Report on Harbour seal satellite monitoring program, Horns Reef, North Sea*, (Fiskeri- og Søfarsmuseet, 2002) <http://www.ens.dk/sites/ens.dk/files/undergrund-forsyning/vedvarende-energi/vindkraft-vindmoeller/havvindmoeller/miljoepaavirkninger/hornsrev1/harbour20seal20satellite20monitoring20program.pdf>.
[8] Jakob Tougaard, Jonas Teilmann, and Jacob Rye Hansen, *Effects of the Horns Reef Wind Farm on harbour porpoises – Interim report to Elsam Engineering A/S for the harbour porpoise monitoring programme* (National Environmental Research Institute, Ministry of the Environment, 2004).
[9] Elsam Engineering A/S, *Elsam Offshore Wind Turbines – Horns Rev: Annual status report for the environmental monitoring programme, 1 January 2004 – 31 December 2004, Report July 2005* <http://www.ens.dk/en/node/2018>.
[10] Henrik Skov et al, *Investigations of harbour porpoises at the planned site for wind turbines at Horns Reef. Status report: 1/1/2001 – 1/4/2002. Technical report for Tech-wise A/S* (Ornis Consult A/S, 2002).

Horns Rev	*Thermal Animal Detection System: Development of a method for estimating collision frequency of migrating birds at offshore wind turbines* [11]
Horns Rev	*First phase of the project 'Development of method for estimating the collision frequency between migrating birds and offshore wind turbines' – the choice of equipment* [12]
Nysted	*Investigations of migratory birds during operation of Nysted offshore wind farm at Rødsand: Preliminary analysis of data from spring 2004*[13]
Horns Rev and Nysted	*Monitoring effects of offshore windfarms on harbour porpoises using PODS (porpoises detectors)*[14]
Rødsand (Nysted)	*Base-line investigations of birds in relation to an offshore wind farm at Rødsand: results and conclusions, 2000*[15]
Rødsand (Nysted)	*Base-line investigations of birds in relation to an offshore wind farm at Rødsand: results and conclusions, 2001*[16]
Rødsand (Nysted)	*Base-line investigations of birds in relation to an offshore wind farm at Rødsand: results and conclusions, 2002*[17]
Nysted	*Annual Status Report Nysted Offshore Wind Farm, Environmental Monitoring Program 2004, January 1st 2004 – December 31st 2004*[18]
Nysted	*Annual Status Report Nysted Offshore Wind Farm, Environmental Monitoring Program 2003, January 1st 2003 – December 31st 2003.*[19]
Nysted	*Nysted Offshore Wind Farm and Rødsand. Annual Status Report for the Environmental Monitoring Program 1st January 1st 2001 – 31st December 2001*[20]
Horns Rev	*Harbour Porpoises on Horns Reef – Effects of the Horns Reef Wind Farm: Annual Status Report 2003 to Elsam Engineering A/S, NERI Technical Report Final version June 2004*[21]

[11] Mark Desholm, *Thermal Animal Detection System (TADS). Development of a method for estimating collision frequency of migrating birds at offshore wind turbines. NERI Technical Report No 440* (National Environmental Research Institute, 2003).

[12] Mark Desholm, *First phase of the project 'Development of a method for estimating collision frequency of migrating birds and offshore wind turbines' – the choice of equipment* (National Environmental Research Institute, 2001).

[13] Johnny Kahlert, Mark Desholm and Ib Clausager, Department of Wildlife Ecology and Biodiversity, NERI Note 2004 (commissioned by Energi E2), Investigations of migratory birds during operation of Nysted offshore wind farm at Rødsand: Preliminary analysis of data from spring 2004, accessed via www.ens.dk/en/node/2018 on 28th May 2013.

[14] Ministry of the Environment, Denmark, *Monitoring effects of offshore windfarms on harbour porpoises using PODS (porpoise detectors): Technical Report* (Ministry of the Environment, Denmark 2002).

[15] Mark Desholm et al, *Base-line investigations of birds in relation to an offshore wind farm at Rødsand: results and conclusions, 2000* (National Environmental Research Institute, Ministry of Environment and Energy (Denmark), 2001).

[16] Johnny Kahlert et al, *Base-line investigations of birds in relation to an offshore wind farm at Rødsand: results and conclusions, 2001* (National Environmental Research Institute & Ministry of Environment and Energy (Denmark), 2002).

[17] Mark Desholm et al, *Base-line investigations of birds in relation to an offshore wind farm at Rødsand: results and conclusions, 2002* (National Environmental Research Institute & Ministry of Environment and Energy (Denmark), 2003).

[18] Energi E2, *Annual Status Report Nysted Offshore Wind Farm, Environmental Monitoring Program 2004, January 1st 2004 – December 31st 2004* (Energi E2, 2005).

[19] Energi E2, *Annual Status Report Nysted Offshore Wind Farm, Environmental Monitoring Program 2003, January 1st 2003 – December 31st 2003* (Energi E2, 2004).

[20] SEAS Wind Energy Centre, *Nysted Offshore Wind Farm and Rødsand. Annual Status Report for the Environmental Monitoring Program 1st January 1st 2001 – 31st December 2001* (SEAS Wind Energy Centre, 2002).

[21] Jakob Tougaard et al, *Harbour Porpoises on Horns Reef – Effects of the Horns Reef Wind Farm: Annual Status Report 2003 to Elsam Engineering A/S, NERI Technical Report Final version June 2004* (National Environmental Research Institute, 2004).

Horns Rev	*Sandeels and clams (Spisula sp.) in the wind turbine park at Horns Reef, report to Techwise April 2003, Preliminary Report*[22]
Horns Rev	*Sandeels in the wind farm area at Horns Reef, report to Elsam August 2004, Final Report*[23]
Horns Rev	*Seals using the Areas of Horns Rev, Satellite Tracking of Seals*[24]
Horns Rev	*Satellite tracking of Harbour Seals on Horns Reef: Use of the Horns Reef wind farm area and the North Sea, Report to Techwise A/S March 2003*[25]
Horns Rev	*Short-term effects of the construction of wind turbines on harbour porpoises at Horns Reef*[26]
Horns Rev	*Offshore Wind Farm. Horns Rev. Annual Status Report for the Environmental Monitoring Programme, 1st January 2001 – 31st December 2001*[27]
Horns Rev	*Modelling total numbers and distribution of Common Scoter Melanitta nigra at Horns Rev 2007* [28]
Horns Rev	*Use of the North Sea by Harbour Seal with special emphasis on the Horns Reef area*[29]
Horns Rev	*Horns Rev Offshore Wind Farm, Annual Status Report for the Environmental Monitoring Programme, 2005*[30]
Nysted	*Investigations of birds during construction and operation at Nysted offshore wind farm at Rødsand, Annual status report 2003*[31]
Horns Rev	*Harbour seals on Horns Reef, before, during and after construction of Horns Rev Offshore Wind Farm*[32]
Horns Rev	*Benthic Communities at Horns Reef, before, during and after construction of Horns Rev Offshore Wind Farm. Final report Annual Report 2005*[33]

[22] Danish Institute for Fisheries Research, Department of Marine Fisheries, *Sandeels and clams (Spisula sp.) in the wind turbine park at Horns Reef, report to Techwise April 2003, Preliminary Report* (Department of Marine Fisheries, 2003).
[23] Danish Institute for Fisheries Research, Department of Marine Fisheries, *Sandeels in the wind farm area at Horns Reef, report to Elsam August 2004, Final Report,* (Department of Marine Fisheries, 2004).
[24] Techwise, *Report: Seals using the Areas of Horns Rev, Satellite Tracking of Seals* (February 2002) <http://www.ens.dk/en/node/2018>.
[25] Jakob Tougaard et al, *Satellite tracking of Harbour Seals on Horns Reef: Use of the Horns Reef wind farm area and the North Sea, report to Techwise A/S, Biological Papers from the Fisheries and Maritime Museum, Esberg. No. 3* (Fisheries and Maritime Museum, 2003).
[26] Jakob Tougaard et al, *Short-term effects of the construction of wind turbines on harbour porpoises at Horns Reef. Technical report to TechWise A/S* (Techwise, 2002).
[27] Techwise, *Elsam. Offshore Wind Farm. Horns Rev. Annual Status Report for the Environmental Monitoring Programme, 1st January 2001 – 31st December 2001 (Replace Report)* (October 2002) <http://www.ens.dk/en/node/2018>.
[28] Ib Krag Petersen, 2007, *Modelling total numbers and distribution of Common Scoter Melanitta nigra at Horns Rev 2007* (National Environmental Research Institute, University of Aarhus, 2007).
[29] Svend Tougaard and Jakob Tougaard, *Use of the North Sea by Harbour Seal with special emphasis on the Horns Reef area – Test of prototype GPS/GSM – transmitter on harbour seals in the Sealarium, Esbjerg. Annual Status Report for 2003 to Elsam Engineering A/S* (Elsam Engineering, 2004).
[30] Vattenfall A/S, *Horns Rev Offshore Wind Farm, Annual Status Report for the Environmental Monitoring Programme, 2005* (The Environmental Committee of the Danish Offshore Wind Farm Demonstration Projects, November 2006).
[31] Johnny Kahlert et al, *Investigations of birds during construction and operation at Nysted offshore wind farm at Rødsand, Annual status report 2003* (National Environmental Research Institute, Ministry of the Environment, 2004).
[32] Jakob Tougaard et al, *Harbour seals on Horns Reef, before, during and after construction of Horns Rev Offshore Wind Farm. Final report to Vattenfall A/S. Biological Papers from the Fisheries and Maritime Museum No. 5, Esbjerg, Denmark* (Fisheries and Maritime Museum, October 2006).
[33] Simon B Leonhard and John Pedersen, *Benthic Communities at Horns Reef, before, during and after construction of Horns Rev Offshore Wind Farm. Final report Annual Report 2005* (Vattenfall, 2006).

Horns Rev	*Hydroacoustic Monitoring of Fish Communities at Offshore Wind Farms, Horns Rev Offshore Wind Farm, Annual Report 2005*[34]
Nysted	*Life Cycle Assessment of a 150MW Offshore Wind Turbine Farm at Nysted Rødsand, Denmark*[35]
Nysted	*TADS investigations of avian collision risk at Nysted offshore wind farm, autumn 2004*[36]
Nysted	*Preliminary investigations of bird-turbine collisions at Nysted offshore wind farm and final quality control of Thermal Animal Detection Systems (TADS), Autumn 2003 and Spring 2004*[37]
Horns Rev 1	*Effect of the Horns Rev 1 Offshore Wind Farm on Fish Communities. Follow-up Seven Years after Construction*[38]
Horns Rev & Nysted	*Offshore Wind Farms and the Environment: Danish Experiences from Horns Rev and Nysted*[39]
Horns Rev & Nysted	*Danish Offshore Wind: Key Environmental Issues – a Follow-up*[40]
Horns Rev	*Harbour Porpoises on Horns Reef – Effects of the Horns Reef Wind Farm, Annual Status Report 2004 to Elsam Engineering, NERI Technical Report July 2005*[41]
Horns Rev	*Harbour Porpoises on Horns Reef – Effects of the Horns Reef Wind Farm, Annual Status Report 2004 to Elsam Engineering, Final Report to Vattenfall A/S*[42]
Horns Rev & Nysted	*Review Report 2005, The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farms – Environmental impact assessment and monitoring*[43]
Horns Rev & Nysted	*Review Report 2004, The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farms – Environmental impact assessment and monitoring*[44]

[34] Christian B Hvidt et al, *Hydroacoustic Monitoring of Fish Communities at Offshore Wind Farms, Horns Rev Offshore Wind Farm, Annual Report 2005*, (Vattenfall, 2006).
[35] Scott Properzi and Helle Herk-Hansen (Energi E2), *Life Cycle Assessment of a 150MW Offshore Wind Turbine Farm at Nysted Rødsand, Denmark, Presented at European Wind Energy Conference and Exhibition, Copenhagen, Denmark. 4 July 2001*) <http://www.ens.dk/en/node/2018>.
[36] Mark Desholm, *TADS investigations of avian collision risk at Nysted offshore wind farm, autumn 2004* (National Environmental Research Institute/ Ministry of the Environment - Denmark, 2005).
[37] Mark Desholm, *Preliminary investigations of bird-turbine collisions at Nysted offshore wind farm and final quality control of Thermal Animal Detection Systems (TADS), Autumn 2003 and Spring 2004* (National Environmental Research Institute/ Ministry of the Environment (Denmark), 2005).
[38] Simon B Leonhard, Claus Stenberg and Jossiane Støttrup (eds), *Effect of the Horns Rev 1 Offshore Wind Farm on Fish Communities. Follow-up Seven Years after Construction* (Danish Energy Authority, 2011)
[39] Danish Energy Authority, *Offshore wind farms and the environment – Danish Experience from Horns Rev and Nysted* (Danish Energy Authority, 2006).
[40] Danish Energy Agency, *Danish Offshore Wind. Key Environmental Issues – a Follow-up* (The Environmental Group: The Danish Energy Agency, The Danish Nature Agency, Dong Energy and Vattenfall, 2013).
[41] Jakob Tougaard et al, *Harbour Porpoises on Horns Reef – Effects of the Horns Reef Wind Farm, Annual Status Report 2004 to Elsam Engineering* (National Environmental Research Institute, 2005).
[42] Jakob Tougaard et al, *Harbour Porpoises on Horns Reef – Effects of the Horns Reef Wind Farm, Final Report to Vattenfall A/S*, (National Environmental Research Institute, November 2006).
[43] DONG Energy and Vattenfall A/S, *Review Report 2005, The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farms – Environmental impact assessment and monitoring* (The Environmental Group of the Danish Offshore Wind Farm Demonstration Projects, 2006).
[44] Elsam Engineering and ENERGI E2, *Review Report 2004, The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farms – Environmental impact assessment and monitoring, prepared for The Environmental Group of the Danish Offshore Wind Farm Demonstration Projects* (Elsam Engineering and ENERGI E2, 2004).

Horns Rev & Nysted	*Review Report, The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farms – Environmental impact assessment and monitoring, September 2003*[45]
Horns Rev & Nysted	*Review Report 2003, The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farms – Environmental impact assessment and monitoring, September 2004*[46]
Horns Rev & Nysted	*Review Report 2004. The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farm Environmental Impact Assessment and Monitoring. Report prepared for the environmental Committee of the Danish Offshore Wind Farm Demonstration Projects*[47]
Horns Rev & Nysted	*Review Report, The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farms – Environmental impact assessment and monitoring, February 2002*[48]
Horns Rev & Nysted	*Summary on harbour porpoise monitoring 1999 – 2006 around Nysted and Horns Rev Offshore Wind Farms: Report to Energi E2 A/S and Vattenfall A/S, Ministry of the Environment, Denmark, November 2006*[49]
Horns Rev & Nysted	*Summary on seal monitoring 1999 – 2005 around Nysted and Horns Rev Offshore Wind Farms: Technical report to Energi E2 A/S and Vattenfall A/S, Ministry of the Environment, Denmark, November 2006*[50]
Horns Rev & Nysted	*Final results of bird studies at the offshore wind farms at Nysted and Horns Rev, Denmark, NERI Report, Commissioned by DONG energy and Vattenfall A/S, 2006*[51]
Horns Rev 1	*Changes in bird habitat utilisation around the Horns Rev 1 offshore wind farm, with particular emphasis on Common Scoter: Report request. Commissioned by Vattenfall A/S, 2007*[52]

[45] ENERGI E2 and Tech-Wise, *Review Report, The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farms – Environmental impact assessment and monitoring, prepared for The Environmental Group*, (The Environmental Group, 2003).

[46] Elsam Engineering and ENERGI E2, *Review Report 2003, The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farms – Environmental impact assessment and monitoring* (The Environmental Group, September 2004).

[47] Energi E2 A/S, *Review Report 2004. The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farm Environmental Impact Assessment and Monitoring. Report prepared for the environmental Committee of the Danish Offshore Wind Farm Demonstration Projects* (Energi E2 A/S, 2005).

[48] SEAS Wind Energy Centre, *Review Report, The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farms – Environmental impact assessment and monitoring* (The Environmental Group, 2002)

[49] Jonas Teilmann, Jakob Tougaard and Jacob Carstensen, Summary on harbour porpoise monitoring 1999 – 2006 around Nysted and Horns Rev Offshore Wind Farms: Report to Energi E2 A/S and Vattenfall A/S (Ministry of the Environment, Denmark, 2006).

[50] Jonas Teilmann et al, *Summary on seal monitoring 1999 – 2005 around Nysted and Horns Rev Offshore Wind Farms: Technical report to Energi E2 A/S and Vattenfall A/S* (Ministry of the Environment, Denmark, 2006).

[51] Ib Krag Petersen et al, *Final results of bird studies at the offshore wind farms at Nysted and Horns Rev, Denmark* (National Environmental Research Institute and Ministry of the Environment, 2006) 150.

[52] Ib Krag Petersen and Anthony D Fox, *Changes in bird habitat utilisation around the Horns Rev 1 offshore wind farm, with particular emphasis on Common Scoter: Report request. Commissioned by Vattenfall A/S*, (National Environmental Research Institute, 2007).

Horns Rev I	*Food Resources for Common Scoter: Horns Reef Monitoring 2009 – 2010, Report commissioned by the Environmental Group as part of the environmental monitoring programme for large scale offshore wind farms in Denmark*[53]
Horns Rev and Nysted	*Effects of wind farms on harbour porpoise behaviour and population dynamics. Report commissioned by The Environmental Group under the Danish Environmental Monitoring Programme. Scientific Report from Danish Centre for Environment and Energy No. 1* [54]
Horns Rev and Nysted	*Report on a Red-throated Diver Agent-based Model to assess cumulative impact from offshore wind farms*[55]

[53] Simon B Leonhard and Henrik Skov (eds), *Food Resources for Common Scoter: Horns Reef Monitoring 2009 – 2010. Orbicon, DHI, Wageningen IMARES. Report commissioned by the Environmental Group through contract with DONG Energy* (The Danish Energy Authority, 2012).
[54] Jacob Nabe-Nielsen, Jakob Tougard, Jonas Teilmann, and Signe Sveegaard, *Effects of wind farms on harbour porpoise behaviour and population dynamics. Report commissioned by The Environmental Group under the Danish Environmental Monitoring Programme. Scientific Report from Danish Centre for Environment and Energy No. 1* (Danish Centre for Environment and Energy, Aarhus University, 2011).
[55] Chris Topping and Ib Krag Petersen, *Report on a Red-throated Diver Agent-based Model to assess cumulative impact from offshore wind farms* (Danish Centre for Environment and Energy (Aarhus University), 2011).