6. State of the Environment Reporting: A natural capital accounting approach

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Summary

The Australian Capital Territory (ACT) Office of the Commissioner for Sustainability and the Environment (OCSE) developed a set of natural capital accounts (NCA) using the System of Environmental-Economic Accounting for State of the Environment (SoE) reporting in the ACT. In developing the accounts, the OCSE sought to better link environmental information with policy development and sustainability goals while also maintaining legislated environmental reporting requirements and building local capacity. These accounts, released along with a "Proof of Concept" paper for expert and public review, represent the first time that an Australian jurisdiction has attempted to include NCA in regular environmental reporting.

Working with local and federal agencies, the OCSE produced NCA across seven environmental themes: land, environmental condition, biodiversity, water, air, solid waste and environmental expenditure. These used both the SEEA Central Framework and SEEA Experimental Ecosystem Accounting frameworks, employing novel data sets, experimental designs and methodologies not previously used in the production of accounts. The accounts developed and published in the Proof of Concept have provided a valuable tool to initiate dialogue with data custodians and potential users including government, business and community decision makers. Importantly, high-level officials have recognized the importance of the accounts in delivering environmental information in a form which can better inform policy development and sustainability goals.

6.1 Introduction

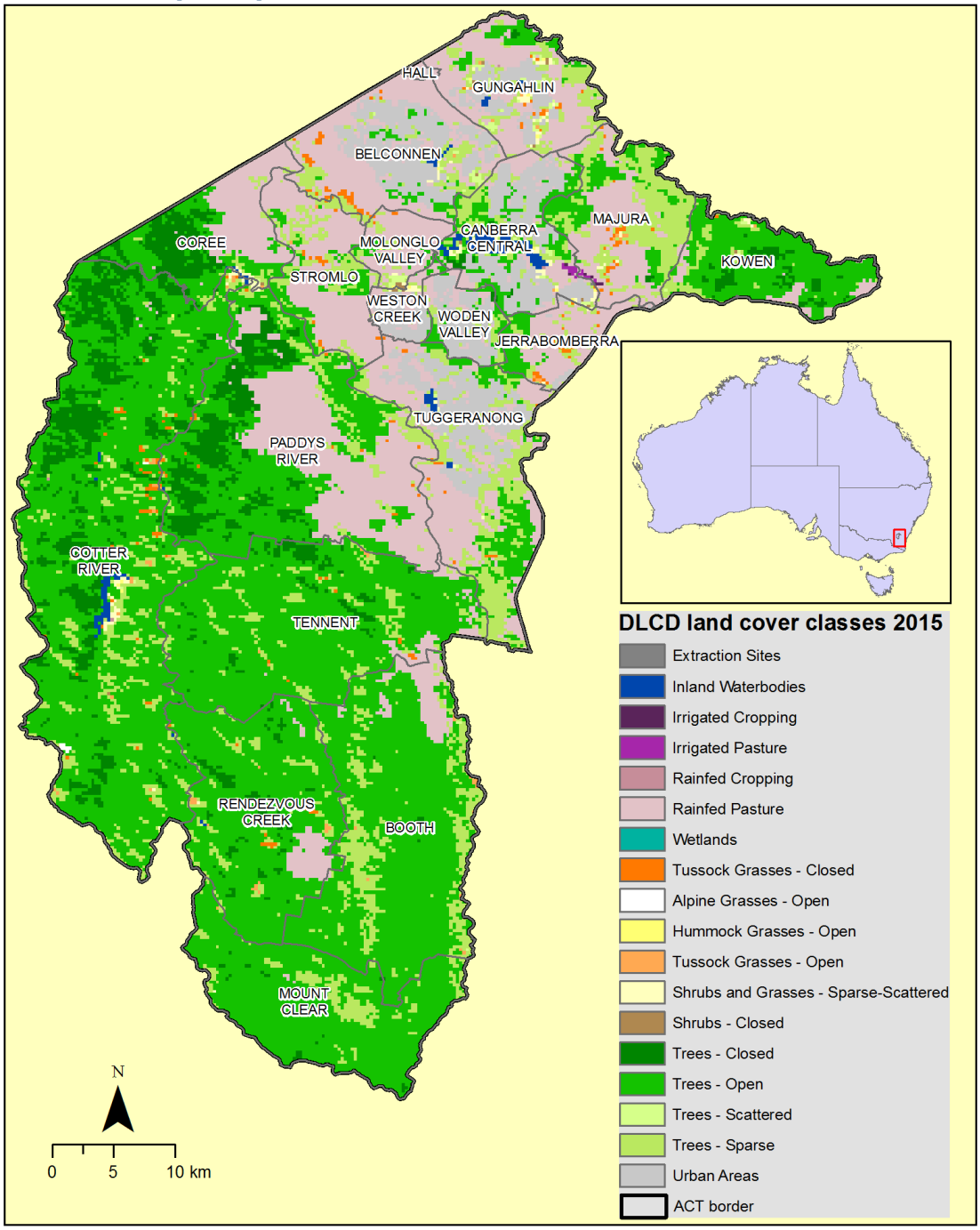
In 2016, at the 1st Forum on Natural Capital Accounting for Better Policy Decisions, we presented plans to use natural capital accounting for State of the Environment (SoE) reporting in the Australian Capital Territory (ACT) (see Smith et al., 2017a). This year we are pleased to report that we successfully executed the plans and, in September 2017, produced a first set of accounts along with a "Proof of Concept" paper. Both the accounts and Proof are now available for expert and public review (Smith et al., 2017b). The accounts were presented to a variety of people, including the ministers responsible for planning and the environment.

In this note we highlight lessons and achievements over the course of the project for development, communication and use of the accounts. The term "environmental-economic accounts" or EEA is used in this paper and other reports prepared as part of this project. For us, EEA and NCA are synonymous.

6.2 Background

The ACT holds a unique place in the Australian cultural and natural landscape. It is a small landlocked jurisdiction dominated by an extensive system of national reserves juxtaposed against the city of Canberra, which is Australia's national capital (Fig. 6.1). Local residents place a high value on environmental health and natural capital, and the ACT Government has set ambitious policy and sustainability goals to guide future development (ACT Government, 2009; OCSE, 2017b). These goals focus on economically, socially and environmentally sustainable policy outcomes that align well with the United Nations Sustainable Development Goals (SDGs). However, despite significant advancements in some areas, the ACT still faces challenges in meeting some of these goals.

Figure 6.1 Australian Capital Territory and dynamic land cover data set (DLCD) classes for 2015



Canberra is a low-density city by national and international standards. It is subject to many related sustainability issues, particularly around transport inefficiencies, waste disposal and energy use (Minister's Annual Report, 2016). The ACT has the highest ecological footprint of all Australian states and territories (ISARG, 2015) and this footprint is much higher than most similar international jurisdictions (Global Footprint Network, 2016). The city of Canberra is also growing rapidly with the population expected to rise from 409,100 to 500,000 by 2030 (ABS, 2013). Much of that growth is expected in greenfields developments with flow-on consequences for the environment, especially for transport and clearing of native vegetation. Furthermore, with world-leading greenhouse gas emissions reduction targets (EPSDD, 2014), air emissions are of particular policy relevance to the ACT.

In 2016, the ACT Office of the Commissioner for Sustainability and the Environment (OCSE) undertook an effort to incorporate national carbon accounting into its regular environmental reporting. The inception and initial stages of this plan were reported by Smith et al. (2017a) which provides extensive background material explaining the boundaries and motivations of the study, as well as the establishment of working groups, communications and engagement strategies, and the rationale for selecting the System of Environmental-Economic Accounts (SEEA). Following this, the OCSE undertook a pilot study to produce an initial set of environmental-economic accounts (EEA) for the ACT (from here "ACT EEA") (OCSE, 2017a). The OCSE also published the "Environmental-Economic Accounts for ACT State of the Environment Reporting: Proof of Concept" (Smith et al., 2017b) ("Proof of Concept") to report on the process and identify benefits and challenges for implementing EEA for the ACT SoE reporting.

6.3 Environmental reporting: The State of the Environment Report

The OCSE produces a quadrennial report called the "State of the Environment" (SoE) report. The next report is due in 2019. The SoE is intended to provide the basis for measurable, transparent and rigorous policy development and facilitate sustainable development outcomes. The content of the SoE report is stipulated by the Commissioner for Sustainability and the Environment Act 1993 (ACT). Over time, concerns have been raised that SoE reporting processes have not always provided the most suitable instrument to inform policy and help the ACT Government achieve sustainability goals.

Previous SoE reports in the ACT and elsewhere typically rely on versions of pressure-state-response models and do not address complex interactions or produce analysis that assists in developing policy. Rather, these kinds of models have been found to be over-simplistic and at risk of bias, reporting outcomes that promote linear causal relationships for what are inherently complex systems (Carr, 2010; Carr et al., 2007; Ness et al., 2010). Furthermore, there has been a reliance on ad hoc studies and data sources with little to no continuity between reports. This makes any sort of temporal analysis or comparison difficult, in turn restricting evidence-based policy development.

To address these concerns, the OCSE joined with the Australian National University and the Australian Bureau of Statistics and others as part of a broader discussion in Australia in which we are considering the practical application and incorporation of environmental information in economic and policy decision making (Vardon et al., 2016). To this end, the OCSE undertook to develop a suite of EEA for the ACT to overcome some of the limitations of the current SoE reporting while still meeting its legislated reporting requirements.

The SEEA provided the definitions and the structures for the organization of data for the ACT EEA. The SEEA was chosen because it supports integration with the national accounts and other economic

data, as well as comparison of results with other jurisdictions and countries producing accounts and, where applicable, will support integration and analysis across themes.

The broad aims of the project were to:

- Develop a suite of EEA for the ACT
- Assess the ability of EEA to meet the OCSE's statutory reporting obligations
- Test the practical issues related to producing the environmental-economic accounts,
- Identify and understand required processes necessary for ongoing implementation of environmental-economic accounts
- Provide a suite of accounts that would instigate discussion
- Allow for exploration of how environmental-economic accounts might be used in broader government, business and community decision making
- Assess the advantages and disadvantages of EEA with regard to previous SoE reporting methodologies

6.4 Development of the ACT environmental-economic accounts

Environmental-economic accounts for Canberra and the ACT were produced across seven different themes. These themes were land, environmental condition, biodiversity, water, air, solid waste and environmental expenditure (Table 6.1).

The accounts were developed through an iterative process. Initial designs were developed by the working group before consultation with relevant government managers and data custodians to explore available data and refine account categories and metrics. Draft accounts were then populated before once more being reviewed and modified appropriately.

In most instances, this process resulted in accounts that followed existing SEEA practices and methodologies. In some cases, we brought together and had to actually build new data sets from raw data held by government. We also had to develop experimental accounting designs to bring the data into alignment and exploit its potential for accounting purposes. All this negotiation prompted us to design organizational consultation methodologies which more actively contributed to gaining, exploring and reporting data sets.

This paper is intended to provide information on the policy links and process and not the detail of the data sources and methods, which can be found elsewhere (Smith et al., 2017b). Table 1 provides a summary of the each of the accounts created and brief notes on data sources. In addition, given the new data, methods and accounting format, we provide a brief description of the experimental Environmental Condition account below.

6.5 Environmental condition accounts

Three environmental domains were covered in the experimental environmental condition accounts: terrestrial (land) condition, water condition, and atmosphere condition. These accounts were largely experimental, sourcing data that was not previously explored in SEEA but also offering considerable insight into environmental trends not previously examined in this application.

The terrestrial condition account was developed using the experimental Environmental Condition Score (ECS). The ECS was calculated as the average of six indicators developed from tree cover, soil exposure, leaf area, river inflow, inundation and carbon uptake (Fig. 6.2). These indicators were selected for the ECS because they capture changes in land cover type as well as responses to changing environmental conditions. Several of these indicators are correlated to water availability, a

primary driver of environmental condition in Australia, but they also reflect land management and the broader consequences of environmental policy such as land clearing regulations. The underlying data behind these indicators were created using satellite remote-sensing and landscape modelling, and are available through Australia's Environmental Explorer (Van Dijk and Summers, 2017). A comprehensive explanation of the ECS and the data used to calculate it can be found at Australian Environmental Explorer (Van Dijk and Summers, 2017).

Figure 6.2 Environmental condition score and individual indicators for the Australian Capital Territory, 2000-2016

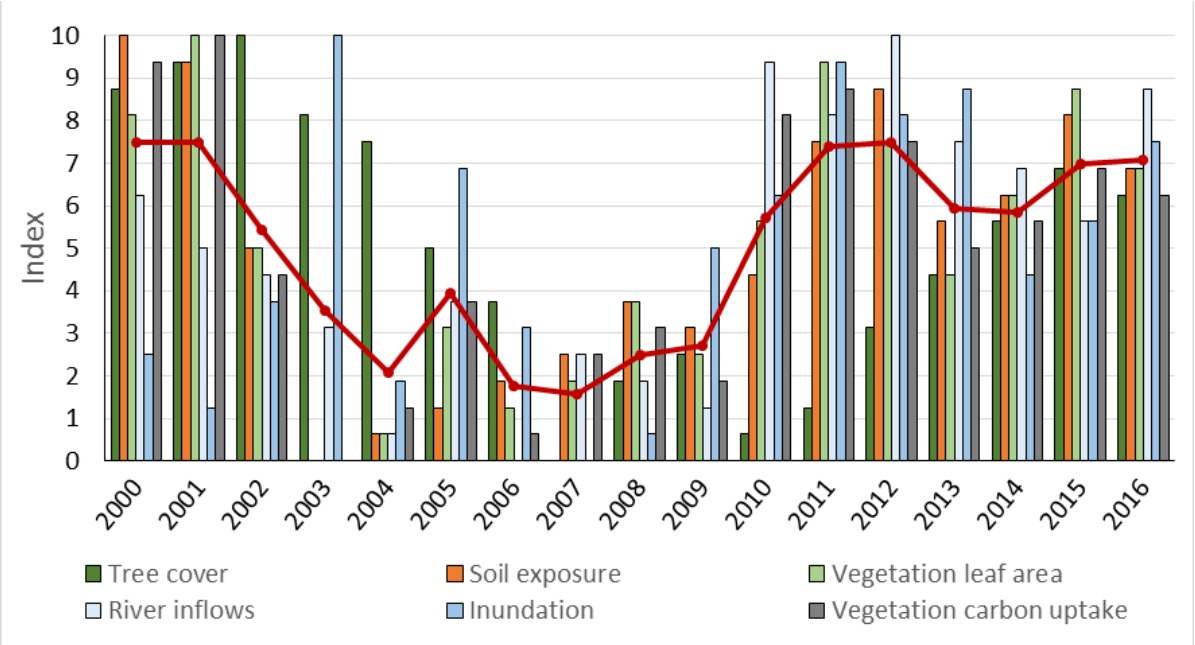


Table 6.1 ACT environmental-economic accounts for State of the Environment reporting accounts summary

Themes	Account	Notes and data sources
Land	Land cover	Geoscience Australia Dynamic land cover data set (Lymburner et al., 2011) (Fig. 1)
	Land use	ACT Territory Plan land use zoning (ACT Government, 2017)
Environmental condition	Terrestrial condition	Environmental Condition Score (ECS) (Van Dijk and Summers, 2017)
	Water condition	Catchment Health Indicator Program (CHIP) developed by the Upper Murrumbidgee Waterwatch Program (Upper Murrumbidgee Waterwatch, 2016)
	Atmospheric condition	Atmospheric carbon dioxide concentration and National Environment Protection Ambient Air Quality Measure (AAQ NEPM) substances; carbon monoxide (CO), ozone (O_3), total volatile organic compounds (TVOC) and particulate matter at 10 µm (PM10) and 2.5 µm (PM2.5) (Department of Environment and Energy, 2016)
Biodiversity	Threatened species	ACT Government legislative instruments that outline conservation policy for species and threatened communities
Water	Physical supply and use	Australian Bureau of Statistics (ABS) Water Account (ABS, 2016) and the Australian Bureau of Meteorology (BoM) National Water Account (BOM, 2016)
	Water asset	Australian Bureau of Statistics (ABS) Water Account (ABS, 2016) and the Australian Bureau of Meteorology (BoM) National Water Account (BOM, 2016)
Air emissions	Greenhouse gas emissions	A range of greenhouse gases recorded as carbon dioxide equivalents (CO_2^e): carbon dioxide (CO_2), methane (CH_4) nitrous oxide (N_2O), sulfur hexafluoride (SF_6) and hydrofluorocarbons. Sourced from ACT Government reports (Pitt and Sherry, 2015) and National greenhouse gas reporting
	Air pollution emissions	Based on the actual emissions of AAQ NEPM substances including; CO, oxides of nitrogen, total volatile organic compounds (TVOC), PM10 and PM2.5 (Department of Environment and Energy, 2016)
Solid waste	Physical supply and use	Australian Bureau of Statistics (ABS) Water Account (ABS, 2016) and the Australian Bureau of Meteorology (BoM) National Water Account (BOM, 2016)
Environmental expenditure	Environmental expenditure	Developed to identify and measure the ACT Government activity with regard to environmental protection and natural resource management services. The account is based on the Classification of Environmental Activities (CES) outlined in the SEEA.
	Value of volunteering	Estimates of the value of volunteer labor to environmental protection and natural resource management. This extension beyond the SEEA is consistent with general national accounting principles and gives important insights into the ways environmental policy objectives may be advanced

The water condition account was developed using the data from the Catchment Health Indicator Program (CHIP) developed by the Upper Murrumbidgee Waterwatch Program (Upper Murrumbidgee Waterwatch, 2016). The CHIP methodology assesses water quality (pH, electrical conductivity, turbidity, phosphorus, nitrates and dissolved oxygen), macro-invertebrates, and riparian condition through time and at numerous sampling sites across the ACT water catchment areas. Indices based on each of these components were combined as weighted averages to provide a single condition index for the account.

The atmosphere condition account consisted of two separate metrics. The first measured the changing concentration of CO_2 in the atmosphere, while the second measured air quality standards that relate to human health. Specifically, National Environment Protection Ambient Air Quality Measure (AAQ NEPM) substances; carbon monoxide (CO), ozone (O_3), total volatile organic compounds (TVOC) and particulate matter at 10 µm (PM10) and 2.5 µm (PM2.5) were used. The metric was based on the number of days that quality standards were exceeded.

6.6 Achievements and lessons

This initial set of ACT EEA was developed to explore the opportunities and challenges of EEA for the ACT SoE reporting. Identifying achievements and lessons through this process is particularly important in embedding the accounts within regular environmental reporting. The successful development of the first suite of accounts was an important step in itself.

The accounts were created by a small multi-disciplinary collaboration of government agencies and academics, demonstrating that it is both practical and feasible to build the accounts with available data and expertise. Furthermore, the ACT EEA and the Proof of Concept provide examples that can be used to establish and maintain dialogue with potential users of the accounts in the ACT (government, business and community decision makers) as well as the data custodians who are critical for ongoing data collection and account design.

High-level officials have uniformly recognized the importance of delivering environmental data in a form which appeals to the needs of the agencies of central government, in this case Treasury and Department of the Chief Minister. Discussions building these relationships continued throughout the development of the ACT EEA and prompted a clearer understanding of the benefits of data sharing and consolidation into accounts. A meeting with ACT Chief Financial Officers was productive, and there was wider engagement and briefings about the Proof of Concept, provided to ministers and ministerial advisers. These discussions have generated further interest in how the accounts might be deployed in decision making and policy contexts. Further briefings have been scheduled.

Through developing the accounts, the working group also established constructive relationships with relevant policy and technical stakeholders including field staff, data producers, collators and archivists. The iterative process of creating the accounts built collaborative relationships with these stakeholders, who have in turn acquired skills and understanding of EEA for improving environmental policy. It also facilitated dialogue and awareness raising about how data collection can be optimized for future accounting applications. Stakeholders have embraced the prospect of reaching a wider audience and finding greater traction by adopting an accounting methodology.

The environmental-economic accounts developed for the ACT SoE demonstrated their value as a mechanism for interpreting and analyzing environmental, social and economic indicators. Previous SoE reports had relied primarily on narrative or discourse analysis and interpretation to explain the linkages and interconnections between indicators. This limited the ability of state of the environment report developers and authors to provide objective and precise analysis, interpretation of the data and its relationship with different indicators. This restriction extended to the value of SoE reporting for policy

and decision making. EEA largely overcomes this problem by a providing the mechanism by which social, economic and environmental indicators can be quantitatively and objectively linked.

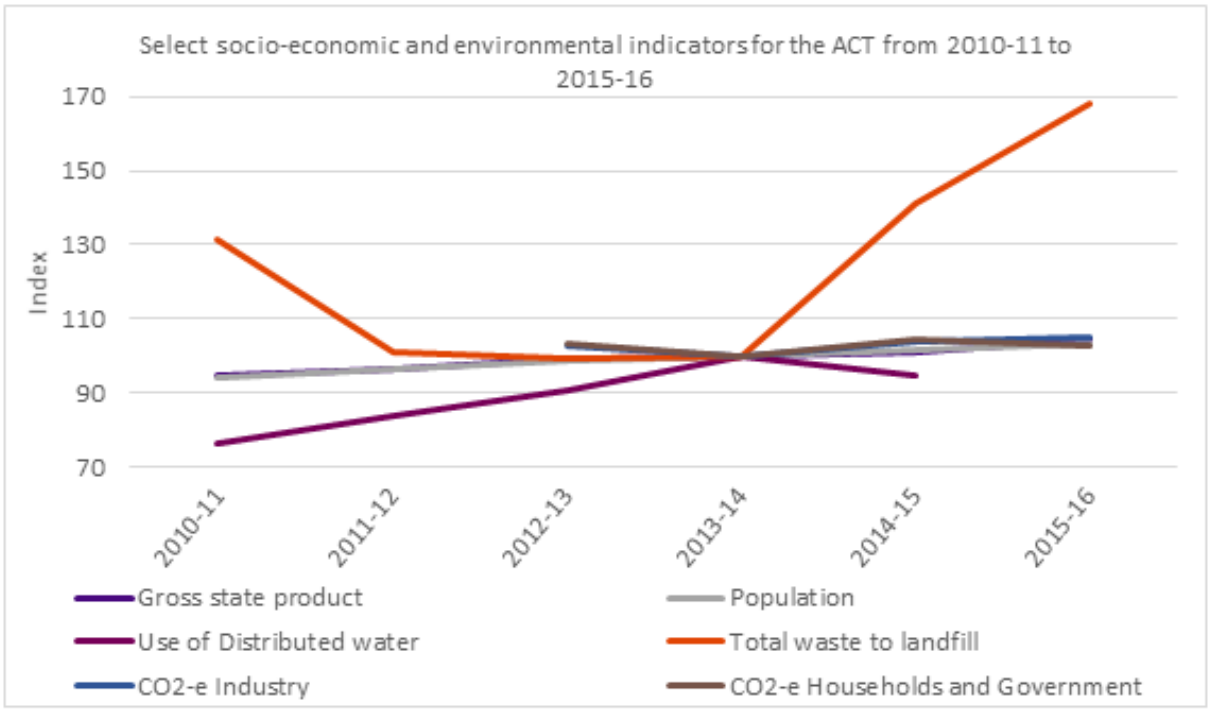
6.7 Linking socio-economic and environmental indicators for improved policy and decisionmaking

The primary goal in implementing EEA within the SoE report is to better link environmental information with environmental policy development and decision making. The following case studies from the Proof of Concept illustrate how accounts can combine indicators from environmental, social and/or economic components of sustainability to produce a quantitative picture of state, trends and relationships.

Case study – Decoupling

Decoupling, as identified by Smith et al. (2017b), refers to the ability of an economy to grow without corresponding increases in environmental pressure. Using socio-economic data from the Australian Bureau of Statistics we were able to observe decoupling trajectories across a number of sectors for the Proof of Concept. The policy uses of this information are of much significance to the ACT given its well-above national average rates of consumption and high ecological footprint (ISARG, 2015). The preliminary findings in Figure 6.3 show ACT decision makers that environmental pressures, as identified by waste, CO_2 emissions, and water use, are (variously) increasing at a rate faster, or equal to, economic growth. Such a scenario places pressure on the environment and is potentially unsustainable. It also conflicts with the ACT Government's triple bottom line and sustainability policy (ACT Government, 2009). Policy and decision makers would be further able to use these findings to determine why these adverse trends are occurring and develop necessary strategies or policies in response.

Figure 6.3 Select socio-economic and environmental indicators for the ACT from 2013-14 to 2015-16



Case study – Valuing environmental volunteering

An important achievement was the incorporation of the value of volunteering in the environmental expenditure account which revealed the importance of this previously unrecognized or quantified contribution. It is clear that environmental volunteering is "worth" millions of dollars to governments (across the whole country) which increasingly need to service environmental issues (particularly as a result of climate change). The usefulness of this account from a policy point of view is that we know that environmental coordinator positions in Australia – vis Landcare coordinators, Frog and WaterWatch coordinators – have often been the positions which are lost in times of budgetary constraints. The environmental volunteers account can be used to argue that the paid coordinators' roles must be retained as it is their coordination function which makes the volunteering beneficial. We have already been made aware of this account being cited in the budget submission of environmental non-government organization and the account has been persistently raised in discussions about policy development in respect of volunteering.

It is clear that environmental volunteering has even more direct policy implications when we consider the role of organizations such as the Great Aussie Bird Count, Red Map, Friends of the Beware Reef, and WaterWatch. Local and regional volunteers are able to undertake regular surveys and respond quickly to survey windows in ways that are impractical or prohibitively expensive for paid employees. In Gippsland Victoria, for example, Beware Reef volunteers are able to regularly access the reef and carry out fish surveys taking advantage of calm seas when opportunity arises. They then feed the data back to researchers hundreds of kilometers away, who would otherwise not have been able to collect it.

6.8 Future Directions

While the Proof of Concept has produced an initial set of environmental accounts, there is much work to be done before the release of the next SoE. Further research and development is required to extend some of the current accounts and develop new accounts not included in the current release. There is also a need to assess how the data and understanding from previous SoE reports can be integrated into a new framework based on NCA. This work needs to be considered iterative and, as Vardon et al. (2016) identify, framed within the context of "decision-centered design."

To this end, efforts are underway to compare the accounting in the Proof of Concept with past reports, improve the accounting already produced, and extend the range of accounts produced. For example, it would be useful to extend the ecosystem condition accounts to better capture biodiversity and to add monetary and valuation components to the land and water accounts. We also intend to develop an energy account and ecosystem service accounts.

6.9 Acknowledgements

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6.10 References

Commissioner for sustainability and the environment act 1993, 1993, ACT, Australian Capital Territory

ABS, Australian Bureau of Statistics, 2013. Population projections, Australia, 2012 to 2101, cat. No. 3222.0. http://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/3222.0Main%20Features12012%20(base)%20to%202101?opendocument&tabname=Summary&prodno=3222.0&issue=2012%20(base)%20to%202101&num=&view=. Accessed on 24 October 2017.

ABS, Australian Bureau of Statistics, 2016. Water account, Australia, 2014-15, cat. No, 4610.0. http://www.abs.gov.au/ausstats/abs@.nsf/mf/4610.0. Accessed on 1 August 2017.

ACT Government, 2009. People, place, prosperity: The ACT's sustainability policy, Canberra, Australia. http://www.cmd.act.gov.au/__data/assets/pdf_file/0003/119730/people_place_prosperity.pdf.

ACT Government, 2017. Territory plan land use zones. http://actmapi-actgov.opendata.arcgis.com/datasets/acee3284096d496bb9eb74ca90b4faf7_3.

BOM, Bureau of Meteorology, 2016. National water account 2016. http://www.bom.gov.au/water/nwa/2016/canberra/index.shtml. Accessed on 1 August 2017.

Carr, E.R., 2010. The place of stories in development: Creating spaces for participation through narrative analysis. Development in Practice 20(2) 219-226.

Carr, E.R., Wingard, P.M., Yorty, S.C., Thompson, M.C., Jensen, N.K., Roberson, J., 2007. Applying dpsir to sustainable development. International Journal of Sustainable Development & World Ecology 14(6) 543-555.

Department of Environment and Energy, 2016. National pollution inventory database, Australian Government Department of Environment and Energy, Canberra, Australia. http://npi.gov.au/npi-data/latest-data.

EPSDD, Environment, Planning and Sustainable Development Directorate, 2014. Carbon neutral ACT government framework ACT Government, Canberra, Australia. http://www.environment.act.gov.au/__data/assets/pdf_file/0020/630065/Carbon-Neutral-ACT-Government-Framework_ACCESS_aug.pdf.

Global Footprint Network, 2016. National Footprint Accounts 2016, Open Data Platform. http://data.footprintnetwork.org. Accessed on 24 October 2017.

ISARG, Integrated Sustainability Analysis Research Group, 2015. The 2011-12 ecological footprint of the population of the Australian Capital Territory. University of Sydney, Sydney, Australia. http://www.environmentcommissioner.act.gov.au/__data/assets/pdf_file/0007/825406/2011-12-Ecological-Footprint-ACT-for-2015-ACT-SoER.pdf.

Lymburner, L., Tan, P., Mueller, N., Thackway, R., Lewis, A., Thankappan, M., Randall, L., Islam, A., Senarath, U., 2011. The national dynamic land cover dataset. Geoscience Australia, Canberra, Australia.

Minister's Annual Report, 2016. Minister's annual report: Climate change and greenhouse gas reduction act 2010. http://www.environment.act.gov.au/home/latest_news/201516-ministers-annual-report-climate-change-and-greenhouse-gas-reduction-act.

Ness, B., Anderberg, S., Olsson, L., 2010. Structuring problems in sustainability science: The multi-level dpsir framework. Geoforum 41(3) 479-488.

OCSE, Office of the Commissioner for Sustainability and the Environment, 2017a. Environmental-economic accounts for the ACT, Canberra, Australia. http://www.environmentcommissioner.act.gov.au/publications/environmental-economic-accounts.

OCSE, Office of the Commissioner for Sustainability and the Environment, 2017b. Implementation status review of ACT government's climate change policy. Office of the Commissioner for Sustainability and the Environment, Canberra, Australia. http://www.environmentcommissioner.act.gov.au/__data/assets/pdf_file/0018/1116324/CSE-ISR-Report-Aug2017_FA_AccPDF_c2.pdf.

Pitt and Sherry, 2015. Interim ACT greenhouse gas inventories for 2012-13 and 2013-14, report prepared for ACT government environment and planning directorate, Canberra, Australia. http://www.environment.act.gov.au/__data/assets/pdf_file/0005/711959/Attachment-A-Interim-ACT-Greenhouse-Gas-Inventory-2012-13-and-2013-14_web.pdf.

Smith, B., Auty, K., Burnett, P., Vardon, M., 2017a. Natural capital accounting for state of environment reporting in the Australian Capital Territory, In: Vardon, M., Bass, S., Ahlroth, S., Ruijs, A. (Eds.), Forum on natural capital accounting for better policy decisions: Taking stock and moving forward. The World Bank: Washington D.C.

Smith, B., Summers, D., Vardon, M., 2017b. Environmental-economic accounts for ACT state of the environment reporting: Proof of concept. ACT Office of the Commissioner for Sustainability and the Environment, Canberra, Australia.

Upper Murrumbidgee Waterwatch, 2016. Catchment health indicator program. Upper Murrumbidgee Waterwatch, Canberra, Australia. http://www.act.waterwatch.org.au/chip.html.

Van Dijk, A.I.J.M., Summers, D.M., 2017. Australia's environment in 2016. Australian National University. http://www.ausenv.online.

Vardon, M., Burnett, P., Dovers, S., 2016. The accounting push and the policy pull: Balancing environment and economic decisions. Ecological Economics 124 145-152.