Towards an integrated structure for SEEA ecosystem stock and flow accounts

ISSUE PAPER FOR THE MEETING ON SEEA EXPERIMENTAL ECOSYSTEM ACCOUNTS

LONDON, 5 – 7 DECEMBER 2011

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A. Introduction

1. The purpose of this paper is to present a possible general structure for ecosystem accounts for the System of Environmental-Economic Accounting (SEEA)-Experimental Ecosystem Accounts. In particular, this paper addresses issue 2 "Structure of Accounts" in the *Proposed Outline, Road Map and List of Issues* (hereafter called the Road Map) which was presented to the London group on Environmental accounting in September 2011.[6]

2. This paper builds on the general principles of environmental accounting outlined in the SEEA-Central Framework as well as drawing on the experience of the European Environment Agency (2011) and the United Kingdom's *National Ecosystem Assessment* (2011). It also draws on the Australian experience and in particular: *Ecosystem Services: Key Concepts and Applications* (SEWPaC 2010); *Pilot Land Accounts for the Great Barrier Reef* (ABS 2010); as well as on-going work in Australia by the Wentworth Group of Concerned Scientists and the Victorian government.

3. In relation to Issue 2 "Structure of Accounts" the tasks identified in the Road Map were:

- Provide general guidance on the structure of the accounts, i.e. what is included at the most basic level and how these accounts are related, focusing on identifying potentially missing elements or redundancies and other issues of how the sequence of accounts may be organized at an aggregated level
- Review the options for ecosystem accounting units for compilation
- Clarify the types of accounts that are included: asset accounts, flow accounts, and/or something else?
- Clarify how the information in the accounts is organized and linked together - and explain the relationship with the SEEA Central Framework

4. This paper examines each of these tasks in reverse of the order in which they are presented above. In so doing a great debt is acknowledged to the EEA and the recent report "*An experimental framework for ecosystem capital accounting in Europe*" and the UK's "*National Ecosystem Assessment*."

B. Types of ecosystem accounts and relation to the SEEA Central framework

5. The SEEA Central Framework defines two general types of accounts: one for stocks (asset accounts) and the other for flows (supply and use tables). The general structure of these is presented in Chapter 2 and additional detail is found in Chapters 3 and 5. Chapter 4 also defines the accounts for monetary transactions related to environmental protection, natural resource management and natural resource use. The Central Framework also defines accounts in both monetary and physical terms. Taking land as an example, you can measure the stock of land in monetary terms as well as in physical area. For example, at 30 June 2011 the stock of land in Australia was 7,692,024 km^2, valued at AUD$3,785 billion (current prices; ABS 2011 *Australian System of National Accounts*[7]).

6. The types and general structure of the accounts presented in the Central Framework provide the starting point for the SEEA Experimental Ecosystem Accounts. Following on from this would imply at least four types of ecosystem accounts:

- Physical accounts for the supply and use of ecosystem goods and services
- Monetary accounts for the supply and use of ecosystem goods and services
- Physical accounts of the environmental assets that supply the ecosystem goods and services

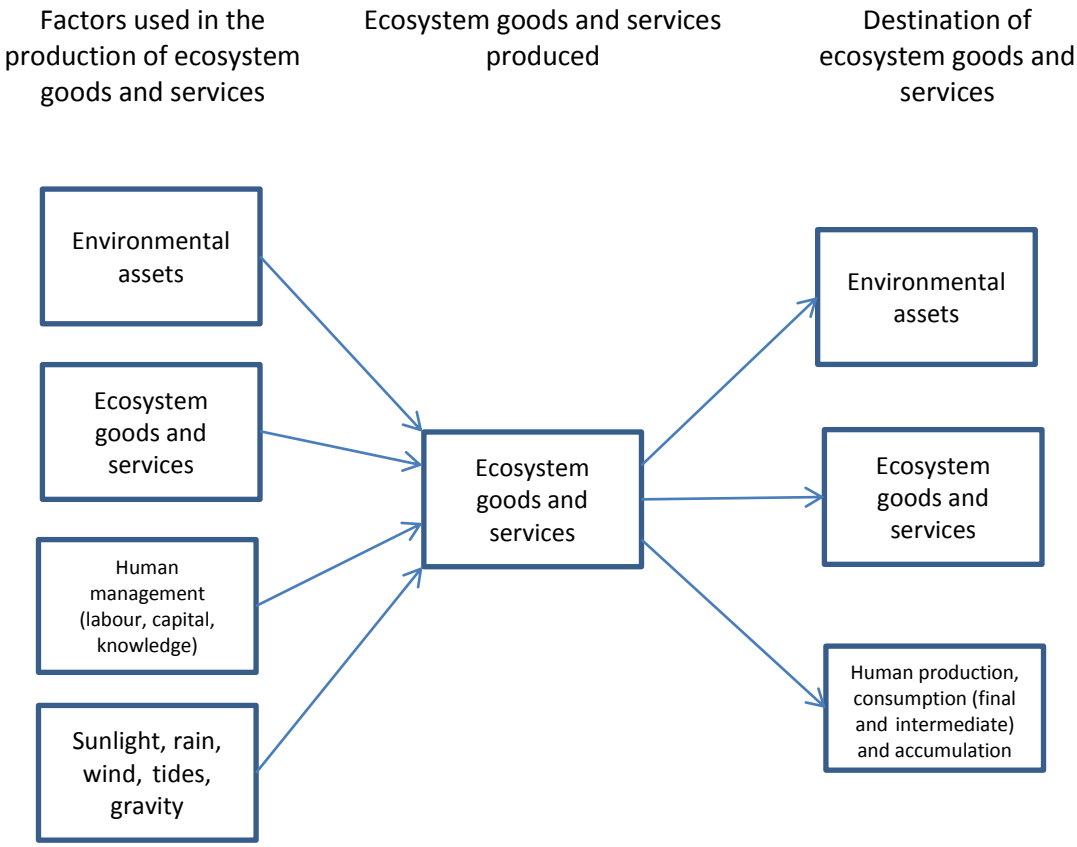
[6] SEEA Experimental Ecosystem Accounts: A Proposed Outline, Road Map and List of Issues. UNSD, EEA and World Bank (2011). http://unstats.un.org/unsd/envaccounting/londongroup/meeting17/LG17_9a.pdf

[7] ABS 2011. Australian System of National Accounts. http://www.abs.gov.au/ausstats/subscriber.nsf/log?openagent&52040_2010-11.pdf&5204.0&Publication&DE6B4AD6BFF518BDCA25794A0011FA29&&2010-11&17.11.2011&Latest

- Monetary accounts of the environmental assets that supply the ecosystem goods and services

7. The stock (asset) and flow (supply and use) accounts need to be related. In particular the production of ecosystem goods and services needs to be related to the environmental assets and other inputs used to generate these goods and services. The destination of the goods and services generated then needs to be determined. This type of view of the production of ecosystem goods and services is analogous to the macroeconomic theory that guides the System of National Accounts, where capital, labour and intermediate consumption of natural resources and goods and services are combined by producing units (economic units) to generate a supply of products (goods and services). These products can be used as further inputs to production (intermediate consumption), accumulated in the economy (as inventories), used for producing more capital (fixed capital formation) or used by final consumers.

Figure1. Inputs for the generation of ecosystem services



8. An important point is that the mix of goods and services delivered from a particular suite of inputs can be altered via human intervention (e.g. a forest can be converted to farmland) or natural variation (e.g. rainfall will drive the level of production of provisioning services from dry-land agriculture). The type and level of ecosystem goods and services produced is also related to the condition or quality of the environmental assets, which can also be improved through human intervention.

9. A fifth type of ecosystem account that links the monetary transactions described in Chapter 4 of the Central Framework to the ecosystem accounts listed above may also be useful. A hybrid presentation of data from these four types of ecosystem accounts with related data (e.g. from environmental protection expenditure accounts), along the lines of those suggested in Chapter 6 of the Central framework could also be considered.

10. The diversity of ecosystem goods and services supplied, the many factors involved in their generation and the multiple ways in which they are used means that a sequence of accounts is appropriate. The starting point for this could be the sequence of accounts described in the SEEA Central framework. It is also clear that ecosystem accounts need to be developed at multiple spatial and temporal scales, and accounts will need to be spatially nested. They could begin with the land accounts from the Central Framework which would be used to spatially locate the production of particular ecosystems goods and services. This has been done for water accounts in Australia. This approach is developed further, but still incompletely, in Section D.

C. Ecosystem accounting units

11. One of the issues apparent in the discussion of accounting units is that there is not yet an agreed terminology for the description of the units and their aggregates. Agreement on the key concepts and terminology used to describe the units relating to ecosystem accounting should be a key outcome of the development of the SEEA Experimental Ecosystem Accounts.

12. We propose that accounting units for ecosystems are evident at two levels. The first is a unit at the base of data (or base data level), while the second is a grouping or groupings of these base units into accounting aggregates amenable for statistical output, in this case as accounting tables. The units at the base of economic statistics have been termed statistical units by the United Nations[8] and are well known in economic statistics. The statistical units of the economy, including businesses and households, are well documented in the *System of National Accounts* (SNA) and related documents. National statistical offices, like the Australian Bureau of Statistics (ABS), have much experience in the use of economic units for the compilation of national accounts and other economic data.

13. In the absence of another term, the term statistical unit has also been applied to the units at the base of environmental statistics by the ABS[9] and the United Nations[10]. We are not wedded to the terminology, but pending the adoption of another term, we will continue to use the term statistical unit in relation to the units at the base of environmental statistics.

14. The statistical units of the environment are less well developed in the formal sense than their economic counterparts, although there is a great deal of knowledge and experience in these matters in the physical sciences as well as in the systems used to administer transfers of land ownership. It seems that for many purposes the statistical units of the environment are spatially based. For example, 100m by 100m grid cells or parcels of land defined in the cadastre would be the statistical units at the base of land accounts. For water accounts, the statistical units are the rivers, lakes and groundwater bodies. These units can be sub-divided, for example reaches of rivers. For more information on this please refer to the ABS paper *Building Blocks for Land and Ecosystem Accounts* presented to the London Group meeting in September 2011[11]. Annex 1 provides a list of the data items and the underlying statistical units identified for land and ecosystem accounts.

15. We define a statistical unit to be the entity about which information is sought and for which statistics are ultimately compiled[12]. It is the unit at the base of aggregates presented in environmental statistics and accounts, including ecosystem accounts, or other tabulations of data.

[8] UNSD October 20007 "Statistical Units" paragraph 14: http://unstats.un.org/unsd/isdts/docs/StatisticalUnits.pdf

[9] The Building Blocks for Land and Ecosystem Accounts (Vardon et al . 2011) http://unstats.un.org/unsd/envaccounting/londongroup/meeting17/LG17_9c.pdf

[10] International Recommendations for Water Statistics. UN 2010. http://unstats.un.org/unsd/envaccounting/irws/

[11] Building Blocks for Land and Ecosystem accounts. (Vardon et al . 2011) http://unstats.un.org/unsd/envaccounting/londongroup/meeting17/LG17_9c.pdf

[12] After paragraph 14, UNSD October 20007 "Statistical Units": http://unstats.un.org/unsd/isdts/docs/StatisticalUnits.pdf

16. The identification and description of the statistical units for ecosystem accounting is necessary to:

- Define the components of the environmental assets (including ecosystems) about which data are compiled, and the economic units that own or manage these environmental assets from which data may also be collected;
- Define the main characteristics of statistical units so that survey frames, related statistical processes (e.g. sampling regime) and infrastructure needed for land and ecosystem accounts can be constructed or adapted from existing infrastructure;
- Describe the main classifications of statistical units relevant to land and ecosystem accounts;
- Understand how the characteristics and classifications of statistical units could be adapted over time and space to show the dynamic nature of ecosystems
- Understand how the characteristics and classifications of statistical units are useful for aggregating and disaggregating data.

17. In order to construct ecosystem accounts it is important that both the environmental and economic units are clearly articulated and that they are defined in such a way as to facilitate the collection and integration of data from different sources to create ecosystem accounts.

18. The relationship of statistical units to accounting units needs to be clarified. Our interpretation of ecosystem accounting units is that they are aggregates of statistical units within specific spatially defined regions, for a specified time period. As such ecosystem accounting units may refer to catchments, sub-catchments, watersheds, bioregions, river reaches, wetlands, etc. These ecosystem accounting units are generally defined from an ecological point of view.

19. The ecosystem accounting units are essentially groupings of similar statistical units, similar to the way all factories in a country are grouped together to form the manufacturing industry. When producing an account, the data about the factors is aggregated together and presented as a column (or row) in, for example, physical supply and use tables for water, for a specified region and time. The ABS (2010) Water Account, Australia[13] shows this for the nation as whole as well as for each of the states and territories (8 in all) for particular time periods (2008-09).

20. This interpretation of ecosystem accounting units appears consistent with the eight broad habitat types shown in the UK National Ecosystem Assessment (DEFRA 2011) as would the five Socio-Economic Landscape Units (SELU) proposed by the EEA (2011). A feature of these ecosystem accounting units is that they combine information on land cover (e.g. urban areas, crops and pasture, forests, etc.) with information on terrain or position in landscape (mountain, coastal areas, lowlands, etc).

21. In Australia, four types of subnational accounting units have been used in the production of environmental accounts. These are:

- States and Territories. The Commonwealth of Australia is made up of 6 states and two territories.
- Natural resource management (NRM) regions. Australia has 56 NRM regions. Each region has an authority responsible for management of natural resources. These authorities are known by a variety of names, including Catchment Management Authorities (CMAs).
- Statistical Local Areas (pre 2011) or Statistical Areas (post 2011). These are areas defined by the Australian Statistical Geographical Classification (ASGC)[14] primarily for the output of information

[13] ABS (2010) Water Account, Australia. http://www.abs.gov.au/AUSSTATS/subscriber.nsf/log?openagent&46100_2008-09.pdf&4610.0&Publication&D2335EFFE939C9BCCA2577E700158B1C&&2008-09&29.11.2010&Previous

[14] Australian Statistical Geography Standard. ABS July 2011. http://www.abs.gov.au/AUSSTATS/abs@.nsf/ProductsbyTopic/8B8ABC8EC62D8F46CA2570AE000DD3B5?OpenDocument

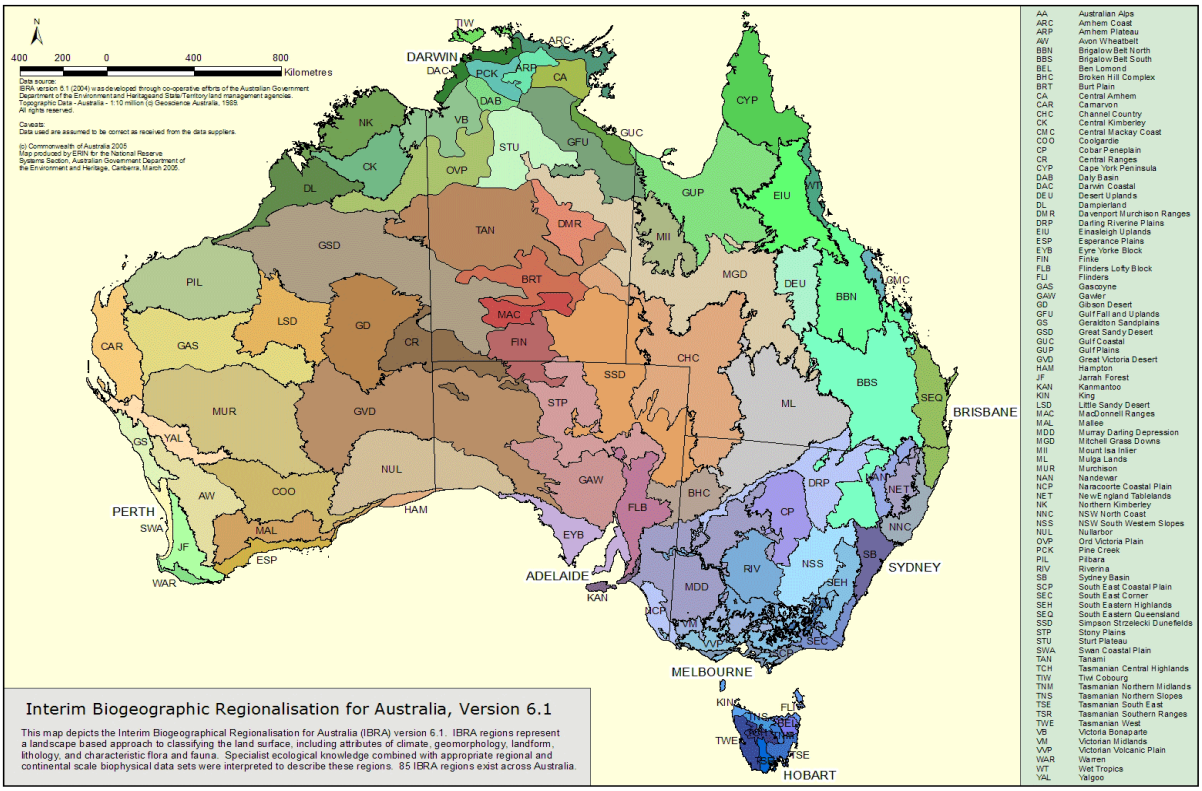
collected via ABS data collections. The ASGC is a four level hierarchical classification that defines areas that may be used to approximate other output regions (i.e. those defined outside the ABS).

- Drainage Divisions and River Basins. Australia has 12 major Drainage Divisions, which are further divided into 245 River Basins, based on surface water hydrology.

22. These spatially defined accounting units have been used for two main reasons. Firstly they are spatial areas of interest to decision makers, and secondly they facilitate the integration of data from different sources. The use of consistently defined spatial output regions will allow ecosystem accounts to be linked with other environmental accounts that have sub-national spatially defined regions. For example land and water accounts in Australia.

23. Two more types of accounting units are under investigation for the preparation of ecosystem accounts: the Interim Biogeographic Regions of Australia (IBRA, Fig 2.) of Australia and land cover classes. The IBRA are, like the ecosystem units used in the UK National Ecosystem Assessment and the EEA SELU, a combination of land cover, climate and terrain. However, missing from the IBRA classification is urban areas and coastal margins. It is thought that by starting with the IBRA regions, and then separately identifying urban areas (from land cover data) and distinguishing a coast zone (or margin), this could approximate the UK National Ecosystem Assessment broad habitat types or the EEA SELU. These modified IBRA regions could form the basis of the ecosystem accounting units for Australia, where they are already used for environmental reporting purposes.

Figure 2. Interim Biogeographic Regions of Australia



24. At least two accounting issues related to the use of spatially defined accounting units need to be addressed. The first is the transfer of ecosystem goods and services between accounting units. This would be analogous to imports and exports between countries. The second is the dynamic nature of ecosystems, meaning the boundaries between accounting units will change spatially over time. This may be like the different industries that make up the economy expanding and contracting over time.

25. An important issue in ecosystem accounting is how to integrate the information from the environmental units with information from the economic units. In particular, economic units own

areas of land containing the environmental assets and are responsible for the human management inputs, including determining the type of management activities undertaken.

D. Proposed structure for ecosystem accounts.

26. As indicated in Section B, there are probably four main types of ecosystem accounts: physical assets, monetary assets, physical flows and monetary flows. Each type of account may have several tables associated with it. It not unusual in national or environmental accounting to have a series of interconnected accounts. For example the sequence of accounts described in Chapter 6 of the SEEA Central Framework or the 12 standard tables defined in the SEEA-Water[15].

27. The section below identifies a series of tables for physical asset and flow accounts. Their monetary equivalents are discussed. The tables identified in the text below (8 in all) have been included at the end of this paper for ease of reference.

1. Proposed accounts for flows of ecosystem goods and services

28. Table 1 presents a proposed structure showing the generation of ecosystem goods and services according to CICES classes (in rows) from spatially defined accounting units (in columns). The accounting units equate the water catchments of which there are ten in Victoria. Further, those units are used as administrative units for Catchment Management Authorities which administer environmental funds on behalf of the Victorian government. In Victoria the spatially defined accounting units are the CMA regions, but these could be for any spatially specific grouping, including broad habitat types, SELUs, IBRA regions or land cover classification. Because of the many ecosystem goods and services and the variety of measurement units, for presentation purposes one approach would be to split the tables in three or more parts using the main headings of the CICES. The table is similar to Figure 5 (p. 11) shown in the UK National Ecosystem Assessment Synthesis of Key Findings[16] but in this case symbols are used to indicate the direction of change.

29. In Table 1 the units of measurement for goods and services are unspecified as they would be different for each good or service. It is proposed that for each good and service in this table a separate supply use table is constructed using appropriate measurements according to the general structure laid out in the SEEA Central Framework. It should be noted that some ecosystem goods and services are already included in the Central Framework, for example, carbon and water. The water physical supply and use table from the Central Framework is shown as Table 2.

30. The structure of Table 2 shows the flows of ecosystem goods and services that flow into the economy (as defined by the production boundary), with the economy defined as groups of economic units classified by industry (e.g. agriculture, mining, manufacturing) and sector (households, rest of the world). It does not show flows that stay entirely within the environment or flows, which although of benefit to humanity, are not able to be easily attributed to a supplier or user.

31. In the case of water, flows within the environment are articulated in the asset account[17], and the suppliers are the different types of inland water resources (i.e. surface water, groundwater, soil water, etc). It may be that the structure of the water asset accounts can be adapted to a supply use table for flows within the environment. To achieve this, the columns of the physical supply and use table from the Central Framework would be changed to the groups of ecosystem accounting units classified by either land cover, land use or other grouping. This is essentially what is proposed by the EEA (2011) in the "*Mock-up accounts*" for table C1 *Water stock accounts* and table C3 *Annual water flow account*.

[15] SEEA-Water UNSD 2007. http://unstats.un.org/unsd/envaccounting/seeaw/seeawdraftmanual.pdf

[16] UK National Ecosystem Assessment Synthesis of Key Findings (2011). http://archive.defra.gov.uk/environment/natural/documents/UKNEA_SynthesisReport.pdf

[17] SEEA-Water Table 6.1 p. 162 http://unstats.un.org/unsd/envaccounting/seeaw/seeawdraftmanual.pdf

32. The monetary account for the flows of ecosystem goods and services could be constructed along similar lines. For the provisioning services these are relatively straightforward and the experience with agricultural commodities, many of the material flows (e.g. minerals and timber) and water is well developed. However, valuation of other flows is more problematic and this issue is not addressed here.

33. The management of the areas producing ecosystem goods and services will entail expenditures by management agents and these would be included in the environment protection expenditure (EPE) accounts of the Central Framework. The main issue would be one of practicality as in most cases EPE accounts are done at a national level, with no subnational spatial output regions.

2. Proposed asset accounts for environmental assets supplying the flows of ecosystem goods and services

34. A starting point for asset accounts would be to define particular spaces that produce ecosystem goods and services. This would be a relatively straight forward starting point and would form a natural link to the land accounts of the Central Framework.

35. Building on this notion Table 3 presents an asset account for land showing land cover types in the rows and the CMAs for Victoria in the columns. CMAs are used in this case as they are the economic unit responsible for managing the natural resources, including land cover, that occur within these spatially defined regions. The presentation shows only stocks at a point in time. For each region you then need to record opening stocks, changes and closing stocks of each land cover type, which is shown in table 4. The changes between land cover types could also be presented as a symmetrical change matrix (e.g. the Eucalypt Woodlands that become 'cleared, non-native vegetation', the Eucalypt Tall Open Forests that become 'regrowth modified native vegetation', etc.).

36. Table 5 presents an account showing dominant land cover by dominant land use. This account could be done for each spatially defined output area. This table will show the close overlaps between some uses and cover (in particular for agriculture), but it will also highlight important differences, such as land used predominantly for agriculture may contain areas of forest or other vegetation, and areas used for the maintenance and restoration of environmental function will cover a variety of land covers, including forest types. A separate table could show opening stocks, additions, reductions and closing stocks for each dominant land use (and the table would be like table 4 except that land use would be in the rows, not vegetation type.

37. The *extent* of each vegetation type can be further divided to provide an indication of the *condition* of each vegetation type. This would be for each statistical unit, which in this case is likely to be a grid of 1 km^2, and condition could be measured in a representative sample of units to be used as a basis for estimating the condition for all units within a particular area (e.g. one of the Victorian CMAs). For presentation purposes condition could be shown as a series of condition (or quality) classes. A land condition account showing vegetation types by 6 condition classes (numbered 1-5, with 5 being the best, plus a 6th 'unknown' condition class) is shown is Table 6. For Table 6 the underpinnings of the vegetation condition metric could be: extent; structure; degree of disturbance (or time since disturbance, e.g. logging, fire, grazing by exotic herbivores); connectivity of remnant vegetation; and extent of weeds/exotic plants. The degree of disturbance could be partially assessed by land use information. Table 7 shows how this point in time data would look as an asset account with opening and closing stocks of land cover condition.

38. The condition of vegetation types (or other groupings of statistical units into spatially defined output areas) would be underpinned by a range of data. Importantly, while the data are summarised in table according to condition classes, the condition of each statistical unit would be assessed on a continuous scale, and assigned to a class based on this. The condition measures for each statistical unit could be assigned based on a range of criteria applied to the individual environmental assets occurring in the spatially defined output area. For example, condition of assets could be assessed based on measurements of flora (for vegetation type as a proxy), fauna, soil, rivers, wetlands,

floodplain and groundwater as proposed by the Wentworth Group for use in the NRM environmental accounting trials. Table 8 shows how this might be presented, with the potential for an index to be developed to estimate total condition for each area.

39. Monetary asset accounts could also be developed along similar lines to those explained in the Central Framework. Many of the environmental assets in the specifically defined spatial output areas will have market values or values that can be inferred from market information. Again this is an area of on-going discussion, so asset accounts in monetary terms are not proposed here.

E. Discussion

40. One of the fundamental issues is how to account for the changing nature of ecosystems and the high degree of variability in the production of ecosystem goods and services in both space and time. Much of the variation is due to natural climatic variation (e.g. seasonal – summer/winter – and year-to-year patterns in temperature and rainfall). Overlaid on these natural cycles are human activities, some aimed directly at changing the mix of ecosystem goods and services produced from particular area (e.g. farming) and others which impact on the environment (e.g. the discharge of pollutants into the air or water).

41. To account for human and natural variations, it is necessary to identify the main agents in the system and understand their interactions. At the lowest base data level of environmental data (possibly 20 by 20 metre grids) we need the capacity to define the economic units that interact with the environment. For direct land management activities, such as forestry and agriculture, this would appear relatively straightforward. Taking agriculture as an example, the economic units are the farms. Each farm has an asset base and undertakes a variety of activities in order to produce a defined suite of ecosystem goods and services (mostly provisioning services). To do this they also have to manage their environmental asset base (e.g. land, soil, water). In some cases the sale of ecosystem goods and services will be foregone in some periods in order to improve the condition of environmental assets and increase production in other years (e.g. fallow land). In other cases production will be increased through the application of inputs generated by distant ecosystems: for example irrigation and fertilisation. The farm uses a mix of local environmental assets, local and distant ecosystem inputs and as part of this enters into a series of monetary transactions.

42. A question then arises: to what do we assign the production of ecosystem goods and services? Is it the economic unit, the ecosystem (with the farms being a type of ecosystem) or both? In the case of the farm it is probably both. The key issue is that the economic and environmental statistical units need to be able to be integrated.

F. Questions for discussion

- What is the basic model for the production and use of ecosystem goods and services?
- What would the full suite (i.e. type and sequence) of ecosystem accounts look like?
- How do we account for changes in the production due to natural phenomenon (e.g. variation in rainfall) and human intervention?
- Could we account for future expected benefits in terms of the flow of ecosystem goods and services in physical terms in the environmental assets accounts? (akin to NPV of economic assets)
- Does CICES need to be consistent with the classifications used in the construction of environmental protection expenditure accounts?
- What aggregates out of the ecosystem accounts might be useful for policy makers?

G. Acknowledgement

43. A great many people have contributed to the development of the ideas contained in this paper and some also provided comment on earlier drafts. We would particularly like to thank: Gary Stoneham (Victorian Department of Treasury and Finance); Warwick McDonald, Belinda Alison (Bureau of Meteorology); Steven Cork, Phil Gibbons and Judith Ajani (Australian National University); Simone Maynard (South East Queensland Catchment Management Authority); Carl Obst; Peter Cosier (Wentworth Group of Concerned Scientists); Valdis Juskevics, Alistair Nairn, Mark Lound and John Ovington (ABS).

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Table 1. Generation of ecosystem good and services by NRM regions (Based on CICES) – Physical flow account

	NRM regions of Victoria										
	Corangamite	East Gippsland	Glenelg Hopkins	Goulburn Broken	Mallee	North Central	North East	Port Phillip and Westernport	West Gippsland	Wimmera	VICTORIA TOTAL
PROVISIONING SERVICES											
Nutrition											
Food - terrestrial											
Food - freshwater											
Food - marine											
Freshwater											
Materials											
Biotic (e.g. timber, fodder, medicines)											
Abiotic (e.g. minerals and fossil fuels)											
Renewable energy											
Biotic (e.g. biofuels)											
Abiotic (e.g. wind, solar, hydro)											
REGULATION AND MAINTENANCE											
Regulation of wastes											
Flow regulation											
Air flow regulation											
Water flow regulation											
Mass flow regulation											
Regulation of physical environment											
Atmosphere											
Water quality											
Pedogenesis and soil quality											
Regulation of biotic environment											
Lifecycle maintenance and habitat protection											
Pest and disease control											
Gene pool protection											
CULTURAL SERVICES											
Symbolic											
Aesthetic and heritage											
Religious and spiritual											
Intellectual and experiential											
Recreational and community activities											
Information and knowledge											
Information for cognitive development											

Table 2. Supply and use table for water – Physical flow account

Table 3.5.1 Physical supply and use table for water			(Cubic metres of water)										
Physical supply table for water resources													
			Abstraction of water; Production of water; Generation of return flows								**Flows from the Rest of the world**	**Flows from the Environment**	**Total supply**
			Agriculture, forestry and fishing	Mining & quarrying, Manufacturing and Construction	Electricity, gas, steam and air conditioning supply	Water collection, treatment and supply		Sewerage	Other industries		Imports		
						Total	*of which* Households						
Sources of water													
	Inland water resources	Surface water											
		Groundwater											
		Soil water											
		Total											
	Other water resources	Precipitation											
		Sea water											
		Total											
	Total abstracted water												
Abstraction													
	Water for distribution	By Water collection, treatment and supply											
		By Other industries											
	Water for own-use												
Flows of wastewater and resused water													
	Wastewater produced and sent for treatment												
	Reused water produced	For distribution											
		For own use											
Return flows of water and evapotranspiration													
	To inland water resources	Surface water											
		Ground water											
		Soil water											
		Total											
	To other sources												
	Total Return flows												
	Evapotranspiration												
Water incorporated into products													

Physical use table for water resources													
			Abstraction of water; Intermediate consumption; Return flows							**Final consumption**	**Accumulation**	**Flows from the Rest of the world**	**Flows to the Environment**	**Total use**
			Agriculture, forestry and fishing	Mining & quarrying, Manufacturing and Construction	Electricity, gas, steam and air conditioning supply	Water collection, treatment and supply		Sewerage	Other industries	Households		Exports		
						Total	*of which* Households							
Sources of water														
	Inland water resources	Surface water												
		Groundwater												
		Soil water												
		Total												
	Other water sources	Precipitation												
		Sea water												
		Total												
	Total abstracted water													
Use of abstractions														
	Distributed water	From Water collection, treatment and supply												
		From other sources												
	Water for own use (incl undistributed water)													
Flows of wastewater and reused water														
	Wastewater received from other units													
	Reused water used													
	Total													
Return flows of water and evapotranspiration														
	Returns of water to the environment													
		To inland water resources												
		To other sources												
	Total return flows													
	Evapotranspiration													
Water incorporated into products														

Source SEEA Central Framework, p. 101, Table 3.5.1

Table 3. Land cover (ha) asset account by NRM regions of Victoria

	Corangamite	East Gippsland	Glenelg Hopkins	Goulburn Broken	Mallee	North Central	North East	Port Phillip and Westernport	West Gippsland	Wimmera	Vic Total
Acacia Forests and Woodlands	1,870.4	21,612.1	3,355.6	202.0			1,408.9	1,185.6	13,918.9	2.0	**43,555.5**
Acacia Shrublands		2.1		97.0	24.9						**124.0**
Hummock Grasslands											**0.0**
Cleared, non-native vegetation, buildings	39,016.7	3,806.1	69,476.7	23,342.7	7,139.7	14,547.8	115,273.5	4,122.6	86,083.8	6,029.4	**368,839.0**
Callitris Forests and Woodlands		8.8		19.0			447.0			11.0	**485.8**
Eucalypt Open Forests	164,542.9	1,248,080.9	112,214.9	480,460.5	6,498.5	254,489.0	829,113.4	227,815.1	492,373.3	47,023.4	**3,862,611.9**
Eucalypt Woodlands	58,522.2	257,761.2	262,318.5	131,335.7	84,538.4	121,908.1	273,004.3	48,257.8	100,360.6	215,677.1	**1,553,683.9**
Tussock Grasslands	774.2		248.0	4,160.3	209.0	17,644.2	139.2	4,355.8	350.0	862.6	**28,743.3**
Heathlands	299.9	10,364.9	21,723.1				3,455.6		71.5	1,815.8	**37,730.8**
Eucalypt Low Open Forests											**0.0**
Mallee Woodlands and Shrublands			299.0	1,964.0	1,330,638.5	30,418.7				148,060.7	**1,511,380.9**
Mangroves	56.9							629.1	2,592.0		**3,278.0**
Naturally bare - sand, rock, claypan, mudflat		1,896.9	7.0				24.0	46.0	1,539.0		**3,512.9**
Other Forests and Woodlands	4,891.6	44,131.9	24,581.6	1,959.0	138,194.4	102.0	2,366.6	12,137.3	19,744.4	36,466.7	**284,575.5**
Other Shrublands	3,663.4	11,287.7	15,801.0	757.5	21,836.6	10,889.0	4,885.3	4,740.6	18,872.5	15,755.0	**108,488.6**
Melaleuca Forests and Woodlands	493.2	0.1	8,106.6					2,210.8	3,830.0		**14,640.7**
Rainforests and Vine Thickets	8,586.0	11,391.9		5,273.3				5,768.8	3,734.0		**34,754.0**
Regrowth, modified native vegetation											**0.0**
Chenopod Shrublands, Samphire Shrublands and Forblands			12.0		47,891.8	7,816.0		131.0	48.0	879.0	**56,777.8**
Sea and estuaries											**0.0**
Casuarina Forests and Woodlands	3,023.0		1,674.0		159,260.7	4,039.7			11.0	13,833.8	**181,842.2**
Acacia Open Woodlands											**0.0**
Eucalypt Open Woodlands										7.1	**7.1**
Other Grasslands, Herblands, Sedgelands and Rushlands	4,138.1	14,015.2	8,339.1	3,949.9	51,329.1	1,439.8	22,619.3	3,706.5	29304.6	9,978.4	**148,820.0**
Low Closed Forests and Tall Closed Shrublands											**0.0**
Eucalypt Tall Open Forests	44,010.0	185,746.5	390.1	92,195.4		231.1	89,669.9	74,989.6	127354.6	214.9	**614,802.1**
Tropical Eucalypt Woodlands/Grasslands											**0.0**
Unclassified native vegetation		2.7									**2.7**
Unknown/no data	36511.6	114413.7	44047.7	39,800.8	51,524.2	44,498.7	170,744.9	28632.1	33017.1	34849.2	**598,040.0**
Inland aquatic - freshwater, salt lakes, lagoons	46907		11659	15389.8	21,109.5	3,546.9	18,151.9	3432.7	37487.8	16905	**174,589.6**
VICTORIA TOTAL	**417,307.1**	**1,924,522.7**	**584,253.9**	**800,906.9**	**1,920,195.3**	**511,571.0**	**1,531,303.8**	**422,161.4**	**970,693.1**	**548,371.1**	**9,631,286.3**

Table 4. Land account by land cover (ha) for each spatially defined output area (Country or subnational areas).

	Opening stock	Additions				Reductions					Closing stock
Vegetation type (ha)		Natural growth	Managed growth	Upwards reappraisal	*Total additions*	Natural reductions	Managed reductions	Catastrophic losses	Upwards reappraisal	*Total reductions*	
Acacia Forests and Woodlands											
Acacia Shrublands											
Hummock Grasslands											
Cleared, non-native vegetation, buildings											
Callitris Forests and Woodlands											
Eucalypt Open Forests											
Eucalypt Woodlands											
Tussock Grasslands											
Heathlands											
Eucalypt Low Open Forests											
Mallee Woodlands and Shrublands											
Mangroves											
Naturally bare - sand, rock, claypan, mudflat											
Other Forests and Woodlands											
Other Shrublands											
Melaleuca Forests and Woodlands											
Rainforests and Vine Thickets											
Regrowth, modified native vegetation											
Chenopod Shrublands, Samphire Shrublands and Forblands											
Sea and estuaries											
Casuarina Forests and Woodlands											
Acacia Open Woodlands											
Eucalypt Open Woodlands											
Other Grasslands, Herblands, Sedgelands and Rushlands											
Low Closed Forests and Tall Closed Shrublands											
Eucalypt Tall Open Forests											
Tropical Eucalypt Woodlands/Grasslands											
Unclassified native vegetation											
Unknown/no data											
Inland aquatic - freshwater, salt lakes, lagoons											
TOTAL											

Table 5. Dominant land cover by dominant land use (ha) for each spatially defined output area (Country or subnational areas).

	Agriculture	Forestry	Aquaculture	Built up areas	Maintenance and restoration of environmental function	Other use n.e.c.	Not in use	**TOTAL**
Acacia Forests and Woodlands								
Acacia Shrublands								
Hummock Grasslands								
Cleared, non-native vegetation, buildings								
Callitris Forests and Woodlands								
Eucalypt Open Forests								
Eucalypt Woodlands								
Tussock Grasslands								
Heathlands								
Eucalypt Low Open Forests								
Mallee Woodlands and Shrublands								
Mangroves								
Naturally bare - sand, rock, claypan, mudflat								
Other Forests and Woodlands								
Other Shrublands								
Melaleuca Forests and Woodlands								
Rainforests and Vine Thickets								
Regrowth, modified native vegetation								
Chenopod Shrublands, Samphire Shrublands and Forblands								
Sea and estuaries								
Casuarina Forests and Woodlands								
Acacia Open Woodlands								
Eucalypt Open Woodlands								
Other Grasslands, Herblands, Sedgelands and Rushlands								
Low Closed Forests and Tall Closed Shrublands								
Eucalypt Tall Open Forests								
Tropical Eucalypt Woodlands/Grasslands								
Unclassified native vegetation								
Unknown/no data								
Inland aquatic - freshwater, salt lakes, lagoons								
TOTAL								

Table 6. Land cover by condition class for each spatially defined output area (Country or subnational areas).

	Vegetation condition class						
Land cover (ha)	1	2	3	4	5	Unknown	**TOTAL**
Acacia Forests and Woodlands							
Acacia Shrublands							
Hummock Grasslands							
Cleared, non-native vegetation, buildings							
Callitris Forests and Woodlands							
Eucalypt Open Forests							
Eucalypt Woodlands							
Tussock Grasslands							
Heathlands							
Eucalypt Low Open Forests							
Mallee Woodlands and Shrublands							
Mangroves							
Naturally bare - sand, rock, claypan, mudflat							
Other Forests and Woodlands							
Other Shrublands							
Melaleuca Forests and Woodlands							
Rainforests and Vine Thickets							
Regrowth, modified native vegetation							
Chenopod Shrublands, Samphire Shrublands and Forblands							
Sea and estuaries							
Casuarina Forests and Woodlands							
Acacia Open Woodlands							
Eucalypt Open Woodlands							
Other Grasslands, Herblands, Sedgelands and Rushlands							
Low Closed Forests and Tall Closed Shrublands							
Eucalypt Tall Open Forests							
Tropical Eucalypt Woodlands/Grasslands							
Unclassified native vegetation							
Unknown/no data							
Inland aquatic - freshwater, salt lakes, lagoons							
TOTAL							

Table 7. Land cover condition accounts (ha) for each spatially defined output area (Country or subnational areas).

	Condition 1	Condition 2	Condition 3	Condition 4	Condition 5	Condition Unknown	Total Area
Opening stock of vegetation							
(**type 1, e.g. mangroves)**							
Additions to area							
From other land covers							
Natural expansion							
Managed expansion							
Form other condition classes*							
Natural expansion							
Managed expansion							
Reclassifications							
Total additions to area							
Reductions to area							
To other land covers							
Natural reduction							
Managed reduction							
To other condition classes*							
Natural reduction							
Managed reduction							
Catastrophic losses							
Reclassifications							
Total reductions to area							
Net change							
Closing stock of vegetation type 1							

*From other condition classes within vegetation type 1. That is changes in condition within vegetation type 1.

Table 8. Ecosystem condition account for each for each spatially defined output area (Country or subnational areas).

	Condition class							**Weight for index**	**Contribution to index (average by weight)**
	1	2	3	4	5	Unknown	**Average condition**		
LAND									
Flora									
Fauna									
Soil									
WATER									
Surface water (rivers, wetlands, etc)									
Groundwater									
TOTAL									

Annex 1 Data items and underlying statistical units identified for land and ecosystem accounts

	Data item	Comment	Approach (data source)
Physical			
	Land area	e.g. hectares	Cadastre, business and household surveys
	Land cover	e.g. forest, grassland, 'hard' surfaces	Mostly grid
	Topography	e.g. slope, elevation	Mostly grid
	Species	both plants and animals	Mostly grid
	Soil type		Mostly grid
	Soil depth		Mostly grid
	Soil nutrients		Mostly grid
	Climate	Rainfall, temperature, wind	Mostly grid
	Water resources	e.g. water source (river, lake, artificial reservoir, soil water) by volume	Grid and cadastre
	Subsurface resources	Minerals, oil and gas	Grid and cadastre
	Timber		Mostly grid
	Ecosystem goods and services		Grid, business and household surveys
Socio-economic			
	Ownership	e.g. by sector or industry	Cadastre, business and household surveys
	Operation (leased land)	e.g. by sector or industry	Cadastre, business and household surveys
	Land management activities	e.g. by Classification of environmental and land management activities	Cadastre, business and household surveys
	Land use	e.g. by production of goods and services	Cadastre, business and household surveys
	Land value		Cadastre
	Other natural resource values	e.g. timber, water	Cadastre, business and household surveys
	Income	e.g. household and business	Cadastre, business and household surveys
	Taxes paid	e.g. household and business	Cadastre, business and household surveys
	Zoning	e.g. residential, industrial, commercial, etc	Cadastre
	Fixed assets	e.g. buildings and other produced assets on the land	Cadastre, business and household surveys