



Mapping and Assessment for Integrated Ecosystem Accounting Webinar

Hydrological ecosystem services accounts & SEEA water accounting

Accounting for water and water related ecosystem services using the System of Environment-Economic Accounting

21 June 2021



Content of presentation

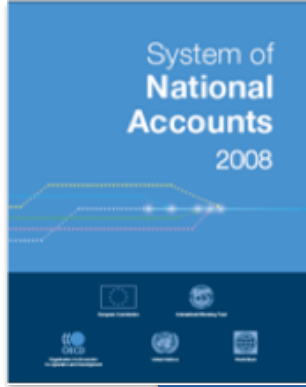
What is environmental-economic accounting and the SEEA?

Water accounting

- Asset and flow accounts
- Ecosystem services
- Valuation

Case study

Using environmental-economic accounts



System of National Accounts

- Monetary measures
- Asset and production boundaries set by economics
- Production defined as being capable of being sold in markets
- Assets defined as being owned and capable of being used for economic gain



SEEA Central Framework

- Physical quantity measures added to monetary measures
- Asset boundary expanded
- Assets no longer have to be owned or capable of being used for economic gain

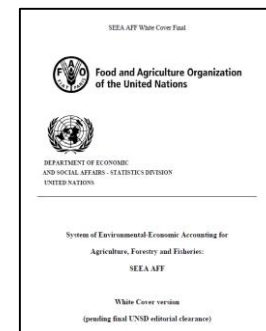
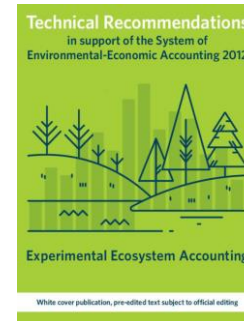
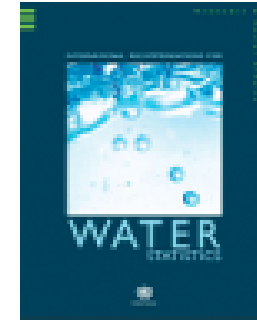
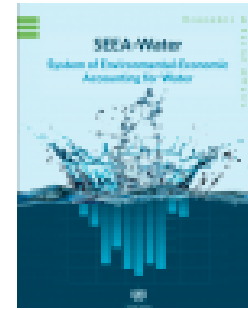


SEEA ~~Experimental~~ Ecosystem

- Physical quality (or condition) measures added
- Production boundary extended
- Production from ecosystems recognized and does not need to be sold in markets

Additional material in support of SEEA

- SEEA Water
- SEEA Energy
- SEEA Applications and Extensions
- SEEA Agriculture Forestry and Fisheries
- Technical Recommendations in support of Experimental Ecosystem Accounting
- International Recommendations for Water Statistics

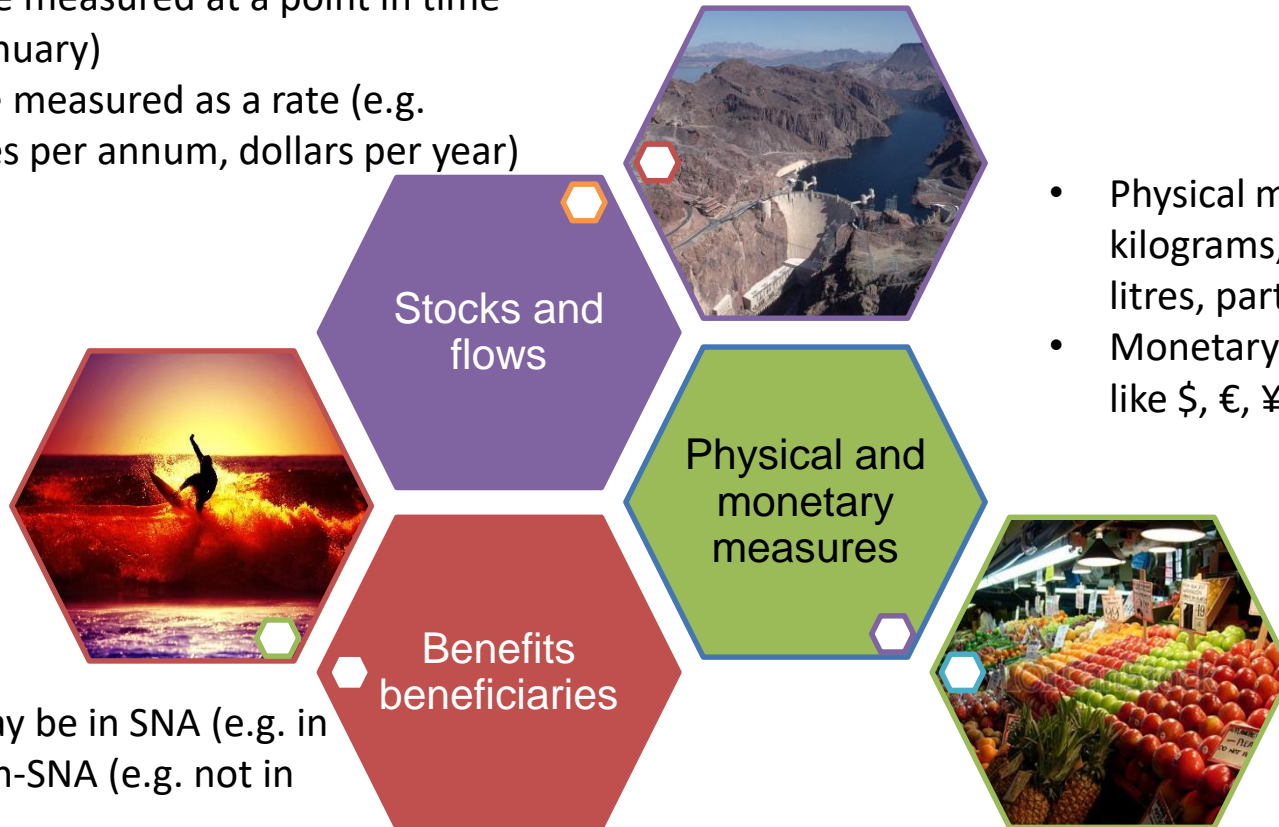


SEEA-Energy Manual

Draft: [English](#)

Three pairs of concepts for environmental accounting

- Stocks are measured at a point in time (e.g. 1 January)
- Flows are measured as a rate (e.g. megalitres per annum, dollars per year)



- Physical measures like kilograms, hectares, litres, parts per million
- Monetary measure like \$, €, ¥, £, etc.



- Benefits may be in SNA (e.g. in GDP) or non-SNA (e.g. not in GDP)
- Beneficiaries are people of groupings of people (e.g. farmers, government, miners)

Units, classifications and geographic scope

- **Measurement units**

- Use a single unit for each PSUT – joules, cubic metres, tonnes
- Monetary –current price, constant price, purchase price, producer price

- **Classifications**

- Industry classification (ISIC) > ANZSIC
- Sector classification, Business (financial/non-financial), Government, Not-for-profit (NPISH), Households
- Classification of natural inputs
- Central Product Classification (CPC)
- Standard International Energy product Classification (SIEC)
- Groups of residuals – waste, wastewater, emissions, etc.

- **Geographic scope**

- Start with economic territory/country
- Record flows based on residence of economic units in the territory
- Flow not based solely on geographic location

Monetary valuation is important (but controversial)

Economics is the language of decision-making which commonly uses data in monetary terms

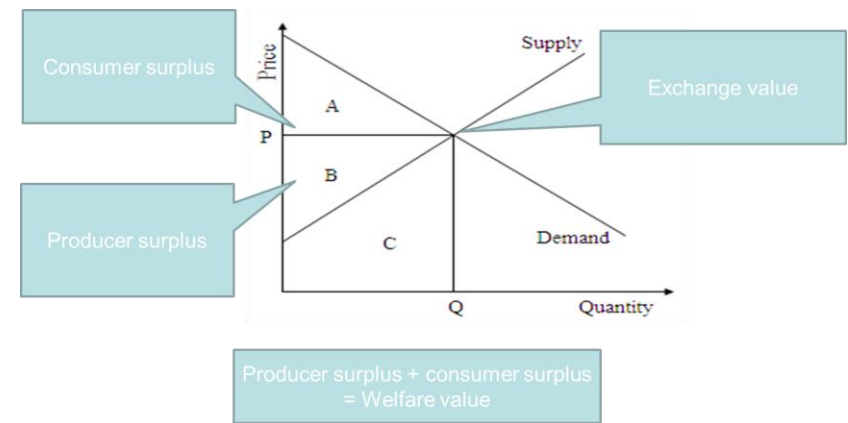
- Exchange and welfare values

Value is always context dependent

- Diamonds and water
- Ice and Innuits

Value to who?

- Public and private benefits (and costs)



Why use SEEA?

Incompleteness of current economic accounts

- Don't incorporate many flows between economy and the environment or flows in physical terms
- Do not account effectively for the cost of the use of natural resources
- No clear or common definition of environmental activity

Synthesizes and harmonizes available information and improves data coherence and coordination

Links to information required for assessing sustainability (SDG, Green Growth, etc.)

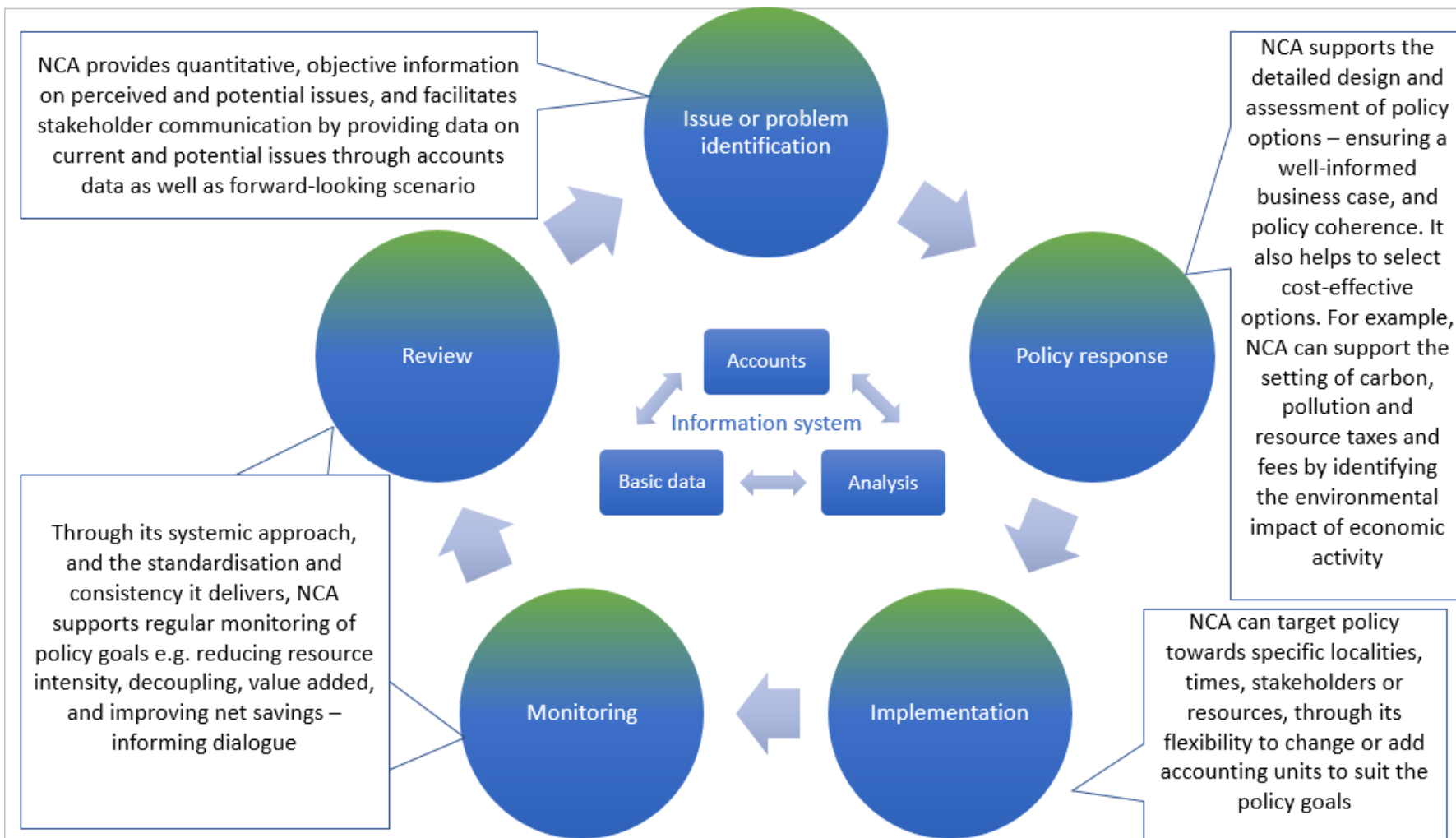
Provides a regular suite of integrated information for decision making

- Enabling regular reflection and identification of issues
- Track effectiveness of current policy and management (Accountability)
- Assess policy options and implement policy and management decisions



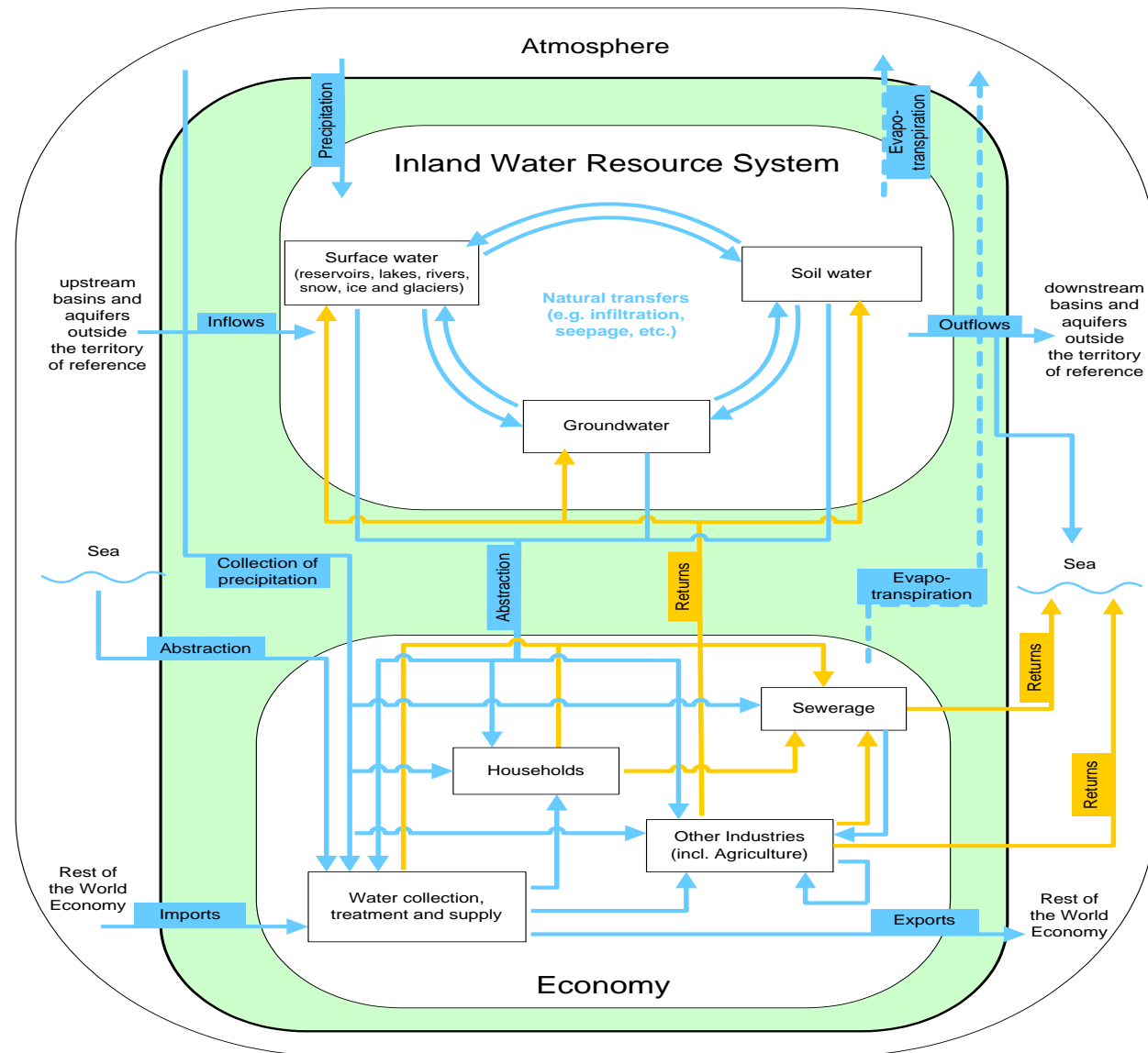
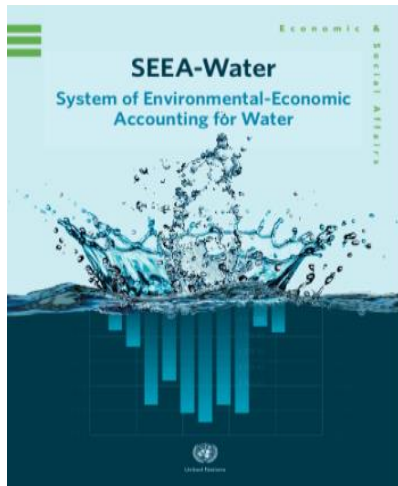
“If you don't measure it, you can't manage it”

The policy cycle and accounting – more than just monitoring



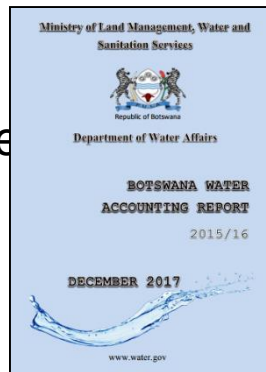
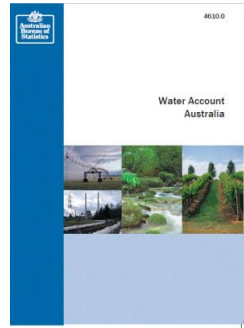
SEEA-Water

- Stocks and flows
- Economy and environment
- Volume and values

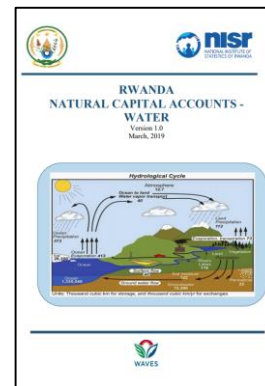


Many countries build water accounts

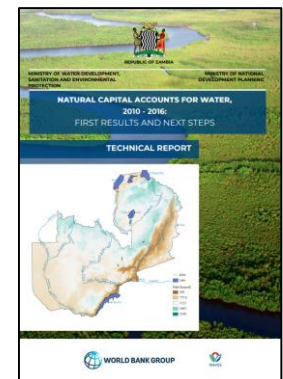
Andorra
Australia
Austria
Bahamas
Bahrain
Botswana
Brazil
Canada
China
Colombia
Denmark
Dominican Republic
Egypt
France
Germany
Guatemala
Hungary
Israel
Indonesia
Iraq
Italy
Jordan



Mexico
Namibia
Netherlands
New Zealand
Oman
Panama
Peru
Philippines
Portugal
Singapore
South Africa
Spain
Sweden
Switzerland
Trinidad and Tobago
Ukraine
Armenia



Estonia
Greece
Lebanon
Mauritius
Madagascar
Norway
Romania
Rwanda
Tunisia
Turkey
United Kingdom
Zambia
USA



SEEA Water Standard Tables

“core tables” in the SEEA Central Framework

1. Physical supply
2. Physical use
3. Gross and net emissions
4. Emissions by ISIC 37
5. Hybrid (Monetary and Physical) supply
6. Hybrid use
7. Hybrid supply and use
8. Hybrid water supply and sewerage for own use
9. Government accounts for water related collective consumption services (Monetary)
10. National expenditure for waste management (Monetary)
11. Financial accounts for waste water management (Monetary)
12. Asset account (Physical)

+ 12 Supplementary tables

Physical asset account for water resources

Table 5.11.2 Physical asset account for water resources (cubic metres)

	Type of water resource					Total	
	Surface water				Groundwater		Soil water
	Artificial reservoirs	Lakes	Rivers and streams	Glaciers, snow and ice			
Opening stock of water resources	1 500	2 700	5 000		100 000	500	109 700
Additions to stock							
Returns	300		53		315		669
Precipitation	124	246	50			23 015	23 435
Inflows from other territories			17 650				17 650
Inflows from other inland water resources	1 054	339	2 487		437	0	4 317
Discoveries of water in aquifers							
<i>Total additions to stock</i>	1 478	585	20 240		752	23 015	46 071
Reductions in stock							
Abstraction	280	20	141		476	50	967
for hydro power generation							
for cooling water							
Evaporation & actual evapotranspiration	80	215	54			21 125	21 474
Outflows to other territories			9 430				9 430
Outflows to the sea			10 000				10 000
Outflows to other inland water resources	1 000	100	1 343		87	1 787	4 317
<i>Total reductions in stock</i>	1 360	335	20 968		563	22 962	46 188
Closing stock of water resources	1 618	2 950	4 272		100 189	553	109 583



Physical Supply Table for Water

Physical supply table for water									Flows from the rest of the world	Flows from the	Total supply
Abstraction of water; Production of water; Generation of return flows									Imports	the	
	Agriculture, forestry and fishing	Mining & quarrying, Manufacturing and Construction	Electricity, gas, steam and air conditioning	Water collection, treatment and supply	Sewerage	Other industries					
				Total (excluding household	Household activity						
Sources of abstracted water											
Inland water resources											
Surface water										440.6	440.6
Groundwater										476.3	476.3
Soil water										50	50
Total										966.9	966.9
Other water sources											
Precipitation										101	101
Sea water										101.1	101.1
Total										202.1	202.1
Total supply abstracted water										1169	1169
Abstracted water											
For distribution				405.6							405.6
For own-use	108.4	114.6	404.2	23	10.8	100.1	2.3				763.4
Wastewater and reused water											
Wastewater											
Wastewater to treatment	17.9	117.6	5.6	1.4	235.5	0	49.1				427.1
Own treatment											0
Reused water produced											
For distribution						42.7					42.7
For own use		10									10
Return flows of water											
To inland water resources											
Surface water			300		0.5	52.5	0.2				352.7
Groundwater	65	23.5		47.3	4.1	175	0.5				311.3
Soil water											0
Total	65	23.5	300	47.3	4.6	227.5	0.7				664
To other sources		5.9	100		0.2	256.3					362.2
Total Return flows	65	29.4	400	47.3	4.8	483.8	0.7				1026.2
Evaporation of abstracted water, transpiration and water incorporated into products											
Evaporation of abstracted water	76.2	43.2	2.5	1.8	10	0.7	3.6				138
Transpiration											
Water incorporated into products											
Total supply	267.5	314.8	812.3	479.1	261.1	627.3	55.7		0	1169	3986.8
Physical use table for water											

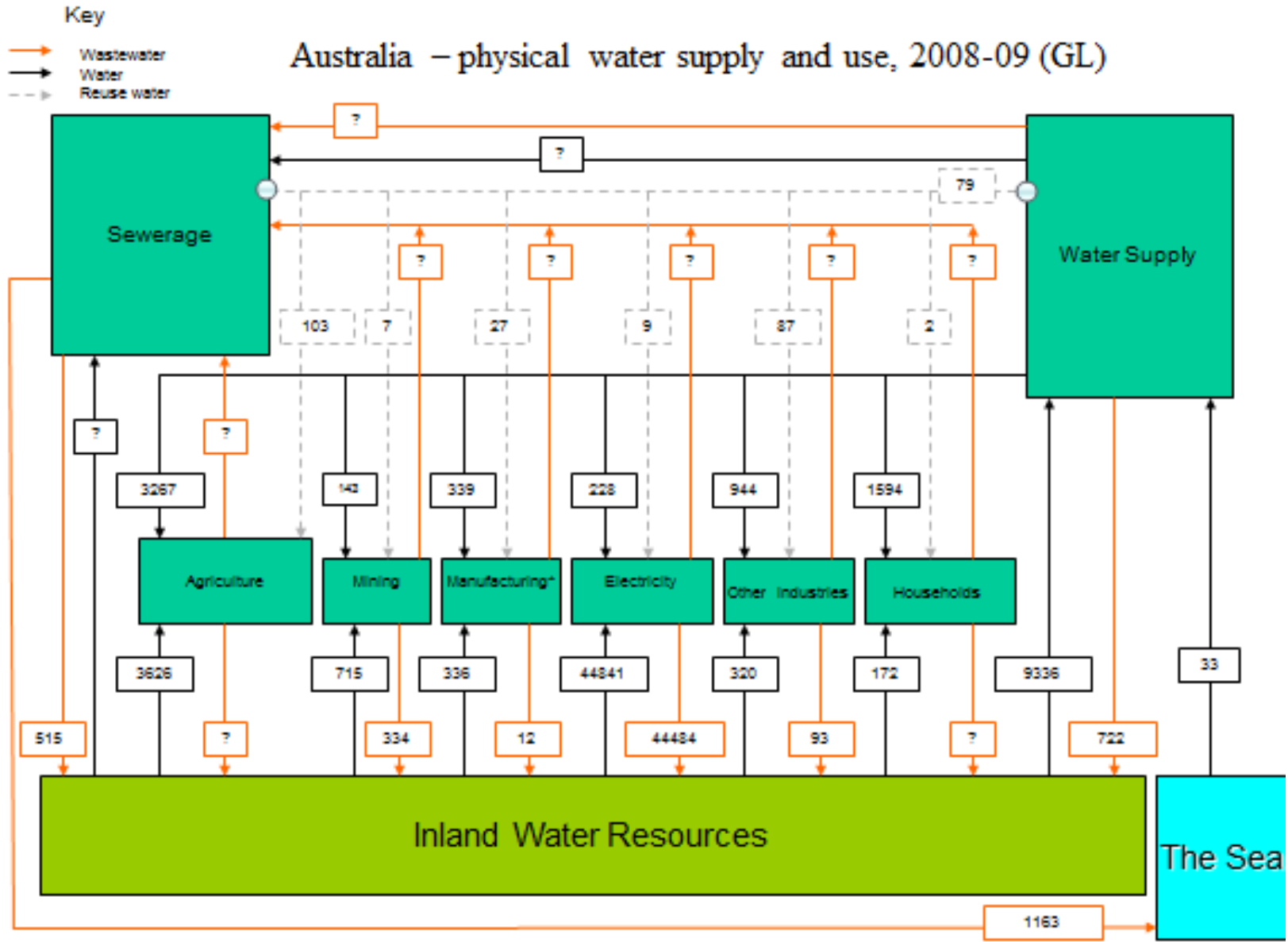


Physical Use Table for Water

Physical use table for water

	Abstraction of water; Intermediate consumption; Return flows							Final consumption Households	Accumulation	Flows to the rest of the world Exports	Flows to the environment	Total use
	Agriculture, forestry and fishing	Mining & quarrying, Manufacturing and Construction	Electricity, gas, steam and air conditioning	Water collection, treatment and supply		Sewerage	Other industries					
				Total (excluding household	Household activity							
Sources of abstracted water												
Inland water resources												
Surface water	55.3	79.7	301	4.5	0	0.1						440.6
Groundwater	3.1	34.8	3.2	423.1	9.8		2.3					466.5
Soil water	50											50
Total	108.4	114.5	304.2	427.6	9.8	0.1	2.3					957.1
Other water sources												
Precipitation				0	1	100						100
Sea water			100	1.1								101.1
Total	0	0	100	1.1	1	100	0					201.1
Total use abstracted water	108.4	114.5	404.2	428.7	10.8	100.1	2.3					1158.2
Abstracted water												
Distributed water	38.7	45	3.9	27.4	0	0	51.1	239.5		0		405.6
Own use	108.4	114.6	404.2	23	0	100.1	2.3	10.8				763.4
Wastewater and reused water												
Wastewater												
Wastewater received from other units				0		427.1				0		427.1
Own treatment	12	40.7										52.7
Reused water												
Distributed reuse												
Own use												
Total	12	40.7	0	0	0	427.1	0	0		0		479.8
Return flows of water												
Returns of water to the environment												
To inland water resources											668.6	668.6
To other sources											362.4	362.4
Total return flows											1031	1031
Evaporation of abstracted water, transpiration and water incorporated into products												
Evaporation of abstracted water											138	138
Transpiration												
Water incorporated into products												
Total use	267.5	314.8	812.3	479.1	10.8	627.3	55.7	250.3	0	0	1169	3986.8

Australia – physical water supply and use, 2008-09 (GL)





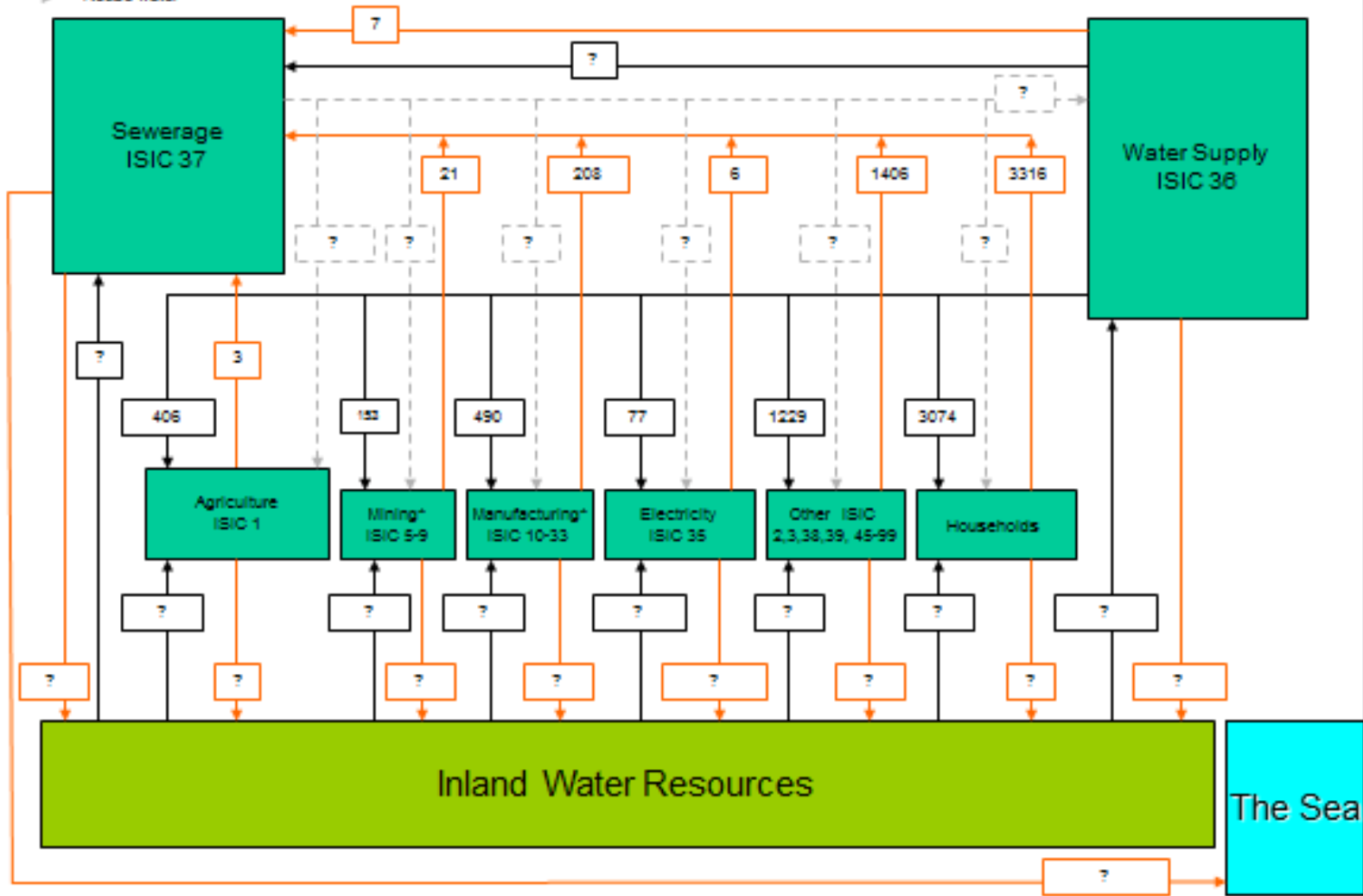
Monetary Supply and Use Account

	Industries (by ISIC Division)							Rest of the world	Taxes less subsidies on products, trade and transport margins	Actual final		Total
	ISIC 01-03	ISIC 05-33, 41-43	ISIC 35	ISIC 36	ISIC 37	ISIC 38, 39, 45-99	Industry			Households	Government	
Supply of water products (Currency units)												
Natural water	L.1.1	L.1.1	L.1.1	L.1.1	L.1.1	L.1.1	L.1.1		M.1.1.1- [N.1.1.1+N.1.2.1]			1.1- [N.1.1.1+N.1.2.1]
Sewerage services	L.1.2	L.1.2	L.1.2	L.1.2	L.1.2	L.1.2	L.1.2		M.1.1.2- [N.1.1.2+N.1.2.2]			1.2- [N.1.1.2+N.1.2.2]
Total supply of products												
Intermediate consumption and final use (Currency units)												
Natural water	L.4.1	L.4.1	L.4.1	L.4.1	L.4.1	L.4.1	L.4.1			N.1.1.1+ N.1.2.1	N.1.1.1+ N.1.2.1	L.4.1+N.1.1
Sewerage services	L.5.1	L.5.1	L.5.1	L.5.1	L.5.1	L.5.1	L.5.1			N.1.1.2+ N.1.2.2	N.1.1.2+ N.1.2.2	L.5.1+N.1.1 +N.1.2.2

Key

- Wastewater
- Water
- - - Reuse water

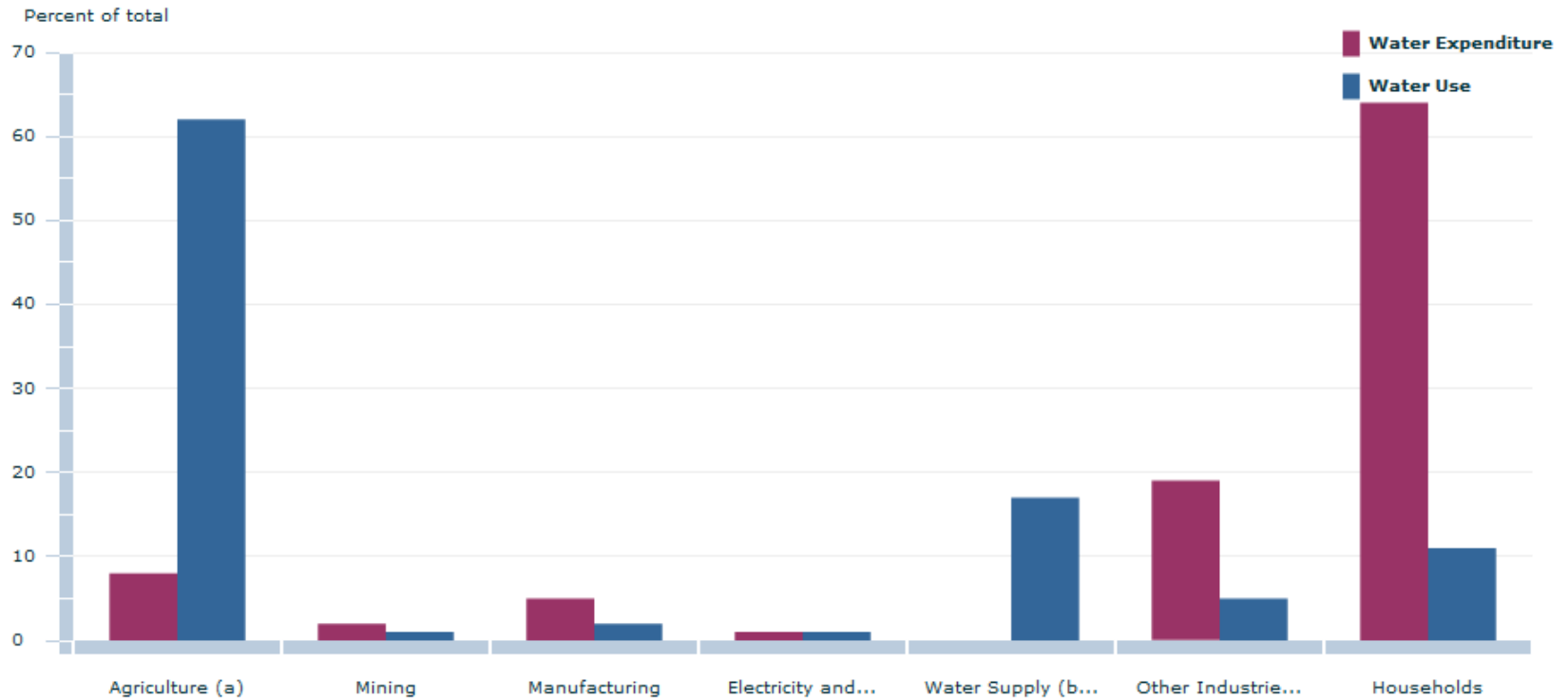
Australia – monetary water supply and use, 2008-09 (million AUD\$)



Water Account, Australia

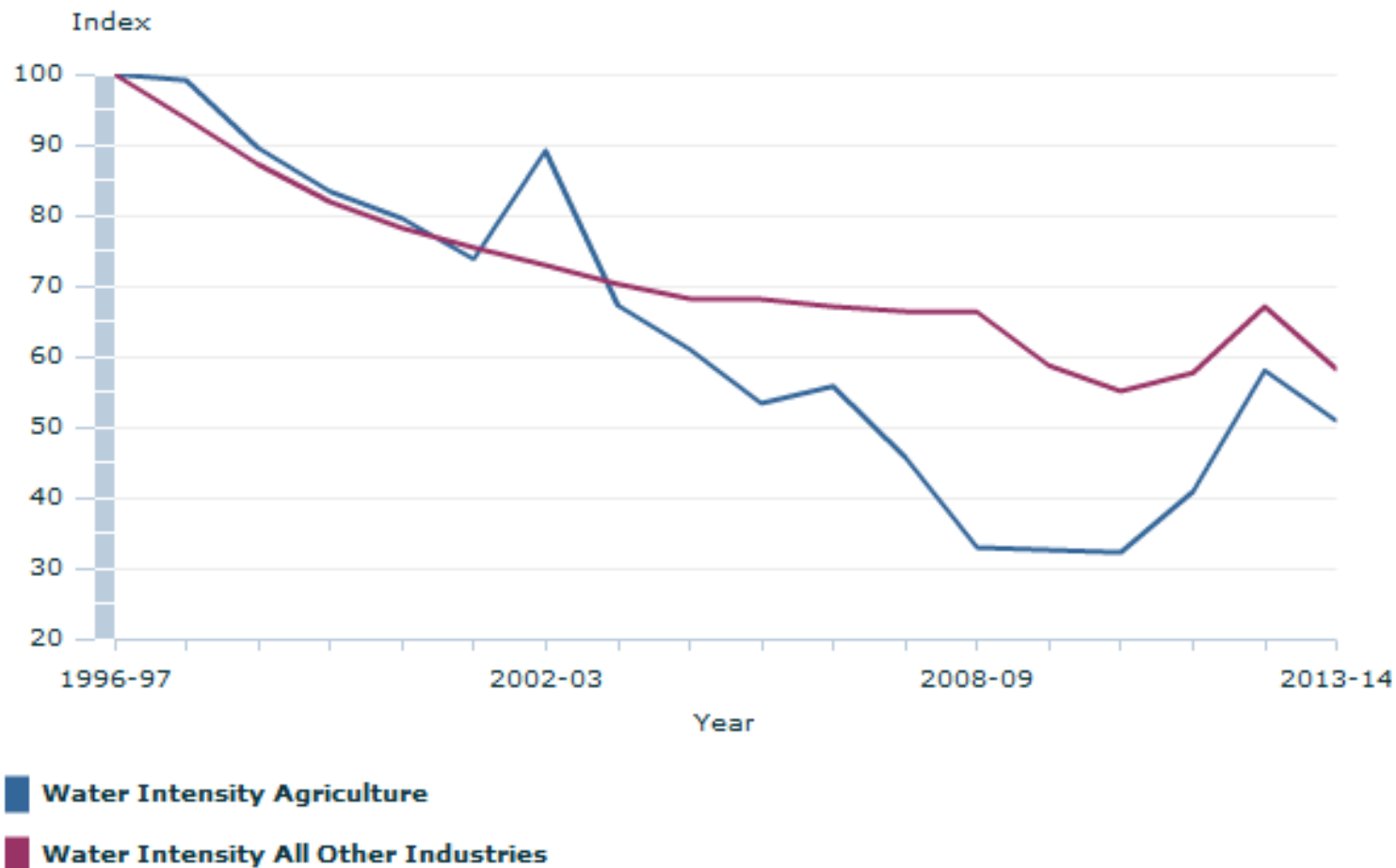
Monetary vs. physical use of distributed water (% of total use), 2013-14

Distributed Water, Expenditure & Use.



Australia, Industry intensity of water use: 1996-97 to 2013-14

CHANGE IN WATER INTENSITY (a), Agriculture & all other industries, 1996-97 to 2013-14





Water emissions account

Physical supply table for gross releases of substances to water							
	Generation of gross releases to water			Accumulation	Flows with the rest of the world	Flows from the environment	Total supply
	Sewerage industry	Other industries	Households	Emissions from fixed assets			
Emissions by type of substance							
BOD / COD *	5 594	11 998	2 712				20 304
Suspended solids							
Heavy metals							
Phosphorous	836	1 587	533				2 956
Nitrogen	10 033	47 258	1 908				59 199
Releases to other economic units							
BOD / COD *		7 927	8 950				16 877
Suspended solids							
Heavy metals							
Phosphorous		814	6 786				7 600
Nitrogen		15 139	30 463				45 602
Physical use table for gross releases of substances to water							
	Collection of gross releases to water			Flows with the rest of the world	Flows to the environment	Total use	
	Sewerage industry	Other industries	Households				
Emissions received by the environment							
BOD / COD *					20 304		20 304
Suspended solids							
Heavy metals							
Phosphorous					2 956		2 956
Nitrogen					59 199		59 199
Collection by other economic units							
BOD / COD *	16 877						16 877
Suspended solids							
Heavy metals							
Phosphorous	7 600						7 600
Nitrogen	45 602						45 602



Water-related ecosystem services

Provisioning services

- Water supply
- Soil and sediment retention

Regulating and maintenance services

- Water purification services
 - Retention and breakdown of nutrients
 - Retention and breakdown of other pollutants
- Water flow regulation services
 - Baseline flow maintenance services
 - Peak flow mitigation services
- Flood control services
 - Coastal protection services
 - River flood mitigation services
- Storm mitigation services

Cultural services

- Recreation-related services
- Visual amenity services
- Education, scientific and research services
- Spiritual, artistic and symbolic services
- Other cultural services





Com mod

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H I G H

Ecology tools for carbon. We do service. Model based services. All the have d. As each of mod

A R T I

Article has been received. Accepted Available

Editor: Kit ARIES InVEST LUJ Carbon Nutrient

Received: 14 1
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RESEAR

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Kenneth Michel Bernard Evariste

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Correspondent Kenneth J. Bagstad Email: kjbagst.

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A comparative ass services quantific

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¹ U.S. Geological Survey, Geosciences & BSR, San Francisco, CA, USA ² Socioeconomics Program, USDI–Burea

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Contents

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 2. Study context
 - 2.1. Tools review.
 - 2.2. Evaluative criteria
 3. Findings: analytical and m
 - 3.1. Aspatial ecosystem
 - 3.2. Independently appl
 - 3.3. Independently appl
 - 3.4. Proprietary, general
 - 3.5. Site-scale modeling
 - 3.6. Monetary valuation
 - 3.7. Application of selec
 4. Conclusions
 - 4.1. General findings.
 - 4.2. Feasibility for wide:
 - 4.3. Implications for pul
 - 4.4. Lowering barriers to Disclosure statement.
- Acknowledgments.
Appendix A. Supporting inf
References

* Corresponding author. Tel.: +1 302 E-mail address: kjbagst@usgs.gov

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People and Nat

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Spatially explicit bio-geographical

Alessandra La Notte^a

^a Rural Water and Ecos Ispra 21027, Italy; ^b Euro

This case study explicit, biophysio bio-geographical the construction, 2005 was estimi considered, the 1 between a bioph estimates of pote provided by river

Keywords: water

Introduction

Biodiversity provide: food provision, carbo which underpin econ quality of life (Mille The Economics of I In 2001, the Europea halt biodiversity loss to date, there are cle been reached (Mace led to this target ne lack of current polici tainable use of ecosy services. In 2010 th posed a renewed visi ensuing period, build national deliberation: beyond 2010, which i gic plan for the Unit Diversity (EC 2011). vices play a key rol Biodiversity delivers provided by ecosys ecosystems are linke flow of ecosystem se essary structures and or potential to deliv vices result in benefi De Groot et al. 2010 The proper valuation support the EU biodi

*Corresponding author.

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Environmental Management (2019) https://doi.org/10.1007/s00267-018

Assessing the Cap Using Remote Ser

Leonardo Vargas^{a, *}, Loui

Received: 18 March 2017 / Accepte © The Author(s) 2018

Abstract

Ecosystems contribute to eco Information on ecosystems a economic statistics. Ecosyste accounts. Ecosystem account actual flows of ecosystem s sustainably supply ecosystem not available over large scale: used as an indicator to assess patterns in this capacity for th ecosystems to supply timber, ecosystem capacities with th provides insights on how the accounting. Ecosystem cap important for the design and

Keywords Ecosystem capaci

Introduction

Ecosystems provide a wide essential for human survival.

Electronic supplementary mater (https://doi.org/10.1007/s00267-0) material, which is available to aut

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Empirical validation c at a national scale

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HIGHLIGHTS

- Ecosystem service models are widely used but rarely validated with empirica data.
- We validated the InVEST water yield model with long-term river flow dat: in the UK
- We investigated model sensitivity an compared performance with alternativ input data.
- The model can be highly sensitive to variation or errors in the input param ters.
- The InVEST model performed wel when national scale input data wer used.

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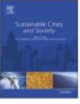
http://dx.doi.org/10.1016/j.jscs.2016.06.2 0048-9697/© 2016 Elsevier B.V. All rights res

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Water accounts in decision-making processes of urban water management: Benefits, limitations and implications in a real implementation

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ARTICLE INFO

Keywords: SEEA-Water Urban water management Urban public policies Water resources

ABSTRACT

Data management for decision support is a challenging aspect of any decision-making process. Water management is not an exception. The objective of this paper is to present a procedure for compiling water accounts at an urban level to support political decision-making processes with solid foundations. The System of Environmental-Economic Accounting for Water (SEEA-Water) was used for this purpose. The case study of Santo Domingo de los Colorados in Ecuador serves to illustrate the benefits and the limitations of the available data and to identify data gaps. The compilation of the SEEA-Water at a local level is a pioneering work. The results reveal the water flows from the environment to the economy, within the economy, from the economy to the environment, water quality, and the contribution of water resources to different economic activities for the period 2014–2015 at the local level. The information was categorized for the water supply industry, the sewage industry, for the rest of the industries and services, and for the households. On the basis of our empirical ex- ample, this paper shows how SEEA-Water underpins informed decision-making on urban water management and serves to improve the quality of water-related data.

1. Introduction

In the last decade, environmental issues became an important concern for decision makers, at both the national and international levels (Gudynas, 2011; Ironkwe & Success, 2017). Stakeholders use the available information to make informed choices. They also formulate hypotheses about future repercussions of such choices (Vardon, Castañeda, Nagy, & Schenau, 2018). The interactions between anthropogenic activities and the environment cannot be understood and described separately (Liu et al., 2018). Understanding the crucial role of the environment as a source of natural capital and as a sink for waste products resulting from the production of man-made capital and other human activities, was the first step towards the integration of environmental aspects into policy-decision-making (Borrego-Martín, Gutiérrez-Martín, & Berbel, 2016; Borrego-Martín, Gutiérrez-Martín, & Berbel, 2015; Borrego-Martín, Gutiérrez-Martín, & Berbel, 2018; Elmqvist et al., 2013; Ironkwe & Success, 2017).

In 1992, a system for integration of environmental and economic accounting was proposed in Agenda 21 (United Nations, 1994). This idea grew stronger after the *United Nations Conference on Sustainable Development* (Rio+20) held in Rio de Janeiro, Brazil in 2012. Some

common characteristics behind this idea are that environmental accounts provide tools to link environmental data with economic data, present global information for policy-making, and include time series data (Hecht, 2000, 2012; Recuero Virto, Weber, & Jeantil, 2018). Consequently, environmental accounting plays a crucial role in transforming available data into useful information for supporting appropriate decision-making options (Liu et al., 2018).

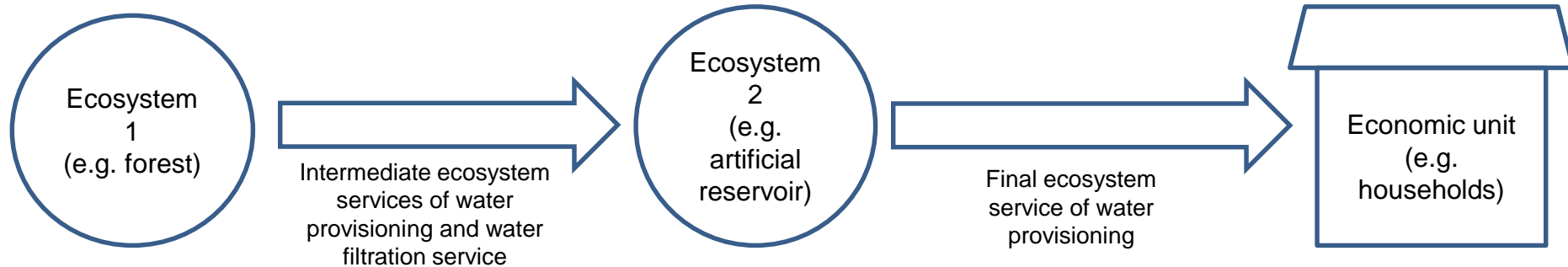
Different approaches such as Environmental flow analysis (EFA) and Environmental Metabolism (including material and energy flows) (e.g., Bai & Schandl, 2016; Conke & Ferreira, 2015), Energy Analysis (e.g., Shan & Chen, 2016; Wang, Cao, & Chen, 2017; Yue, Yuan, Li, Ren, & Wang, 2016), Carbon Footprinting (e.g., Ajani, Keith, Blakers, Mackey, & King, 2013; Casolani, Pattara, & Liberatore, 2016), Life-Cycle Assessment (LCA) (e.g., Guindé et al., 2011; Liu, Wang, Yang, Zhou, & Liu, 2017; Lundin & Morrison, 2002), analysis of Environmental Inventory as well as Multi-Criteria Optimization (MCO) and management are all used for environmental accounting.

However, despite the large amount of research that has already been undertaken, new perspectives to integrate natural and social dimensions are needed (Folke et al., 2011). The central framework of the System of Environmental-Economic Accounting (SEEA) was developed

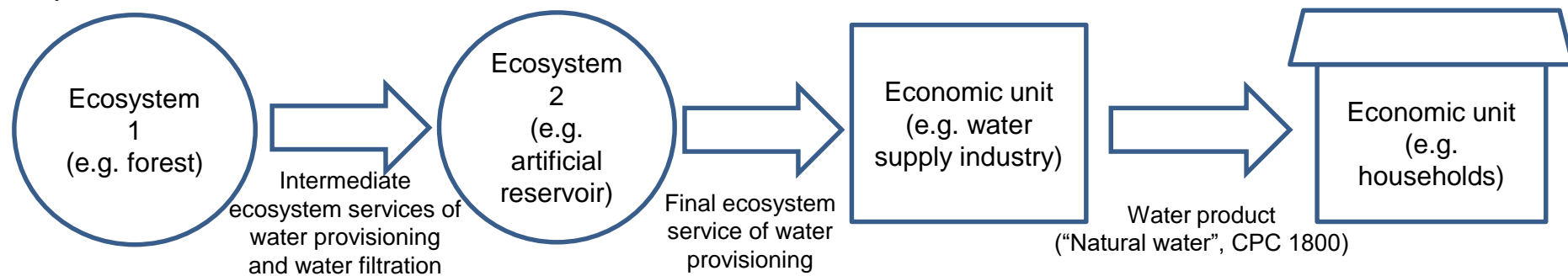
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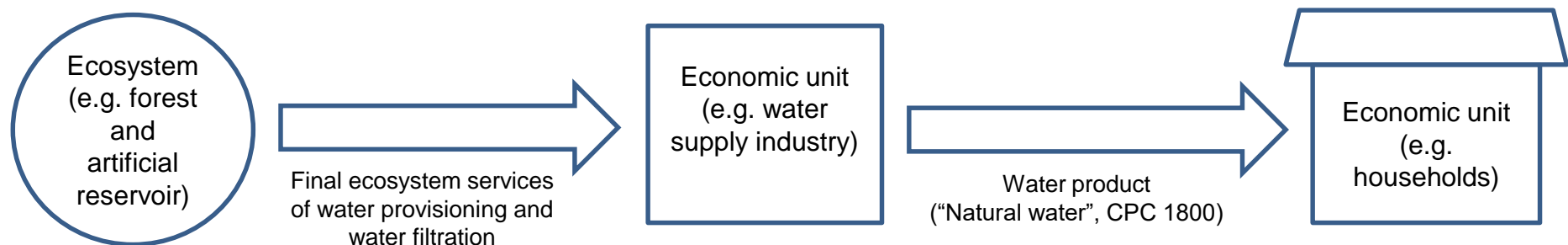
a. Water abstracted from an artificial reservoir directly by households



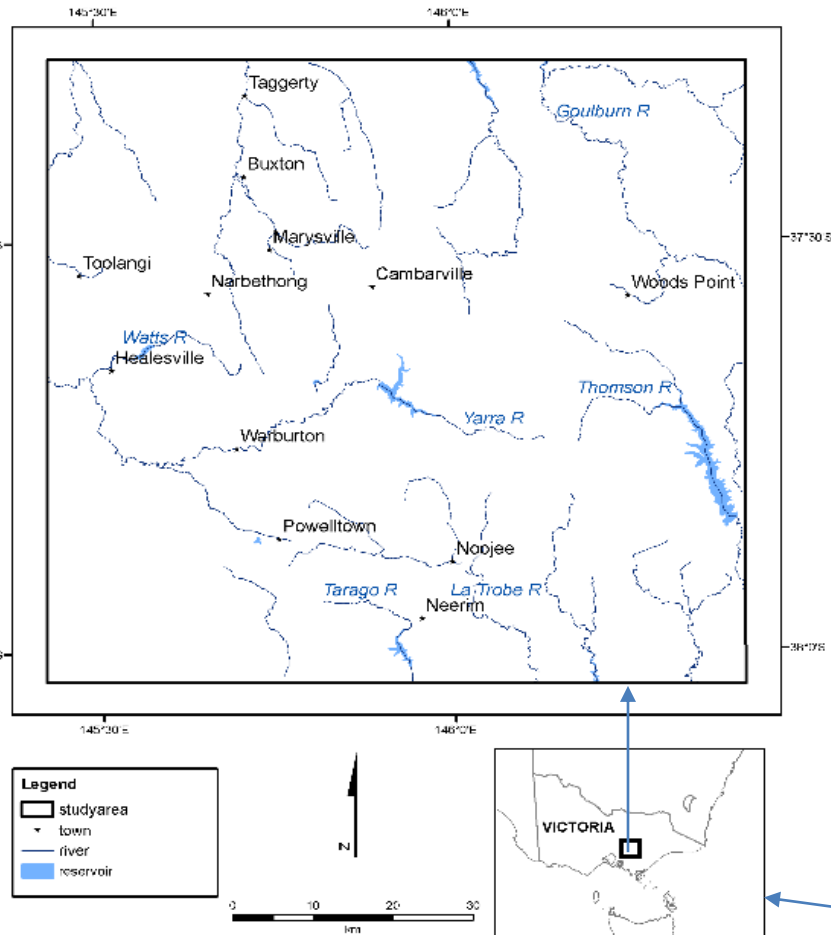
b. Water abstracted from artificial reservoirs by water supply industry, supplied to households with forests and artificial reservoir shown as two ecosystems



c. Water abstracted from artificial reservoir by water supply industry, supplied to households with forests and artificial reservoir shown as one ecosystem

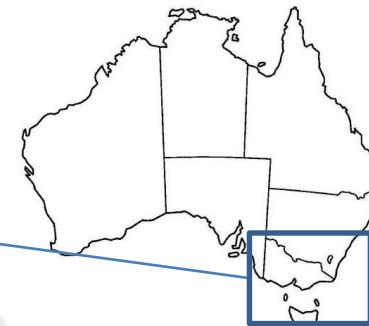


Case study – Central Highland of Victoria Australia



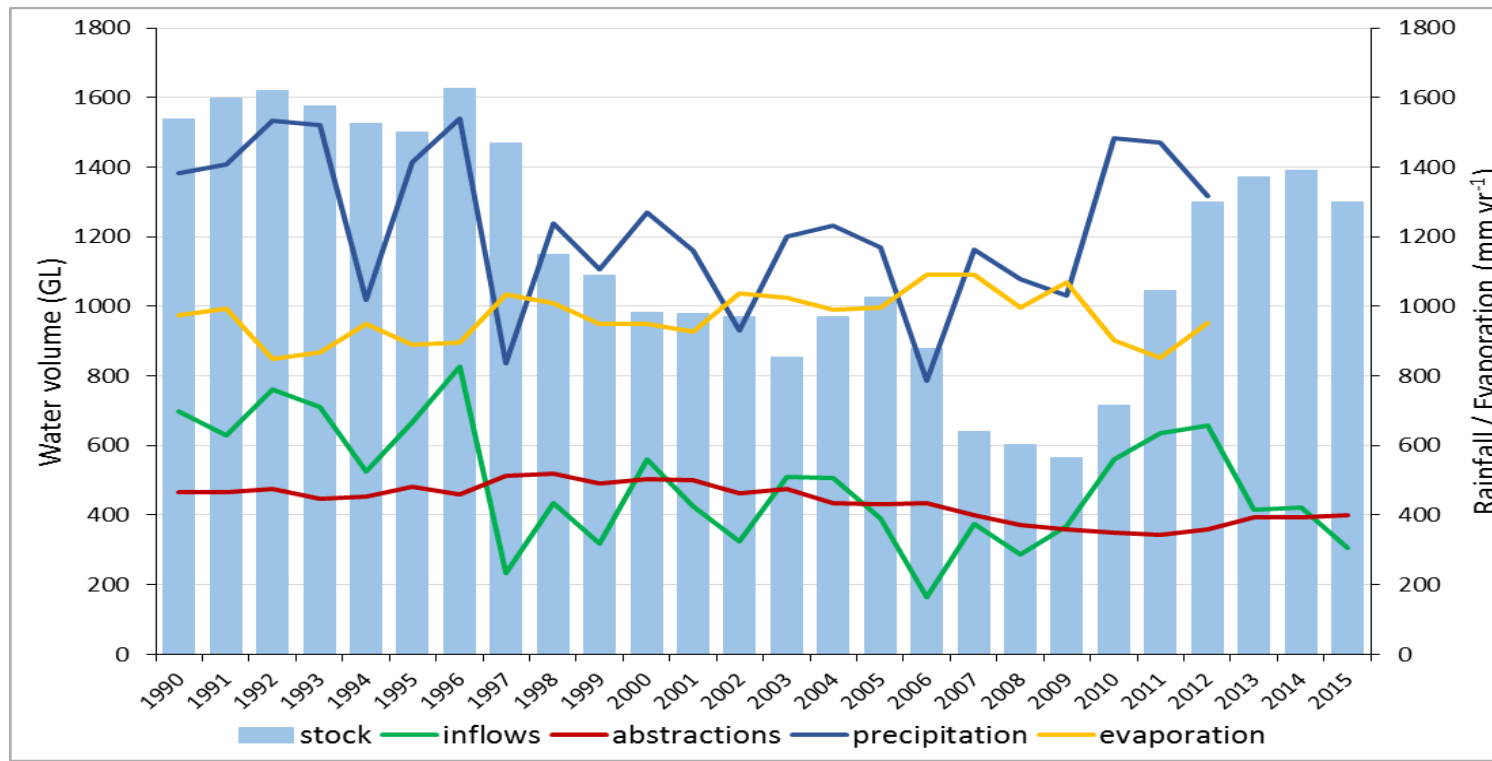
Context

- Near Melbourne a city of 5+ million people
- Mix of land covers and much native forest
- Land use conflict
- Proposal to expand national park network
- Systematic information lacking
- Suite of ecosystem accounts prepared for the area
- Applying the SEEA to specific issues





Times series of physical water stocks and flows



Keith, H., Vardon, M., Stein, J.A., L. Stein, J.L. and & Lindenmayer, D. (2017). Ecosystem accounts define explicit and spatial trade-offs for managing natural resources. *Nature Ecology & Evolution* (18 September 2017): doi:10.1038/s41559-017-0309-1 <https://www.nature.com/articles/s41559-017-0309-1>

Value of water supplied by Melbourne Water

STRAIGHT FROM ANNUAL REPORTS – ADJUSTEMENTS MADE AS
MELBOURNE WATER ALSO PROVIDES SEWERAGE SERVICES

	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
	(\$m)	(\$m)	(\$m)	(\$m)	(\$m)	(\$m)
Revenue						
Revenue from water supply	379.7	512.3	547.6	911.2	876.2	964.2
Other revenue	617.6	727.9	710.6	805.5	873.5	889.1
Total revenue	997.3	1,240.2	1,258.2	1,716.7	1,749.7	1,853.3
Expenses						
Operating and other expenses	(253.0)	(272.2)	(367.7)	(404.9)	(408.2)	(366.3)
Wages, employee benefits	(75.0)	(103.5)	(86.9)	(100.7)	(106.4)	(115.6)
Depreciation and amortisation	(231.9)	(242.6)	(315.9)	(351.6)	(367.5)	(373.8)
Financial expenses	(223.3)	(249.2)	(549.3)	(727.6)	(707.2)	(676.7)
Total expenses	(783.2)	(867.5)	(1,319.8)	(1,584.8)	(1,589.3)	(1,532.4)
					(1,115.4)	
Net result before tax	214.1	372.7	(61.6)	131.9	160.4	339.2
Tax (expense)/benefit	(56.2)	(102.8)	21.8	(42.0)	(44.2)	(185.9)
Net result after tax	157.9	269.9	(39.8)	89.9	116.2	153.4
					160.40	
Estimated IVA for Melbourne Water = Wages, employee benefits + depreciation and amortisation + net result before tax	521.0	718.8	341.2	584.2	634.3	828.6
Estimated IVA for water supply = Estimated IVA for Melbourne Water x percentage of revenue from water supply	198.4	296.9	148.5	310.1	317.6	431.1

Note all values in AUD, current prices. USD:AUD ~ 1.0:1.3



Valuation of ecosystem services – exchange value

Three methods were considered

1. Resource rent

- Problem of negative rents

2. Production function

- Data intensive and data not readily available

3. Replacement cost

- Replacement cost chosen - data available and use recommended by Edens, B. and Graveland, C. (2014). *Water Resources and Economics*: 7, 66–81.

Note: SEEA Ecosystem Accounting – valuation is guidance only (not standard)



Replacement Cost method

Assumptions

1. that the service if lost would be replaced
2. that water consumption patterns would be unaffected by any increase in cost.

Options for replacement of water in Central Highlands

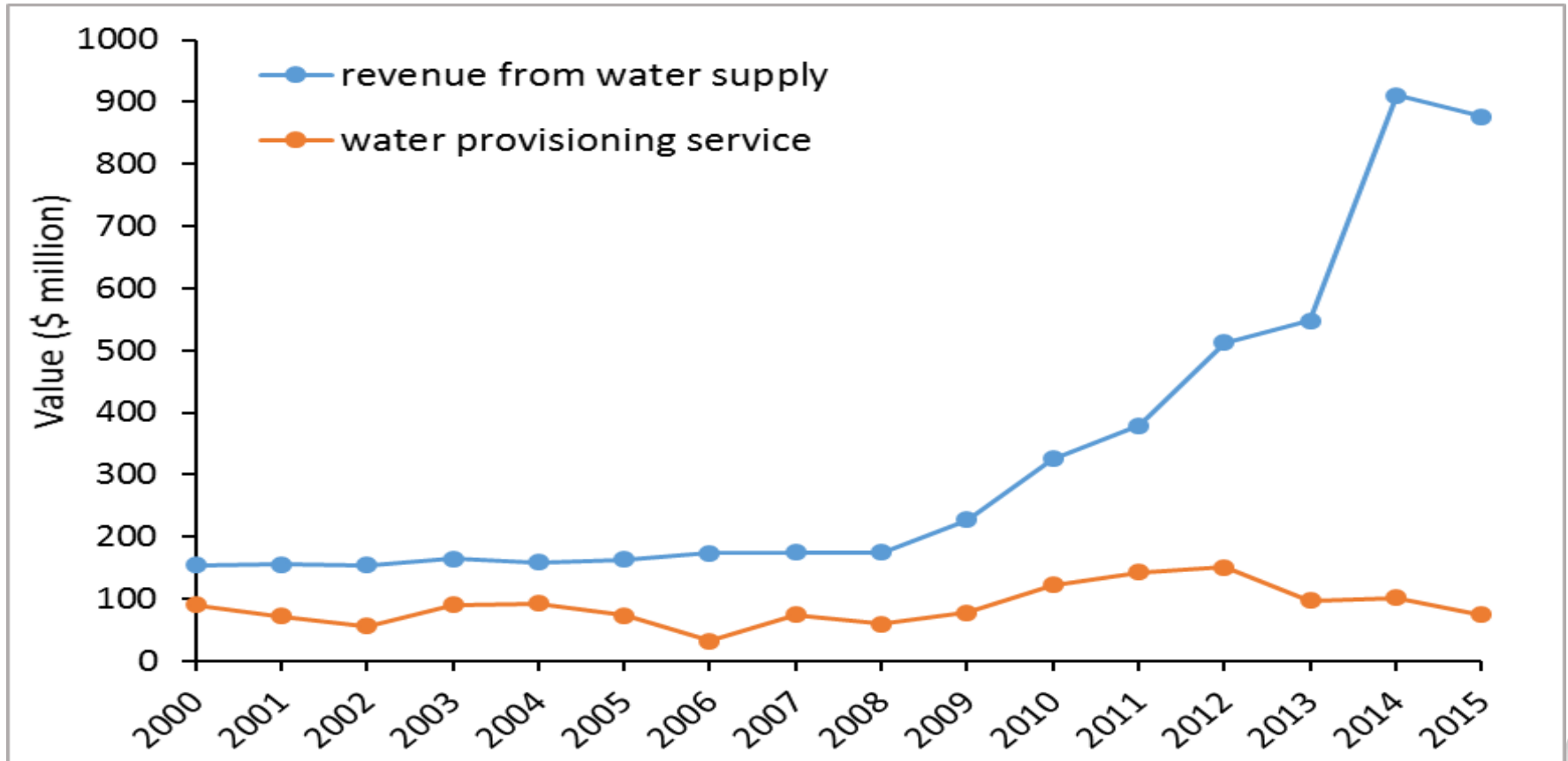
1. transfer of water from other regions
2. use of desalination
3. use of recycled water

LEAST COST BUT NOT CHOSEN BY
GOVERNMENT





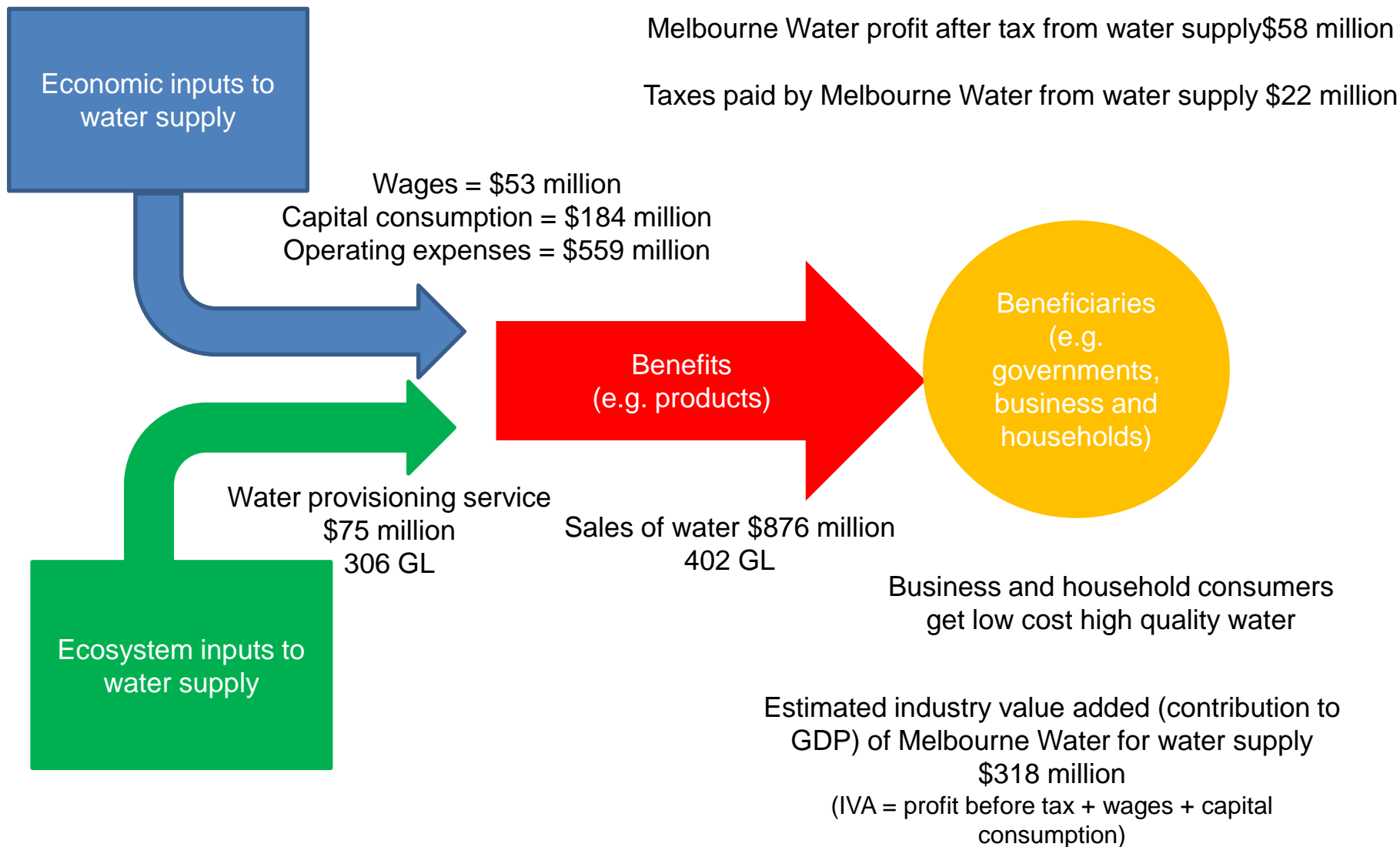
Value of water sales and ecosystem services used



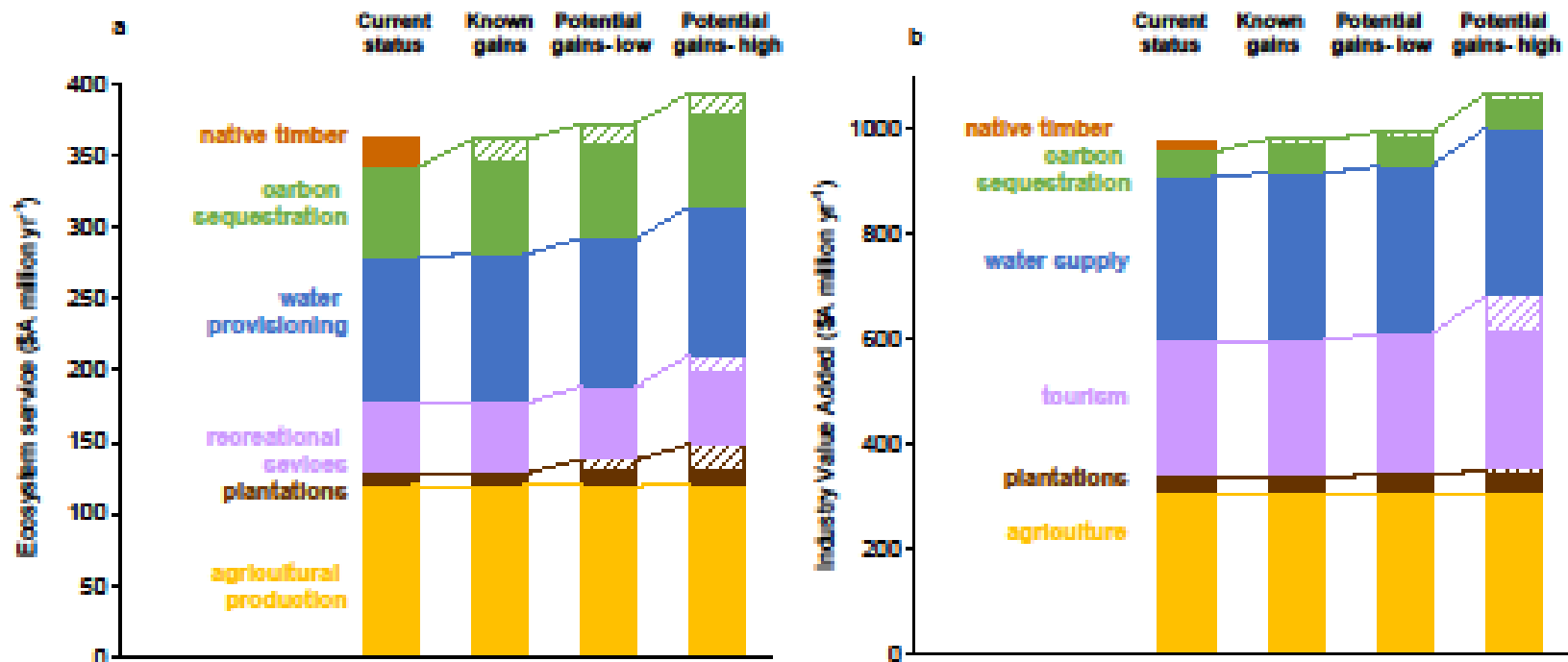
Note all values in AUD, current prices. USD:AUD ~ 1.0:1.3



Melbourne Water 2014-15: use of ecosystem services, cost of water production and industry value added



Value of ecosystems and value added of industries using ecosystem service in the Central Highlands of Victoria – three scenarios



Note all values in AUD, current prices. USD:AUD ~ 1.0:1.3

Key message

SEEA is:

- A way of organizing economic and environment information that decision makers at the heart of government understand – Ministries of Finance and Central Planning Agencies
- Ecosystem accounting is a rapidly evolving area and accounting for the ecosystem services related to water will make water accounts more useful
- Water accounts have been produced and used for water management and policy in many countries



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Questions

