A report on upcoming experimental estimates of water resource stocks for Australia

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EXECUTIVE SUMMARY

1 The balance sheet of the Australian system of national accounts currently includes the economic value of water resource stocks as part of national wealth but records this value as an unquantified component of the value of land. The 2008 edition of the *System of National Accounts* SNA (2008 SNA) recommends reporting estimates of the monetary value of water resources. In support of this recommendation, the London Group on Environmental Accounting has recently established agreement on a workable means to value water resource stocks. This consensus, coupled with data from Australia's National Water Commission (NWC) on trading in water access entitlements, has made it possible to develop an experimental time series of estimates of the value of water resource for Australia. The production of this series can be undertaken in Australia using existing data sources.

2 This paper reports on the development of a time series of experimental estimates of the value of water resources in Australia. These estimates will be released as a special article in the next edition of the Australian Bureau of Statistics (ABS) publication *Water Account, Australia*. Estimates will be provided in respect of Australian states and territories, and by each institutional sector. This paper clarifies key underlying concepts important to the understanding and measurement of water resource asset values and describes the data sources and estimation methodology underpinning the upcoming experimental estimates.

3 The scope of the upcoming experimental estimates extends to all water resources within Australian water catchments with active water management plans that are also subject to tradable water rights, specifically those water rights called water access entitlements.

4 A water access entitlement is a right to access a share (i.e. quota) of water from a water catchment that is subject to a formal management plan. In Australia, this type of entitlement is valid in perpetuity and is typically tradable on open markets, separately from the land it adjoins. Thus, the market value of the tradable water access entitlement represents buyer expectations of the benefits from holding and using the water resource i.e. it equates to the value of the water asset itself.

5 The NWC provides data – for each Australian water catchment – on the volume of water governed by water access entitlements currently on issue. NWC water trading data allow calculation of the average price per mega litre (ML) of trades in water access entitlements for each catchment. By assuming that water entitlement trade prices are representative of all water in the catchment, it becomes possible to calculate the market value of all water access entitlements for each catchment.

6 To our knowledge, no national statistical office has yet published official estimates of the value of national water resource stocks. This is probably not surprising given the range of conceptual and data challenges involved, and the upcoming experimental estimates have required decisions on several matters that will benefit from further discussion and research. For instance, what is the appropriate scope of water resources to be subjected to valuation; and how should asset values be generated for catchments where trading in water rights is too thin to deliver price information of sufficient quality?

BACKGROUND

7 It is over twenty years since the 1993 SNA first recommended the inclusion of monetary estimates of water resources among the non-produced assets of the national balance sheet. Nevertheless, to date no national statistical agency has published estimates of the value of its water resources within either its official economic or environmental accounts. There are a number of reasons why this is so; in the first instance the relevant international statistical standards – the 2008 SNA and the *System of Environmental-Economic Accounting* (SEEA 2012) – do not provide complete guidance on exactly what resources are to be valued and how these valuations should be achieved in practice. Second, the vast majority of economic transactions related to water are purchases of water flows, rather than purchases of the water resource stock – consequently, monetary valuation of water has to date been focused on water flows rather than stocks. Third, in the majority of countries water prices are usually highly regulated and typically set too low to allow businesses engaged in the water supply business to generate resource rents, that is, the operating surplus generated by the water supplier typically provides a return on produced capital used in production but is insufficient to also support a return on the natural resource used in production (Comisari *et al.* 2011). Consequently, the techniques normally used to value these types of non-produced assets could not be used in respect of water resources.

8 The London Group on Environmental Accounting meeting held in London in November 2013 established a degree of clarity in how water resources might be valued. It agreed that water resource stocks can be valued on the basis of prices paid for tradable rights to use these resources in perpetuity. This paper reports on upcoming estimates produced by the ABS using this approach. In taking this direction, Australia is in a fortunate position since active water markets apply to Australia's most economically significant water resources – resources that are actively traded in the form of both permanent trades of water resources and trades in temporary (annual) water allocations. The National Water Commission (NWC) collects the range and detail of data required to estimate the value of Australian water resource stocks.

WHY VALUE WATER RESOURCE STOCKS?

9 The 2008 SNA recommends inclusion of monetary values for water resources within the national balance sheet. Stocks of water resources are treated as economic assets within both the SNA and the SEEA. Apart from meeting reporting recommendations of the SNA, there are various reasons why a country would generate estimates of the value of water resources, including:

- To measure the contribution of water resources to the wealth of the nation;
- To assist in explaining and predicting changes in land values and land use - especially land used for irrigated agricultural production;
- Provide a basis for developing ongoing measures of efficiency of water use i.e. to determine whether, over time, these resources are being used more (or less) productively;
- Derive a real economic rate of return on water assets for public (and private) budget planning and project management purposes;

- Establish a broad basis for potential financial gains from adopting water efficiency measures; and
- Provide a basis for the evaluation of trade-offs necessary in allocating water between competing uses.

10 The valuation of water resources is an important element in the sustainable management of this resource and in improving our understanding of the role of water resources within the economy.

VALUATION OPTIONS AND EXPERIENCE

11 For the purpose of this exercise, the value of the water resource stock is based on market prices paid to transfer its ownership from one institutional unit to another. This relatively narrow view of the economic value of water reflects the principles embodied in the 2008 SNA and is standard practice within official economic statistics.

12 The SEEA and the SNA both provide guidance in the valuation of water resource stocks. The SEEA Central Framework provides a description of water resources and the classes of water that are in scope of the asset accounts. In addition, a physical asset account is described for water resources (SEEA, Table 5.11.2). The discussion of monetary asset accounts for water resources is largely confined to a discussion of possibilities and difficulties associated with these accounts. The valuation of water resources is assigned to the research agenda of the SEEA Central Framework (SEEA, Annex 2, paragraph A2.26) where it states that:

> "valuation of water resources is not outlined in detail because the application of the general principles of valuation of environmental assets tends to be inappropriate for water resources."

13 The SEEA nevertheless suggests that compilers consider the use of water access entitlements to value the water resource (paragraph 5.494).

14 The SEEA module devoted to water resources (SEEA-Water) provides no guidance on how to value stocks of water resources. The 2008 SNA provides a solitary observation on the valuation of water resources, non-cultivated biological resources and other natural resources. It suggests that as:

> "observed prices are not likely to be available, they are usually valued by the present value of the future returns expected from them." (Paragraph 13.51.)

15 The technique suggested by the 2008 SNA involves calculating the present value of resource rents expected to arise from the business of water supply. It requires splitting the operating surplus generated by water suppliers into a return on produced capital and a return on the natural resource (in this case, the water resource) — the latter return, known as 'resource rent' is aggregated for the expected life of the resource. The present value of this aggregation represents the value of the water resource.

16 The SEEA reaffirms conclusions drawn from the work undertaken by Comisari *et al.* (2011) which strongly suggests that, under typical conditions of water supply, the use of this technique is unlikely to generate analytically useful results for water resource valuation. In particular, urban water prices are typically highly regulated and kept low — to the extent that revenue earned on water sales will usually generate only a modest return on produced capital and typically no return on natural capital.

17 In 2013 the London Group on Environmental Accounting agreed with a proposal (Comisari and Vardon, 2013) that the use of water rights and in particular, the market value of permanent rights to use a water resource, represents a viable means to value water resources.

18 The use of tradable quotas to value a natural resource is a technique recognised and accepted within environmental economic accounting. For example, the 2003 SEEA Handbook discusses the use of permanent rights to value the underlying natural resources in relation to the valuation of fish stocks. It states that:

> "The value of the quota represents the NPV [Net Present Value] of the owner's expected income using the quota over its period of validity. If the fishery is managed with such quotas and the quotas are valid in perpetuity, the value of all quotas, at the market price, should be equal to the value of the use of the fish stock." (Paragraph 7.273.)

19 This technique is used by Statistics New Zealand to value its fish resources (Harkness and Aki, 2008).

20 The estimates described in this paper follow the asset boundary of the 2008 SNA and associated valuation principles, but this is not the only possible approach. The Food and Agriculture Organisation of the United Nations (FAO) describes a considerably broader notion of economic value of water, called total economic value of water (TEV). This notion is made up of various use and non-use values associated with water. Among the use values of water, both direct use and indirect use values can be described. Direct use values arise from direct interaction with the water resource and could be viewed as being made up of:

a. Consumptive use value. For example water for human consumption or water for irrigation;
b. Non-consumptive use value. For example for recreational water sports or the aesthetic value of a pleasant view. It is possible that a *distant use value* of water might be derived through the media (through portrayals in movies or magazines, for example)

21 The valuation of water resources is beset with conceptual and methodological difficulties. However, non-consumptive use values, indirect values and especially non-use values present especially onerous challenges.

SCOPE OF WATER RESOURCES TO BE ESTIMATED

22 An important decision point relates to the scope of water resources to be included in the Australian estimates. The question arises because some catchments report active trade in water access entitlements while other catchments do not have an active water management

plan and therefore have no water access entitlements. Other catchments, despite having tradable water access entitlements, may experience little or no trading activity in these instruments. In generating estimates of the value of water resources, what resources should be judged 'in scope'?

23 In this context, it seems clear that water rights cannot be used to attach a value to water resources unless these resources are subject to tradable water rights. That is, in principle, it is difficult to view an unsaleable entity as an economic asset. Therefore, water resources located in catchments without an active management plan (i.e. where water access entitlements do not exist) fall outside the scope of our estimates.

24 In most cases, the monetary estimates of water resources presented here are generated in respect of water resources where the access entitlement is tradable separately from adjoining land. However, tradable water entitlements in respect of Western Australia are included though these rights in most cases lack independent transferability and instead can only be sold together with adjoining land.

25 A question could be asked: where tradable water rights exist within a water catchment but the market yields no sales (or minimal sales) in the current accounting period, should these water resources nevertheless be considered in scope? The ABS has taken the view that these resources *are* in scope since they have an economic owner, have value and are tradable. The issue is a measurement problem – that is, a lack of confidence in the prices arising from the existence of 'thin' trading. The solution is to generate estimates for all water resources subject to tradable water access entitlements.

26 The upcoming estimates of water resource values are expressed in current prices only. They reflect all factors potentially impacting on the market value of water, including water quality. Any attempt to generate volume estimates of the value of water resources would need to consider temporal and spatial variation in water quality

27 Appendix 1 provides a more in-depth discussion of the scope of water resources to be estimated and in particular how we understand and account for the separation of water values from associated land.

USE OF TRADABLE WATER RIGHTS TO VALUE WATER RESOURCES

28 The widespread use of tradable water rights in Australia provides the opportunity and mechanism to develop estimates of the market value of Australia's water resource stocks. Appendix 2 describes the operation of Australia's system of water rights, however, the instrument of most importance in this valuation exercise is the *water access entitlement* defined as a "perpetual or ongoing entitlement to exclusive access to a share of water from a specified consumptive pool as defined in the relevant water plan." (Council of Australian Governments, *National Water Initiative,* 2004)

29 The water access entitlement is a right to access a share (i.e. quota) of water from a water catchment that is subject to a formal management plan. This type of entitlement is valid in perpetuity. The water access entitlement is typically tradable on open markets, separately

from the land it adjoins. Thus, the market value of the tradable water access entitlement represents the value of the use of the water resource. The price paid for a water access entitlement will reflect buyer expectations of the benefits from holding and using the resource.

30 The NWC publishes an annual *National Water Report* containing estimates, for each state and territory, of the total amount of water subject to water access entitlements. It also contains information on the sale of water access entitlements, in particular: the amount paid for these instruments; and the volume of water changing hands.

31 Given the conceptual match between the value of water access entitlement and the value of the underlying water resource, it is possible to calculate the value of water resources for each of Australia's states and territories. It is equal to the total value of water access entitlements and is calculated as:

$$\text{Value WAE} = \text{Price WAE} * \text{WAE on Issue}$$

Where:

Value WAE = total market value of traded water access entitlements in the current period

Price WAE = Weighted Average Price per ML of water in the current period

WAE on Issue = Water access entitlements on issue in catchments at 30 June (Mega litres)

32 The key assumption underpinning this methodology is that the market prices achieved for trading in water access entitlements are representative of all water in the catchment. Assuming this, it becomes possible to calculate the market value of all water access entitlements for each catchment.

33 Additional data on all individual water trades within Australia – provided on request by the NWC – allow our calculations to be performed at the water catchment level which delivers a better match of prices paid to water volumes traded.

COMMENTARY ON EXPERIMENTAL ESTIMATES OF WATER RESOURCE VALUES

34 Since no national statistical agency has yet published estimates of the value of its country's water resource stocks, the analysis and commentary on our upcoming experimental numbers cannot be compared to national data produced elsewhere. Comparisons may be made with work undertaken within the research community and with data that are otherwise related to the value of water resource stocks

35 As with any asset, the price of water governed by water access entitlements can be expected to change over time. A range of factors may explain these price movements, including; changing profitability of those productive activities using the water; perceived long term changes in water availability; growth in water access entitlements on issue; changing interest rates; the entry of the Commonwealth government into the water market; and continued improvements in the operation of Australia's maturing water markets. The price of water access entitlements should not be affected by *normal* year-to-year variability in rainfall since the entitlement relates to *permanent* use of water resources.

36 A more active and open market in water access entitlements should deliver more representative pricing. In this context 'representative' means that the price achieved for water access entitlements sold during the accounting period is indicative of the value of the remaining entitlements not sold. Generally, a 'thicker' market can be assumed to deliver more representative prices. Table 1 shows the percentage of water access entitlements traded in each state and territory for selected years.

37 Water markets in Australia are well-developed by international standards but remain relatively young markets – especially for states located away from the Murray-Darling Basin. The brief time series shown in Table 1 reveals the impact of the Commonwealth Environmental Water Holder (CEWH)[1] on trading volumes earlier in the time series (especially in 2008-09 and 2009-10) and the very recent emergence of entitlement trading in Western Australia and Tasmania. Across the whole of Australia, the water market appears to be maturing and settling; with around four percent of water access entitlements now traded each year – by way of comparison, a similar proportion of existing dwellings are traded each year in Australia and prices observed in respect of these dwelling trades are considered sufficiently representative to underpin capital stock estimates for dwellings as published in the Australian system of national accounts.

Table 1 Percentage of water access entitlements traded in selected years, by state and territory.

	2007-08	2009-10	2011-12	2012-13
NSW	7.3	13.3	5.8	5.1
Victoria	11.8	11.9	5.7	3.4
Queensland	3.3	3.8	2.2	3.8
SA	22.4	8.7	5.3	3.8
WA	0.5	0.5	0.5	3.2
Tasmania	0.2	0.2	3.1	2.1
NT	-	-	-	-
ACT	-	-	-	-
Australia	6.9	8.9	4.4	4.1

VALUATION AT THE STATE/TERRITORY LEVEL

38 In Australia, water management is a state and territory responsibility and the design and operation of water rights and water trading varies somewhat between states and territories. In using water rights to value the water resource, better data results are expected if trading in water access entitlements is relatively unrestricted, for example, if these rights can be sold separately from land and can be sold to any buyer, including buyers who do not hold land. Data is even better if inter-catchment trading takes place, as occurs in the Murray-Darling Basin. There is also more confidence in the representativeness of market prices when a significant portion of these rights are sold every year. Most of the larger states of Australia operate under

[1] The Commonwealth Environmental Water Holder is the Australian government body responsible for the management of environmental water owned by the Commonwealth government.

conditions that solidly support the use of water rights to value the water resource, and this is especially so where the water resources of the Murray-Darling Basin are concerned. For New South Wales, Victoria, South Australia and, to a large extent Queensland, the design and operation of water rights and water trading gives rise to information that is conducive to the generation of monetary values for water resources.

39 The operation of water access entitlements and water trading in Western Australia and Tasmania provides some concern around the consequent quality of estimates of the value of water resources. In Western Australia, water access entitlements are not separated from the land to the degree observed in other states and territories. In Western Australia, water entitlements typically can only be separated from land in irrigation cooperatives, and even then they may be sold only to another land holder demonstrating a use for the water. This type of restriction results in thinner trades and gives rise to concerns about how representative observed water trade prices are. (The Harvey Irrigation District is currently the only jurisdiction in WA allowing open trade in water access entitlements.)

40 The current situation in Tasmania is also not ideal. While trading of water access entitlements takes place in Tasmania, there is currently no legal requirement for entities involved in water trading to report prices to the Tasmanian Department of Primary Industries, Parks, Water and the Environment (DPIPWE) and the department has no mechanism to collect these data. The DPIPWE has stated an intention to facilitate further development of water trading as a key action item under the Water Development Plan for Tasmania.

41 For Western Australia, Tasmania, the Northern Territory and the Australian Capital Territory, the average price used in valuing water resource stocks is the average price observed across the remaining four states. This methodology is not ideal since there is a significant risk of the NSW/Victoria/Queensland/SA water price being unrepresentative of the other states and territories. In this respect, possibly the greater risk is that the combined NSW/Victoria/Queensland/SA price will overstate the correct value for WA and Tasmania. The ready access to water trading across especially NSW, Victoria and SA; the entry of the Commonwealth Environmental Water Holder (CEWH) into the Murray-Darling Basin water market; and the existence of large, interconnected water areas in NSW/Victoria/SA could reasonably be expected to deliver a greater number of potential buyers and therefore higher average water prices. This can be tested to some degree through an analysis of ABS Gross Value of Irrigated Agriculture (GVIAP) data (cat. no. 4610.0.55.008).

42 ABS cat. no. 4610.0.55.008 contains state-based estimates of gross agricultural product arising from irrigated production, as well as corresponding volumes of irrigation water applied. The data are also available by type of agricultural production (rice, cotton, hay etc.). Table 2 records, for each state and territory, GVIAP per ML of irrigated water used in agricultural production in 2011-12.

Table 2 GVIAP ($) per ML of irrigated water used in agricultural production, by state and territory 2011-12

	2011-12
	GVIAP ($) per ML
NSW	894
Vic.	2342
Qld	1895
SA	2210
WA	3190
Tas.	3265
NT	4540
ACT	2262
Australia	1657
Murray-Darling Basin	1139

43 The data clearly suggest that in 2011-12 each ML of irrigated water leads to a greater value of agricultural product in WA and Tasmania than for either of NSW, Victoria, Queensland or SA. That is, a ML of irrigated water is relatively more valuable as an input to agriculture in the states of WA and Tasmania. Other things being equal, the more valuable is the output of irrigated agricultural production, the more the producer is willing to pay for the input of irrigated water. Therefore, the use of an average water price across NSW/Victoria/Queensland/SA as a proxy for water prices in WA and Tasmania should not overstate prices in WA and Tasmania.

44 Of course, the above analysis is indicative only, since water resources are used for purposes other than agriculture-related irrigation and GVIAP is not equivalent to the cost of water – it is not a given that higher value end-use of water leads to a higher price for water inputs.

45 Nevertheless, in the absence of better pricing information for WA and Tasmania, it is recommended that the average water price observed across NSW/Victoria/Queensland/SA is a conservative and defensible proxy for water prices in the remaining states and territories.

46 While the proposed experimental estimates of water resource values are considered defensible, they could be expected to improve further over time with the continued expansion and maturing of Australian water markets; continuing unbundling of water rights from land in more and more catchments; improved data collection; and ongoing improvements in our understanding of the data.

COMMONWEALTH ENVIRONMENTAL WATER HOLDER AND SECTORAL ESTIMATES

47 The Commonwealth government of Australia owns water resources ('environmental water') for the express purpose of protecting or restoring environmental assets in the Murray-Darling Basin and in other areas where this environmental water is held. The Commonwealth government describes how it attempts to meet this purpose in the *Framework for determining Commonwealth environmental watering actions*. The *Water Act 2007* establishes the

Commonwealth Environmental Water Holder (CEWH) as the manager of the Commonwealth's environmental water holdings.

48 With the advent of the CEWH, the assumption that the value of water resources is necessarily a component of the reported value of land is clearly no longer true. The value of water resources owned by the CEWH is *in addition* to the value of 'water associated with land'. The 2008 SNA contains a data item 'water resources' which is an appropriate place to capture such an item:

> "…water and other natural resources are included in the balance sheet to the extent that they have been recognized as having economic value that is not included in the value of the associated land." (Paragraph 13.51.)

49 Thus, in the balance sheet, part of water resources is reported as a component of the value of land and the remainder is reported as a separate line item 'water resources'.

50 The Australian system of national accounts publishes balance sheets both at the national level and also in respect of institutional sectors. If estimates of water resources are to be included in the Australian system of national accounts then sectoral estimates of water resources values are required. Water owned by the CEWH is assigned to the general government sector, while the remainder of Australia's water resources is (at present) owned by non-financial corporations.

51 As for other institutional units, the value of water held by the CEWH is generated by multiplying the holdings of water entitlements (ML) by the average price ($/ML) observed in market trading during the period. The CEWH produces an annual report which provides details of its water entitlement holdings at the end of the financial year. The Australian Commonwealth Department of the Environment (DoE) reports observed market price information for water access entitlements in the Murray-Darling Basin. These holdings of water access entitlements and the prices achieved for trading in these entitlements are available for individual catchments.

52 In some cases, the DoE reports do not report observed prices for certain catchments. Typically this occurs for small catchments where limited trading has taken place. In these instances, proxy prices are used based on a number of considerations, including: price results achieved for this catchment in surrounding years; and results achieved for neighbouring catchments and for similar classes of water entitlement ('high security', 'general security', 'groundwater' etc.).

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APPENDIX 1: DISAGGREGATION OF WATER RESOURCES AND LAND

In attempting to assign an economic value to water resources, the question arises of how to disaggregate water resources from land? The question arises because in addition to the value of space provided by land, the observed price of land typically reflects a combination of additional assets, for example, it may include the value of land improvements and it may include the value of water resources associated with the land. The question has two aspects: firstly it is a conceptual question with an answer based upon principles of economic and environmental accounting. Secondly, it is a practical matter of how data from (especially) the National Water Commission (NWC) can be interpreted and used to deliver meaningful estimates for Australia.

Note that the 2008 SNA largely defers to the SEEA on this matter, stating that

> "The SNA does not specify a disaggregation of land but it is recommended that if a disaggregation is required, it should be according to that used in the SEEA." (Paragraph 10.178.)

SEEA 2012 in turn discusses (paragraphs 5.300 to 5.310) the composite nature of land and the appropriate accounting treatment for situations in which land and other assets are bundled. However, in what can only have been an oversight, the bundling of water and land is not discussed. The ABS has made its own way, using general principles of the SNA and the SEEA.

It could be argued that water must display the features of a stand-alone asset if we wish to report the value of water resources separately from adjoining land. What precisely is meant by a stand-alone asset i.e. what characteristics must a water resource display in order to be considered a stand-alone economic asset?

The 2008 SNA defines an asset as:

> "a store of value representing a benefit or a series of benefits accruing to the economic owner by holding or using the entity over a period of time. It is a means of carrying forward value from one accounting period to another." (Paragraph 3.5.)

Further, SNA (paragraph 2.34) describes an asset as being subject to ownership rights. One of the tests of ownership is the capacity to transfer title of the entity in question. SNA (paragraph 17.318 (d)) describes actual or *de facto* transferability as a strong indication of the existence of an asset.

Where a combined land and water resource can be independently valued and sold separately from each other, it would seem clear that two separate assets exist. Each component ('land' and 'water') might at any time be physically and legally separated, and a series of benefits would then accrue to the different owners of the respective resources.

The flip side of this is that where the land and water elements cannot be separated – for example, because no legislation or market exists to support the independent sale of the water resource – it could be argued that a separate water asset does not exist. That is, while the land contains water resources that provide ongoing benefits to the owner, the lack of any

independent transferability of these resources makes it difficult to conceive of the water resource as a *separate* economic asset – it is an unquantified and indivisible component of the value of 'land'.

An examination of NWC data reveals that water trading activity tends to confirm to one of the following three scenarios:

a. In many catchments water access entitlements are actively traded separately from any land asset and for these catchments it is relatively straightforward to develop robust estimates of the value of water resources contained therein;
b. In other catchments water access entitlements are less actively traded, and this thin trading provides average prices that inspire lower levels of confidence; and
c. Some catchments offer no possibility of trading water access entitlements separately from the land to which they are attached.

Water resources falling under scenarios a) and b) can clearly be considered an economic asset, separate from land. While there are measurement challenges in valuing water resources under scenario b), the concept at least is clear. The treatment of water resources conforming to scenario c) is less straightforward.

Water resources contained within catchments conforming to scenario c) are not transferable separately from adjoining land. While an economic value attaches to these water resources, as stated above, it is inextricably combined with adjoining land and no clear independent economic value appears to exist for water resources relating to this scenario.

Within the 2008 SNA there are however exceptions to this interpretation, the most obvious being the recommendation to value land and dwelling assets separately even though these assets are rarely sold independently. The motivation for this disaggregation would appear to be that it is analytically useful to do so – especially since, in this case, separating produced and non-produced assets is a critical step in the estimation of consumption of fixed capital. In a further example, the 2008 SNA (paragraph 10.80) recommends that 'land improvements' (land contouring, swamp reclamation etc.) and 'land' be separately identified and treated as different types of assets even though the two entities *cannot* be sold separately.

Among Australia's states and territories, it is the norm for water access entitlements to be tradable separately from adjoining land. However, in Western Australia trades of water access entitlements are typically only allowed in combination with land sales. While there are exceptions to this rule, the general observation is that water entitlements are bundled with land in the state of Western Australia. Among the scenarios described above, the situation in Western Australia most closely resembles scenario c).

The position taken in this paper is to assign a value to tradable water entitlements in all states and territories of Australia, including Western Australia. The SNA provides important supporting precedents in its recommendations to disaggregate land and dwelling values; and to disaggregate land and land improvements. The absence of reported values for Western Australian water resources would be difficult to justify and explain to data users, especially when these resources are subject to tradable rights and since reasonable price proxies are

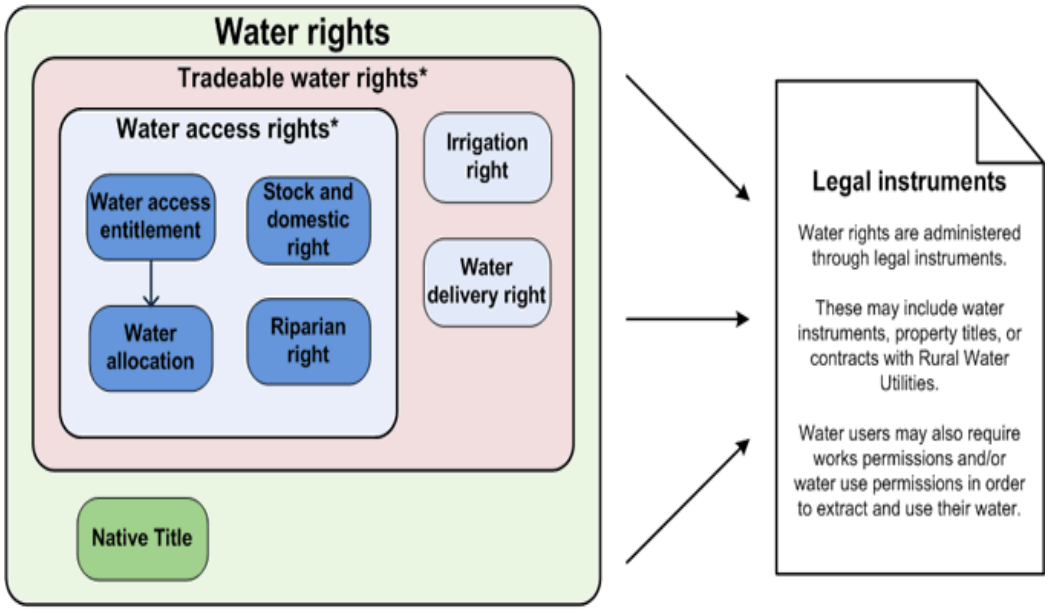
available from other catchments supporting similar types of economic output under comparable conditions. More meaningful estimates of water resources in Australia are generated by including all such resources governed by tradable water entitlements.

APPENDIX 2: OPERATION OF TRADABLE WATER RIGHTS IN AUSTRALIA

Water rights and the Australian National Water Market

Where tradable water rights are in widespread use, the successful valuation of water resources will likely involve the use of information pertaining to these rights. An understanding of these instruments is therefore an important backdrop to the discussion of the valuation and recording of water resources within the Australian system of national accounts and the Australian environmental and economic accounts. In Australia, water access and use is governed by statutory water rights administered by individual state and territory governments. The various water rights operating within the Australia National Water Market are summarised in Diagram 1 and described further in the paragraphs immediately following.

Diagram 1: Water rights in Australia



* Based on the *Water Act 2007*.

The Australian National Water Initiative (NWI) defines a *water access entitlement* as "a perpetual or ongoing entitlement to exclusive access to a share of water from a specified consumptive pool as defined in the relevant water plan". These water access entitlements are attached to land parcels which adjoin waterways or sit above aquifers and have been gifted to the holders—though volume based charges apply to any water extracted under these entitlements. Water access entitlements are tradable, though not all are permitted to be traded separately from the land to which they relate.

A *water allocation* derives directly from the water access entitlement. Each season, the relevant jurisdictional government assesses water availability within a catchment and announces how much (the 'allocation') of the water access entitlements can be used given prevailing water availability. These water allocations are usually determined/reflected as a percentage of the total share to

which each water access entitlement holder is entitled. An example serves to illustrate the relationship between water access entitlements and allocations.

A farmer may hold an ongoing water access entitlement of 10 Giga litres (GL) p.a. However, this does not mean the farmer necessarily has the right to extract 10 GL p.a. Rather, the jurisdictional government may announce that, due to prevailing conditions in the catchment, only 80 per cent of the entitlement may be extracted in the current season. Thus, for the current year the water allocation in this example is 8 GL (i.e. 10 GL access entitlement times the 80 per cent 'allocation').

Australian water allocations are typically tradable separately from land, that is, these allocations can be sold separately from the land to which the allocation was initially attached. Further, in many cases the allocation may be sold to an entity that operates outside of the water catchment from which it is bought. The entity may, in fact, own no land at all.

Irrigators that receive water through a network of irrigation infrastructure operators (IIO) will typically hold a *water delivery right* against the IIO that allows this receipt of water and such rights may be tradable within delivery systems. The IIO is an entity that operates water service infrastructure to deliver water where the primary use is for irrigation. In many cases, irrigators in Australia do not hold a statutory water access entitlement. Instead, the IIO holds the statutory water access entitlement (often called a bulk entitlement) collectively on behalf of these member irrigators. Such member irrigators hold a contractual irrigation right that entitles them to receive water from their IIO. These irrigation rights may be transformed into tradable water access entitlements.

Stock and domestic water rights and *Riparian water rights* provide limited water rights to their holders—typically, drinking water, domestic use, fishing etc. Neither is tradable separately from the land to which they attach. Holders of *Native Title* with respect to water are able to undertake a limited range of non-commercial uses of water. Such rights are tied not only to specific location(s) but also to specific person(s) and cannot be traded.