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Integrating rural and urban water markets in south east Australia: Preliminary analysis

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The trade of water in Australia is constrained and generally limited to irrigators, with other industries and households excluded. A regional general equilibrium model of the Australian economy (TERM-Water) is used to undertake a preliminary analysis of the effects of expanding the trade of water in south east Australia to include both irrigators and urban users. The focus is on the urban centres of Adelaide, Canberra and Melbourne, and the major irrigation districts in the southern Murray-Darling Basin and Gippsland.

Losses from a hypothetical reduction in water availability to gross regional product and household demand are reduced when water trade is allowed. The extent to which these losses are reduced depends on the extent to which trade is allowed and the differing water uses in each trading region. The results of this preliminary modelling show that net gains are greatest, and the costs to industries and regions are generally more dissipated, when trade is unconstrained. When regions with relatively low levels of water consumption (such as Adelaide and Canberra) face shortfalls in water availability and trade with regions that use large volumes of water (such as irrigators in the southern Murray-Darling Basin), they have little effect on traded prices and quantities. The opposite is true, however, when large water users experience shortages. These broad patterns hold when all regions experience the same hypothetical reduction in water availability.

Disclaimer:

The views expressed in this paper are those of the authors and do not necessarily represent the views of the Productivity Commission.

1. Background

On 25 June 2004, the Council of Australian Governments (COAG) agreed to a National Water Initiative covering a range of areas related to national water management. The agreement recognised the need to 'increase the productivity and efficiency of Australia's water use, the need to service rural and urban communities, and to ensure the health of river and groundwater systems by establishing clear pathways to return all systems to environmentally sustainable levels of extraction' (COAG 2004, p. 1). To implement the agreement, signatories agreed to 'progressive removal of barriers to trade in water and meeting other requirements to facilitate the broadening and deepening of the water market, with an open trading market to be [put] in place' (COAG 2004, p. 4). Markets for trading water provide a mechanism for water to be reallocated to more productive uses with gains to buyers and sellers. Revenue from water sales can supplement farm income and provide finance for other on-farm and off-farm activities, or facilitate exit from an industry.

In the *Review of National Competition Policy*, the Productivity Commission argued that if water is to be allocated to its highest value use in the future, the urban and rural water markets will need to become increasingly integrated (PC 2005b, p. 204). Currently, there is little trade between urban users and irrigators. Small volumes of water have been traded on an ad hoc basis — for example, Adelaide's main water provider recently committed to purchase 12.6 gigalitres of River Murray water entitlements, predominantly from irrigators in the Lower Murray swamps (SA Water 2004, p. 54). An expansion of water trade to include both rural and urban sectors could reduce the need for the prescriptive demand management approaches that have become increasingly common in Australian urban areas (Edwards 2003). It could also provide greater flexibility for rural users to react to changing circumstances, such as changes in climatic conditions and water availability.

Peterson et al. (2004) examined the likely economic effects of expanding water trade among irrigators in the southern Murray-Darling Basin (MDB) using a computable general equilibrium (CGE) model, TERM-Water, developed by the Centre of Policy Studies at Monash University. This study found that allowing both intra- and interregional water trade among irrigators substantially lessens the impact of reducing water availability on gross regional product.

This paper extends the analysis of Peterson et al. (2004) to investigate the effects of expanding trade to include both irrigators and urban water users. The focus is on rural and urban water markets in south east Australia — namely, the metropolitan regions of Adelaide, Canberra and Melbourne, and the irrigation areas in the southern MDB and south east Victoria. Urban users include households and industries in the greater metropolitan areas. The effects of water trade between relatively small irrigation districts (such as the Macalister Irrigation District (MID)) and large urban centres (such as Melbourne) are compared with the effects of trade between relatively large rural water supply regions and smaller urban centres (e.g. Adelaide and Canberra).

Water use volumes and water prices and charges of urban and rural water sectors in south east Australia are contrasted in the following section. Section 3 outlines the TERM-water model and database, and specifies the regions that are modelled. Section 4 outlines water's role in the model. Section 5 describes the

simulations. Section 6 presents results from the simulations and model design considerations. Section 7 provides concluding comments.

2. Contrasting rural and urban water sectors in south east Australia

This section examines the levels of water use by irrigators compared with urban households and industries, and the relative prices and charges faced by each of the three sectors, to provide insights into the opportunities for rural–urban water trade.

Comparative water use

Rural water use accounts for more than two thirds of extracted total water use in Australia. Irrigators are generally the major water using group in rural areas, while households, commercial and industrial users are generally the major water using groups in metropolitan urban areas (ABS 2004). In the southern MDB, water use by irrigators in the Goulburn–Murray, Murray and Murrumbidgee irrigation districts in 2000-01 (the base year of this study) was approximately 4100 gigalitres, whereas urban users in Adelaide and Canberra had a combined consumption of 257 gigalitres (table 1). In southern Victoria, water use by irrigators in the MID in East Gippsland was less than one third of the amount consumed in neighbouring Melbourne. Water use by irrigators in the MID is partially constrained by the water available in the Thomson Reservoir (of which irrigators can access a maximum of 45000 megalitres per year).

Table 1. Irrigation and urban water use in south east Australia

Gigalitres per year

Region	*2000-01*	*2003-04*
Southern Murray-Darling Basin		
Murrumbidgee Irrigation Area[1]	857	652
Goulburn–Murray Water Irrigation District[2]	1948	1687
Murray Irrigation Limited[3]	1295	659
Adelaide	194	166
Canberra[3]	63	49
Southern Victoria		
Macalister Irrigation District	152	150
Werribee Irrigation District	10	6
Melbourne	503	433

1. Sales (metered and unmetered). 2. Deliveries. 3. Includes water supplied by ACTEW Corporation to Queanbeyan (New South Wales).

Sources: Goulburn–Murray Water 2001, 2004; Murray Irrigation Limited 2004; Southern Rural Water 2000, 2004; WSAA 2004.

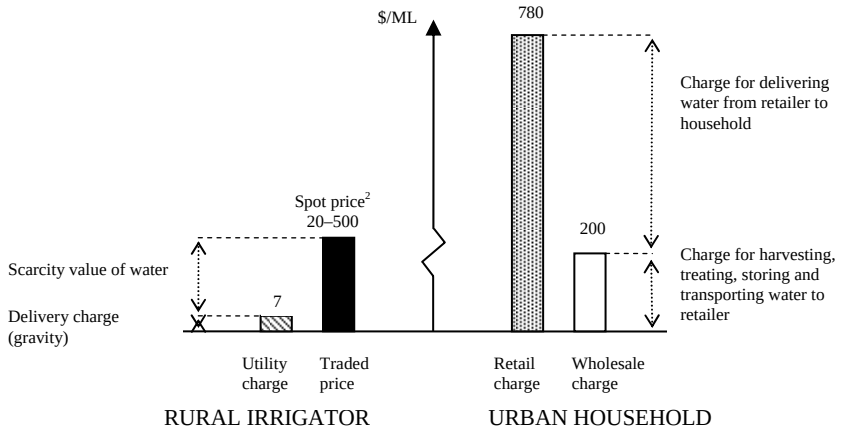
Utility charges and market prices for water

Water charges and prices differ substantially across urban and rural areas. Utility charges to rural irrigators are considerably lower than those to urban users. Irrigators in the southern MDB typically face charges of \$25–40 per megalitre for the supply of water to the farm gate. In general, over half this charge is a fixed

amount that irrigators must pay regardless of whether they use their water allocation. Irrigators in the MID pay approximately $46 per megalitre of water specified by their water entitlement, while no charge is attached to the volume of water used (Southern Rural Water, pers. comm., 14 September 2005). In contrast, Melbourne households face a fixed annual service charge ranging from $44 to $96, and variable retail charges of over $780 per megalitre. Melbourne non-residential customers pay a fixed annual service fee of between $44 and $141 and variable charges of over $840 per megalitre (ESC 2005).

Water utility charges to irrigators and urban households act to recover the costs of providing water services to each sector (box 1). There are significant differences in the level of cost recovery across water authorities and across urban and rural regions. Differences between urban and rural water charges may be partly attributed to urban water users being more costly to service (on a per megalitre basis) than rural users and partly to differences in cost recovery (to the extent that differences in cost recovery exist). The additional charges Melbourne households pay per megalitre of water compared with rural irrigators in Goulburn–Murray, for example, reflect additional costs of storing, treating and delivering urban water as well as any differences in the extent of cost recovery (including differences in the way water authorities structure their fixed and variable charges to recover their costs) (figure 1). Differences in urban and rural water charges, due to service costs and levels of cost recovery, are likely to create a wedge between the prices that urban and rural water users will be willing to pay when trade is allowed (box 2). There are well established and transparent markets for water (particularly seasonal allocations) among irrigators, although constraints to trade remain (Peterson et al. 2004). In contrast, urban users are largely excluded from these water markets and there are no equivalent markets for water among urban users.

Figure 1. Variable water charges[1] and prices in Victoria



1. The variable rural irrigation charge and spot prices are based on gravity feed irrigation in the Goulburn–Murray Irrigation District (Victoria). Rural irrigation charges in this district also comprise fixed components relating to entitlement storage and distribution costs. These fixed charges can be large compared with the variable use charge and, therefore, the average cost per megalitre of water faced by irrigators can be well above the variable charge. Urban water charges are based on the charge paid Yarra Valley Water to Melbourne Water and charge paid by households to Yarra Valley Water for the first block of charges (i.e. 0–440 litres/day). All prices are for 2005-06, with the exception of the traded price faced by rural irrigators. 2. Spot prices are highly variable, depending on region, weather conditions and stage in the irrigation season. Spot prices as high as $500/ML were observed during the 2002-03 drought.

Box 1 **Water prices and charges**

Under COAG reforms, governments agreed to set urban and rural water charges so water authorities achieve cost recovery within a band. The lower bound of cost recovery implies water authorities recover the operational, maintenance and administrative costs, externalities, taxes or tax equivalent regimes, dividends, provision for the cost of asset consumption and the interest costs on debt. Upper bound cost recovery encompasses the opportunity cost of capital in a water authority's assets in addition to those costs covered by lower bound cost recovery (PC 2005a, pp. 151–2).

Different types of water charges can be observed in urban and rural sectors, with each reflecting different services. Charges typically comprise fixed and variable components:

- Wholesale urban water charges generally reflect the cost of harvesting, treating, storing and transporting water.
- Retail urban water charges generally reflect the cost of purchasing wholesale water; further treating water (if required) and delivering water to households. Some cities, including Adelaide, Canberra and Melbourne, have introduced inclining block tariffs that are designed to reduce household consumption by making users pay a higher per litre charge beyond a certain level of use.
- Utility charges paid by irrigators to rural water authorities are designed primarily to recover operational, maintenance and capital costs associated with supply activities, including harvesting, storage, diversions and delivery. Irrigation charges in private irrigation districts are set by the shareholders (irrigators).

Although water charges largely reflect the cost of providing water, water allocated to water authorities that provide wholesale urban water or rural irrigation water is unpriced.

Along with regulated water charges, there are markets for irrigators' water entitlements and allocations. Unlike water charges, water markets reveal the scarcity value of water because irrigators can buy and sell water based on its marginal value. At present, most water trade involves temporary water allocations, which can sell for well above the utility charge. Water entitlements, which provide an ongoing right to access water for the term of the right, are significantly more expensive than temporary trades.

Sources: PC 2005a; Peterson et al. 2004.

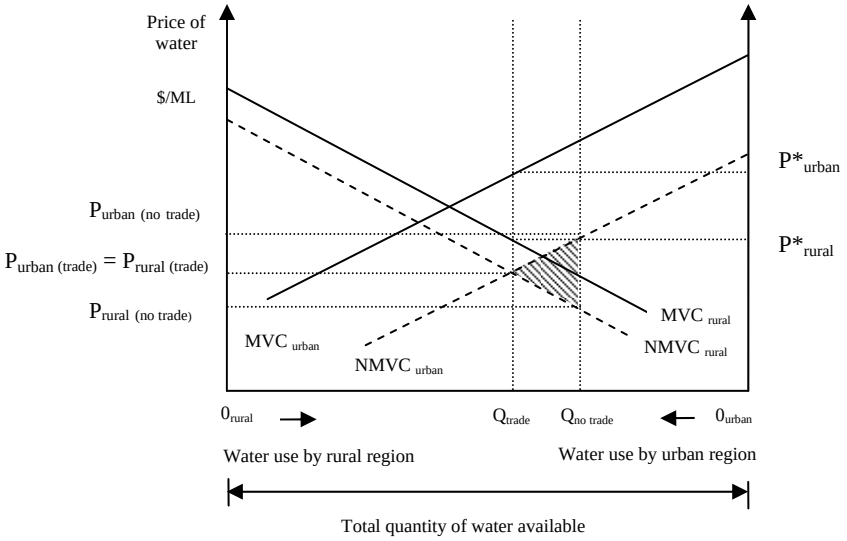
3. TERM-Water model and database

TERM-Water is used to examine the effect of expanding water trade to allow trade between rural and urban water users across south east Australia. It is a multi-region comparative static CGE model that recognises water as an explicit factor of production and a component of household consumption. Thirty five water user groups (comprising 34 industries and the household sector) and 18 regions are represented in the model. Urban water use data for households and non-agricultural industries were added to the original database as well as a mechanism to allow trade of water between irrigators and urban users (see Wittwer 2003). Industry and region water use data are based on the Australian Bureau of Statistics 2000-01 water accounts.

The TERM-Water database contains regional data at the statistical division level (figure 2). The Ovens-Murray, Goulburn and Loddon statistical divisions within the southern MDB are aggregated to form the region Goulburn–Murray. Similarly, East Gippsland (which contains Thomson River irrigators in the MID)

Box 2 **Marginal values and marginal values net of service charges**

Urban and rural water users' incentives to trade water will be determined by the marginal value they derive from consuming an extra unit of water less the service charge associated with having that extra unit of water delivered. This is sometimes referred to as the scarcity value of water. The diagram below shows the gains from trade that would occur if barriers preventing urban and rural trade were removed and trade occurred. The solid lines represent the marginal value of water consumption (MVC) and the dashed lines represent the marginal value of water consumption less service charge (NMVC). Initially, the urban region has an available quantity of water equal to $0_{urban}Q_{no\ trade}$ and the remaining water is used by the rural region $0_{rural}Q_{no\ trade}$. The price rural users are willing to pay for an additional unit of water (excluding service charges) is $P_{rural\ (no\ trade)}$ and the price urban users are willing to pay is $P_{urban\ (no\ trade)}$.



Removing trade restrictions results in water moving from the rural users to urban users until $NMVC_{urban}$ equals $NMVC_{rural,}$ with the final allocation of water occurring at Q_{trade}. The shaded area shows the net gain from removal of barriers to water trade. Not shown is that both rural and urban make net gains. Although the scarcity value of water equalises between the two regions (i.e. $P_{urban\ (trade)} = P_{rural\ (trade)}$), urban and rural users pay different prices per unit of water they consume (i.e. the marginal values of water consumption are different). This price wedge (P^*_{urban}-P^*_{rural}), is approximately equal to the difference in service charges.

Note: The above analysis abstracts from regulations, physical and market based constraints that can limit water trade. It does not explicitly incorporate losses from transporting water between systems. For information on how these factors are likely to affect trade, see Appels, Douglas and Dwyer (2004).

and Gippsland are aggregated to form Gippsland. The remaining Victorian statistical divisions lying west of Melbourne form the Western Districts. In Peterson et al. (2004), the urban regions were grouped with other non-water trading statistical divisions in their respective jurisdictions. In this paper, Adelaide, Canberra and Melbourne are represented as discrete water using regions. The Adelaide and Canberra urban water supply systems are hydrologically connected (that is, they can physically transfer water via conveyance networks such as rivers, channels and pipes) to major irrigation regions in the southern MDB (figure 2). Adelaide draws water from the River Murray via overland pipelines, and Canberra can draw water from the Murrumbidgee River catchment. In contrast, in addition to the Yarra catchment, Melbourne

sources water from the Thomson River in East Gippsland via a pipe network between the Thomson and Upper Yarra reservoirs. Although Melbourne can draw some water from the Central Highlands (and potentially from the Werribee Irrigation District), northern Victoria (and thus the southern MDB) and the western districts of Victoria are not hydrologically connected to Melbourne in any major way. Investment (such as transmission infrastructure between the Melbourne supply system and the Goulburn catchment) would be required to enable large scale trade between Melbourne and the southern MDB. Consideration of the costs of such a connection, while an important issue, is outside the scope of this analysis and left to future research. Future research will also estimate the gains from trade in the absence of reductions in water availability.

Figure 2. Water trading areas

4. Water's role in the model

All users (including households) demand water at the regional level. For each region, users choose their source of water based on relative price changes. The regional choice set depends on the scenario under investigation (outlined in section 5). Prices in the model are not meant to reflect prices paid in the marketplace; rather, they indicate the orders of magnitude that can be expected to precipitate the quantity movements that result from the relative scarcities that develop from the hypothetical water reductions imposed on the model. A detailed description of the model and its database can be found in Wittwer (2003).

Water enters into the production function as a factor of production. Some degree of substitutability with a non-water aggregate is permitted in a way consistent with Peterson et al. (2004). Additional price responsiveness of water demand has been incorporated by disaggregating industries that demand the output of water intensive industries — for example, a Flour/Cereals industry that purchases rice is separately identified. This disaggregation leads to a more elastic demand for rice (and hence a more elastic demand for water by rice producers) than if rice were purchased by a large food processing industry of which rice constitutes a small cost share.

Unlike Peterson et al. (2004), the model in this paper directly incorporates water demanded by households. Changes in water demand by households enter the household's consumption function via purchases of Water and Drains services. These purchases enter the household budget function through the Linear Expenditures System (LES) that determines all household demand. The LES is linear in income and prices; directly additive (that is, utility provided by consuming one good is independent of consumption of any other good); and excludes the possibility of inferior goods.

In response to a change in water price, households will adjust spending to maintain water's share in their overall budget. In other words, the price elasticity of demand for water is equal to one. Consumption of water accounts for between 1 per cent (Adelaide) and 0.1 per cent (Murray) of household budget shares across the regions.

5. Reductions in water availability and trading scenarios

The starting point of the modelling framework is one of equilibrium, i.e. markets have cleared. To induce movement out of equilibrium and provide opportunities for trade, the volume of water available to users is reduced by 10 per cent. In the model, water is permanently removed from use and is not re-allocated to any other sector, nor is water explicitly valued in the model. When water availability is reduced, trade enables water to move across regions and into industries and households such that the water users with relatively low marginal values sell to users with relatively higher valuations. The simulations illustrate how the flexibility added by trade opportunities allows users to respond more easily to a reduction in the water available for their use.

Two simulations are undertaken:

1. Urban: water available to urban users in Adelaide, Canberra and Melbourne is reduced by 10 per cent.
2. Combined Rural and Urban: water available to all regions under consideration is reduced by 10 per cent.

In each simulation, the reduction in water availability is undertaken under short run static modelling assumptions — that is, capital is fixed and the ability of labour to migrate between regions and industries is limited.

Peterson et al. (2004) investigated expanding intra- and interregional trade among irrigators in the southern MDB. In this paper, the focus is on wider regional trade but for south east Australia (mainland) only. For each simulation, four trading scenarios are investigated (which are in addition to any current trades within a region):

1. No trade: no trade is permitted between any regions.
2. Rural trade only: trade is permitted only between rural regions in the southern MDB.
3. Partial urban–rural trade ('partial trade'): trade is permitted between urban and rural regions where some connectivity exists and some regulatory constraints to trade exist. This scenario allows water trade between Adelaide, Canberra and the rural regions in the southern MDB, as well as water trade

between Melbourne and surrounding Victorian areas (Gippsland). With some limiting factors, this is largely the situation as it exists today.

4. Full trade: trade is permitted between urban and rural regions in south east Australia. This scenario allows unrestricted water trade between regions that could be connected with some infrastructure development — Melbourne, Adelaide, Canberra, rural regions in the southern MDB, and Gippsland.

6. Preliminary modelling results

The results of the simulations for each trade scenario are presented in this section. Detailed results of all simulations are presented in the attached technical appendix.

10 per cent reduction in water allocations to Melbourne, Adelaide and Canberra (urban water reductions)

The results of the four scenarios involving a 10 per cent reduction in urban water availability show that allowing trade across an increasing number of users reduces water use losses to any one urban region and has little effect on household consumption or gross regional product. Without trade, the urban regions are forced to absorb the entire reduction in water availability, driving up urban prices with no mechanism of expanding supply (column 1, table 2). Allowing rural trading only slightly alters these results with small amounts of water being sold from Murrumbidgee and Murray to the areas of Goulburn–Murray, Murray Lands and the Mallee (column 2, table 2).

Table 2. Changes in water use from a 10 per cent urban water reduction[1]

Gigalitres (% of regional water use)

	1. No trade	*2. Rural trade*	*3. Partial trade*	*4. Full trade*
Murrumbidgee	0.00 (0.00)	–2.47 (–0.17)	–13.72 (–0.92)	–35.36 (–2.37)
Murray	0.00 (0.00)	–2.45 (–0.16)	–12.62 (–0.83)	–34.42 (–2.27)
Melbourne	–118.38 (–10.00)	–118.38 (–10.00)	–42.98 (–3.63)	–11.84 (–1.00)
Mallee	0.00 (0.00)	0.58 (0.09)	–2.89 (–0.43)	–11.86 (–1.77)
Gippsland	0.00 (0.00)	0.00 (0.00)	–75.40 (–10.00)	–15.44 (–2.05)
Goulburn–Murray	0.00 (0.00)	3.56 (0.27)	–3.13 (–0.24)	–31.33 (–2.42)
Adelaide	–26.72 (–10.00)	–26.72 (–10.00)	–0.55 (–0.21)	–2.13 (–0.79)
Murray Lands	0.00 (0.00)	0.78 (0.17)	–2.26 (–0.48)	–10.84 (–2.31)
Canberra	–8.73 (–10.00)	–8.73 (–10.00)	–0.26 (–0.30)	–0.61 (–0.70)
Total[2]	**153.83**	**153.82**	**153.81**	**153.83**

1.Small changes in rural trade column are a result of intra-regional water trades. 2. Differenced due to rounding.
Source: TERM-Water simulations.

When partial trading is allowed (i.e., Melbourne trades with Gippsland, and Adelaide and Canberra trade within the southern MDB region), price differentials can be exploited. In the simulation, Melbourne loses 10 per cent of its water availability, or just over 118 GL, thereby driving up the relative price change with respect to Gippsland. Gippsland takes advantage of this price differential by selling 75 GL, or 10 per cent of its current water availability (primarily from the dairy and crops and livestock industries), to Melbourne.

Melbourne reduces its own consumption by 43 GL, or 3.6 per cent of its initial allocation. In the real world, this volume would be constrained by water available to irrigators in the Thomson Reservoir.

By contrast, water use in Adelaide and Canberra is not large enough to affect appreciably the MDB region price when partial trading is allowed. The relative price increases experienced by both Adelaide and Canberra without trade are much larger than the price increases that occur when the two begin to trade with other Murray-Darling Basin irrigating regions such as the Murrumbidgee and Murray regions. The relatively small price movements lead to relatively small amounts of water being traded in the region. However, these small trades are enough to allow Adelaide and Canberra to replace almost all of their water loss (column 3, table 2).

If full trade is allowed so all regions face the same changes in price, the Murrumbidgee and Murray regions, in particular the rice and crops and livestock industries, substantially increase the amounts they sell (although sales are still small shares as a per cent of their total water use). The Mallee and Goulburn–Murray regions also increase their sales from 2.9 GL and 3.1 GL respectively in partial trade, to 12 GL and 31 GL, respectively. Melbourne continues to buy water, but from sources other than Gippsland (whose sales fall from 75 GL in the partial trade scenario to 15 GL under full trade). Finally, as the relative price differential between the MDB and south east Victoria trading regions disappears, Adelaide stops buying water and reduces its own consumption by 2.1 GL. Canberra continues to replace almost all of its water reduction through trade.

The pattern of these changes is reflected in the changes in gross regional product across the four scenarios (table 3). When no trade, or only rural trade, is allowed, output declines are concentrated in the urban areas affected by the 10 per cent water reduction. As water trade expands, reductions in gross regional product in Melbourne, Adelaide and Canberra fall, while those in the rural regions increase. Gippsland's gross regional product falls by 0.37 per cent when it sells water exclusively to Melbourne (partial trade scenario), but this decline is substantially reduced (to 0.07 per cent) when the Goulburn–Murray region starts to sell as well (full trade scenario). Overall, the declines in gross regional product for south east mainland Australia are substantially reduced as trade opens up. With no trade, the region's output falls by 0.11 per cent; with full trade, the loss is 0.03 per cent.

The effects on household consumption from a 10 per cent reduction in water allocation to urban areas are small — a result that holds across all four scenarios (full results contained in the technical appendix). As stated, household use of water in rural areas account for no more than 1.7 per cent of total water use, while the urban areas of Melbourne, Adelaide and Canberra household consumption shares are much higher (24 per cent of total water use in Melbourne, almost 50 per cent in Adelaide and 35 per cent in Canberra. Note: these shares are for the entire urban region. Household shares in metropolitan areas serviced by water utilities may be higher.).

Household consumption of water in Melbourne falls by less than 2.4 per cent with no trade but by only 0.2 per cent with full trade. Canberra follows a similar trend (see details in the technical appendix), as does Adelaide, except that household water demand in Adelaide increases (in response to price declines) in the partial trade scenario. This is because as Adelaide trades with the southern MDB, the relative price is low

enough to induce the Adelaide to buy all of the water lost (table 2). This translates into a smaller price decline to households in Adelaide over the initial price increase with no trade. When full trade is introduced, Adelaide's price increases to that of the broader regional level, and households again face increasing prices and so reduce demand.

Table 3. Changes in gross regional product from a 10 per cent urban water reduction

Per cent

	1. No trade	*2. Rural trade*	*3. Partial trade*	*4. Full trade*
Murrumbidgee	−0.004	−0.012	−0.066	−0.169
Murray	−0.000	−0.010	−0.065	−0.198
Melbourne	−0.135	−0.135	−0.046	−0.016
Mallee	0.002	0.008	−0.044	−0.173
Gippsland	−0.014	−0.014	−0.373	−0.068
Goulburn−Murray	−0.011	−0.006	−0.023	−0.095
Adelaide	−0.142	−0.142	−0.008	−0.013
Murray Lands	−0.005	0.007	−0.060	−0.199
Canberra	−0.093	−0.093	−0.005	−0.005
Total South East Australia	**–0.11**	**−0.11**	**−0.05**	**−0.03**
(Value in $ million)	**(–258)**	**(–257)**	**(–113)**	**(–74)**

Source: TERM-Water simulations.

The small changes in household water demand and water prices have very small effects on overall household consumption, because water is a small part of household budgets and the price changes observed in the scenarios are small. While household consumption falls across all regions and scenarios, no region experiences declines in household consumption that are larger than 0.1 per cent.

Overall, when large areas such as Melbourne trade with relatively small rural areas such as Gippsland or Goulburn–Murray, Melbourne consumers dictate the direction and extent of the price changes, leading to rural areas selling water. When the smaller urban areas, such as Adelaide and Canberra, trade with large rural areas, such as the Murrumbidgee and Murray regions, the smaller urban areas do not affect the regional price to any great extent, causing smaller quantities of water to move in trade and lower regional price effects. When full trade is introduced, the larger rural markets dominate and somewhat suppress the price increases experienced in the urban areas, reducing overall losses in gross regional product.

10 per cent reduction in water allocations to all regions in south east Australia (combined rural and urban water reductions)

Again in this scenario allowing trade among an increasing number of users reduces the effects on GRP of a given water quantity reduction to an urban region. Tables 4 and 5 present the changes in water use under the four scenarios and the resulting changes in gross regional product, respectively. Rural regions will sell water to urban regions if there is a positive price change differential and trade is possible, but there is little effect on household consumption or overall gross regional product.

In the 'no trade' scenario, the impacts of reductions in the quantity of water available for use within each region lead to the greatest price rise in the region where the opportunity cost of water (shadow price) rises the most — the cities of Melbourne, Adelaide and Canberra. Among the rural regions, the Mallee experienced the greatest price rise. Given no trade is allowed, each region must reduce its own consumption of water (column 1, table 4) and thus reduce output (column 1, table 5).

When trade is permitted between the rural regions, the Murrumbidgee, Murray and Murray Lands regions sell water to the Mallee and Goulburn–Murray regions primarily from the more water intensive rice and dairy industries. (Traded volumes are the difference between the first and second columns in table 4.) Through trade, the Mallee, for example, buys back over 2.5 percentage points of the 10 per cent reduction in water allocations (table 4).

Table 4. Changes in water quantities (combined rural and rural)

Gigalitres (% of total water use)

	1. No trade	*2. Rural trade*	*3. Partial trade*	*4. Full trade*
Murrumbidgee	–149.32 (–10.00)	–164.65 (–11.03)	–172.62 (–11.56)	–183.48 (–12.29)
Murray	–151.39 (–10.00)	–155.89 (–10.30)	–162.53 (–10.74)	–173.12 (–11.44)
Melbourne	–118.38 (–10.00)	–118.38 (–10.00)	–72.58 (–6.13)	–57.35 (–4.84)
Mallee	–67.17 (–10.00)	–49.68 (–7.40)	–52.08 (–7.75)	–58.10 (–8.65)
Gippsland	–75.42 (–10.00)	–75.42 (–10.00)	–121.23 (–16.07)	–84.55 (–11.21)
Goulburn–Murray	–129.66 (–10.00)	–118.92 (–9.17)	–121.21 (–9.35)	–138.10 (–10.65)
Adelaide	–26.72 (–10.00)	–26.72 (–10.00)	–10.93 (–4.09)	–12.04 (–4.51)
Murray Lands	–46.91 (–10.00)	–55.31 (–11.79)	–57.96 (–12.35)	–64.24 (–13.69)
Canberra	–8.73 (–10.00)	–8.73 (–10.00)	–2.58 (–2.95)	–2.71 (–3.11)
Total[1]	**773.70**	**773.70**	**773.72**	**773.69**

1. Totals differ due to rounding. *Source*: TERM-Water simulations.

Table 5. Changes in gross regional product (combined urban and rural)

Per cent

	1. No trade	*2. Rural trade*	*3. Partial trade*	*4. Full trade*
Murrumbidgee	–1.02	–1.11	–1.19	–1.29
Murray	–1.23	–1.28	–1.36	–1.49
Melbourne	–0.19	–0.19	–0.13	–0.11
Mallee	–1.44	–1.03	–1.10	–1.22
Gippsland	–0.45	–0.45	–0.74	–0.50
Goulburn–Murray	–0.58	–0.56	–0.59	–0.66
Adelaide	–0.19	–0.19	–0.09	–0.09
Murray Lands	–1.07	–1.28	–1.37	–1.52
Canberra	–0.11	–0.11	–0.04	–0.04
Total South East Australia	**–0.28**	**–0.28**	**–0.24**	**–0.23**
(Value in $ million)	**(–651)**	**(–646)**	**(–557)**	**(–538)**

Source: TERM-Water simulations.

By expanding rural water trade to Adelaide and Canberra ('partial trade'), these urban regions can now buy water to mitigate the effects of their reduced water allocations and purchase 21.9 gigalitres from the rural sources. Trading equalises the change in the price of water between rural regions and the urban regions of Adelaide and Canberra, with urban prices falling to the lower rural prices. By permitting water trade between Melbourne and Gippsland, Melbourne buys 45.8 gigalitres.

Full trade enables water to be freely traded between all of the southern MDB and south east Victoria (among all regions represented in the tables shown). These two areas trade internally in the 'partial trade' scenario, under which water prices rose substantially less in the southern MDB trading region than south east Victoria. Full trade equalises the change in water prices by the Victorian regions of Melbourne and Giippsland importing water from southern MDB regions (51.9 gigalitres).

Household demand for water falls the most in Canberra, followed by Melbourne, when no trade between regions is allowed (see technical appendix for details). As stated above the opportunity costs of water is highest in the urban regions and in Mallee for the rural regions. When full trade is allowed, pricing pressure in these areas is relieved and, with new sources of supply, water demand declines are greatly reduced.

Model design considerations

The TERM-Water model has been applied in this work as a comparative static model in which water use in each region is assumed to equal allocations to irrigators and the volume of water available to urban users in 2000-01. Ideally, the database should represent water use in an average year. While this is largely the case for rural water users in the southern MDB, water availability in urban centres in southern Australia is below average. In 2000-01, demand-side management regimes, of varying degrees, were in place in Adelaide, Canberra and Melbourne, restricting urban water use to various extents in those areas. Consequently, the pre-trade water use data may underestimate the water use that would occur in unconstrained conditions and may affect the estimated trade volumes presented in this report. To what extent, and in which direction, is an empirical question depending on the level of urban water use without constraints.

Given that water use in the model equals water availability, there is no representation of the stock of water held in storages. This is important when considering the integration of rural and urban markets, because the volume of these storages is substantially different across trading regions, as is the way in which supply security is managed. Reductions in water availability do not account for large differences in supply security between the urban and rural sectors. The Thomson Reservoir that supplies irrigators in East Gippsland, for example, has a storage capacity of approximately 1.1 million megalitres, which is approximately 60 per cent of Melbourne's total storage capacity. The storage is managed such that the reservoir has not fallen below 40 per cent capacity, whereas some rural storages have fallen to much lower levels. In contrast, rural users have capacity rights to less than 5 per cent of the reservoir (Melbourne Water 2005). If a dry period occurs after a relatively wet period, and the urban storage is near full as a result, urban users may have opportunities to sell water to irrigators without reducing consumption or overly affecting supply security.

The model includes no representation of which entities (water users and service providers) may trade water and how this may affect assumptions about current wholesale and retail prices. In the model, urban households and industries trade water directly with irrigators via Water and Drains. As noted, the urban (wholesaler–retailer–consumer) and rural (utility–irrigator) market structures may, if appropriate access and competition arrangements are established, enable a variety of competitive trading arrangements to emerge — for example, irrigators trading directly with urban industrial users, or urban wholesalers and retailers vying for trade with rural utilities or irrigators. Such competitive market arrangements could reduce the current prices associated with storing, processing and delivering water to urban users.

7. Conclusions

Allowing trade between irrigators and urban users results in gains to both buyers and sellers. Reducing urban water availability leads, through trade, to the transfer of water from irrigators to urban users. When water is reduced to all users, water still moves to urban users. The gains from trade are affected by the extent to which trade is constrained, the relative levels of water use by the trading regions, and the ability of users to substitute water for other inputs. Changes in GRP in the urban water reduction scenario are much smaller, and gains from trade larger, than when water availability is reduced for all regions. When urban water users alone experience reductions, they find a ready supply from the rural regions that are willing to sell at the higher price, reducing the overall economic impact as measured by GRP. When all regions experience reductions, opportunities for trade are fewer, price increases higher and GRP losses greater. The largest users of water in Adelaide, Canberra and Melbourne are households; the model allows them to more easily adjust their water use, and given water's small share in overall household expenditure, changed water allocations have a more limited effect.

If water allocations to urban regions are reduced, increasing opportunities for trade significantly reduce the estimated losses in gross regional product from a decrease in water availability. As the trade regime is expanded from rural to partial and eventually full trade, those regions with more water to trade (that is, the rural regions) can enter trade and substantially increase the amount of water available to those who have suffered the water allocation reductions (that is, the urban areas).

The modelling results show that the entry of urban centres with relatively low levels of water consumption (Adelaide and Canberra) has a negligible effect on water markets in the southern MDB. However, the entry of Melbourne into the Gippsland water market is shown to have a significant effect (for example, on the dairy industry in Gippsland). In practice, effects will be limited by the hydrological connectivity between the MID and Melbourne. As a consequence, urban trade with the MID will be limited to the volumes that irrigators can access from the Thomson Reservoir. When full trade is allowed under the model, Melbourne purchases water from irrigators in the southern MDB, and reduced its purchases from Gippsland, dissipating the changes to GRP.

The model has important limitations, including a lack of dynamics to understand the impacts of storage and supply security on decisions to buy and sell water, and a stylised representation of trade that may affect the extent of price convergence between urban and rural users. Nevertheless, the paper provides insights into the gains of removing constraints to rural and urban water trade.

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Technical appendix

The following tables and figures present further information on the Productivity Commission's modelling of the potential effects of integrating rural and urban water markets in south east Australia. This modelling extends the Commission's work on rural water trade in the southern Murray-Darling Basin, which is available from the Commission's website http://www.pc.gov.au/research/swp/watertrade/index.html.

Results were generated using a computable general equilibrium model, TERM-Water, developed by the Centre of Policy Studies at Monash University. TERM-Water is outlined in the following document:

> Wittwer, G. (2003). *An Outline of TERM and Modifications to Include Water Usage in the Murray-Darling Basin*, Preliminary report prepared for the Productivity Commission. Melbourne: Centre of Policy studies, Monash University.

More information on TERM-Water is available at http://www.monash.edu.au/policy/elecpapr/g-141.htm.

Table 1. Regions and industries[1] represented in TERM-Water

Regions	*Industries*	
Gippsland VIC	Crops and Livestock	Petroleum, Coal and Chemical
Murrumbidgee NSW	Dairy Cattle	Non-Metallic Mineral Product
Murray NSW	Cotton	Metal Products
West NSW	Rice	Machinery and Equipment
Rest of NSW	Fruit	Other Manufacturing
Melbourne VIC	Grapes	Electricity and Gas
Mallee VIC	Sugar Cane	Water and Drains
Goulburn–Murray VIC	Vegetables	Construction
Rest of VIC	Plant Nursery	Trade
Brisbane/Moreton QLD	Agricultural Services	Hotels and Cafés
Rest of QLD	Forestry and Fishing	Transport
Adelaide SA	Mining	Finance, Property and Business
Murray Lands SA	Food Tobacco Drink	Government, Defence and Education
Rest of SA	Flour and Cereals	Health and Community
Perth WA	Dairy Products	Owner Dwelling
Rest of WA	Textile, Clothing and Footwear	Households
Tas. NT	Wood and Paper	Cultural, Recreational and Personal Services
Canberra ACT	Printing and Publishing	

1. Includes the household sector.

Figure 1. Stylised water trading areas in south east Australia in TERM-Water

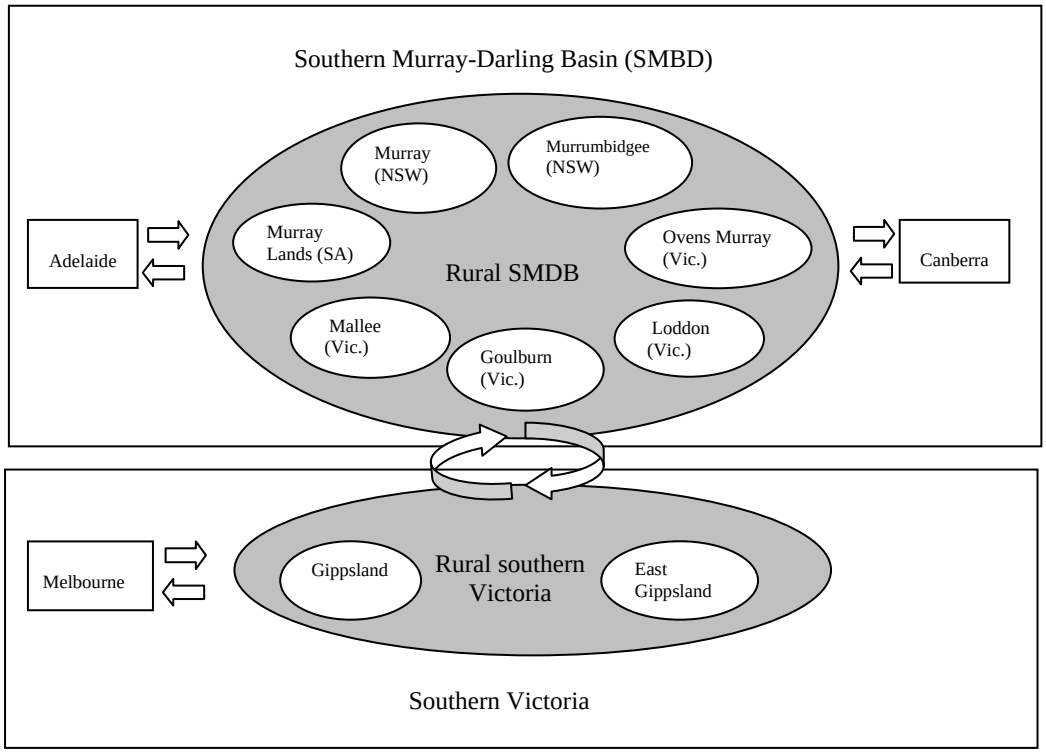


Figure 2. TERM-Water production nesting

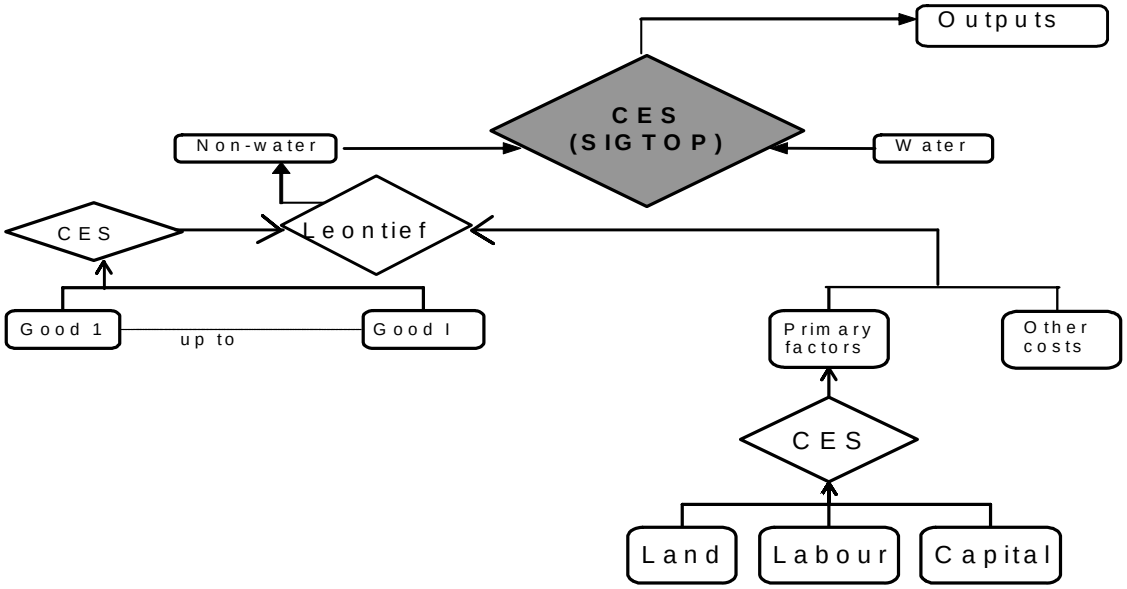
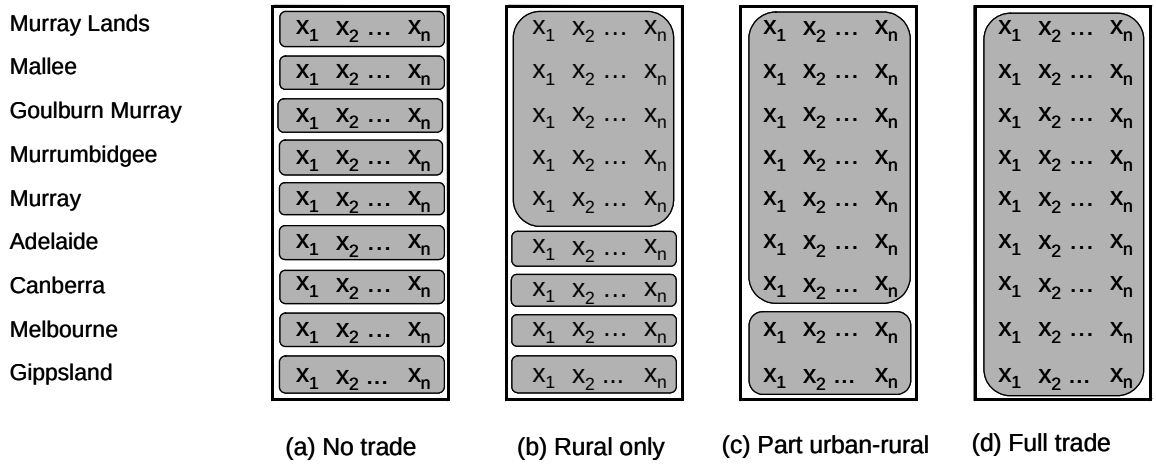


Figure 3. Trading block matrix of four scenarios[1]



1. Sector within the regions are denoted by x_i.

Table 2. No trade (urban: water availability in Adelaide, Canberra and Melbourne is reduced by 10 per cent)

	Murrumbidgee	*Murray*	*Melbourne*	*Mallee*	*Gippsland*	*Goulburn –Murray*	*Adelaide*	*Murray Lands*	*Canberra*
Regional price change	**0.00**	**0.00**	**0.53**	**0.00**	**0.01**	**0.00**	**1.01**	**0.00**	**1.70**
Change in water use	GL	GL	GL	GL	GL	GL	GL	GL	GL
Crops and Livestock	0.23	0.15	–31.45	–0.18	–0.41	–0.13	–1.65	–1.34	–0.09
Dairy Cattle	0.08	0.63	–26.21	0.81	0.80	4.15	2.12	–12.06	0.28
Cotton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rice	–0.56	–0.88	0.00	–0.35	0.00	–3.66	0.00	0.00	0.00
Fruit	0.09	0.03	–3.81	0.01	–0.01	0.01	0.00	–3.25	–0.04
Grapes	0.12	0.05	–3.20	–0.16	0.00	–0.01	–0.02	0.00	–0.17
Sugar Cane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vegetables	0.03	0.03	–2.41	0.01	–0.03	0.01	–0.01	–1.52	0.01
Plant Nursery	0.01	0.01	–1.40	0.01	0.00	0.03	0.01	–0.49	0.01
Agricultural Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Forestry and Fishing	0.00	0.00	–0.05	0.00	–0.01	0.00	0.00	–0.01	0.00
Mining	0.00	0.00	–0.25	0.00	–0.01	0.00	0.00	–0.43	0.00
Food, Tobacco & Drink	0.00	0.00	–1.50	–0.01	0.00	–0.01	–0.01	–1.22	–0.02
Flour and Cereals	0.00	0.00	–0.11	0.00	0.00	0.00	0.00	–0.14	0.00
Dairy Products	0.00	0.00	–0.37	0.00	–0.01	–0.02	–0.02	–0.15	0.00
Textiles Clothing Footwear	0.00	0.00	–1.30	0.00	0.00	–0.01	–0.01	–0.10	0.00
Wood and Paper	0.00	0.00	–1.46	0.00	–0.01	0.00	–0.01	–0.66	0.00
Printing and Publishing	0.00	0.00	–1.00	0.00	0.00	0.00	0.00	–0.15	0.00
Petroleum, Coal & Chem	0.00	0.00	–1.69	0.00	0.00	0.00	–0.01	–0.45	0.00
Non-Metallic Mineral Product	0.00	0.00	–0.21	0.00	0.00	0.00	0.00	–0.07	0.00
Metal Products	0.00	0.00	–0.38	0.00	0.00	0.00	0.00	–0.21	0.00
Machinery and Equipment	0.00	0.00	–2.31	0.00	0.00	0.00	–0.01	–0.13	0.00
Other Manufacturing	0.00	0.00	–0.36	0.00	0.00	0.00	0.00	–0.10	0.00
Electricity and Gas	0.00	0.00	–0.93	0.00	–0.06	0.00	0.00	–0.08	0.00
Water and Drains	–0.07	–0.05	–24.66	–0.18	–0.30	–0.55	–0.53	–1.20	–0.01
Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–0.01	0.00
Trade	0.00	0.00	–0.49	0.00	0.00	0.00	0.00	–0.22	0.00
Hotels and Cafés	0.00	0.00	–0.18	0.00	0.00	0.00	0.00	–0.08	0.00
Transport	0.00	0.00	–0.25	0.00	0.00	0.00	0.00	–0.11	0.00
Finance, Property and Business	0.00	0.00	–0.29	0.00	0.00	0.00	0.00	–0.09	0.00
Government, Defence and Education	0.00	0.00	–0.80	0.00	0.00	0.00	–0.01	–0.27	0.00
Owner Dwelling	0.00	0.00	–0.10	0.00	0.00	0.00	0.00	–0.04	0.00
Health and Community	0.00	0.00	–0.25	0.00	0.00	0.00	0.00	–0.14	0.00
Cultural, Recreational & Personal Services	0.00	0.00	–4.36	0.00	–0.01	–0.01	–0.02	–1.38	0.00
Households	0.07	0.04	–6.62	0.04	0.07	0.22	0.18	–0.65	0.04
Total	0.00	0.00	–118.39	0.00	0.00	0.00	0.00	–26.72	0.00

Source: TERM-Water simulations.

Table 3. Rural trade (urban: water availability in Adelaide, Canberra and Melbourne is reduced by 10 per cent)

	Murrumbidgee (SMDB)[1]	*Murray (SMDB)*	*Melbourne (Melbourne)*	*Mallee (SMDB)*	*Gippsland (Gippsland)*	*Goulburn –Murray (SMDB)*	*Adelaide (Adelaide)*	*Murray Lands (SMDB)*	*Canberra (Canberra)*
Regional price change	**0.00**	**0.00**	**0.53**	**0.00**	**0.01**	**0.00**	**1.01**	**0.00**	**1.70**
Change in water use	GL	GL	GL	GL	GL	GL	GL	GL	GL
Crops and Livestock	–0.06	–0.05	–31.45	–0.07	–0.40	0.15	–1.60	–1.34	–0.02
Dairy Cattle	0.06	0.53	–26.23	0.89	0.78	4.98	2.06	–12.06	0.67
Cotton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rice	–2.55	–2.94	0.00	–0.15	0.00	–1.45	0.00	0.00	0.00
Fruit	0.04	0.02	–3.81	0.04	–0.01	0.09	0.00	–3.25	0.08
Grapes	0.03	0.00	–3.20	–0.03	0.00	0.01	–0.02	0.00	0.00
Sugar Cane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vegetables	0.02	0.02	–2.41	0.02	–0.03	0.02	–0.01	–1.52	0.03
Plant Nursery	0.01	0.01	–1.40	0.01	0.00	0.03	0.01	–0.49	0.01
Agricultural Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Forestry and Fishing	0.00	0.00	–0.05	0.00	–0.01	0.00	0.00	–0.01	0.00
Mining	0.00	0.00	–0.25	0.00	–0.01	0.00	0.00	–0.43	0.00
Food, Tobacco and Drink	0.00	0.00	–1.50	0.00	0.00	–0.01	–0.01	–1.22	–0.01
Flour and Cereals	0.00	0.00	–0.11	0.00	0.00	0.00	0.00	–0.14	0.00
Dairy Products	0.00	0.00	–0.37	0.00	–0.01	–0.02	–0.01	–0.15	0.00
Textiles Cloth., Footwear	0.00	0.00	–1.30	0.00	0.00	0.00	–0.01	–0.10	0.00
Wood and Paper	0.00	0.00	–1.46	0.00	–0.01	0.00	–0.01	–0.66	0.00
Printing and Publishing	0.00	0.00	–1.00	0.00	0.00	0.00	0.00	–0.15	0.00
Petroleum, Coal & Chem	0.00	0.00	–1.69	0.00	0.00	0.00	–0.01	–0.45	0.00
Non-Metallic Mineral Product	0.00	0.00	–0.21	0.00	0.00	0.00	0.00	–0.07	0.00
Metal Products	0.00	0.00	–0.38	0.00	0.00	0.00	0.00	–0.21	0.00
Machinery & Equipment	0.00	0.00	–2.30	0.00	0.00	0.00	–0.01	–0.13	0.00
Other Manufacturing	0.00	0.00	–0.36	0.00	0.00	0.00	0.00	–0.10	0.00
Electricity and Gas	0.00	0.00	–0.93	0.00	–0.05	0.00	0.00	–0.08	0.00
Water and Drains	–0.08	–0.07	–24.66	–0.16	–0.29	–0.45	–0.52	–1.20	–0.01
Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–0.01	0.00
Trade	0.00	0.00	–0.49	0.00	0.00	0.00	0.00	–0.22	0.00
Hotels and Cafés	0.00	0.00	–0.18	0.00	0.00	0.00	0.00	–0.08	0.00
Transport	0.00	0.00	–0.25	0.00	0.00	0.00	0.00	–0.11	0.00
Finance, Property and Business	0.00	0.00	–0.29	0.00	0.00	0.00	0.00	–0.09	0.00
Government, Defence and Education	0.00	0.00	–0.80	0.00	0.00	0.00	–0.01	–0.27	0.00
Owner Dwelling	0.00	0.00	–0.10	0.00	0.00	0.00	0.00	–0.04	0.00
Health and Community	0.00	0.00	–0.25	0.00	0.00	0.00	0.00	–0.14	0.00
Cultural, Recreational and Personal Services	0.00	0.00	–4.36	0.00	–0.01	–0.01	–0.02	–1.38	0.00
Households	0.07	0.04	–6.62	0.04	0.08	0.23	0.18	–0.65	0.04
Total	–2.47	–2.45	–118.39	0.59	0.00	3.56	0.00	–26.72	0.78

1. Names in parentheses indicate areas within which water use regions can trade. SMDB = southern Murray-Darling Basin.

Source: TERM-Water simulations

Table 4. Partial trade (urban: water availability in Adelaide, Canberra and Melbourne is reduced by 10 per cent)

	Murrumbidgee (SMDB)[1]	*Murray (SMDB)*	*Melbourne (SEVIC)*	*Mallee (SMDB)*	*Gippsland (SEVIC)*	*Goulburn –Murray (SMDB)*	*Adelaide (SMDB)*	*Murray Lands (MDB)*	*Canberra (SMDB)*
Regional price change	**0.01**	**0.01**	**0.16**	**0.01**	**0.16**	**0.01**	**0.01**	**0.01**	**0.01**
Change in water use	GL	GL	GL	GL	GL	GL	GL	GL	GL
Crops and Livestock	–2.38	–1.70	–10.51	–1.22	–6.92	–1.84	–3.64	–0.03	–0.35
Dairy Cattle	0.09	0.62	–5.67	0.90	–63.89	5.19	4.64	–0.02	–0.26
Cotton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rice	–10.07	–10.82	0.00	–0.51	0.00	–4.74	0.00	0.00	0.00
Fruit	–0.39	–0.14	–1.54	–0.27	–0.16	–0.52	–0.02	–0.07	–0.65
Grapes	–0.68	–0.34	–0.91	–1.38	0.00	–0.10	–0.05	0.00	–0.82
Sugar Cane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vegetables	–0.09	–0.06	–1.06	–0.05	–0.75	–0.07	–0.06	–0.04	–0.10
Plant Nursery	–0.01	–0.01	–0.64	–0.01	–0.08	–0.03	–0.02	–0.01	–0.01
Agricultural Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Forestry and Fishing	0.00	0.00	–0.02	0.00	–0.04	0.00	0.00	0.00	0.00
Mining	0.00	0.00	–0.13	0.00	–0.07	0.00	0.00	–0.02	0.00
Food, Tobac & Drink	–0.01	–0.01	–0.75	–0.02	–0.03	–0.04	–0.02	–0.07	–0.06
Flour and Cereals	–0.01	–0.01	–0.06	0.00	0.00	–0.01	0.00	–0.01	0.00
Dairy Products	0.00	0.00	–0.23	0.00	–0.08	–0.04	–0.03	–0.02	–0.01
Textiles Clothing Footwear	0.00	0.00	–0.65	0.00	–0.02	–0.01	–0.01	–0.01	0.00
Wood and Paper	–0.01	0.00	–0.71	0.00	–0.15	–0.02	–0.02	–0.03	0.00
Printing & Publishing	0.00	0.00	–0.51	0.00	–0.01	0.00	0.00	–0.01	0.00
Petroleum, Coal & Chemical	0.00	0.00	–0.86	0.00	–0.03	–0.01	–0.02	–0.02	0.00
Non-Metallic Mineral Product	0.00	0.00	–0.11	0.00	–0.01	0.00	0.00	0.00	0.00
Metal Products	0.00	0.00	–0.19	0.00	–0.01	0.00	–0.01	–0.01	0.00
Machinery & Equip.	0.00	0.00	–1.16	0.00	–0.01	–0.01	–0.02	–0.01	0.00
Other Manufacturing	0.00	0.00	–0.18	0.00	0.00	0.00	0.00	–0.01	0.00
Electricity and Gas	0.00	0.00	–0.47	0.00	–0.49	–0.01	–0.01	0.00	0.00
Water and Drains	–0.16	–0.14	–11.23	–0.31	–2.30	–0.84	–0.65	–0.06	–0.02
Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Trade	0.00	0.00	–0.25	0.00	–0.02	0.00	0.00	–0.01	0.00
Hotels and Cafés	0.00	0.00	–0.09	0.00	–0.01	0.00	0.00	0.00	0.00
Transport	0.00	0.00	–0.13	0.00	0.00	0.00	0.00	–0.01	0.00
Finance, Property & Business	0.00	0.00	–0.15	0.00	0.00	0.00	0.00	0.00	0.00
Government, Defence & Education	0.00	0.00	–0.41	0.00	–0.03	–0.01	–0.01	–0.01	0.00
Owner Dwelling	0.00	0.00	–0.05	0.00	0.00	0.00	0.00	0.00	0.00
Health & Community	0.00	0.00	–0.13	0.00	–0.01	0.00	0.00	–0.01	0.00
Cultural, Recreational & Personal Services	–0.01	0.00	–2.21	0.00	–0.11	–0.03	–0.03	–0.07	0.00
Households	0.00	0.01	–1.99	0.00	–0.17	0.01	–0.01	0.01	0.01
Total	–13.72	–12.62	–42.98	–2.90	–75.40	–3.13	0.00	–0.55	–2.26

1. Names in parentheses indicate areas within which water use regions can trade. In the partial trade scenario, for example, Murrumbidgee, Murray, Mallee, Murray Lands, Goulburn, the Australian Capital Territory and Adelaide can trade within the southern Murray Darling Basin (SMDB). SEVIC = south east Victoria.

Source: TERM-Water simulations.

Table 5. Full trade (urban: water availability in Adelaide, Canberra and Melbourne is reduced by 10 per cent)

	Murrumbidgee (SEAUST)[1]	*Murray (SEAUST)*	*Melbourne (SEAUST)*	*Mallee (SEAUST)*	*Gippsland (SEAUST)*	*Goulburn –Murray (SEAUST)*	*Adelaide (SEAUST)*	*Murray Lands (SEAUST)*	*Canberra (SEAUST)*
Regional price change	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**
Change in water use	GL	GL	GL	GL	GL	GL	GL	GL	GL
Crops and Livestock	–6.36	–4.53	–2.69	–3.22	–1.82	–5.07	–1.66	–0.08	–0.91
Dairy Cattle	–0.16	–1.23	–1.05	–2.39	–12.25	–13.31	2.13	–0.79	–5.58
Cotton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rice	–25.23	–26.78	0.00	–0.97	0.00	–8.66	0.00	0.00	0.00
Fruit	–1.00	–0.35	–0.42	–0.70	–0.04	–1.35	–0.01	–0.18	–1.67
Grapes	–1.85	–0.92	–0.20	–3.63	0.00	–0.26	0.00	0.00	–2.18
Sugar Cane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vegetables	–0.24	–0.17	–0.31	–0.15	–0.22	–0.20	–0.03	–0.11	–0.27
Plant Nursery	–0.02	–0.02	–0.19	–0.02	–0.02	–0.08	–0.01	–0.04	–0.03
Agricultural Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Forestry and Fishing	0.00	0.00	–0.01	0.00	–0.01	–0.01	0.00	0.00	0.00
Mining	0.00	0.00	–0.04	0.00	–0.02	0.00	0.00	–0.05	0.00
Food, Tobac & Drink	–0.03	–0.01	–0.24	–0.04	–0.01	–0.08	–0.01	–0.15	–0.13
Flour and Cereals	–0.01	–0.01	–0.03	0.00	0.00	–0.02	0.00	–0.03	0.00
Dairy Products	0.00	0.00	–0.08	–0.01	–0.02	–0.05	–0.01	–0.02	–0.02
Textiles Clothing Footwear	–0.01	0.00	–0.20	0.00	–0.01	–0.03	–0.01	–0.01	0.00
Wood and Paper	–0.01	–0.01	–0.22	0.00	–0.05	–0.04	–0.01	–0.07	0.00
Printing & Publishing	0.00	0.00	–0.16	0.00	0.00	–0.01	0.00	–0.02	0.00
Petroleum, Coal and Chemical	0.00	0.00	–0.27	0.00	–0.01	–0.02	–0.01	–0.05	0.00
Non-Metallic Mineral Product	0.00	0.00	–0.03	0.00	0.00	0.00	0.00	–0.01	0.00
Metal Products	0.00	0.00	–0.06	0.00	0.00	–0.01	0.00	–0.03	0.00
Machinery & Equip.	0.00	0.00	–0.37	0.00	–0.01	–0.02	–0.01	–0.02	0.00
Other Manufacturing	0.00	0.00	–0.06	0.00	0.00	0.00	0.00	–0.01	0.00
Electricity and Gas	–0.01	0.00	–0.15	0.00	–0.16	–0.02	0.00	–0.01	0.00
Water and Drains	–0.35	–0.32	–3.42	–0.69	–0.68	–1.86	–0.31	–0.14	–0.03
Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Trade	–0.01	0.00	–0.08	0.00	–0.01	–0.01	0.00	–0.03	0.00
Hotels and Cafés	0.00	0.00	–0.03	0.00	0.00	–0.01	0.00	–0.01	0.00
Transport	0.00	0.00	–0.04	0.00	0.00	0.00	0.00	–0.01	0.00
Finance, Property and Business	0.00	0.00	–0.05	0.00	0.00	0.00	0.00	–0.01	0.00
Government, Defence and Education	0.00	0.00	–0.13	0.00	–0.01	–0.02	0.00	–0.03	0.00
Owner Dwelling	0.00	0.00	–0.02	0.00	0.00	0.00	0.00	–0.01	0.00
Health & Community	0.00	0.00	–0.04	0.00	0.00	–0.01	0.00	–0.02	0.00
Cultural, Recreational and Personal Services	–0.01	–0.01	–0.70	–0.01	–0.03	–0.07	–0.02	–0.17	–0.01
Households	–0.03	–0.02	–0.55	–0.03	–0.05	–0.11	–0.02	–0.02	0.00
Total	–35.36	–34.42	–11.84	–11.86	–15.44	–31.33	0.00	–2.13	–10.84

1. Names in parentheses indicate areas within which water use regions can trade. SEAUST = south east mainland Australia.

Source: TERM-Water simulations.

Table 6. No trade (combined urban and rural: water availability reduced by 10 per cent)

	Murrumbidgee	*Murray*	*Melbourne*	*Mallee*	*Gippsland*	*Goulburn –Murray*	*Adelaide*	*Murray Lands*	*Canberra*
Regional price change	**0.20**	**0.20**	**0.56**	**0.28**	**0.22**	**0.22**	**1.01**	**0.19**	**1.68**
Change in water use	GL	GL	GL	GL	GL	GL	GL	GL	GL
Crops and Livestock	-28.36	-20.43	-32.44	-18.42	-8.71	-23.67	-1.32	-3.48	-1.58
Dairy Cattle	-0.63	-4.68	-22.47	-16.55	-60.94	-63.18	-12.01	-26.85	0.00
Cotton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rice	-104.69	-118.06	0.00	-1.69	0.00	-24.55	0.00	0.00	0.00
Fruit	-4.01	-1.42	-3.80	-3.58	-0.18	-5.67	-3.16	-6.45	0.00
Grapes	-8.71	-4.41	-2.97	-22.21	0.00	-1.22	0.00	-8.33	0.00
Sugar Cane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vegetables	-0.93	-0.68	-2.44	-0.69	-0.90	-0.81	-1.49	-0.95	0.00
Plant Nursery	-0.08	-0.07	-1.42	-0.10	-0.09	-0.31	-0.48	-0.08	-0.12
Agricultural Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Forestry and Fishing	-0.01	0.00	-0.05	0.00	-0.05	-0.02	-0.01	0.00	-0.01
Mining	0.00	0.00	-0.25	0.00	-0.09	-0.01	-0.43	-0.01	0.00
Food, Tobacco and Drink	-0.11	-0.04	-1.59	-0.18	-0.04	-0.32	-1.31	-0.49	-0.01
Flour and Cereals	-0.05	-0.06	-0.18	0.00	0.00	-0.11	-0.21	-0.01	0.00
Dairy Products	-0.01	-0.01	-0.54	-0.03	-0.12	-0.27	-0.19	-0.10	0.00
Textiles Clothing Footwear	-0.02	-0.01	-1.34	0.00	-0.03	-0.11	-0.10	0.00	0.00
Wood and Paper	-0.05	-0.03	-1.50	-0.01	-0.19	-0.17	-0.66	0.00	-0.04
Printing and Publishing	0.00	0.00	-1.03	0.00	-0.02	-0.04	-0.15	0.00	0.00
Petroleum, Coal and Chemical	0.00	0.00	-1.75	-0.01	-0.04	-0.07	-0.45	0.00	0.00
Non-Metallic Mineral Product	-0.01	0.00	-0.21	0.00	-0.01	-0.02	-0.07	0.00	-0.01
Metal Products	-0.01	-0.01	-0.39	0.00	-0.01	-0.02	-0.21	0.00	0.00
Machinery & Equip.	-0.01	-0.01	-2.35	-0.01	-0.02	-0.09	-0.13	0.00	-0.02
Other Manufacturing	0.00	0.00	-0.37	0.00	-0.01	-0.01	-0.10	0.00	0.00
Electricity and Gas	-0.02	-0.01	-0.96	-0.01	-0.61	-0.08	-0.08	0.00	-0.33
Water and Drains	-1.35	-1.24	-25.65	-3.41	-2.93	-7.96	-1.20	-0.12	-2.69
Construction	-0.01	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	-0.07
Trade	-0.02	-0.02	-0.51	-0.01	-0.02	-0.04	-0.23	-0.01	-0.14
Hotels and Cafés	-0.01	-0.01	-0.19	-0.01	-0.01	-0.02	-0.08	0.00	-0.08
Transport	-0.01	-0.01	-0.26	0.00	-0.01	-0.02	-0.11	0.00	-0.06
Finance, Property and Business	-0.01	-0.01	-0.30	0.00	-0.01	-0.01	-0.09	0.00	-0.19
Government, Defence and Education	-0.01	-0.01	-0.82	-0.01	-0.04	-0.07	-0.27	-0.01	-0.50
Owner Dwelling	-0.01	-0.01	-0.11	0.00	0.00	-0.01	-0.04	0.00	-0.08
Health &Community	-0.01	-0.01	-0.26	0.00	-0.01	-0.02	-0.14	0.00	-0.13
Cultural, Recreational and Personal Services	-0.05	-0.04	-4.49	-0.05	-0.13	-0.26	-1.38	-0.02	-1.39
Households	-0.12	-0.09	-7.77	-0.19	-0.24	-0.53	-0.64	0.01	-1.28
Total	-149.32	-151.39	-118.38	-67.18	-75.42	-129.66	-26.72	-46.92	-8.73

Source: TERM-Water simulations.

Table 7. Rural trade (combined urban and rural: water availability reduced by 10 per cent)

	Murrumbidgee (SMDB)[1]	*Murray (SMDB)*	*Melbourne (Melbourne)*	*Mallee (SMDB)*	*Gippsland (Gippsland)*	*Goulburn-Murray (SMDB)*	*Adelaide (Adelaide)*	*Murray Lands (SMDB)*	*Canberra (Canberra)*
Regional price change	**0.21**	**0.21**	**0.56**	**0.21**	**0.22**	**0.21**	**1.01**	**0.21**	**1.68**
Change in water use	GL	GL	GL	GL	GL	GL	GL	GL	GL
Crops and Livestock	-29.93	-21.39	-32.42	-14.59	-8.65	-23.00	-1.32	-3.87	-1.58
Dairy Cattle	-0.72	-5.25	-22.58	-10.93	-61.04	-61.18	-12.02	-32.35	0.00
Cotton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rice	-117.22	-120.52	0.00	-0.54	0.00	-16.98	0.00	0.00	0.00
Fruit	-4.21	-1.48	-3.80	-2.88	-0.18	-5.50	-3.16	-7.22	0.00
Grapes	-9.54	-4.78	-2.99	-16.82	0.00	-1.20	0.00	-9.89	0.00
Sugar Cane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vegetables	-0.98	-0.71	-2.44	-0.57	-0.89	-0.79	-1.49	-1.06	0.00
Plant Nursery	-0.08	-0.07	-1.42	-0.08	-0.09	-0.30	-0.48	-0.09	-0.12
Agricultural Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Forestry and Fishing	-0.01	0.00	-0.05	0.00	-0.05	-0.02	-0.01	0.00	-0.01
Mining	-0.01	0.00	-0.25	0.00	-0.09	-0.01	-0.43	-0.01	0.00
Food, Tobac. & Drink	-0.11	-0.04	-1.59	-0.16	-0.04	-0.31	-1.31	-0.53	-0.01
Flour and Cereals	-0.05	-0.06	-0.18	0.00	0.00	-0.11	-0.21	-0.01	0.00
Dairy Products	-0.01	-0.01	-0.53	-0.02	-0.11	-0.26	-0.18	-0.11	0.00
Textiles Clothing Footwear	-0.02	-0.01	-1.34	0.00	-0.03	-0.11	-0.10	0.00	0.00
Wood and Paper	-0.05	-0.03	-1.50	-0.01	-0.18	-0.17	-0.66	0.00	-0.04
Printing & Publishing	0.00	0.00	-1.03	0.00	-0.02	-0.04	-0.15	0.00	0.00
Petroleum, Coal and Chemical	0.00	0.00	-1.74	-0.01	-0.04	-0.07	-0.45	0.00	0.00
Non-Metallic Mineral Product	-0.01	0.00	-0.21	0.00	-0.01	-0.02	-0.07	0.00	-0.01
Metal Products	-0.01	-0.01	-0.39	0.00	-0.01	-0.02	-0.21	0.00	0.00
Machinery & Equip.	-0.01	-0.01	-2.35	-0.01	-0.02	-0.08	-0.13	0.00	-0.02
Other Manufacturing	0.00	0.00	-0.37	0.00	-0.01	-0.01	-0.10	0.00	0.00
Electricity and Gas	-0.03	-0.01	-0.96	0.00	-0.61	-0.08	-0.08	0.00	-0.33
Water and Drains	-1.40	-1.28	-25.62	-2.87	-2.92	-7.75	-1.20	-0.13	-2.69
Construction	-0.01	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	-0.07
Trade	-0.02	-0.02	-0.51	-0.01	-0.02	-0.03	-0.23	-0.01	-0.14
Hotels and Cafés	-0.01	-0.01	-0.19	0.00	-0.01	-0.02	-0.08	0.00	-0.08
Transport	-0.01	-0.01	-0.26	0.00	-0.01	-0.01	-0.11	0.00	-0.06
Finance, Property and Business	-0.01	-0.01	-0.30	0.00	-0.01	-0.01	-0.09	0.00	-0.19
Government, Defence and Education	-0.01	-0.01	-0.82	-0.01	-0.04	-0.07	-0.27	-0.01	-0.50
Owner Dwelling	-0.01	-0.01	-0.11	0.00	0.00	-0.01	-0.04	0.00	-0.08
Health & Community	-0.01	-0.01	-0.26	0.00	-0.01	-0.02	-0.14	0.00	-0.13
Cultural, Recreational & Personal Services	-0.06	-0.04	-4.49	-0.04	-0.13	-0.25	-1.38	-0.02	-1.39
Households	-0.12	-0.10	-7.71	-0.13	-0.24	-0.51	-0.63	0.01	-1.28
Total	-164.65	-155.89	-118.39	-49.68	-75.42	-118.92	-26.72	-55.31	-8.73

1. Names in parentheses indicate areas within which water use regions can trade. SMDB = southern Murray-Darling Basin.

Source: TERM-Water simulations.

Table 8. Partial trade (combined urban and rural: water availability reduced by 10 per cent)

	Murrumbidgee (SMDB)[1]	*Murray (SMDB)*	*Melbourne (SEVIC)*	*Mallee (SMDB)*	*Gippsland (SEVIC)*	*Goulburn-Murray (SMDB)*	*Adelaide (SMDB)*	*Murray Lands (SMDB)*	*Canberra (SMDB)*
Regional price change	**0.23**	**0.23**	**0.32**	**0.23**	**0.32**	**0.23**	**0.23**	**0.23**	**0.23**
Change in water use	GL	GL	GL	GL	GL	GL	GL	GL	GL
Crops and Livestock	-31.80	-22.73	-19.06	-15.43	-12.22	-24.49	-0.36	-4.07	-0.25
Dairy Cattle	-0.70	-5.12	-9.25	-10.89	-101.52	-60.86	-5.33	-33.54	0.00
Cotton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rice	-122.20	-125.37	0.00	-0.75	0.00	-17.14	0.00	0.00	0.00
Fruit	-4.49	-1.58	-2.47	-3.07	-0.25	-5.88	-0.81	-7.73	0.00
Grapes	-10.24	-5.12	-1.52	-17.85	0.00	-1.27	0.00	-10.48	0.00
Sugar Cane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vegetables	-1.04	-0.76	-1.68	-0.61	-1.19	-0.84	-0.49	-1.14	0.00
Plant Nursery	-0.09	-0.07	-1.01	-0.09	-0.12	-0.34	-0.16	-0.11	-0.02
Agricultural Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Forestry and Fishing	-0.01	0.00	-0.04	0.00	-0.07	-0.02	-0.01	0.00	0.00
Mining	-0.01	0.00	-0.19	0.00	-0.11	-0.01	-0.20	-0.01	0.00
Food, Tobac. & Drink	-0.11	-0.05	-1.21	-0.16	-0.05	-0.33	-0.65	-0.55	-0.01
Flour and Cereals	-0.05	-0.06	-0.16	0.00	0.00	-0.11	-0.14	-0.01	0.00
Dairy Products	-0.01	-0.01	-0.48	-0.03	-0.15	-0.28	-0.11	-0.12	0.00
Textiles Clothing Footwear	-0.02	-0.01	-1.00	0.00	-0.03	-0.11	-0.05	0.00	0.00
Wood and Paper	-0.05	-0.04	-1.10	-0.01	-0.23	-0.17	-0.28	0.00	-0.01
Printing & Publishing	0.00	0.00	-0.78	0.00	-0.02	-0.04	-0.07	0.00	0.00
Petroleum, Coal and Chemical	0.00	0.00	-1.32	-0.01	-0.04	-0.07	-0.21	0.00	0.00
Non–Metallic Mineral Product	-0.01	0.00	-0.16	0.00	-0.01	-0.02	-0.03	0.00	0.00
Metal Products	-0.01	-0.01	-0.29	0.00	-0.01	-0.02	-0.10	0.00	0.00
Machinery & Equip	-0.01	-0.01	-1.76	-0.01	-0.02	-0.09	-0.06	0.00	-0.01
Other Manufacturing	0.00	0.00	-0.28	0.00	-0.01	-0.02	-0.05	0.00	0.00
Electricity and Gas	-0.03	-0.01	-0.72	-0.01	-0.75	-0.08	-0.04	0.00	-0.13
Water and Drains	-1.42	-1.31	-18.19	-2.93	-3.74	-7.91	-0.56	-0.13	-0.89
Construction	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.03
Trade	-0.02	-0.02	-0.39	-0.01	-0.02	-0.04	-0.11	-0.01	-0.06
Hotels and Cafés	-0.01	-0.02	-0.14	0.00	-0.01	-0.02	-0.04	0.00	-0.03
Transport	-0.01	-0.01	-0.20	0.00	-0.01	-0.02	-0.05	0.00	-0.02
Finance, Property and Business	-0.01	-0.01	-0.23	0.00	-0.01	-0.01	-0.04	0.00	-0.08
Government, Defence and Education	-0.01	-0.01	-0.62	-0.01	-0.04	-0.07	-0.13	-0.01	-0.20
Owner Dwelling	-0.01	-0.01	-0.08	0.00	0.00	-0.01	-0.02	0.00	-0.03
Health and Community	-0.01	-0.01	-0.20	0.00	-0.01	-0.02	-0.07	0.00	-0.05
Cultural, Recreational & Personal Services	-0.06	-0.04	-3.39	-0.04	-0.16	-0.26	-0.66	-0.03	-0.55
Households	-0.18	-0.13	-4.68	-0.16	-0.42	-0.67	-0.10	-0.02	-0.22
Total	-172.62	-162.53	-72.58	-52.08	-121.23	-121.21	-10.93	-57.96	-2.58

1. Names in parentheses indicate areas within which water use regions can trade. SMDB = southern Murray-Darling Basin; SEVIC = south east Victoria.

Source: TERM-Water simulations.

Table 9. Full trade (combined urban and rural: water availability reduced by 10 per cent)

	Murrumbidgee (SEAUST)[1]	*Murray (SEAUST)*	*Melbourne (SEAUST)*	*Mallee (SEAUST)*	*Gippsland (SEAUST)*	*Goulburn–Murray (SEAUST)*	*Adelaide (SEAUST)*	*Murray Lands (SEAUST)*	*Canberra (SEAUST)*
Regional price change	**0.24**	**0.24**	**0.24**	**0.24**	**0.24**	**0.24**	**0.24**	**0.24**	**0.24**
Change in water use	GL	GL	GL	GL	GL	GL	GL	GL	GL
Crops and Livestock	-34.22	-24.45	-14.65	-16.53	-9.48	-26.33	-0.38	-4.34	-0.27
Dairy Cattle	-0.88	-6.40	-6.13	-13.32	-68.93	-74.65	-6.13	-38.19	0.00
Cotton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rice	-129.11	-132.27	0.00	-1.56	0.00	-17.32	0.00	0.00	0.00
Fruit	-4.78	-1.69	-1.95	-3.26	-0.20	-6.24	-0.87	-8.24	0.00
Grapes	-11.10	-5.55	-1.07	-19.12	0.00	-1.37	0.00	-11.21	0.00
Sugar Cane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vegetables	-1.11	-0.81	-1.37	-0.65	-0.98	-0.90	-0.52	-1.21	0.00
Plant Nursery	-0.10	-0.08	-0.83	-0.09	-0.10	-0.36	-0.17	-0.11	-0.02
Agricultural Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Forestry and Fishing	-0.01	0.00	-0.03	0.00	-0.06	-0.03	-0.01	0.00	0.00
Mining	-0.01	0.00	-0.16	0.00	-0.09	-0.01	-0.21	-0.01	0.00
Food, Tobacco and Drink	-0.12	-0.05	-1.03	-0.17	-0.04	-0.34	-0.68	-0.58	-0.01
Flour and Cereals	-0.06	-0.06	-0.15	0.00	0.00	-0.12	-0.15	-0.01	0.00
Dairy Products	-0.01	-0.01	-0.41	-0.03	-0.12	-0.29	-0.11	-0.13	0.00
Textiles Clothing Footwear	-0.02	-0.01	-0.85	0.00	-0.03	-0.11	-0.05	0.00	0.00
Wood and Paper	-0.05	-0.04	-0.93	-0.01	-0.20	-0.18	-0.30	-0.01	-0.01
Printing and Publishing	0.00	0.00	-0.66	0.00	-0.02	-0.04	-0.08	0.00	0.00
Petroleum, Coal and Chemical	0.00	0.00	-1.12	-0.01	-0.04	-0.07	-0.22	0.00	0.00
Non–Metallic Mineral Product	-0.01	0.00	-0.14	0.00	-0.01	-0.02	-0.03	0.00	0.00
Metal Products	-0.01	-0.01	-0.25	0.00	-0.01	-0.02	-0.10	0.00	0.00
Machinery & Equip.	-0.01	-0.01	-1.49	-0.01	-0.02	-0.09	-0.07	0.00	-0.01
Other Manufacturing	0.00	0.00	-0.24	0.00	-0.01	-0.02	-0.05	0.00	0.00
Electricity and Gas	-0.03	-0.02	-0.62	-0.01	-0.64	-0.09	-0.04	0.00	-0.14
Water and Drains	-1.49	-1.37	-15.10	-3.08	-3.05	-8.30	-0.59	-0.14	-0.93
Construction	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.03
Trade	-0.02	-0.02	-0.33	-0.01	-0.02	-0.04	-0.11	-0.01	-0.06
Hotels and Cafés	-0.01	-0.02	-0.12	-0.01	-0.01	-0.02	-0.04	0.00	-0.03
Transport	-0.01	-0.01	-0.17	0.00	-0.01	-0.02	-0.05	0.00	-0.03
Finance, Property and Business	-0.02	-0.01	-0.19	0.00	-0.01	-0.01	-0.04	0.00	-0.08
Government, Defence and Education	-0.02	-0.01	-0.53	-0.01	-0.04	-0.08	-0.14	-0.01	-0.21
Owner Dwelling	-0.01	-0.01	-0.07	0.00	0.00	-0.01	-0.02	0.00	-0.03
Health and Community	-0.01	-0.01	-0.17	0.00	-0.01	-0.02	-0.07	0.00	-0.05
Cultural, Recreational and Personal Services	-0.06	-0.04	-2.88	-0.05	-0.14	-0.27	-0.69	-0.03	-0.57
Households	-0.20	-0.15	-3.73	-0.18	-0.33	-0.76	-0.13	-0.02	-0.23
Total	-183.48	-173.12	-57.36	-58.10	-84.56	-138.10	-12.04	-64.25	-2.71

1. Names in parentheses indicate areas within which water use regions can trade. SEAUST = south east Australia.

Table 10. Change in water demand by households (urban)

Per cent

	1. No trade	*2. Rural trade*	*3. Partial trade*	*4. Full trade*
Murrumbidgee	0.472	0.464	0.022	-0.186
Murray	0.410	0.401	0.045	-0.179
Melbourne	-2.382	-2.380	-0.715	-0.196
Mallee	0.454	0.465	0.002	-0.306
Gippsland	0.327	0.330	-0.741	-0.201
Goulburn–Murray	0.522	0.537	0.032	-0.256
Adelaide	-0.484	-0.484	0.008	-0.015
Murray Lands	0.432	0.435	0.088	-0.028
Canberra	-4.048	-4.048	-0.064	-0.110

Source: TERM-Water simulations.

Table 11. Change in total household consumption (urban)

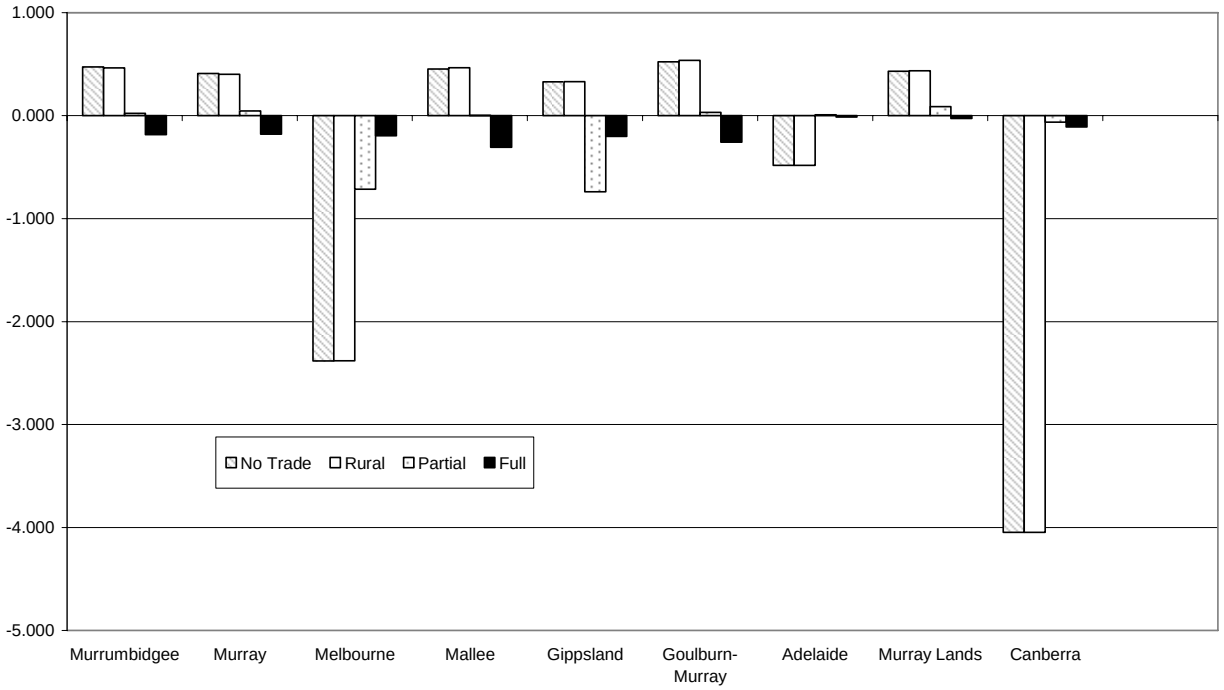
Per cent

	1. No trade	*2. Rural trade*	*3. Partial trade*	*4. Full trade*
Murrumbidgee	-0.002	-0.006	-0.033	-0.084
Murray	0.000	-0.005	-0.033	-0.099
Melbourne	-0.067	-0.067	-0.023	-0.008
Mallee	0.001	0.004	-0.022	-0.087
Gippsland	-0.007	-0.007	-0.187	-0.034
Goulburn–Murray	-0.006	-0.003	-0.012	-0.048
Adelaide	-0.071	-0.071	-0.004	-0.007
Murray Lands	-0.003	0.004	-0.030	-0.100
Canberra	-0.046	-0.046	-0.003	-0.003

Source: TERM-Water simulations.

Figure 3. Change in household demand for urban water reductions

Per cent



Source: TERM-Water simulations.

Table 12. Change in water demand by households (combined urban and rural)

Per cent

	1. No trade	*2. Rural trade*	*3. Partial trade*	*4. Full trade*
Murrumbidgee	-0.786	-0.853	-1.211	-1.385
Murray	-0.859	-0.888	-1.172	-1.358
Melbourne	-2.796	-2.772	-1.684	-1.341
Mallee	-2.221	-1.517	-1.879	-2.127
Gippsland	-1.072	-1.044	-1.835	-1.439
Goulburn–Murray	-1.248	-1.189	-1.564	-1.787
Adelaide	-0.48	-0.473	-0.078	-0.094
Murray Lands	0.109	0.077	-0.183	-0.285
Canberra	-4.168	-4.162	-0.703	-0.741

Source: TERM-Water simulations.

Table 13. Change in total household consumption (combined urban and rural)

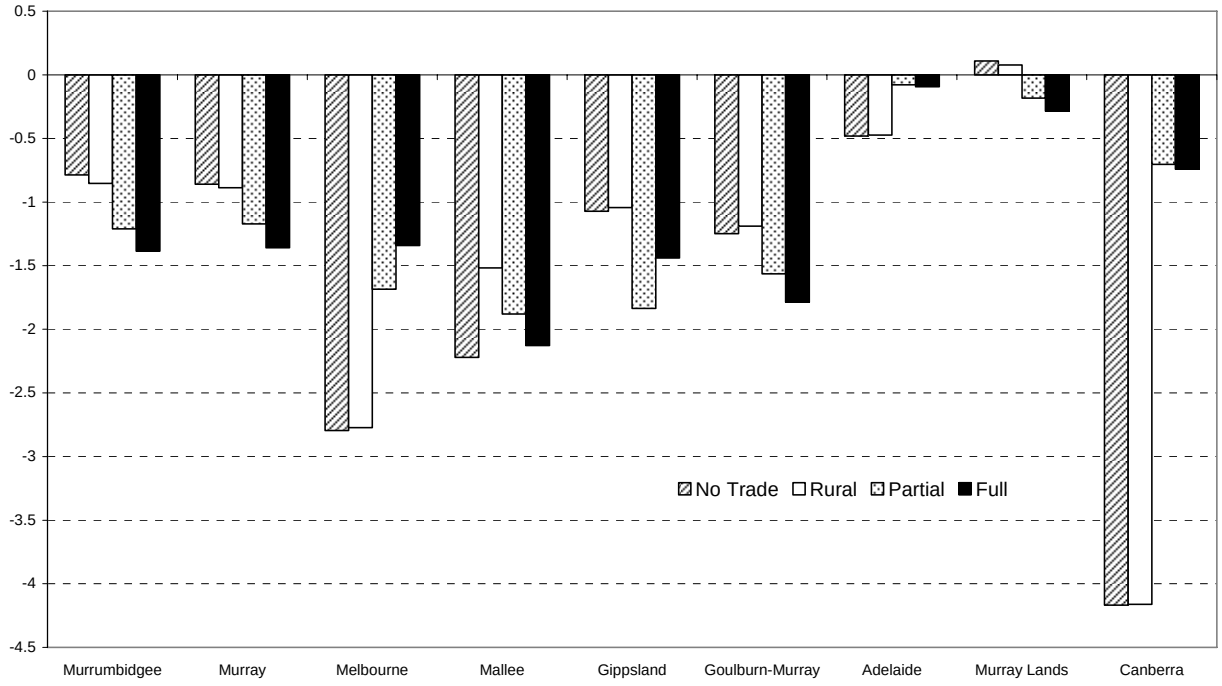
Per cent

	1. No trade	*2. Rural trade*	*3. Partial trade*	*4. Full trade*
Murrumbidgee	-0.511	-0.555	-0.595	-0.648
Murray	-0.615	-0.642	-0.684	-0.75
Melbourne	-0.096	-0.096	-0.067	-0.057
Mallee	-0.724	-0.515	-0.549	-0.611
Gippsland	-0.224	-0.223	-0.373	-0.25
Goulburn–Murray	-0.292	-0.283	-0.296	-0.331
Adelaide	-0.095	-0.095	-0.043	-0.046
Murray Lands	-0.538	-0.641	-0.688	-0.763
Canberra	-0.056	-0.056	-0.018	-0.018

Source: TERM-Water simulations.

Figure 4. Change in household demand from urban and rural water reductions

Per cent



Source: TERM-Water simulations.