Realising Environmental Demands in Water Markets[*]

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1. Property rights and markets

To achieve Pareto efficiency through market allocation, property rights over resources must be comprehensively defined and defended. This ensures that the full range of benefits and costs arising from their use are assigned and enforced. Competition between those with interests in a resource ensures that allocation is to the highest marginal net value use (Kasper 1998). The difference between the marginal net values of a resource prior to and subsequent to market place reallocations is known as the gains from trade. These gains from trade provide a powerful rationale for society to ensure the definition and defence of property rights.

A complication to this logic arises when it is recognised that the definition and defence of property rights and their subsequent reallocation by trading in markets are costly activities in themselves. The existence of these so-called transaction costs limits the extent of gains from trade. Indeed if the transaction costs involved are greater than the potential gains from trade, then trade in a resource may prove unproductive for society. Put simply, in those circumstances, the costs involved in establishing and implementing trade are greater than the benefits that would result (Demsetz 1967).

Such a situation can arise when a resource can be used to provide benefits that are "non-excludable": that is, when the identification of beneficiaries is problematic (rights definition) and/or where beneficiaries cannot be precluded from use (rights defence). For example, if an ecosystem provides existence benefits to people – that is, the enjoyment experienced from the knowledge that ecosystem remains intact – identifying which individuals are enjoying the benefits and then securing exclusive use is at best expensive and at worst impossible.

Hence, where some alternative uses of a resource are associated with rights that are readily defined and defended whilst other suffer from transaction costs that are high relative to their net marginal values, it can be confidently predicted that market allocation will favour the former uses. In the ecosystem example above, the likely outcome is that uses involving the production of "excludable" goods such as food, fibre and minerals will prevail over "non-excludable" goods such as existence benefits. This gives rise to concerns that the market allocation process results in a

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[*] Paper presented at the Institute for Public Affairs Symposium "Establishing Australian Water Markets", Melbourne, 9 August 2004.

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"misallocation" of resources. The consequential "inefficiency" is deemed to be a failure of market allocation.

But is this "inefficient"? If the transaction costs exceed the potential gains from trade in the "non-excludable" goods, then society is better off without the trade taking place. However, that conclusion is based on all the transaction costs being born by the individuals with interests in a resource. That is not the case for the majority of resources, even in the most "laissez-faire" of economies. Governments act to take advantage of economies of scale in performing many of the tasks associated with the definition and defence of property rights. Parliamentary legislation codifies rights. Legal precedent clarifies rights in an evolutionary context. Police, the courts and the penal system target enforcement. In all of these cases, transaction costs are borne by society at large, rather than by individuals, with consequential cost savings.

Taking the logic further, governments can take a more interventionist stand by either directly or indirectly controlling resources that provide "non-excludable" benefits to people. For example, governments set aside areas of land as National Parks and require minimum flow levels in rivers to be secure from extraction. Such intervention avoids the transaction costs associated with market allocation processes. The temptation then is to conclude that so long as the marginal benefits of intervention are greater than the marginal costs then government action is justified. This conclusion is flawed, however, if the transaction costs associated with the process of government intervention are ignored in the calculation of the marginal costs of intervention. Government actions – including the taxation process used to fund intervention – involve costs. Furthermore, the incentives associated with government action induce inefficiencies. Rent-seeking behaviour by parties interested in both the excludable and non-excludable alternative resource uses can drive a wedge between political outcomes and economic efficiency.

What this means is that neither a laissez faire market based system nor a command and control government regulated system of allocation is likely to deliver Pareto efficient resource allocation. Nor is one system guaranteed to deliver Pareto superior outcomes relative to the other. A key goal of policy is thus to determine the appropriate balance between the two systems.

In the case of many environmental resources, past policy in Australia has focused on the regulatory approach. Specifically in the case of the water resource, environmental flows have been mandated and extractions allocated largely via government issued licences.

There has been a growing recognition of the potential efficiency advantages offered by market allocation with technological advances in information processing reducing transaction costs. In addition, there has been a realisation, internationally, of the extent of the transaction costs involved with government allocation and a better understanding of the significance of rent-seeking behaviour. These factors have induced more policy makers to turn their attention to markets and market-based instruments of natural resource management.

One expression of this shift has been the effort to establish water markets in Australia. Fundamentally, this has taken the form of the more complete definition of rights to

extract water for irrigation purposes – including the capping of volumes extracted – and the separation of water rights from land titles to facilitate trade.

Whilst the shift toward towards market-based water management has created improved efficiency in the use of water for consumptive purposes (Young et al. 2000), questions remain regarding the efficiency of the outcome with respect to non-consumptive, non-market, environmental uses of water. Fundamentally, allocation to these uses remains a function of government regulation because the decision as to the "split" between extractive and non-consumptive uses of water – that is, how much water should remain as 'environmental flows' – rests with state government agencies, albeit more recently with the inputs of advisory groups comprising local people, scientists and representatives of vested interest groups.

The issue of allocating water to environmental purposes is addressed in this paper. Two specific questions are addressed:

1. Are governments and their agencies setting environmental flows at economically efficient levels; and
2. Can markets play a larger role in determining the allocation of water for environmental protection purposes?

The paper is structured around these two questions. In the next section, the processes of establishing environmental flow levels in a regulatory setting are considered. Included is a review of some studies conducted to estimate the community's level of demand for environmental flows. In Section 3, the potential for private sector conservation enterprises (PSCEs) to act in water markets to represent the community's demands for environmental flows is assessed. This is done by considering the evidence of such organizations working to secure the supply of environmental protection benefits from land-based ecosystems. Some conclusions are drawn in Section 4.

2. Regulatory setting of environmental flows

For governments to set the level of environmental flows in rivers at efficient levels, they must be able to identify the marginal benefits of environmental flows. This would enable the flow level to be set so that the marginal values of alternative uses of water can be equilibrated. In other words, the marginal benefit of water allocated as an environmental flow needs to be equal to the marginal benefit arising from the next best alternative use of the water, presumably the most valuable extractive use. This is the familiar equi-marginal principle that underpins conventional cost benefit analysis. Additional to the foregone benefits, account should also be made of the transaction costs inherent in the policy process and its implementation.

Hence, for governments to implement the equi-marginal priciple, knowledge of the values placed by the community on all potential uses of the water should be acquired. This includes information on the non-marketed values associated with environmental flows. Whilst well-functioning markets are good sources of information regarding the values of people for the extractive uses of water, value information regarding the non-marketed environmental values is more problematic.

Some attempts have been made to estimate these non-market values in the context of water allocations. For instance, as part of the process used to develop water management plans for the rivers of NSW, Bennett and Morrison (2001) used choice modelling to estimate the values associated with river attributes that would be advantaged by greater environmental flows. These included riverside vegetation health, and the number of fish and bird species relying on the river habitat. Choice modelling is a non-market valuation technique that presents respondents in a survey with a sequence of potential future water management arrangements and outcomes. Respondents' choices between these alternatives are used to infer the values of environmental attributes, in monetary terms, given that one of the impacts of changed water management conditions is a directly felt monetary impost.

A selection of the Bennett and Morrison (2001) results is provided in Table 1.

Table 1: Attribute Value Estimates ($ per household)

River	Vegetation	Fish	Birds
Bega	$2.32	$7.37	$0.92
Clarence	$2.02	$0.08*	$1.86
Georges	$1.51	$2.11	$0.67*
Murrumbidgee	$1.45	$2.58	$1.59
Gwydir	$1.49	$2.36	$1.89
Out			
MUR	$2.17	$3.81	$1.80
GWY	$2.01	$3.43	$0.55*

* insignificant coefficients in model at the 5 percent level.
Source: Bennett and Morrison (2001)

The units of measurement of the attribute value estimates displayed in Tables 2 are dollars per unit of each attribute. For instance, from the Bega River survey, the Fish Specie attribute value can be interpreted as: On average, respondent households in the Bega Valley value the presence of an additional fish specie in the river at $7.37 per household.

Similarly, Rolfe et al. (2002) have undertaken choice modelling studies of the environmental values of water in the Fitzroy Basin of Central Queensland. They asked various samples of people resident in Rockhampton, Emerald and Brisbane to choose between alternative water management regimes for rivers in the Fitzroy. One of the attributes used to describe the outcomes of those strategies was the number of kilometres of waterways in the catchment that remain in good health. Estimates of the value of this attribute were calculated for the different groups of respondents and for different sub-catchments. Values in the order of 2 to 10 cents per annum over a 20-year period per kilometre were reported.

van Bueren et al. (2004) report environmental values of rivers estimated as a component of the National Land and Water Resources Audit. This work used the context of a river restoration programme in contrast to the Rolfe et al. where river protection was the focus. It also used a nation-wide context. An estimate of 8 cents per annum over a 20-year period per household per 10km stretch of restored river was reported.

Whilst some environmental valuation studies have been attempted, their use in the policy process of determining environmental flows has been limited. For instance, the Bennett and Morrison results have yet to be sanctioned for release by NSW Government agencies. A number of points arise from this observation.

First, the limited use made of the studies can be attributed to their controversial nature. Techniques for estimating non-market values such as choice modelling rely on peoples' responses to questions that are essentially hypothetical. People provide answers that are expectations rather than revelations of actual behaviour. This has lead to debate in Australia regarding the accuracy of estimates so derived that go back to the controversial use of a related technique, contingent valuation, to estimate the environmental protection values associated with Coronation Hill in the Northern Territory (Moran 1991). However Bennett and Morrison argue that their estimates are reliable due to the strength of the models on which they are based. Those models explained a relatively large proportion of the total variability evident in the choice data[1], the environmental attribute coefficients were consistently found to be significant and respondents' age and income were both significant and consistent with *a priori* expectations.

Second, the limited number of environmental valuation studies can be attributed to their cost. The collection of primary data through surveys is expensive and it can be expected that there is a positive relationship between the cost of non-market valuation exercises and the reliability of their results. Put simply, cost-saving short cuts in such exercises are likely to be detrimental to the quality of their outputs. The high cost of non-market value information should come as no surprise when it is recognised that the transaction costs of markets generating such information are sufficiently high to preclude their formation. None the less, these transaction costs of governments acting to ensure efficiency are a barrier to the information being collected.

An alternative to expending resources on information collection is to rely on the judgements of elected representatives to determine the efficient allocation of water between consumptive and non-consumptive uses. This is the most widely applied process of determining environmental flow levels in the Australian context. Whilst this approach does reduce the transaction cost burden on society, its ability to deliver the most efficient allocation must be questioned on rent seeking grounds. The political process that drives the allocation decision is driven by the incentive for re-election. In the Australian case, this centres on the search by politicians for the votes of those in marginal electorates who can sway an election result one way or the other. This is unlikely to deliver an outcome that provides outcomes that are in the best interests of society at large. The decision regarding the extent of environmental flows to be provided for the Snowy River is a case at point. There, the results of a Commission of Inquiry were largely ignored when the decision on flows was taken in order to secure the support of the independent local member in the Victorian Parliament.

It can be argued that decision makers prefer a situation where information regarding the relative marginal values of non-marketed environmental uses of water is not available. If the voters are ignorant of value information, it is easier for their representatives to make decisions that favour their re-election prospects even if those

[1] Adjusted rho squared statistics for the models ranged from 0.21 to 0.41, with values greater than 0.2 being regarded as robust.

decisions have net costs to society. This argument can also help to explain the reluctance of decision makers to commission and/or use non-market valuation studies, a point raised by Gillespie et al (2003) in detailing the curtailment of such a study into the value of environmental flows under the Living Murray programme of the Murray Darling Basin Commission.

The resultant picture is one in which the operation of governments to set environmental flow levels is confounded by costly information and incentives that are likely to lead to inefficient allocations. However, the studies performed to estimate the extent of values society enjoys from environmental flows in Australian rivers show that that these values are significant and warrant consideration in the resource allocation process. Given the weaknesses inherent in the regulatory approach, are there better prospects for a market solution?

3. Market demands for environmental flows

The non-excludability of some of the environmental benefits arising from environmental flows in rivers has been argued to result from the high transaction costs of defining and defending exclusive rights to those benefits. Yet there are some environmental flow benefits that are excludable. These mostly relate to uses that rely on direct contact with the water. For instance, environmental flows can improve peoples' recreational enjoyment from a river – fishing, swimming and boating. Such uses can be excludable. For example, a kayak tour or houseboat operator reliant on a particular level of flow for their clients' satisfaction may purchase water to secure that flow. With the profit motive providing the incentive for non-consumptive purchases of water, some non-excludable benefits may be provided as a positive externality (Anderson 2004). This can arise because there is joint production of excludable and non-excludable benefits through the supply of environmental flows.

Similarly, a group of anglers may form to purchase environmental flows to ensure an ecologically healthy habitat for spawning fish. In this case, the costs associated with overcoming the free-rider problem within a group may be low enough not to overwhelm the potential benefits of improved fish catch probabilities. Again it is the prospect of a direct use benefit being enjoyed that could motivate purchase. That benefit – the catching and consumption of a fish – is excludable and exclusion from a length of a river to all who are not members of the angling group is also possible. However, along with the excludable good, non-excludable benefits such as the protection of other species of flora and fauna may be supplied.

Anderson and Leal (1991) cite cases in the UK and the USA where the protection of environmental assets has been successful due to the purchase of use rights by groups seeking hunting and fishing opportunities. Similarly, documentation of the revitalisation of the African Elephant population in Zimbabwe (Sanera and Shaw 1996) demonstrates the significance of hunting property rights. Thus, by securing use rights to resources, people interested in types of uses that are consistent with non-use benefit provision effectively provide the wider public good. In a sense, the use benefits for which rights can be defined and defended 'piggy back' the non-use benefits where property rights are more problematic.

These two classes of example illustrate the possibility of private sector interests buying water in markets for non-consumptive use values. It is also possible that entities could be established specifically to purchase environmental flows for non-excludable benefits. Motivations for such actions include philanthropy. In this case, people provide funds either as individuals or coordinated in some group structure, to buy water in order to supply non-excludable goods such as existence values. They will enjoy these benefits but so will all other members of the community. Such an action contradicts the free-rider incentive by which people are hypothesised not to spend money in this way, hoping that others will pay enough so that the good is supplied and then enjoyed at no personal cost to the free-rider.

For groups to form to raise funds to purchase non-excludable water use benefits, they must confront the free-rider incentive. This in itself can be an exercise ladened with transaction costs. It involves seeking out people who value the benefits being provided and then convincing them of the merits of paying. These transaction costs are essentially being born to mimic the exclusion process required for efficient market provision. The formation of groups of people with high marginal values for the non-excludable benefit means that the surplus they enjoy from having the good provided is sufficient to yield a surplus large enough to be redeployed in meeting some of these transaction costs.

Water markets in Australia are perhaps as yet too young to expect such private purchases of water for environmental flows to have emerged. To date only one purchase of water to create an environmental flow is known to the author and that was funded by a grant from government. A wide range of entities is potentially capable of forming to see the provision of environmental flow benefits. Profit maximisers, not-for-profits, clubs and societies all may arise. Whether they will develop or not as the market matures remains conjectural.

The Australian context of large areas with relatively sparse population is very different from the European and United States settings. Similarly, Australian rivers do not support populations of "charismatic mega fauna" that are likely to either support large-scale tourist or hunting demands[2]. Furthermore, there are potential issues surrounding the suitability of flows purchased for some river recreational activities to support the ecological functioning of a riparian system. For example, flows purchased to support the houseboat industry may be made in the summer when ecologically, the ecology of inland rivers is adapted to low flow levels.

One way to assess the likelihood of the private sector realising the community's demands for environmental flows is to consider the evidence offered by conservation initiatives undertaken on the land resource by private sector conservation enterprises.

Before proceeding, however, it is worth noting that the emergence of private buyers of water – and of land – for environmental conservation purposes in Australia is – or will be – occurring in a context of government intervention. In the land case,

[2] An exemption maybe the crocodile in northern Australia, but there, most habitat is found in unregulated river systems.

governments across Australia have already established large-scale estates of national parks and nature reserves. For water, as has been noted, environmental flows have been regulated. The emergence of private, conservation motivated, buyers in land and water markets is thus reflecting demands at the margin. For there to be any market demand is indicative of the strength of demand at the margin given the transaction costs associated with overcoming the free rider problem.

In a survey of 174 Australian PSCEs, Bennett and Usher (2004) found that the sector is involved in numerous direct conservation[3] activities. These include:

- Ownership of natural areas;
- Management of natural areas including on-ground works that maintain, restore or enhance biodiversity; and
- Use of private funds to conserve native wildlife and habitat through establishment and management of reserves and sanctuaries.

In addition, activities undertaken by these organisations that facilitate nature conservation activities include:

- Administration of conservation covenants and/or revolving funds that facilitate land purchases; and
- Administration of devolved grant schemes; and
- Brokering between groups that undertake on-ground works and those seeking to achieve nature conservation goals.

The distribution of these activities across groups is shown in Table 2.

Table 2: Direct conservation activities

Activity	Respondent PSCEs involved	*Percentage of respondent PSCEs*
Ownership of natural areas	27	*16*
Management of natural areas	156	*90*
Administration of covenants	32	*18*
Administration of devolved grants	93	*53*
Brokering conservation activities	45	*26*
Technical advice/support	101	*58*

Source: Bennett and Usher (2004)

The evidence from the survey shows that PSCEs are active in the Australian conservation scene in every state and territory:

- Fifteen of the PSCEs responding had per annum revenue of over $1m.
- Total annual revenues across the PSCEs surveyed are in the order of $99m.
- Total average value of responding PSCEs' assets exceeded $112m.
- In the 2002/03 financial year around 31,000 volunteers worked with the surveyed PSCEs, representing the equivalent of over 1600 full time equivalent workers.

[3] Indirect conservation activities include lobbying the government for changes to biodiversity conservation policies and programmes of community education activities.

- In the same year, over 800 paid employees worked for the responding PSCEs.

Bennett and Usher found that the activities of the PSCEs responding to the survey were largely independent of their location. However the geographic focus of PSCEs was found to give rise to different concentrations of activity. Owning natural areas was more frequently observed in national or state focused PSCEs than those with a regional and local site focus[4]. For example, 30 per cent of the national PSCEs and 39 per cent of state focused PSCEs surveyed owned natural areas, compared with seven per cent for regional and 15 per cent for local site focused PSCEs.

PSCE with a national focus were also found to be more likely (50 per cent) to act as a broker between PSCEs undertaking on-ground works and those wanting them. In contrast to the trend observed for ownership of natural areas, the next most likely PSCEs to act as brokers were those with a regional focus (34 per cent) rather than state focused PSCEs (26 per cent)[5]. However, state focused PSCEs were more likely to be involved in both the administration of covenants[6] and provision of technical advice/support[7] than other PSCEs. Table 3 displays the data collected on activity differences.

Table 3. PSCE activities by focus of operations

	Percentage of PSCE, separated by focus of operations, undertaking an activity					
Focus\Activity	Own	Manage	Covenant	Devolved Grants	Broker	Tech. advice
	%	%	%	%	%	%
National	30	80	10	30	50	70
State	39	78	30	48	26	87
Regional	7	90	23	63	34	64
Local	15	94	10	49	13	40
Chi square	13.9	5.1	7.0	5.9	11.7	20.2
Significance level	0.00	0.17	0.07	0.12	0.01	0.00

Source: Bennett and Usher (2004)

Other differences across PSCEs were observed to be less marked. For instance, activities carried out were generally invariant across the scales of PSCEs, as indicated by revenue. The exception was PSCEs with larger revenue flows, which were more likely to be involved in the provision of technical advice and support[8]. Similarly, activities were independent of PSCE structure, with the exception that public

[4] Significant at the one per cent level, however there is a caveat relating to this result due to the small numbers of observations in some categories.
[5] Significant at the one per cent level.
[6] Significant at the ten per cent level, however there is a caveat relating to this result due to the small numbers of observations in some categories.
[7] Significant at the one per cent level.
[8] The difference is significance at the one per cent level.

corporations with elected boards were more likely to be involved in the ownership of natural areas[9].

The Bennett and Usher study shows that PSCEs are active participants in the protection of natural ecosystems in Australia. The activities undertaken by these groups are broad ranging, but most of the PSCEs surveyed were involved with the on-ground management of nature protection areas. PSCE were shown to be responsible for significant funds being invested and considerable labour resources being mobilised for the achievement of nature conservation objectives.

An important consideration in determining the prospects of PSCEs in mobilising demand for non-excludable environmental benefits is their sources of funds. Whilst a wide range of funding sources were accessed, nearly all the PSCEs responding to the Bennett and Usher survey received government grants as one source of revenue. Table 4 sets out information on revenue sources for responding PSCEs.

Table 4. PSCE revenue sources

Sources of revenue	Respondent PSCEs in receipt	*Percentage of respondent PSCEs*
Government grants	156	*90*
Philanthropic grants	32	*18*
Sponsorships	53	*31*
Donations	116	*67*
Membership dues	138	*80*
Merchandising	45	*26*
Events	42	*24*
Tourism	23	*13*

Source: Bennett and Usher (2004)

The strength of the devolved grant activity in the sector may also be a reflection of government funding policy, that is, to channel public funds through PSCEs at a regional or local level so as to ensure that a 'grass roots' approach is secured. Notwithstanding the prevalence of government derived funding, donations and membership fees were also shown to be important sources of funding for the survey PSCEs. Furthermore, the success of this sector in leveraging non-cash private sector resources is significant. Of particular importance is the labour input; the volunteer labour force in the sector is substantial.

The prevalence of government grants as a revenue source within the PSCE sector may indicate that significant barriers confront these organisations in the raising of private sector revenue streams. One explanation of this is that the free-rider hypothesis is verified by the survey. Alternatively, it may be evidence of structural impediments to PSCEs that are the result of government policies. For instance, bans on the ownership

[9] Significant at the five per cent level. This result however goes with a caveat relating to the small numbers of observations in these categories.

of native species could prevent the formation of profitable enterprises based on the protection of natural ecosystems for the breeding of species for sale to collectors.

However, it may also signal that the level of supply offered through public sector provision is sufficient for most people. Hence it may only be a small minority in the community that is sufficiently dissatisfied by government provision that they seek private alternatives.

The results call into question the long-term sustainability of many PSCEs if a change in government policy led to either, less funds being available to PSCEs for leveraging other resources, or a greater channelling of public funds for the environment to public sector agencies. However, Bennett and Usher admit that the data collected do not enable an analysis of the degree to which PSCEs are dependent on government funding. It may be the case that whilst many PSCEs receive some form of government funding, their primary source of funds is the private sector.

4. Conclusions

Defining, defending and then trading property rights in water is being advanced as a means of improving the efficiency with which the Australian community uses this frequently scarce resource. The gains from trade that this policy approach offers need to be considered in the light of the transaction costs involved. It is argued in this paper that the transaction costs involved in defining, defending and trading the rights associated with some aspects of water may be sufficiently high to offset completely the gains from trade that may be available. These aspects are characterised by 'non-excludability' and include many of the environmental benefits supplied by riparian ecosystems.

The conventional approach to securing the supply of these environmental benefits has been for governments to circumvent the market transaction costs by regulating peoples' behaviour. In the case of water, this has usually been done through the setting of caps on extractions from rivers or minimum required flow levels – known as environmental flows. This approach is called into question for three reasons.

First, governments incur transaction costs themselves in the determination of the appropriate level the environmental flows should take and then the implementation and monitoring of the regulation. These costs may well be greater than the net benefits generated by the flow.

Second, the process by which governments determine environmental flows may be compromised in terms of achieving greater efficiency in resource allocation (and hence greater net social well-being) because of rent seeking behaviour. The resource use outcomes derived through the political process can be more about securing the votes of vested interest groups than achieving efficiency.

Third, the transaction costs associated with dealing with free-rider behaviour may not always be so large as to negate gains from trade in water for the non-excludable uses. This can occur because of ultruism or philanthropy, motivations that are independent of free-rider response. It may also occur because of the joint production of excludable

and non-excludable water-derived benefits. Technological advances may also make inroads into transaction costs. New and cost-effective ways to exclude users may be developed.

These issues have been explored in this paper from two angles. First the use of non-market valuation techniques to estimate the benefits arising from environmental flows was considered. It was shown that whilst some such studies have been undertaken they have not as yet seen wide application in the regulatory policy process of setting environmental flow levels. This provides some evidence of the high transaction costs associated with government regulatory behaviour but also may indicate the presence of rent seeking in that decision making process.

The second angle involved the analysis of PSCEs in Australia. These organizations have made a significant contribution to the conservation of land-based ecosystems in Australia and this evidence supports the hypothesis that similar efforts to protect water-based ecosystems would also be successful once water markets become better established and more widely recognised as vehicles by which nature conservation benefits may be secured.

Hence two key conclusions are that government regulatory processes to determine and implement environmental flows are both costly and incentive incompatible and that PSCEs do hold some promise as environmental flow suppliers. Does this inevitably lead to the conclusion that governments should simply exploit their economies of scale in defining and defending water rights and leave individual, corporate and group interests to determine allocations through trade? Certainly under such a scenario, there would be no need for non-market valuation studies as the market would be the venue whereby entities revealed their values. And the prospects of rent-seeking behaviour would be minimised.

However, it is dubious to think that free-riding would not emerge, at least to some degree, given the degree of non-excludability associated with benefits such as existence demand. Similarly, equity issues – especially those associated with intergenerational equity and the prospect of irreversible outcomes such as species extinction arising from the actions of the current generation – are unlikely to be incorporated in purely market-based processes.

One option that could be seen as a potential middle ground between markets and regulation is for a staged approach to the allocation of water to environmental flows. In the first stage, governments – using scientific research and non-market valuation techniques as guides – determine what could be described as ‘safe minimum standards’ (Bishop 1978) of environmental flows. These would be set to ensure the avoidance of irreversible environmental outcomes as well as to reflect the base levels of benefits the current generation enjoys from river ecosystems. Once announced, these levels would be held immune from political manipulation. That would send the signal to those who value environmental flows more highly that the only way they will see more supplied is through their individual or group actions in water markets. Hence, governments could not “crowd-out” the endeavours of PSCEs nor could individuals hope for a return from lobbying governments for a change in the level of flows. Furthermore, governments may use PSCEs as management agents for environmental flows. This would involve PSCEs competing to be allocated the

environmental flows mandated by government. Under contracts specifying the environmental goals to be achieved, PSCEs could manage the water under their control to achieve those environmental goals and perhaps more. For instance, allocated environmental flow volumes could be sold in water markets at times of greater scarcity (summer) and bought in winter when they would be both less expensive and more environmental advantageous. In other words, seasonal marginal value difference between extractive and non-consumptive uses of water could be exploited to achieve gains from trade for all parties and profits for the contracting PSCE that could be used to pursue further environmental improvements.

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