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Response to a position paper 'Sustainable Options for an Urban Water Supply' by Professor Nancy Millis for the Joint Academies' Committee on Sustainability

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Background

Professor Nancy Millis deals with an urban water supply (Melbourne) as a specific case study of integrated sustainability assessment. The paper details the methodology by which a preferred series of options for saving water were developed through interaction of a government appointed Strategy Committee and a series of Technical Groups with wide representation. 'Clear terms of reference ensured that the opinion and concerns of the general community and others were widely sought and considered' against a backdrop of an increasing population by about a third in the next 50 years.

Modelling interacting factors

Models for integration
Contribution from a range of disciplines (note 1) is required to predict and manage changes in water supply and demand. The need to integrate different kinds of knowledge – expert, local and indigenous – has also been espoused and specialist knowledge brokers have been appointed to act as translators in at least two Co-operative Research Centres. Also, especially in the urban water sector, many believe that more business and commercial expertise is needed to underpin investment in innovation and provide better customer services. Public-private partnerships and consultants are already well-established in the urban water sector, but entry of the private sector into urban water and sewerage monopolies is recent and untested (eg Services Sydney is currently mounting a challenge to Sydney Water's monopoly on sewerage through the National Competition Council). Acess to venture capital, role of taxation, and pricing for cost recovery been poorly integrated so far. Further information is provided in a recent book on Water Innovation (Bowmer, 2004).

The process described as 'socioeconomic integration' has evolved to cover interdisciplinary approaches to natural resource management for sustainability, and much has been written on the topic and on participatory approaches to decision-making (eg Hajkowitz et al., 2000; Dale et al., 2001; Aitken, 2001; Buchy and Proctor, 2001; Venning and Higgins, 2001; Syme and Nancarrow, 2002; Bell and Morse, 2003).

Models for integration have been reviewed recently by Kington (2003). She describes four integration frameworks developed by Rossini and Porter (1979): common group learning through intensive group interaction, modelling, negotiation amongst experts, and integration by a leader. In the Melbourne case study elements of all the models have been used, as reflected in the process of public participation and principles underpinning the Committee's best judgement. These include, for example, 'cost effective outcomes, acceptance of environmental groups and adoption of best practice'. The case study provides clear targets for water savings using a range of methods. However, from the material presented, it is not clear exactly how the various interests and disciplinary inputs were pulled together to make the expert judgment or how projected population increases might impact more generally on water cycle management, especially on disposal or recycling of increased volumes of stormwater and sewage.

B*enefits, costs and pricing*
Integrating information from a range of different disciplines and values is a great challenge. One approach is to try to map into one domain and to assign economic and surrogate economic values to ecological and social phenomena – the discipline of ecological economics. Attempts are currently underway to articulate the benefits or costs of particular allocations and uses of available water (CSIRO, 2004a; O'Connell *et al*., in press) and to take a more holistic account of benefits that includes measures of human, manufacturing and natural capital (Harris *et al*., 2003).

Systems approach
In general a systems approach is recommended (Clayton and Radcliffe, 1997) to provide a formal mechanism for integrating across disciplines and knowledge bases, and to incorporate uncertainty. A systems approach places as much emphasis on connections between options as on the options themselves. Clayton and Radcliffe advocate a technique of positional analysis and sustainability assessment maps to present and predict change in 'non-equivalent dimensions'. The method is described as a reasonable compromise between transparent and accessible decision-making and more informed and focussed decisions.

A systems approach could be used to embed the Melbourne case study in a wider context of sustainability. For example a recent review of sustainable societies in Australia (Goldie *et al*., 2004) lists as critical issues, together with water resources: human health, land use, energy, equity, climate change, labour forces and work, urban design and transport, and population growth.

Decision support systems (see later) might also have been used to test and record the assumptions and rigour of the information base, to provide a bigger range of options, and to avoid unintended consequences through too tight a focus.

Evaluating outcomes against disparate values

With few exceptions (eg Sydney Water; Seebohm, 2001) it seems that participatory processes and shared decision-making are new in the urban water industry and the Melbourne Strategy Committee are to be applauded on their initiative. A cross-check against a recent toolkit for community involvement (Aslin and Brown, 2004) shows that most of the available techniques were used in the case study. However, additional information on stakeholder analysis and social profiling may have identified groups with needs and values. It is not clear how these were traded off in the final expert judgment, to what extent stakeholders are satisfied with the outcome, and how adaptive management will be practiced.

Also it is noted that advocacy for the environment will be a critical component in developing options. Plans for water sharing, priority allocation to environmental needs, access to stormwater run-off for maintenance of river flow, and need to reduce marine pollution seem to be gaps in the case study. In Sydney the combination of drought and water recycling has resulted in the clogging of the Hawkesbury River with Salvinia, the lesson being that depriving a river of runoff through over-zealous reuse of stormwater could be unsustainable. Also recent plans to explore desalination as a new water source has highlighted public preference to source new water through recycling, reducing current reliance on ocean outfalls as well as avoiding increased needs for energy (Lane, 2004; Fullerton, 2004). This debate highlights the need to consider environmental flows and pollution mitigation in developing new water management options.

Developing policy strategies

Covering a full range of options
Decision support and predictive tools that can cover the full range of options will be required for developing integrated policy strategies. For example the Environmental Management Support system (EMSS) has been used successfully in SE Queensland Healthy Waterways Program and MUSIC software is available form the CRC for Catchment Hydrology to manage stormwater.

A suite of programs are available from the Urban Waterscapes program (CSIRO, 2004b). *Water Smart City Planne*r is a spatially-explicit integrated modelling system with decision support capabilities that can accommodate climate change, land use development patterns, and population growth. *Water Smart Communities* will consider alterations in water services to defray the enormous costs of replacing aging and overloaded infrastructure. Options considered include small scale decentralised urban catchment management and local reuse and disposal (an approach also advocated by Fox, 2003). *Water Smart Communities – New Urban Cultures*

will replace evaluation of water services and supply systems on an issue-by-issue basis, with a holistic approach that incorporates customers' values and lifestyles. *Wealth from Water* will examine interdependencies between material flows, water, energy, wastes, transport and other factors. This bigger picture view of urban water and waste management should soon be available to enrich and extend the case study presented for Melbourne, as well as being applied to other cities.

Adaptive management

Scenario testing and adaptive management will be critical in developing policy since many of the assumptions about water supply and demand may change. Challenges include:

- Variations in supply caused by climate change and variability
- Increased stormwater run-off as population density and spread increases
- Costs of aging and overloaded infrastructure
- Uncertainties associated with effect of pricing review on behaviour
- Prospects for removal of institutional monopolies: for example, development of a co-operatively owned network of nested sub catchments (Fox 2003)
- Emergence and adoption of new technologies, such as desalination and aquifer storage recovery
- Uncertainties about population change (see below and Table 1).

Dovers (2001) provides a list of twenty four methods and techniques for informing policy in the face of uncertainty, many of which are employed in the Melbourne case study, but including also alternative discussion methods such as citizen's juries, use of non-market valuation, formalised strategic risk assessment and explicit adaptive management frameworks. Dovers lists fourteen attributes of adaptive institutions. He also raises the critical issue of evaluation of policy and performance including the need to demonstrate links across sectors, portfolios and jurisdictions and to provide independent assessments. Auditors General, and the Productivity Commission are suggested. (Note in New South Wales the separation of the regulator, the Department of Planning Infrastructure and Natural Resources from the operator, State Water, and the role of the Independent Pricing and Review Tribunal in setting water pricing and reviewing the customer service charter; and in Queensland the independence of the water supply agency, Sunwater, from the water manager, Queensland Department of Natural Resources and Mines). The Melbourne urban case study does not extend into describing the institutional arrangements for implementation and review of policy.

Compensation for population increase

Population increase of one third by year 2050 is assumed in the Melbourne case study –see introductory comments. The recommended demand reduction measures will save 88GL pa by year 2050, equivalent to 13-14% of current use (note 23% claimed), so that even with a possible increase in supply of 21 GL the recommended measures cannot compensate sufficiently. Vastly different population trajectories are projected by Franz and Poldy for Melbourne (Table1 of attachment). It seems that substantial further measures will be required if sustainability is to be achieved.

Assessment in a larger social context

Urban and rural relativities

This case study on water deals specifically with Melbourne supply and demand so it is interesting to note that the COAG Water Reform Framework and more recent National Water Initiative principles have been applied differently in other jurisdictions and in rural situations. For example, a hierarchy of rights to water access is described in NSW Water Sharing Plans. Basic rights and town supplies have priority over irrigation users, and urban authorities can trade water. The concept of priority uses and shares of the available resource would be different approach to the one used in the case study. Trading between municipalities or industries, and (where geography and infrastructure permits) between rural and urban use, are possibilities that could be considered in the future.

Pricing reform

Paul Perkins, Chairman of the Barton Group recently commented in the press (Lane, 2004) that 'Putting a price on water …will be vital. We haven't applied value to urban water yet. A farmer that saves water will be rewarded under the system that puts a cap on water and allows its trade. We have no mechanism for doing that in the city'. Other prospects include tiered pricing to penalise higher volume users, pricing adjusted to scarcity and differential charging for water of different sources and quality. A series of discussion papers have been prepared recently for the Queensland Department of Natural Resources and Mines covering water management charges (ACIL Tasman, 2004), addressing externalities through water charges (Newby *et al.,* undated) and addressing water scarcity with charges (CIE, 2004).

Pricing, an important lever in behavioural change, is treated in the Melbourne case study (Table 1) as a separate item representing a substantial saving (10GL). Presumably this estimate is contingent on the adoption of all of the other levers, and is additional to the other items. It would be interesting to see the justification for this approach

Benchmarking

Benchmarking is covered by 'adoption of best practice' in the Melbourne case study though no details are given. An international benchmarking network for over a thousand water and sanitation utilities has been developed recently that could provide useful insights into suitable performance data and choice of benchmarking partners (Ramsey, 2004). A recent report on water recycling in Australia (Radcliffe 2004) gives comparative figures on recycling from sewage treatment plants and targets for the use of recycled water or reduced overall water use (Table 2). The report comments on the wide range of costs applied to drinking water and recycled water in different jurisdictions. Best practice case studies are given in Perkins and McRae (2004) and the Australian Water Industry Roadmapping project for delivery of water and wastewater services (Barton group, 2004). Dillon and Ellis (2004), in a review for the Australian Water Conservation and Reuse Research Program, claim that through a range of means including re-use of rainwater and stormwater, Australian cities draw on catchments could be halved in Australian cities (compared with 13% in the Melbourne case study).

A broader perspective

Cullen (2004) has recently reported on options and challenges for water use in South Australia which include protecting existing sources of water through attention to catchment management, reducing demand, and developing alternative sources of water. In other states urban planning is providing headlines as the States struggle with the increasing demands on infrastructure in urban and coastal areas. For example 'Queensland will lock up development in the Gold and Sunshine Coasts and push west most of the one million migrants it expects over the next two decades' (Roberts and Koch, 2004). In New South Wales the Department of Infrastructure Planning and Natural Resources (2004) has announced Metropolitan and Far North Coast Strategies that will guide land use and infrastructure development over the next 30 years. These approaches to policy and planning give a broader perspective than outlined in the Melbourne case study, which is highly focussed on reducing demand for water.

Summary

The case study on sustainable options for an urban water supply provides a clear focus on options for reducing demand. The process used has clearly raised public awareness and the author, her Strategy Committee and Technical Groups deserve congratulation for pioneering the process of public participation and stakeholder consultation in Melbourne. The response here is intended to flag some of the issues that could be considered so that options for reducing water demand can be included in a more holistic sustainability strategy.

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Additional information

Note 1. Disciplines required include: meteorology and physics for climate variability and change; catchment and groundwater hydrology; aquatic ecology; demography; civil and chemical engineering; economics; social research for design of effective stakeholder participation in decision-making and effective institutional processes; urban planning; psychology especially for understanding individual behaviour and concepts of fairness and risk; education; communication; philosophy; information technology including visualisation and data management; software engineering, eg to design decision support systems; predictive modelling; statistics and law.

Table 1. Population trajectories for Melbourne (millions of people) on assumptions about immigration into Australia (Foran and Poldy 2001)

The importance of population as a driver in water policy is demonstrated by trajectories of people living in capital cities calculated from three levels of net immigration combined with declining fertility rates and increasing longevity. Projections range from a population decline after about 2021 to a several fold increase by 2101.

Net immigration level	Melbourne population in millions		
Absolute numbers pa to Australia	1998 ABS data	2051	2101
Zero	3.371	3.274	2.589
70 000		4.290	4.269
0.67% of population		5.982	9.350

Table 2. Recycled water use in State capitals (2001-2) as a percentage of sewage treatment plant effluent; and targets for recycling or for reduction in overall use (Radcliffe, 2004)

City	Recycled %	Targets
Adelaide	11.1	
Brisbane	6.0	
Perth	3.3	Recycle 20% of wastewater by 2012
Sydney	2.3	Reduce per capita use by 35%
Melbourne	2.0	20% recycling by 2010[1]
Hobart	0.1	
Canberra		20% recycling by 2013

[1] Water use per head to reduce from 380 to 327 L /day by 2050 equivalent to a reduction of 14%, compared with an aimed reduction of 23% (this case study; Millis 2004).