THE USES OF RECYCLED WATER

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Summary

There is a continuing increase of population in many countries leading to a need for additional water and food supplies. The likely impact of global warming influencing the availability of water from surface catchments and groundwater supplies is being increasingly recognized. The use of water recycling programs is being considered in many communities as a response to increasing pressure on the availability of existing water resources. The adoption of recycled water for irrigation of crops for food production, improved amenities in expanding urban areas, for supplementing domestic water supplies for non human contact uses, the scope for introducing recycled water back into drinking water supplies, for use in industry, for returns to the environment in place up up-stream water consumption and the economics of these options is discussed. Emphasis is given to the particular importance of not cross-linking recycled water systems with drinking water systems where the recycled water does not meet drinking water standards. A list of issues is given of matters that should be considered when potential uses of recycled water are being considered.

1. Introduction

There is rising recognition that many of the world's existing water resources, especially in urban areas, are coming under increased demand pressure. There are a wide range of potential uses for recycled water, the actual use being a function of the standard to which the water has been reclaimed. In practice, the treatment is usually oriented to a commonly acceptable standard, but industrial users may be encouraged to further treat the water at the point of receipt to meet their own particular needs.

The breadth of uses at different treatment levels can be illustrated from experience derived in California where water reclamation and reuse has been practiced for more than 50 years. A range of uses drawn from that experience is given in table 1. The majority of water reuse was in agricultural irrigation (63 %) followed by landscape irrigation (13 %). Groundwater recharge has been about 14 %, but is increasing.

Types of Use	***Treatment level***		
	Disinfected Tertiary	**Disinfected Secondary**	**Undisinfected Secondary**
Urban uses and Landscape Irrigation			
Fire protection	√		
Toilet & Urinal flushing	√		
Irrigation of Parks, Schoolyards, Residential Landscaping	√		
Irrigation of cemeteries, Highway landscaping		√	
Irrigation of Nurseries		√	
Landscape impoundment	√	√*	
Agricultural Irrigation			
Pasture for milking animals		√	
Fodder and Fibre Crops			√
Orchards (no contact between fruit and recycled water)			√
Vineyards (no contact between fruit and recycled water)	√		√
Non food-bearing trees			√
Food crops eaten after processing		√	
Food crops eaten raw	√		
Commercial and Industrial uses			
Cooling & Air Conditioning with cooling towers	√	√*	
Structural fire-fighting	√		
Commercial Car Washes	√		
Commercial Laundries	√		
Artificial Snow Making	√		
Soil Compaction, Concrete Mixing		√	
Environmental and other uses			
Recreational Pools with Body contact (Swimming)	√		
Wildlife Habitat - Wetland		√	
Aquaculture	√	√*	
Groundwater Recharge			
Seawater Intrusion Barrier	√*		
Replenishment of potable aquifers	√*		
** Restrictions may apply*			

Table 1. Examples of Recycled water uses and the minimum treatment levels required to protect public health (Radcliffe 2004).

1.1. Piping Systems

Where the recycled water is being supplied through a pipeline system to users, such as for urban domestic, commercial and industrial use in locations which also have a reticulated potable water, the recycled supply system may be described as a component of a dual reticulation system or a third pipe system. Customarily, and in many cases by legislative obligation, recycled water is transmitted in purple or lilac colored pipes to differentiate them from pipes carrying drinking (potable) water.

1.2. Treatment systems

A conventional framework for water recycling treatment and resultant potential uses usually encompasses a collection system, primary treatment, secondary treatment and where appropriate, tertiary or advanced treatment involving chemical coagulation, filtering options and disinfection.

Primary treatment involves sedimentation and removal of coarse particles. Recycling of this product is not recommended.

Secondary treatment uses biological oxidation which may be achieved in engineered or managed wetland environments. The product can be used without disinfection for non-food crops and other uses where there is control to exclude human access and minimized aerosol production. However, a disinfected product is to be preferred, especially where used for surface irrigation of food crops, public lakes and reserves with limited access, groundwater recharge of aquifers, reconstituted environmental wetland habitats, stream augmentation and industrial cooling processes.

Tertiary or advanced treatment involving chemical coagulation and filtration, now usually by use of membrane technology, followed by disinfection and in some cases advanced oxidation. This results in a product suitable for amenity, landscape and golf course irrigation, toilet flushing, vehicle washing, laundry use, food crop irrigation and water bodies with unrestricted access. With advanced oxidation included, indirect potable use via groundwater recharge of a potable aquifer and by augmentation of surface reservoirs can be considered.

However, care must be taken to ensure that specific proposals will meet the regulatory requirements of local jurisdictions.

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Bibliography and Suggestions for further study

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EPHC (2009). Australian Guidelines for Water Recycling. Environment Protection and Heritage Council, the National Health and Medical Research Council and the Natural Resource Management Ministerial Council. http://www.ephc.gov.au/taxonomy/term/39 (accessed July 29 2009) [These HACCP-based guidelines consider the use of recycled water for environmental use, for augmentation of drinking water supplies, for the use of managed aquifer recharge and the use of recycled storm water.]

US EPA (2009). Water Recycling and Reuse: The Environmental Benefits http://www.epa.gov/region09/water/recycling/ (accessed 1 February 2010) [This website provides a succinct summary of the benefits of using recycling water.]

Biographical Sketch

Dr John Radcliffe AM PhD FTSE FAIAST FASP is an Honorary Research Fellow in CSIRO Australia. He is a member of the Council of the University of Adelaide and the Science Advisory Committee of Earthwatch Australia. He was a Commissioner of Australia's National Water Commission 2005-2008

Dr Radcliffe is a Fellow of the Australian Academy of Technological Sciences and Engineering and in 2004, wrote the review "Water Recycling in Australia" for the Academy.

Until retirement in 1999, Dr Radcliffe was a Deputy Chief Executive of CSIRO. Previously, he was Director-General of Agriculture in South Australia from 1985 to 1992, during which time he was Murray Darling Basin Commissioner.

He has an agricultural science degree from the University of Adelaide and a PhD from Oregon State University.