Considering Location, Compliance, and Storage in Decisions on Brackish Water Resource Development

Andrea M. Traviglia[1] and Gregory W. Characklis[2]

Abstract: In the past, brackish water resources have often been dismissed due to concerns over the cost gap between desalination and conventional treatment, but this simple comparison neglects several important factors that should be considered when making water supply development choices. Although desalination is more expensive than conventional treatment, the costs of delivering potable water are also linked to source location (relative to users) and steps needed to maintain regulatory compliance and supply reliability, factors largely unexplored in previous cost comparisons. This work describes an approach to more comprehensively evaluate the costs of developing and using brackish surface water and groundwater resources, then compares these to similar costs for freshwater supplies. Freshwater and brackish water supplies are compared in terms of the "total cost of supply and treatment," which includes the costs of raw water acquisition, storage, conveyance, treatment, and residuals disposal. Results show that brackish resources become economically competitive under a wide range of circumstances when these other cost factors are considered. This is especially true for smaller systems, and economies of scale can play an important role in determining the circumstances under which a brackish resource is economically preferred. Results are most sensitive to variation in the capital costs of membranes and conventional treatment, as well as the recovery rate of desalination processes.

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Introduction

Population growth, economic development, and society's growing environmental awareness, combined with a dwindling availability of new supplies, have increased water scarcity in many regions (NRC 2001; USGS 2002). Brackish water resources have considerable potential for helping some communities meet future demand, as they are often undeveloped or underutilized (USBR 2003). In the past, brackish supplies have often been dismissed due to concerns over the cost gap between desalination and conventional treatment, but this simple comparison neglects important factors that can compensate for treatment cost differences. Among these are costs for raw water acquisition and conveyance, residuals disposal (e.g., sludge, concentrate), and maintenance of supply reliability. Even when comparing treatment expenses alone, doing so without consideration of source water quality (and its implications for regulatory compliance) can lead to less representative cost estimates.

While desalination is more expensive than standard conventional treatment, many conventional facilities are unable to meet current or pending regulatory standards without the addition of expensive ancillary processes (e.g., alternative disinfectants, activated carbon) (Pontius 1999; Clark et al. 1994). These process additions can reduce the cost gap between conventional and desalination, particularly if desalination is accomplished via membranes, which are capable of meeting virtually all existing standards without any additions (USBR 2003). Raw water acquisition and conveyance can also play a large role in supply costs as scarcity has forced many communities to search farther afield for undeveloped freshwater resources (NRC 2001). The costs of building and operating conveyance infrastructure can be quite high and brackish sources, which have often been passed over in favor of higher-quality supplies, may be closer than untapped freshwater supplies in many regions. In addition, freshwater sources in water-scarce areas are typically subject to greater competition and must therefore be managed (e.g., reservoirs) in order to maintain high levels of supply reliability, imposing additional costs relative to underdeveloped brackish resources.

Few comparative analyses of desalination and conventional treatment costs exist in the literature. The objective of this work is to more comprehensively compare the costs of developing brackish water and freshwater resources by including not only treatment costs, but also costs associated with acquiring raw water, maintaining compliance, and ensuring supply reliability. In so doing, this investigation provides some general insights into the relative magnitude of costs in these areas and their potential to affect water supply decisions.

[1]Project Engineer, Malcolm Pirnie, Inc., 2170 Highland Ave., Suite 250, Birmingham, AL 35205. E-mail: atraviglia@pirnie.com

[2]Assistant Professor, Dept. of Environmental Sciences and Engineering, School of Public Health, Rosenau Hall-CB7431, Univ. of North Carolina, Chapel Hill, NC 27599-7431 (corresponding author). E-mail: charack@email.unc.edu

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