Project Number
WRF-04-001
USBR AGREEMENT: #00-FC-81-0248

Sustainable Underground Storage of Recoverable Water

Principal Investigator:
Will Logan, *National Academy of Sciences*

Sponsors
Awwa Research Foundation
WateReuse Foundation
U.S. Geological Survey
CALFED Bay-Delta Program
California Department of Water Resources, Conjunctive Water Management Branch
City of Phoenix
Inland Empire Utilities Agency
Sanitation Districts of Los Angeles County
Chino Basin Watermaster
NRC President's Committee of the National Academies.

Document Title: Prospects for Managed Underground Storage of Recoverable Water

Objective:
The study provides an overview of some of the research and education needs and priorities concerning sustainable underground storage technology and implementation, assessing geological, geochemical, biological, engineering, and institutional factors that may affect the performance of such projects.

Overall Conclusions:
The challenges to sustaining present and future water supplies are great and growing. The present overdrafting of aquifers and overallocation of rivers in many regions is a clear indication of these challenges, but the former also creates in many cases the underground storage potential needed to accommodate managed underground storage (MUS) systems. Thus, demand for water management tools such as MUS is likely to continue to grow.

Some simple forms of MUS have been used for millennia, and even the most recent development–aquifer storage and recovery–now has about four decades of history behind it. These systems use water from a variety of sources such as surface water, groundwater, treated effluent, and occasionally stormwater. They recharge groundwater through recharge basins, vadose zone wells, and direct recharge wells. The water is stored in a wide spectrum of confined and unconfined aquifer types, from unconsolidated alluvial deposits to limestones and fractured volcanic rocks. Recovery typically is achieved through either extraction wells or dual-purpose recharge and recovery wells, but occasionally is achieved via natural discharge of the water to surface waterbodies. Finally, the recovered water is used for drinking water, irrigation, industrial cooling, and environmental and other purposes. There is, therefore, adequate experience from which to draw some general conclusions about the degree to which MUS systems are successful in meeting their stated goals and the challenges and difficulties that some of them face.

Although failures have occurred and the potential for contaminating groundwater is a considerable risk, most MUS systems have successfully achieved their stated purposes. In fact, there are MUS systems that have functioned without major problems for decades. However, increasing efforts to
use karst and fractured aquifers for storage will increase the potential for failures. Chemical reactivity of the aquifer in the former case and uncertainty over flow paths in either case are much greater and the treatment potential is lower compared to alluvial aquifers. Learning from past positive and negative performance will help guide development of the many new MUS systems that are under consideration.

In the future, multiple strategies are likely to be needed to manage water supplies and meet demands for water in the face of scarcity. Various water conservation and management strategies, including transfers and water recycling, can be used to stretch available water supplies. However, each of these has its rate of delivery limits. Water storage facilities will continue to be an essential component of water management, particularly in areas where water availability varies greatly over seasons or years, such as the arid Southwest. Integrated strategies will be needed in which all measures for improving water quality and managing water scarcity are considered

and, if appropriate, employed in a balanced, systematic fashion. Seasonal to multi-year storage of water will often be a necessary component of such strategies.

Recommendations:
Given the growing complexity of the nation's water management challenges, and the generally successful track record of managed underground storage in a variety of forms and environments, MUS should be seriously considered as a tool in a water manager's arsenal

In anticipating, planning for, and developing MUS projects, water managers should consider them in a watershed and regionally based context and as part of the overall water management strategies.