American Water Resources Association
2017 International Conference: Cutting-Edge Solutions to Wicked Water Problems
September 10-11, 2017
Tel Aviv University, Tel Aviv, Israel

Monday, Sept. 11
13:30 – 15:00
SESSION 10: Water Banking, Recharge, and Reuse

Arizona Water Banking Authority - Its impact in Supplementing Water Supplies in Arizona - Mark Taylor, Westland Resources, Tucson, AZ, USA

The Arizona Water Banking Authority (AWBA), a regulatory agency authorized to store Colorado River Water within the regional groundwater aquifers of Central Arizona for future use, was established in 1996 to address the ongoing water resource issues of Arizona. Among many of these, the AWBA set out to address continued groundwater depletion in the central valleys of Arizona, to provide solutions to past underuse of the CAP system, to challenge California's excess use of the Colorado River and to secure Arizona's allocation of Colorado River Water. The AWBA brings into the State wet water thereby recharging the aquifers, firming M&I and Indian water for future shortages, and providing good water management for the State of Arizona. Success on the part of the AWBA is defined by having a well-planned regulatory structure in place which has the authority to enforce, monitor and provide an open market for storage credits, and a methodology for recovery of the water when needed for all regions within Arizona as well as neighboring States, and to store wet water for credits with the ability to use these water credits from the river in the future when needed--a win-win for all involved. The current challenge is how do we get the water back out of the aquifer when needed, where needed, in the proper quantities, and quality, and at an affordable cost. Arizona having an important asset such as the CAP canal system, can now through the recently approved 'System Use Agreement', provide wheeling of non-project water, water exchanges between stakeholders, and recover stored water for firming existing water providers. Arizona has overcome many problems in the past through innovation and corporation. But problems still exist which need to be resolved. These include regulating water quality of the recovered water, determining excess capacity of the canal system and developing methodologies of allocating cost between benefiting partners. These too will be solved by using ingenuity and collaboration between the partners.

Effective Water Banking--The Kern County Experience - Richard Luthy, Stanford University, Stanford, CA, USA (co-authors: C. M. Stip, S.R. Dahan, R. Abdulnour)

Water banking operations in Kern County, California are hailed as the most effective groundwater storage program in the United States, and probably the whole world. Groundwater banking in California is essential as a means of coping with ever-increasing dry spells and declining winter snowpack as a result of climate change. This presentation will discuss the Kern County operations, finance, and future directions, and will conclude by discussing the replicability of this experience for other water scarce areas. Located at the southern end of the San Joaquin Valley, the Kern area is conveniently situated in terms of geology and proximity to water supply and delivery systems. The California Aqueduct (State Water Project) is on the west, the Friant-Kern Canal (Central Valley Project) and Kern River on the east, and a Cross Valley Canal links these units. The groundwater basin in Kern County is closed, meaning no

loss to surface waters once water is placed in the ground. Extensive groundwater pumping in the last century depleted the unconfined aquifer, creating room for storage. The unconfined aquifer is 50-70% sand with high transmissivity. Recharge is done by surface spreading. Despite the limited impact of previous State policy initiatives, a multi-year drought prompted the State to initiate an emergency water bank in 1991 as an experiment for large-scale water trading. In 1994 the State gave a part of the Kern Fan, where they had unsuccessfully tried to launch a groundwater bank, to local ownership and allowed the transfer of water entitlements from agricultural users to urban entities. Kern County water bank operations grew following agreements with the State on operations and management, water quality criteria, and habitat conservation. Today, the various program elements allow for exchange deliveries with upstream storage transfer via the California Aqueduct as well as for out-of-county, long-term arrangements with southern California entities. The three largest water banks--Arvin-Edison, Kern and Semitropic--have a combined storage capacity of about 3 million acre-ft. Compared to surface reservoirs, water banking capital costs are much lower; also, once the water is recharged there are no evaporative losses. The Irvine Ranch Water District's arrangement with Kern County water district is an example of equity ownership of water banking capacity. Irvine Ranch is also exploring storage on behalf of other cities in return for 50% of the water stored being left for its use. Experience shows the need for local control, as no district wants to give an outsider control of rights in their basin. Also, competition for wet-year supplies between agencies remains an issue given the expansion in groundwater banking and growing restrictions on exports from the Bay Delta in Northern California. As the scale of the operation grows, so do challenges in keeping track of water withdrawals and impacts on adjacent operations during prolonged drought. Such mechanisms can help build future flexibility within strict water rights systems. Developing the rules and principles for improved allocation and demand prioritization through water banking could provide sustainable solutions to water scarcity well beyond California.

Case Study in the Development and Implementation of a Successful Groundwater Management Plan for a Large Groundwater Basin: Chino Basin Optimum Basin Management Program - Mark Wildermuth, Wildermuth Environmental, Lake Forest, CA, USA

The Chino Basin is a large, adjudicated groundwater basin located in southern California. There are about 300 pumpers and annual groundwater production ranges between 150,000 to 200,000 acre-feet per year (AFY). The basin contains about 6 million AF of water in storage and covers about 220 square miles. In 1998, a court order required the Chino Basin Watermaster (Watermaster) to develop an Optimum Basin Management Program (OBMP). Watermaster, given a two-year time period by the Court, convened a facilitated process that was successful in the development of the OBMP. The OBMP is currently being implemented at an ultimate cost of about $800 million. The estimated net present value of benefits achieved by the OBMP exceed one billion dollars. One of the principle goals of the OBMP was to develop the maximum yield of the Chino Basin for the benefit of the basin's producers. This is being accomplished by increasing the recharge of stormwater, dry-weather discharge, recycled water and imported water in the forebay areas of the basin. And by modifying pumping patterns in areas of historic groundwater discharge to: minimize basin outflow, induce more streambed recharge, and protect sensitive riparian habitat and downstream water rights. The OBMP also includes the expansion of conjunctive use involving multiple sources of surface and recycled waters, groundwater and unused storage space in the Chino BasinSince the development of the OBMP, Watermaster and the Inland Empire Utilities Agency (IEUA) constructed or improved 21 groundwater recharge basins and increased recharge by 17,000 AFY. By 2020, they will expand the recharge program another 14,600 AFY. Watermaster, IEUA and basin pumpers constructed 30,000 AFY of new groundwater extraction and desalination facilities that pump groundwater degraded by over 100 years of irrigated agriculture and

dairying with the result of maximizing the basin yield and protecting surface water quality downstream of the basin. Watermaster, IEUA and basin pumpers are in the process of expanding production of the degraded groundwater and treatment facilities to 40,000 AFY by 2018. The basin has about one million AF of unused storage space available for conjunctive use. Within that space, the Watermaster, IEUA and the Metropolitan Water District of Southern California developed a 33,000 AFY dry-year yield program that was subsequently successfully used during the recent historical drought. The basin pumpers have currently stored about 490,000 AF for subsequent periods of below normal imported water supply availability. Watermaster and the basin pumpers are currently developing plans to fully exploit the unused storage space in the basin. This presentation will describe the background and chronology of the OBMP development and implementation, the process used to achieve success, challenges to continuing implementation, and lessons that are transferable to the management of other groundwater basins

Reclaiming Wastewater to Promote Water Resources Resilience - Rafael E. Frias III, Black & Veatch Corp., Coral Springs, FL

The paradigm shift of converting what would normally be considered a waste into a resource through beneficial reuse is a strategy that may be implemented to achieve water supply resilience, while improving the health of our ecosystems. Reclaimed water may be used as an Alternative Water Supply (AWS) to support the following goals:

- Abatement of salt water intrusion to avoid contamination of fresh groundwater with salt water
- Increased groundwater availability and supply
- Localized water quality improvements for impaired groundwater systems
- Elimination of outfalls that discharge nutrient-laden effluent into surface waters (e.g. ocean outfalls) to protect water quality and aquatic habitats
- Limit land subsidence resulting from the overdrafting of aquifer systems
- Minimize the impacts of sea-level rise related to land subsidence (increased flooding) and saltwater intrusion (increased expansion of the salt water front)

Notable examples of reclaimed water schemes that have considered these goals include Orange County Water District's Groundwater Replenishment System in Orange County, California; Western Australia Water Corporation's Groundwater Replenishment Scheme in Perth, Australia; and the upcoming Sustainable Water Initiative for Tomorrow (SWIFT) by Hampton Roads Sanitation District (HRSD) in Virginia Beach, Virginia. This presentation will focus on how the strategy of reclaiming the effluent from wastewater treatment plants may be implemented to achieve multiple benefits during reuse.