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 9: Factors Affecting Optimal Water Use and Wastewater Provision

Do Water Meters Reduce Domestic Consumption? - Chad Staddon, University West of England, Bristol, Bristol, UK

At the present time 40% of UK households nationwide are on water meters and household consumption stands at approximately 150 litres/person/day (lpd), slightly more than Western European averages, but significantly less than North American or Australian levels. Largely out of concern for the long-term effects of climate change on water supply, the UK government is currently trying to build a consensus around the idea of legislating compulsory metering for the nation's 28 million households. However, there is much confusion as to the actual objectives to be served by such a policy, estimated to cost in excess of £3 billion. This paper presents the best available current research on water metering around the world, with a special emphasis on European, North American and Commonwealth comparator nations. In summary, the research suggests that there is little evidence that compulsory universal metering can achieve either the water conservation or social equity goals articulated by the UK government. The author concludes that policymakers need to think much more carefully about metering technologies and the purposes they are intended to serve.

Water Intensity to Support Resilient Army Installations - Elisabeth Jenicek, and **Marc Kodack** US Army Corps of Engineers, Champaign, IL, USA, and Office of the Deputy Assistant Secretary for Environment and Sustainability for the U.S. Army, Washington, DC, USA respectively (co-author: N. Garfinkle)

Water is a critical resource for the US Army's global mission. Insufficient supplies will compromise readiness and mission sustainment, affecting the ability to train and support the force. Incorporation of water availability into the Army's stationing analysis framework is being considered, however, there is insufficient data to determine the critical amount of water required by installations, nor sufficient guidance on how to achieve reductions in water directed to non-essential functions. Impairment or loss of water supplies will cause significant interruptions to mission, and thus increased capability to prioritize demands and secure critical levels of water supplies will support sustainable readiness. These conditions spurred a research effort to develop water use intensity factors for the range of facilities found at installations to answer the following questions: What is the range of water demand for an installation starting with the minimum of supplying mission-critical uses only to supporting all water end uses? How long of an interruption in water supply can be tolerated, using available back-up sources, before mission-critical functions are affected and the level of desired risk is exceeded? How does water demand vary as compared to use factors, such as square footage, population, Soldiers trained, meals served, or patients treated? What is the correlation between water demand and climate zone? Meeting water reduction targets can be especially difficult at installations which are often located in regions characterized by a broad spectrum of conditions that affect water availability, quality, security, cost, and applicability of water-efficient technologies. Installations document water use with data from meters

located at points of water production or purchase. Although US Federal policy requires building-scale energy meters, the Department of Defense establishes criteria for installation of meters based on the cost, not the scarcity, of water. Few water meters are installed and therefore little building or end use demand data is available to determine the water used by individual facility categories. There is also a dearth of information about the amount of water that should be consumed by individual water end uses on an installation. Studies of water demand off-post focus primarily on residential building classes, with little benchmark data available for commercial, industrial, and institutional facility groups. Some buildings in this inventory correspond well to civilian equivalents, e.g., offices and recreational facilities. Other buildings are unique to the military mission, including motor pools and training for chemical and biological protection. There are Army facilities that appear similar to civilian counterparts, but carry unique resource footprints corresponding with their use, e.g., barracks (very different from college dormitories) and family housing (smaller than off-post equivalents, but typically supporting larger families).For Army fixed installations, water supply represents a critical resource for which there is no substitute. Any interruption in supply will result in degraded training, reducing readiness of Soldiers and their equipment, force projection, industrial base disruptions, and reduced quality of life for Soldiers, military families, and civilians. The ability to quantify a minimum sustainable amount of required water for prioritizing allocation is invaluable to sustaining the mission.

Water, Wastewater, and Energy Solutions for Off-grid Bedouin, Palestinian, and Jordanian Communities – Clive Lipchin, Arava Institute for Environmental Studies' Center for Transboundary Water Management

The response to increasing strains on water resources from population growth, globalization, economic growth, urbanization, inequalities of and conflicts over shared transboundary resources, has led to an analysis of the Food-Energy-Water (FEW) Nexus and its role in development approaches for communities. The FEW Nexus concept developed because these life-sustaining sources - food, energy, and water, are inextricably linked and constitute essential human rights. Using this as a framework, a more systematic analysis of interactions between human activities and their environment can be determined, with the purpose of working towards coordinated management on local, national and international levels. Addressing the FEW Nexus in an integrated approach is crucial in conflict zones with shared environmental resources. In arid zones especially, access and management of FEW resources can positively impact community development.

The FEW Nexus analyzes the relationship that these resources have with the economic, social, and political health of communities. In specific regions of the Middle East, the FEW Nexus is used as a conflict mitigation strategy in respect to transboundary environmental management and resource availability. The FEW issues faced by Israel, Palestine and Jordan represent a unique opportunity to develop community-based methods, strategies, technologies, and innovative resource management models to increase community resilience and ensure the sustainability of FEW systems and the agricultural productivity in the region.

The Center for Transboundary Water Management at the Arava Institute for Environmental Studies in Israel is implementing an off grid FEW Nexus approach addressing the need for conflict mitigation relating to transboundary environmental management. The project specifically implements on-site, off-grid solutions for communities lacking access to centralized water, wastewater and energy infrastructure. The project includes greywater treatment and reuse systems; renewable energy, hydroponics micro-systems, and more. Work is being carried out in Palestinian communities in the West Bank, Jordanian farms in the Jordan Valley and Bedouin communities in Israel’s Negev Desert. Lessons

learned in the Middle East can be used in addressing challenges in other arid regions of the world such as Native American communities in Arizona and New Mexico.

Urban Water and Sewage Management: Efficiency Indices and Optimal Size - Nava Haruvy, Netanya Academic College, Netanya, Israel (co-authors: S. Shalhevet, S.Madhala Brick)

In 2001, the Israeli Government introduced the Water and Sewage Corporations Act that called for establishing corporations to take over the local municipalities' water and sewage management roles. Later acts were added to reduce the number of water and sewage corporations and combine neighboring corporations into larger regional ones. Since then, 56 corporations were established, mostly small companies that provide up to ten million cubic meters (supplying approximately 110 thousand consumers). About half of them serve only one municipality. The research goal was to examine advantages to size and estimate the optimal size of the corporation. This method included constructing a database of the corporations; defining indices of corporate efficiency; running regressions to estimate the impact of different factors on corporate efficiency and their optimal size. The database of the water and sewage corporations' characteristics included information from the corporations' financial reports for the years 2007-2013, information about each local municipality, and results of wastewater treatment tests. The indices included financial, economic, environmental and social measures. The financial measures included gross profit, administrative and general costs, investments, working capital and long-term obligations, all calculated as a ratio of the corporations' income. The economic measure was a production productivity index that presented the percentage of change in physical production relative to the percentage of change in production costs. The environmental measure was an index of wastewater treatment quality, and the social measure was the water depreciation as a percentage of the water quality. The results of regression analysis pointed to several factors that have an impact on the corporations' profitability as a ratio of its income: *Age: Profitability increases over time, especially in the first few years of the corporation.*Income: The profitability increases logarithmically with income or population size, especially for smaller corporations.*Number of municipalities: Profitability decreases with the increase in the number of municipalities served.*Socio-economic level: Profitability is higher for corporations serving either low or high socio-economic populations, relative to medium socio-economic ones.*Compactness: Profitability is higher in more compact municipalities.*Peripherality: Profitability is higher in the centrally located municipalities.*Height: Profitability is lower in municipalities that have a higher point of maximum altitude. *Ownership of a sewage treatment plant: Independent ownership of a plant contributes to profits, but only for large corporations. The results showed that initially the operating costs per cubic meter of water or sewage decrease with the increase in their quantity. This benefit of increased size is especially prominent for the relatively smaller corporations. However, this is only true up to a point, from which the operation costs per cubic meter begin to increase. The conclusion is that there are advantages to size up to an optimal size, and disadvantages to size above that point. The optimal size for water supply is about 35 million cubic meters/year, serving about 387 thousand consumers. The optimal size for sewage treatment is about 40 million cubic meters/year, serving about 445 thousand consumers.