Marana Pilot Project

By Eve Halper and Eric Holler, Tucson Field Office

A research update conference was held in Marana on October 22nd. The purpose for the conference was to share information on desalination research taking place in Arizona. Researchers presented the results of innovative techniques aimed at lowering the cost of Reverse Osmosis and mitigating its environmental impacts at the Marana pilot, including a visit to the working pilot. Tom Poulson shared what's going on in Phoenix as a part of the Central Arizona Salinity Study (CASS) and presentations on proposed future research as well as sustainable strategies.

The audience included Curt Brown, Director of Reclamation's Science and Technology Grant Program, Chuck Moody, a Reclamation water treatment expert, PXAO Area Manager Carol Erwin, Mike Norris and Angela Adams from Reclamation's Water Quality Improvement Center in Yuma, Kathy Jacobs from the Arizona Water Institute, Sharon Megdal from the Water Resources Research Center, and Leslie Tolbert, Vice President for Research at the University of Arizona. The event was organized by Eric Holler, Program Manager in PXAO's Tucson Field Office, with assistance from the Town of Marana.

The pilot also tested whether the RO waste stream, or concentrate, could be used to grow salt-tolerant plants.

CAP (Colorado River) water is a crucial resource for Central and Southern Arizona, but it is far saltier than the native groundwater used by most residents. These salts, also known as "Total Dissolved Solids" or TDS, shorten the lives of appliances, increase the need for detergent and impair the taste of drinking water. They also make it difficult to reclaim and reuse wastewater.

Entrance to Marana Pilot Project

Water providers in the Northwest Tucson area are considering treating CAP water with reverse osmosis (RO) to reduce TDS, but they face several obstacles, including high costs and environmental impacts. To address these challenges, Reclamation put together a collaborative research project, the "Marana Pilot Project", partnering with the several local water providers and the University of Arizona. On October 22, 2008, staff from Arizona utilities, state agencies and consulting firms, as well as several Reclamation offices, met to visit and learn about this unique project.

Before CAP water can be treated with RO, suspended particles and organic matter must be removed. Typically this is done with chemicals, which can introduce unwanted by-products, or with expensive filtration processes. Pre-treatment is a considerable part of the total cost of RO.

Managing the "waste" stream from RO is even costlier than pre-treatment. About 85% of the incoming water leaves reverse osmosis with very low TDS, but the remaining 15% is left with a salt concentration 1/10th that of seawater. Managing this "concentrate" is difficult and expensive, especially where ocean disposal is not available. In inland areas, concentrate is often put into evaporation ponds, taking up large amounts of land and posing hazards to wildlife.


Evaporation Ponds

The Marana Pilot Project is testing slowsand filtration as an inexpensive pre-treatment for RO. Slowsand filtration, a simple process, has been used since the 19th century to treat drinking water, but has only recently been tested as an RO pre-treatment. A slowsand filter consists of a tank containing a fine sand on top of a layer of gravel. Raw water flows in from the top and percolates by gravity through the sand. Organic material is removed by a biological layer called the "schmutzdecke", which forms at the top of the sand layer. When the now clean water reaches the bottom of the filter, it is collected through a drain consisting of a perforated pipe under the gravel.

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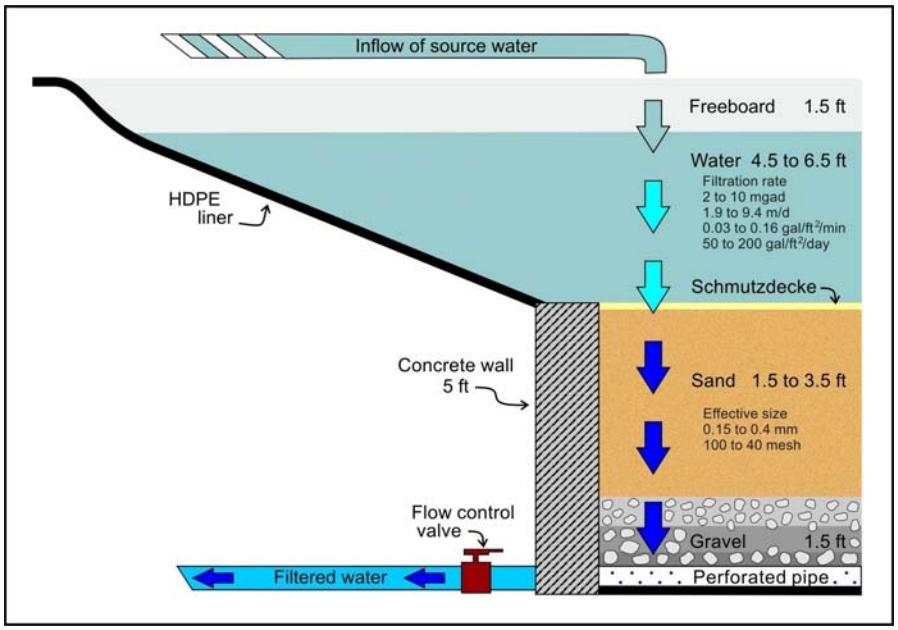

Slowsand Filtration Diagram

Slowsand filter after draining water

Slowsand filter after being filled up

Because slowsand filtration requires no expensive chemicals and little energy, it is much cheaper than conventional chemical treatment or micro/ultrafiltration. The quality of the water produced by the Marana slowsand filters, the first large-scale pilot to treat CAP water, has been sufficient to be used for RO pre-treatment, at a significantly lower cost.

To address the problem of concentrate management, University of Arizona scientists suggested a cheaper and more sustainable strategy: growing salt-tolerant plants, or halophytes. Besides being aesthetically unpleasing, evaporation ponds expose wildlife to the high levels of selenium in the concentrate. Some halophytes also have commercial uses, for instance as animal feed. Two types of halophytes: Atriplex lentiformis (Four-wing saltbush), and Paspallium, a turfgrass, were tested to see if they would thrive when irrigated with RO concentrate. Scientists also wanted to determine whether the salts from the concentrate would be contained in the vadose zone (the zone between the land surface and the water table), so as not to contaminate the underlying aquifer.

The experiment tested three irrigation patterns to see which one would consume the most concentrate while minimizing drainage.

Lining the Trenches

Lined trenches after planting

Lined and unlined plots were constructed so that six sets of growing conditions could be compared. One group of Atriplex was irrigated a constant rate. The others were irrigated at either the rate of evaporation and one-and-a-half times the rate of evaporation, as measured by a nearby weather station.

In the lined plots, Atriplex grew fastest when irrigated at 1.5 times the evaporation rate; Atriplex also grew faster when given saltier concentrate. In the unlined plots, plants irrigated at 1 and 1.5 times the evaporation rate grew at about the same pace. (Both groups grew faster than those irrigated at a constant rate.) Very little drainage has been recovered from the lined plots, suggesting that it is possible to prevent the salts from reaching the water table. In short, results showed that halophytes could consume at least as much concentrate as an evaporation pond, while keeping the salts at the soil surface.

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Future research may include using concentrate for cultivating tilapia and shrimp, or even algae for energy production.

Visiting the Papsallium (turf grass)

Weather station for irrigation control

The Marana Pilot Project demonstrates the ability of local utilities, academia and the Federal Government to work together to produce real-world innovations. It has proven that slowsand filtration can be an effective and cost-saving pre-treatment for RO of CAP water. It has also shown that unsightly evaporation ponds can be replaced attractive plantings, converting a troublesome waste product into a useful resource. If the technologies tested at the Marana Pilot can be scaled up, the costs and environmental impacts of reverse osmosis could be reduced significantly, making it an attractive and affordable option for inland water providers. As you can see from the pictures, the project made quite an impression.

Carol Erwin, Curt Brown (Director of Reclamation Science and Technology Program) and Martin Yoklic, University of Arizona

Thanks to Kathy Jacobs, Executive Director, AZ Water Institute, for several photos.