WESTCAS Issue Paper
Research and Technology

SALINITY MANAGEMENT

Background

Salinity management is becoming a critical environmental issue facing municipalities across the Nation, especially in the Western United States. Water utilities must look to other alternative resources and develop additional management strategies to meet current and future water demands during a time period of growing population, drought, and global warming. Wastewater effluent must remain a viable water resource for irrigation of crops and turf and indirect potable use through groundwater recharge. Agencies are also looking to use brackish groundwater and seawater as a potable water resource. However, the salt laden concentrate from brackish groundwater, seawater and wastewater effluent treatment must be reprocessed to recover more water prior to safe and environmentally sound disposal of the salts. In addition, these salts must be completely removed from the water cycle so treatment costs are not borne over and over by utilities. ***The underlying issue is that salinity is not only a water quality issue, but more importantly salinity is a water resource management issue.***

With the Central Arizona Project (CAP) now delivering its full 1.5 million acre-feet capacity of Colorado River water annually to central Arizona, a comprehensive study of the salinity impact from this water supply, and other sources, was both timely and necessary. A regional "salt balance", developed as part of the Central Arizona Salinity Study (CASS), showed that the Phoenix metro area imports approximately 1.5 million tons of salt per year. Most of this salt arrives via two major surface water supplies - the Colorado and the Salt River systems. Since only about 400,000 tons leave the area, approximately 1.1 million tons (almost three-fourths) remain. Most of these salts end up accumulating in the groundwater basin.

Water with a high Total Dissolved Solids (TDS) concentration impacts virtually all sectors of society - residential, commercial, industrial, and agricultural. An economic modeling evaluation assessed the impact of TDS on different sectors of society. The model equated a 100 mg/L increase in TDS of the two primary surface water sources (the Salt River and Colorado River) with approximately a $30 million annual increase in societal related costs. The economic impacts are expected to increase substantially in the future with the compound affects of continued salt importation via the rivers and additional salt loading as the population grows.

The approach developed for the Central Arizona Salinity Study (CASS) could be used in other groundwater basins, and is not necessarily limited to the arid west. The following discussion taken from the CASS Phase 2 Report will present how CASS identified the most critical issues related to salinity management in Central Arizona and what work remains to be done to better develop, prioritize, and balance salinity mitigation programs.

Regional Approaches to Salinity Management

Twenty-one alternative salinity management strategies were assessed to determine where it would make the most economic sense to manage salinity. These strategies involved salinity management on the watershed, on rivers/canals, at water treatment plants, at wastewater treatment plants, and through treatment of brackish groundwater.

The conclusions were as follows:

- Salinity management on the Colorado River via the Colorado River Basin Salinity Control Program (CRBSCP) is the most cost effective method to reduce salinity in central Arizona, the Lower Colorado River Basin States, and Mexico by preventing salt from entering the Colorado River. The CRBSCP should be fully funded.

- Large scale desalination projects along the Colorado or Salt Rivers or along the CAP canal are not viable due to high capital and operating costs, significant loss of potable water in the desalination process, and difficulties in managing the large amounts of concentrate produced.

- Constructing desalting facilities at existing potable surface water treatment plants is a possible option. One of the advantages of desalination at water treatment plants is that the salts are removed before they cause damages to the urban infrastructure. Some of the disadvantages are; the increased costs associated with advanced water treatment, the loss of approximately 15 percent of the water supply in the wasted concentrate, and the large quantity of concentrate that would have to be managed. Depending on local conditions and public expectations (i.e. the willingness to pay, the water quality expected, etc.), the benefit of removing salt at water treatment plants may or may not be practical.

- Advanced water treatment could be used to treat high TDS effluent. TDS concentrations are increasing at some wastewater treatment and water reclamation plants to the point where the effluent may not be usable for “high end” purposes, such as golf course turf irrigation and artificial groundwater recharge. Desalination of effluent is one method which would keep high TDS effluent in a city’s water portfolio.

- Desalination of brackish groundwater is a viable option for augmenting water resources. The cost to desalinate brackish groundwater is costly but potentially less expensive than other new water resource options.

Brackish Water Treatment

The issues associated with utilizing brackish groundwater for a potable water supply are: regulations, water sustainability, water quality, and treatment technology. The following is a summary of the key findings:

- The long-term sustainability of pumping brackish groundwater is uncertain and would have to be evaluated on a site specific basis. Pumped groundwater must comply with the

Arizona Department of Water Resources (ADWR) Groundwater Management Code that manages long-term water supplies.

- Depending on local conditions, brackish groundwater may need to be treated for a variety of constituents other then just TDS to meet federal, state, and local water quality regulations.

- It may be beneficial to use a blending scenario where a portion of the brackish water is treated by a desalination process and then blended with non-desalinated groundwater prior to introduction to the public water supply system. Blending scenarios may also mitigate the need to post-treat or stabilize water prior to sending it to the distribution system and may decrease treatment costs.

- The most common concentrate disposal methods in central Arizona are evaporation ponds and discharge to sanitary sewers. Both technologies have pitfalls that may limit the amount of brackish groundwater that can be utilized. Evaporation ponds are land intensive which increases the over all costs dramatically where land is expensive such as urban areas. Discharging concentrate to a sanitary sewer increases the salinity of the effluent leaving the waste water treatment plant (WWTP). This is especially a problem at smaller WWTP's which don't have the size to fully dilute the incoming concentrate.

Salinity Control at Waste Water Treatment Plants

It is anticipated that WWTP's will continue to experience increasing salinity concentration in the future because of high TDS source waters, increased residential and commercial water softener usage, industrial processes, increased quantities of concentrated salts from cooling towers, and increased concentrate from membrane treatment facilities. This can present a problem for wastewater utilities in meeting discharge standards set in their National Pollutant Discharge Elimination Systems (NPDES) permits and in providing a water resource suitable for its intended uses.

Several strategies can be implemented separately or in combination to manage salinity at wastewater treatment plants. They include the following:

- Regulate TDS discharges from large point source contributors such as industrial facilities.

- Assess a surcharge to pay fro the cost of desalinization at the WWTP. The fee would be proportional to the amount of salt a customer contributed to the sewer.

- Promote a Best Management Practices (BMP) program to manage salinity entering the sewer system from non-point sources. An examples of a BMP would be to use demand-based water softeners instead of timer-based water softeners.

- Desalinate effluent prior to reuse where necessary, such as turf irrigation and groundwater recharge.

Concentrate Management

Depending on site specific circumstances, the cost of concentrate management can be 50% of a major desalinization facility. For inland States, the most common concentrate management strategies are sewer disposal or evaporation ponds. New approaches to concentrate management are being evaluated through several national and regional research projects. Overall:

- Current approaches to concentrate management are either costly or incur significant water losses.

- There is no single technology that will meet all concentrate management applications.

- Further research is needed to better develop new approaches to concentrate management.

- Once salts are removed from water they should be disposed of in an environmentally sound manner and not put back into the water system, such as sewer disposal of concentrate.

WESTCAS Focus

WESTCAS can help to promote the understanding of salinity management by supporting the following activities:

- Support full funding of the Colorado River Basin Salinity Control Program

- Support a public education program on salinity issues

- Promote programs that limit the amount of salts entering sewer systems

- Support research for desalting brackish water to augment water supplies

- Desalinate effluent for specific non-potable uses and possibly for indirect potable reuse

- Encourage disposal of concentrate in an economical and environmentally sound manner to remove salts from the water cycle

- Promote research into concentrate management and desalination technologies that reduce costs and water losses.