RECHARGING AQUIFERS WITH POTABLE WATER
By Bill Klepczynski

Last year, we learned that California was faced with a critical shortage of water because of overconsumption by agricultural and domestic sources. This year we are starting to hear that Capetown, South Africa is facing the possibility of a severe drought by May 2018 and 4 million people will be in dire need of water because of a lack of rainfall. Whatever the cause, whether it is human activity or a natural phenomenon, shortage of water is a problem for which communities must be prepared to face.

The governmental and financial structure of Anne Arundel County (AAC) is such that it needs growth in order to meet its obligations. However, growth brings with it the problems of increased population and stress on its infrastructure. Currently, there is sufficient water to meet demands but it can be seen that the future will strain the water supply system. Farming on the eastern shore, as in California, is starting to shrink the aquifers that are critical to its water supply. Also, many old-time residents of AAC may remember the problems that were raised by the local droughts of 1930-32, 1960-66 and 1977-81. While no one can predict the future as to whether groundwater sources will become a problem, should steps be taken now to plan for such possibilities? The SWIFT (Sustainable Water Initiative for Tomorrow) Program (Ref. 1) is one to be watched. If it is successful and can economically produce potable water, it should be taken into consideration for the future of AAC.

One community that has realized that they will have a water shortage problem is Hampton Roads, VA. They have developed the SWIFT program in order to **recharge** the Potomac Aquifer which is their main source of potable water. This will combat other problems caused by groundwater depletion: saltwater intrusion and sea level rise.

Many other communities situated along the Coastal Plain aquifers are dealing with many similar environmental challenges. Aquifer levels are dropping, leading to aquifer consolidation and ground subsidence. Coupled with sea level rise and saltwater intrusion, utilities from North Carolina up to New Jersey are facing significant environmental hurdles. For these utilities, water reuse for managed aquifer recharge is a desirable option, particularly for those that also maintain wastewater treatment facilities with effluent nutrient limits.

The Hampton Roads Sanitation District (HRSD) has developed the SWIFT Research Center, an advanced wastewater treatment facility. It starts with water that has been reclaimed at one of their 13 district wastewater treatment plants for release into local waterways. These wastewater treatment plants produce water that **surpasses** strict Virginia Pollutant Discharge Elimination System requirements.

The process that is used by these Wastewater Treatment Facilities can be described by three main treatment levels: **Primary Treatment**, **Secondary Treatment** and **Tertiary Treatment**. These processes ensure that the final water meets stringent state-regulated environmental standards and the Chesapeake Bay total maximum daily loads (TMDLs), and they support the intended use of the receiving waterbody, but it is **not** yet drinkable.

Primary treatment
When wastewater enters an HRSD treatment plant, it first flows through a bar screen that removes large floating objects such as trash, sticks and rags. The captured material is properly disposed of in a landfill and the wastewater flows to a grit chamber and a sedimentation tank. These devices slow the flow of the water and allow sand, grit, human waste solids, and other small particles to settle to the bottom. These solids are then removed along with any scum or grease floating on top.

Secondary treatment
Next, the wastewater travels to secondary treatment facilities that speed up the processes of nature, allowing microorganisms (bacteria and other organisms) to consume 80-90 percent of the "organic matter" – or human, animal and plant waste. The most commonly used secondary treatment technique in HRSD plants is the *activated sludge process*. An activated sludge process speeds up the work of the microorganisms by pumping oxygen-rich air and sludge into close contact with the wastewater in an aeration tank. Over several hours, the organic matter is broken down into harmless by-products. The wastewater is then sent to a final clarifier. In the final clarifier, the microorganisms that grow during the activated sludge process sink to the bottom and are recycled back to the aeration tanks, and the remaining water moves on to the final treatment process.

Tertiary treatment and disinfection
Advanced treatment systems remove additional pollutants such as nutrients, heavy metals and chemical compounds. These systems may use microorganisms that differ from those in secondary treatment, additional chemicals, or an effluent filtration system. This significantly increases plant construction and operation costs but improves the final quality

of HRSD's highly treated water. Finally, the water is disinfected by chlorine, and the use of ultraviolet light. HRSD facilities remove excess chlorine before discharging the cleaned water to local rivers. These processes kill 99 percent of disease-causing pathogens such as bacteria and viruses. The water quality now supports the intended use of the area waterway, meeting the needs of its aquatic life, and it can be released back into the environment.

The effluent from one of these wastewater treatment plants will then be input to the SWIFT Test Facility where it is be subjected to an 8-step process that produces water that meets drinking water standards.

The overall procedure as shown in **Figure 1** prepares water for recharging the Potomac Aquifer. A majority of planned potable reuse schemes use reverse osmosis (RO) membranes and advanced oxidation processes (AOPs) to ensure maximum removal of contaminants from waste water. Whereas the use of RO technology is expensive, energy intensive, and requires the disposal of a concentrated brine stream, the process used in the SWIFT approach provides an alternative but similar approach to that which treats water at the wastewater treatment plants. They also introduce additional steps for removal of trace organic compounds and treat the water to make it compatible with the Potomac aquifer.

The first phase of the SWIFT program is now underway. It is planned to have a one million gallon per day (1 MGD) system in operation by the end of 2018. By 2030, a fully operational 100 MGD system could be putting purified water into the aquifer.

Reference 1:
Design-Build of a 1 MGD Demonstration Facility for Advanced Treatment and Managed Aquifer Recharge – Phase 3 of HRSD's SWIFT Porgram, John J. Dano (HRSD) and Aaron W. Duke (Hazen and Sawyer)

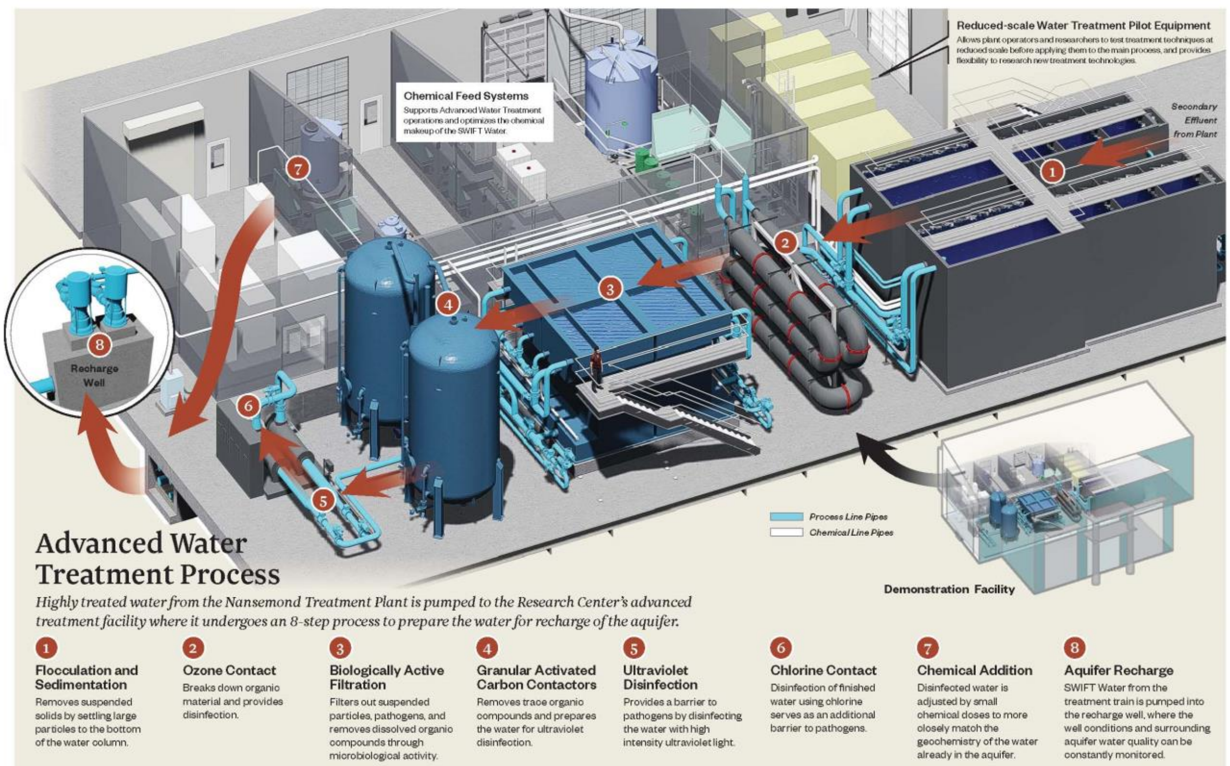

Figure 1