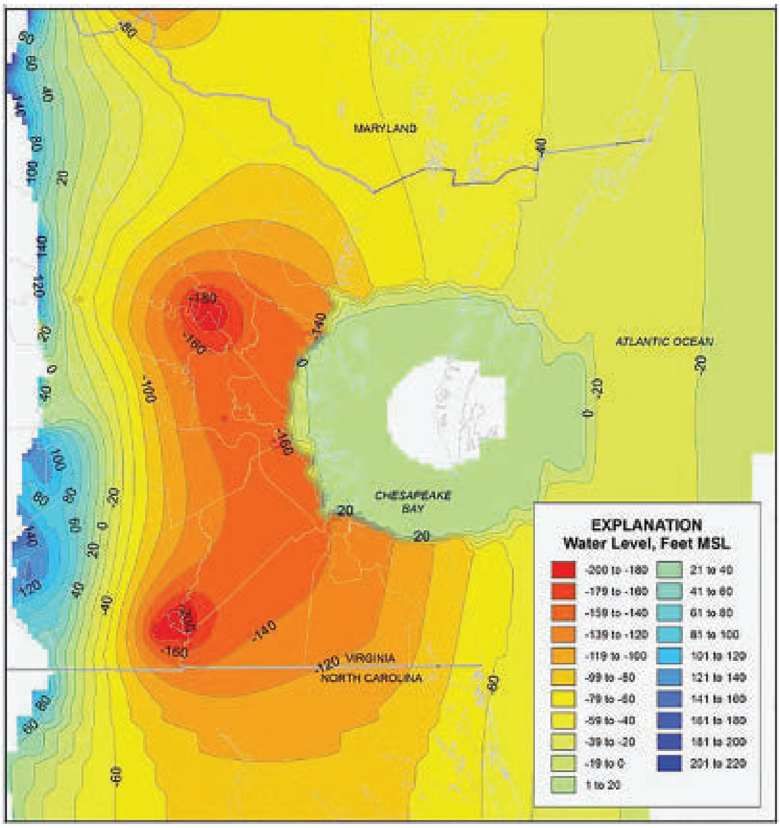
WASTEWATER

Virginia Utility Aims to Eliminate Most Discharges To Surface Waters

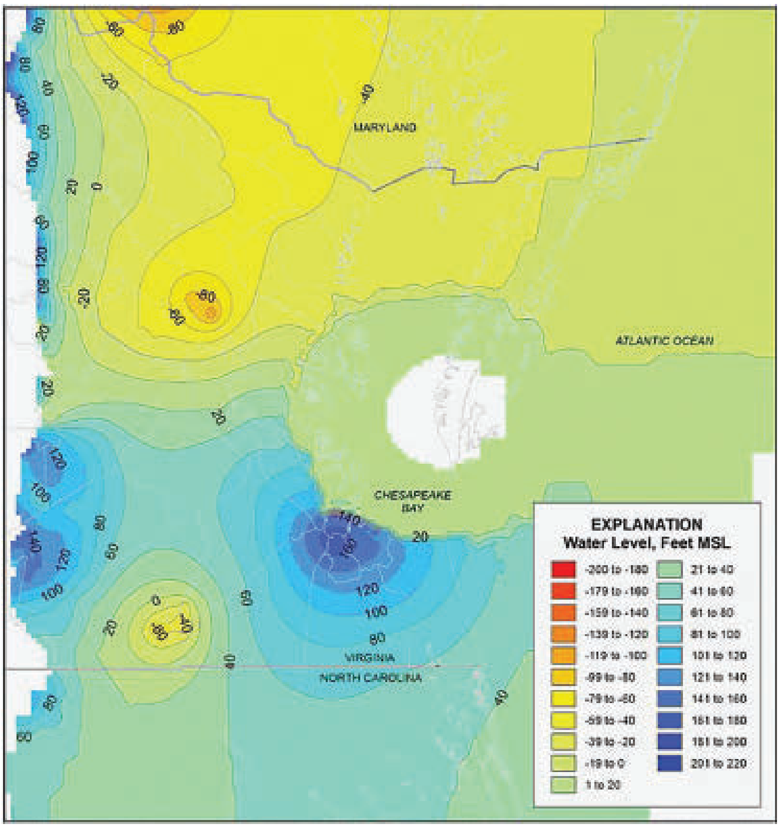
IN AN AMBITIOUS MOVE intended to achieve multiple environmental benefits, the Hampton Roads Sanitation District (HRSD), in southeastern Virginia, is pursuing the goal of treating most of its wastewater to essentially drinking water standards and then injecting the treated flows underground. Known as the Sustainable Water Initiative for Tomorrow (SWIFT), the approach would enable the HRSD to stop discharging most of its treated effluent to surface waters, ensure compliance with future discharge requirements, augment groundwater supplies, and address local problems pertaining to subsidence and saltwater intrusion. Currently undergoing pilot testing, the SWIFT program is expected to cost $1 billion by the time it is completed, in 2030.

Like other point sources engaged in wastewater treatment in the vast watershed of the Chesapeake Bay, the HRSD faces the prospect of having to comply with increasingly stringent discharge limits as part of the total maximum daily load established for the bay by the U.S. Environmental Protection Agency. Both point and nonpoint sources are required to reduce loadings of nitrogen, phosphorus, and sediment. However, if anticipated reductions in these constituents from the agriculture and stormwater sectors do not materialize, wastewater treatment facilities can expect to shoulder more of the regulatory burden associated with the total maximum daily load. At the same time, potential future regulations pertaining to such items as viruses, contaminants of emerging concern, or pharmaceuticals could necessitate additional upgrades by the HRSD at its wastewater treatment facilities.

Against this backdrop, the HRSD "took a long-term look at where we're going to be in 20, 30 years," says Ted Henifin, P.E., the district's general manager. Concluding that the HRSD will continue to have to make major improvements to its facilities, the



PREDICTED PRESSURES IN POTOMAC AQUIFER IN 50 YEARS WITHOUT GROUNDWATER REPLENISHMENT



PREDICTED PRESSURES IN POTOMAC AQUIFER IN 50 YEARS WITH GROUNDWATER REPLENISHMENT

HRSD, BOTH

district's leadership decided to pursue the idea of taking wastewater "all the way to drinking water," as Henifin puts it. Such a move would effectively insulate the HRSD from future regulatory changes while creating a final product with even more value than treated wastewater. The purified water could then be injected belowground, boosting groundwater supplies and helping replenish the Potomac Aquifer.

A massive source of groundwater along the Virginia coast, the Potomac Aquifer covers the state's entire coastal plain and varies significantly in depth depending on location. Along its western edge, the aquifer extends

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to the ground surface, while at the coast, in the area of the HRSD's facilities, the aquifer is confined and extends downward from roughly 400 to 500 ft belowground to approximately 2,000 ft. Despite its size, the aquifer has declined in pressure in recent years, the result of extensive withdrawals of groundwater. The lower pressure has caused the aquifer to compact, contributing to land subsidence that, in turn, has increased the risk associated with sea level rise in the Hampton Roads region. "We are sinking," Henifin says. Although saltwater intrusion has not occurred to any significant degree, concerns have arisen regarding that possibility in the future.

Regional and localized groundwater modeling shows that injecting the treated water will benefit the aquifer system, says Daniel Holloway, P.G., a senior project manager and hydrogeologist for CH2M, of Englewood, Colorado. As the prime consultant for the SWIFT project, CH2M worked with the HRSD to conduct groundwater modeling, coordinate test well drilling, and design the treatment units for the ongoing pilot test. Injecting the treated water "will provide a mound, which will reduce the potential for saltwater intrusion," Holloway notes. At the same time, adding the treated effluent to the aquifer could help address the problem of land subsidence. "It looks as though this project has the potential to arrest that compaction and maybe even reverse it some," he says. Although any increase in elevation would be fairly minor, it would prove to be a "big deal" in the relatively flat Hampton Roads area that is near sea level, he says.

Announced by the HRSD in mid-September, the pilot test of the advanced water treatment processes conducted as part of the SWIFT program was begun in late June with the start-up of a 30 gpm membrane-based system at the district's York River Treatment Plant, in Seaford, Virginia. The membrane-based system employs microfiltration and reverse-osmosis membranes, followed by ultraviolet disinfection and advanced oxidation. The rejected brine from the system is returned to the head of the York River facility for treatment.

In early July the HRSD began pilot testing an approximately 5 gpm carbon-based system at the same facility. Within the carbon-based system, water passes through a flocculation and sedimentation unit before undergoing ozonation and then treatment first by biological activated carbon and then by granular activated carbon. The treated water next undergoes ultraviolet disinfection.

Although both approaches have performed well, the HRSD plans to

CUTOUT SPACES and verdant terraces define the new, blocklike headquarters building for Banque Libano-Française in Beyrouth (Beirut), Lebanon. Designed by Snøhetta, of Oslo, Norway, the project is intended to align with three principles: economic sustainability, social sustainability, and environmental sustainability. To address the first, the architecture firm will ensure that the entire project is fundamentally viable economically. To conform to the second, the tower will include many public spaces in addition to spaces intended for bank employees. The offices will be located strategically around the multilevel terraces, and the plaza around the base of the structure will serve as a public square that will engage the neighborhood. To address the environmental goals, the terraces will be vegetated, and the entire project will be designed to conserve energy both in the materials and methods chosen for its construction and in its operation once completed.

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expand its efforts to test the carbon-based system, Henifin says, because this system confers certain advantages. Compared with the membrane-based system, the carbon-based approach costs less to construct and operate, and its effluent has water quality characteristics that are "much closer to what exists in situ in the groundwater where we're going to be pumping," Henifin notes. "We think [the carbon-based system] is really the direction that's going to work for us."

Ensuring the "geocompatibility" of the finished water with the native groundwater is a key factor in achieving success on the overall project, Holloway says. After undergoing treatment in the membrane system, the water has extremely low levels of total dissolved solids, giving it a different ionic strength than that of the more brackish native groundwater. Although the Potomac Aquifer consists mainly of sand, a "small clay fraction" present in the aquifer could be mobilized by the membrane-treated water and "cause problems right around the well," impairing pumping operations, Holloway says. By contrast, injecting water treated by the carbon-based system would greatly minimize the potential for such problems.

The HRSD plans to begin operating a 1 mgd demonstration project featuring the carbon-based scheme in early 2018 at its Nansemond Treatment Plant, in Suffolk, Virginia. Over the summer, the district issued a request for proposals from design/build teams interested in developing the demonstration facility. The HRSD is engaged in the selection process and aims to award a contract soon, Henifin says. Construction of the pilot facility is expected to be complete in early 2018. A test well has been completed at the Nansemond facility, while a test well at the York River plant remains under construction. The wells will be used to obtain detailed information about the aquifer in these locations. The district is also working with Region 3 of the U.S. Environmental Protection Agency to obtain the necessary regulatory approval to inject the treated water on-site at the Nansemond facility.

The HRSD intends to add advanced purification measures and inject treated effluent on-site at seven of its nine large facilities by 2030, Henifin says. Once all such systems are in place, the HRSD will have the capability to purify and inject approximately 120 mgd, essentially eliminating its discharges to surface waters except in the event of peak flows after wet-weather events. All told, the district aims to eliminate approximately 90 percent of its discharges to surface water.

"Rarely do you get to do something that reduces your discharges significantly," Henifin says. Such a major reduction in discharges is expected to improve water quality conditions in local waterways as well as in the Chesapeake Bay. "We're figuring if we can reduce our discharges by 90 percent, there will be a positive benefit," he says. —JAY LANDERS