READY FOR RESTORATION

By Steve London

Howard County, Md., enhances nutrient removal for Chesapeake Bay

The Howard County Bureau of Utilities in Maryland recently completed a $92-million Addition No. 7 project at the Little Patuxent Water Reclamation Plant (LPWRP) to improve the quality of the plant's effluent discharge and to reduce harmful nutrients reaching Chesapeake Bay. The project's various increments took more than five years to complete and incorporated innovative design solutions and state-of-the-art technologies for denitrification, aeration and disinfection. The project presents a model for Maryland's 66 largest wastewater treatment plants and municipal facilities elsewhere that are facing increasingly stringent regulatory changes.

LPWRP serves the heart of Howard County, where 56% of the population resides. The sewage collection system consists of 820 miles of gravity lines and force mains that connect Columbia, Savage and North Laurel to the plant. Located in the community of Savage, LPWRP has been a recipient of repeated nutrient control measures as goals were set by the three Chesapeake Bay Agreements signed in 1983, 1987 and 2000. The agreements between the U.S. Environmental Protection Agency, Maryland, Pennsylvania, Virginia and the District of Columbia established higher effluent quality standards with the long-term goal of restoring the health of Chesapeake Bay.

The Second Chesapeake Bay Initiative was significant mostly because it called for a 40% reduction in nutrients reaching the bay by 2000. This led to major investments in biological nutrient removal (BNR) infrastructure in plants. BNR methods were to reduce effluent nitrogen concentrations to less than 8 mg/L and phosphorus concentrations to less than 2 mg/L in effluent releases by adding systems conducive to the growth of specific groups of beneficial microorganisms that began the removal of nutrients from wastewater.

The third Chesapeake Bay Agreement in 2000 called for even more aggressive measures over the next decade. A federal strategy implemented under an Executive Order by President Barack Obama in May 2009 called for protecting and restoring the community environments throughout the 64,000-sq-mile watershed and thousands of streams, creeks and rivers. The strategy includes stringent regulations to restore clean water, new conservation practices addressing four million acres of farms, preserving two million acres of undeveloped watershed and reestablishing sustainable oyster populations in 20 tributaries of the bay. Federal agencies are to establish milestones every two years for actions to progress toward measurable environmental improvements agreed upon by the bay states.

Maryland has committed to the installation of enhanced nutrient removal (ENR) technologies that include denitrification filters and membrane reactors at the state's largest wastewater treatment plants. The new ENR facilities will treat wastewater to a maximum monthly nitrogen concentration of 3 mg/L and 0.3 mg/L phosphorus. A Bay Restoration Fund established in 2004 provides state grants to help local jurisdictions fund the new ENR measures.

With a geographic footprint of 64,229 sq miles, Chesapeake Bay ranks as the nation's largest estuary and receives flows from 150 rivers and streams. Unfortunately, the multistate region's growth over the past 50 years brought an inevitable surge in byproduct nutrients from wastewater treatment plants, which have steadily eroded the vitality of the bay's water environment. The chronic erosion of the bay's water quality has had negative impacts on plant and animal life—and particularly the fishery and oyster industries—in the estuary and along its tributaries. Nitrogen and phosphorus are the major problems and are attributed to several sources—in large part to wastewater treatment plant discharges reaching the bay.

Earning Specification

The Howard County Bureau of Utilities needed to expedite the procurement and construction for the ENR technology addition in order to meet the compliance date in July 2012. The utility agency adopted a progressive approach to compress the challenging schedule and lengthy process of traditional design-bid-build procurement. Instead, the utility contracted with the Calverton, Md., office of Atkins Global to serve as the owner's consultant to lead the overall project that was designated Addition No.7.

Atkins had extensive design and engineering responsibilities. The role included recommendations on alternative design, best value-based contractor selection and technology procurement. To expedite the construction and reduce overall risk, Atkins recommended awarding the main ENR and expansion improvements contract as a Construction Manager At Risk (CMAR) agreement for project delivery. The consultant worked with the county to develop the Request for Qualifications and Request for Proposals (RFP) that led to selecting Clark/US, a CMAR joint venture between Clark Construction Group of Bethesda, Md., and Ulliman Schutte Construction office in Rockville, Md.

CMAR directly complemented a project delivery approach that allowed earlier stages of work to commence while later activities were not fully formalized. The approach proved effective in compressing the schedule from the project's start in early 2009 to when the ENR technology addition became operational in February 2012. This provided several months to operate the added ENR process before the state review in July 2012 to assess compliance with the more stringent effluent regulations.

Diffusers greatly improved aeration in the oxic zone basins.

Left: Operational bank of denitrification cells. Center: The filter blocks were assembled on the ground and each was installed side-by-side lengthwise in one long piece. Crews loaded siliceous filter material into a denitrification channel above the blocks. Right: UV disinfection channels

Performance Warranty

Atkins evaluated both post-anoxic zones and denitrification filters as the backbone of the ENR segment of upgrades. The county's alternative project delivery program instilled the latitude to specify preselected equipment based on factors such as performance, warranties, guaranteed delivery dates, etc. Following exhaustive evaluations, Atkins recommended an ENR upgrade comprising seven deep-bed mono-media Leopold elimi-NITE 2.0 denitrification systems from Xylem Inc., along with control panels and related ancillary equipment.

By using an RFP based on performance and manufacturer-based warranty, Howard County was able to save $2 million. Other municipalities stand to gain from more competitively priced procurement for their projects as well.

The Leopold filtration system advances the LPWRP nutrient removal to the limits of proven performance. The elimi-NITE 2.0 ENR filter consists of a gravity downflow packed-bed sand filter media using methanol as an upstream biodegradable carbon source. The siliceous media in the packed-bed sand filter eliminates the need for downstream filtration or clarification units required by less efficient denitrification systems.

The filter media presents an ideal organic substrate for denitrifying microorganisms to cling while maintaining adequate hydraulic detention time for the biological reaction necessary to remove oxygen from the nitrate molecules in the process stream. When bacteria break apart the nitrate to gain oxygen, the nitrate is reduced to nitrous oxide, and then to nitrogen gas. Because nitrogen gas has low water solubility, it is released into the atmosphere as gas bubbles. The microbiological process achieves denitrification at the desired levels below 1 mg/L. At the same time, the filter material also extracts solids that include precipitated phosphorous.

Most importantly, the ENR system now in operation at LPWRP can scrub the effluent down to 3 or 4 mg/L of total nitrogen, compared to 8 mg/L achieved by the earlier BNR method. In tandem with the phosphorous removed upstream in the process reactors, total phosphorous can be reduced to 0.3 mg/L or less.

Preselection also applied to other Xylem equipment. Included were a 400-lamp Wedeco TAK 55 UV disinfection system and Flygt propeller mixers, along with related headworks screening, dewatering and clarification equipment. An additional 7,000 Sanitaire ceramic diffusers were added to the process reactor aeration grids, and the existing centrifugal blowers were replaced with a new turbo-type unit that significantly boosted aeration while saving electricity. Moreover, the capacity of the existing BNR process was expanded with a new process reactor, secondary clarifier, launder covers on the secondary clarifiers and a new solids processing centrifuge.

LPWRP's daily reductions equate to an impressive 37,000 lb of suspended solids, 4,730 lb of nitrogen, and 965 lb of phosphorous. The individual plant will increase by more than 16 million lb the statewide nitrogen reductions achieved by earlier upgrades across the state's wastewater treatment infrastructure. Adding ENR to the state's 66 largest plants should reduce nutrient loading by another 7.5 million lb of nitrogen and 260,000 lb of phosphorus.

The effort to restore vitality to the bay has come a long way, from the earliest baby steps that simply defined goals, to the giant strides achieved at LPWRP. WWD

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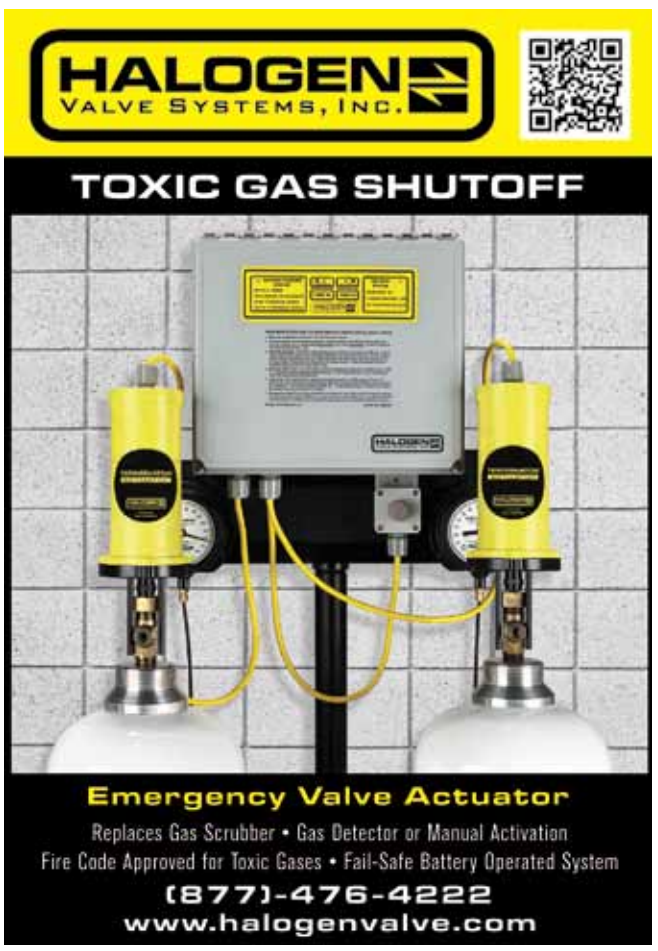

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