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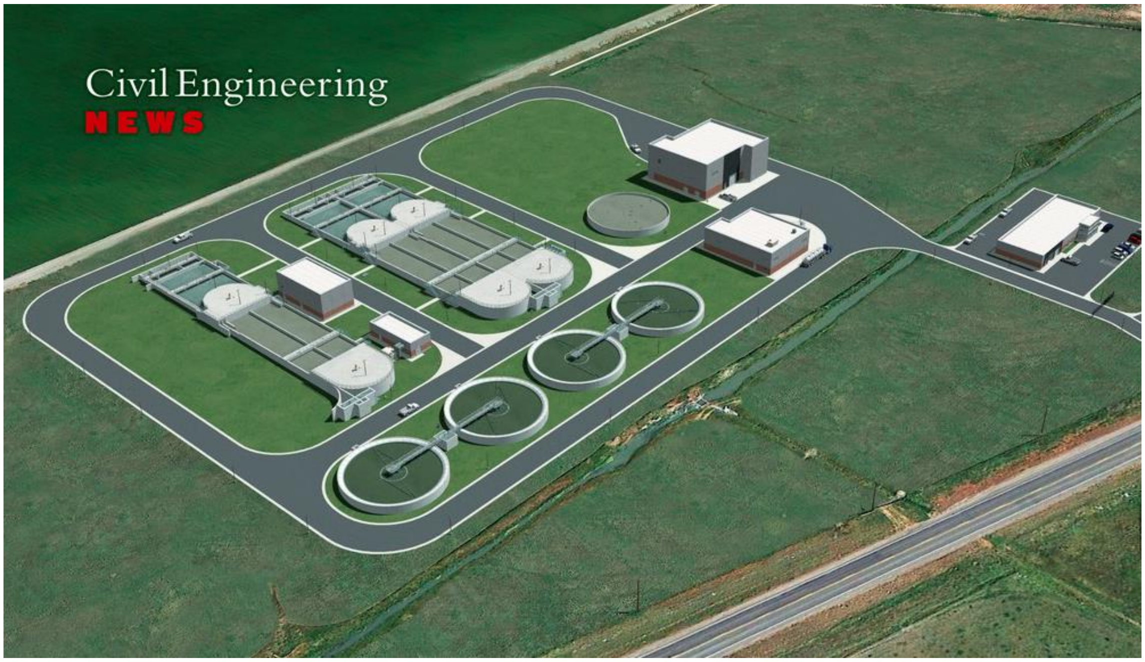

WASTEWATER

Utah Treatment Facility Uses Ballasted Activated Sludge Process to Shrink Footprint, Costs

EARLIER THIS YEAR, the city of Logan, Utah, achieved a key milestone in its efforts to comply with significantly more stringent regulatory requirements pertaining to nutrient levels in its wastewater discharges. In March, the city awarded a preconstruction services contract to MWH Constructors—which is part of Stantec Construction Group—to serve as the construction manager/general contractor (CM/GC) of the new 18 mgd Logan Regional Wastewater Treatment Facility. Construction is anticipated to cost $116 million and is scheduled to begin this summer.

The new advanced treatment facility will replace Logan's existing 15 mgd lagoon treatment system, which consists of 460 acres of treatment lagoons and 240 acres of wetlands that polish the treated wastewater. Besides wastewater from Logan, the system treats flows from Utah State University and the communities of Smithfield, Hyde Park, North Logan, River Heights, Providence, and Nibley. Although the new wastewater facility will enable Logan and the surrounding area to keep pace with population growth, the main factor driving the development of the new facility involves nutrient limits that simply cannot be attained by the existing lagoon system. "Lagoons don't do a really good job of meeting low limits of phosphorus and nitrogen," says Mark Nielsen, P.E., M.ASCE, the senior engineer for the wastewater construction project in Logan's Environmental Department.

The lagoon system discharges to Swift Slough, a waterway that drains to the Cutler Reservoir. Because of low concentrations of dissolved oxygen and excessive amounts of phosphorous in the reservoir, the Division of Water Quality (DWQ) within the Utah Department of Environmental Quality imposed limits on the amount of phosphorus that may be discharged from nonpoint and point sources, including the city of Logan. Separately, the DWQ also modified Logan's wastewater discharge permit several years ago to include a new limit for chronic ammonia. As a result, Logan's new wastewater treatment facility will be required to comply with a mass-based limit for total phosphorus that

Use of a ballasted activated sludge process as part of secondary treatment helped reduce the overall footprint of the 18 mgd Logan Regional Wastewater Treatment Facility, in Logan, Utah, by about 40 percent.

will translate into average concentration limits of 0.9 to 1.0 mg/L, depending on the season. The future ammonia limit will vary seasonally from 1.3 to 3 mg/L, on a monthly average basis.

Although the lagoon system will be phased out for treatment purposes, portions of it will be retained for flow equalization during periods of wet weather, says Craig Ashcroft, P.E., a senior vice president in the Salt Lake City office of Carollo Engineers Inc. The firm, which has its headquarters in Walnut Creek, California, completed the design of the Logan Regional Water Reclamation Facility in April. The design calls for the construction of a new headworks, with screening and grit removal, near the existing headworks of the lagoon facility. "If we have really high flows during peak weather events, those flows will automatically bypass the new treatment plant and be stored in the lagoons," Ashcroft says.

A pump station will convey influent approximately 1 mi to the site of

MICHAEL THOMAS DE VLIEGER, VINCI LLC/MWH CONSTRUCTORS the main treatment facility, where flows will enter biological reactors to undergo secondary treatment and biological nutrient removal. Designed to utilize what is known as the Bardenpho process, the reactors feature three stages—anaerobic, anoxic, and aerobic zones—to facilitate nitrification, denitrification, and the removal of phosphorus. From there, the water will flow to one of four 90 ft diameter clarifiers before undergoing disinfection by means of ultraviolet light. Following disinfection, the effluent will be discharged from the facility.

The "biggest challenge" during the design process involved the poor geotechnical conditions at the project site, Ashcroft says. With foundation-related expenses "driving the cost of the project up considerably," he says, the design team—which included Intermountain GeoEnvironmental Services Inc., of South Salt Lake—decided to evaluate options for ways to reduce these costs. "We looked at a lot of structural alternatives, as far as the foundation design. But it was clear that it was not going to get the cost reduction that we were looking for. So we started looking at process alternatives to minimize the footprint of the project, which would thereby reduce the cost of the foundation design."

This assessment ultimately resulted in the decision to use a ballasted activated sludge process, featuring the BioMag system from Evoqua Water Technologies LLC, which has its headquarters in Pittsburgh. The BioMag system uses magnetite, or oxidized iron ore, as ballast to enhance the settling of solids and improve clarification performance. About five times heavier than the biological solids formed in the bioreactors, the inert magnetite particles combine with the solids, causing them to settle much faster than normal during the clarification process.

"Because the solids settle faster, you can have more solids in your reactor and you need less reactor volume and fewer clarifiers to settle the solids," Ashcroft says. In fact, the improved clarity of the clarified water obviated the need for filtration. All told, the use of the ballasted activated sludge process reduced the overall footprint of the treatment facility by about 40 percent, he notes. "It turned out to be the most cost-effective alternative, as far as shrinking the footprint, reducing capital costs, [and] minimizing operations and maintenance costs," Ashcroft says.

The solids-handling process includes steps designed to recover the magnetite particles ahead of dewatering so that they can be returned to the bioreactors. To this end, waste-activated sludge removed during clarification will pass through a shear mill designed to break up the material before it enters rotating magnetic drums, which separate the magnetite from the solids. The waste-activated sludge then will go to a holding tank before undergoing dewatering by means of rotary presses. Meanwhile, the recovered magnetite will be blended with return-activated sludge and pumped back into the bioreactors. Because the recovery process is expected to retrieve on the order of 93 to 95 percent of the magnetite, a small amount of the inexpensive material will need to be augmented on a regular basis.

For its part, the city of Logan opted to employ the CM/GC approach because of scheduling concerns and a desire to foster more cohesion among project participants, Nielsen says. "If we waited to go through the normal design/bid/build process, we would have not been doing any construction work until next year," he notes. "So in order to get work going this year, we opted to go with the CM/GC method to get the contractor on board sooner." Because the contractor is involved earlier, the CM/GC method "provides a more team-oriented approach" compared with the traditional design/bid/build process, which sometimes can prove acrimonious, Nielsen says. "We wanted to have a team effort for this large of a project."

Substantial completion is expected by October 2021. One of the key challenges to be overcome during construction entails addressing the difficult geotechnical conditions, says Lance Ota, the assistant project manager for MWH Constructors. "The site has highly compressible soils that are heavily saturated with water," Ota says.

Because structures at the site will be supported on steel piles with concrete fill, they are not the cause for apprehension, Ota notes. Rather, the concern centers on the possibility of differential settlement between the pile-supported structures and the subsurface pipelines and duct banks. "We don't want pipes coming apart underground" at some point in the future following the conclusion of construction, he says. As a means of addressing this concern, MWH Constructors plans to rely on the knowledge of local subcontractors competing to win one of the three or four pipeline-related construction packages currently planned to be awarded. "We are looking for innovative ideas from the field," Ota says. "Engineering-wise, everything has been thought through that can be thought through. At this point, it's up to the contractors to pose cost-effective solutions and then validate them with the engineering." —JAY LANDERS