

City of Shelby, Ohio WWTP Eliminates CSOs while Upgrading to a State-of-the-Art Facility



The Pump People®

The City of Shelby, Ohio recently upgraded its activated-sludge wastewater treatment plant to double its capacity to 5 MGD, while expanding its capability to treat and disinfect combined high-volume stormwater and wastewater flows generated by wet-weather conditions.

The project, designed to upgrade much of the plant from its original equipment installed in 1953, included improvements to headworks, upgrading primary settling tanks and aeration systems, adding a new final clarifier, replacing chlorination with ultraviolet disinfection, and implementation of a plant-wide SCADA system. A major component of the upgrade was the replacement of 18 existing Gorman-Rupp pumps throughout the plant with new higher-performance pumps also supplied by Gorman-Rupp. These included storm and raw wastewater pumps, secondary RAS/WAS pumps, and digester recirculation pumps, many still operating from their original 1953 installation.

Eliminating untreated wet-weather combined sewer overflows (CSOs) is a significant issue facing many water utilities nationally. CSOs contain stormwater-

flushed contaminants from the watershed, plus untreated human and industrial wastes. These can include oxygen-consuming organics and nutrients, toxic materials, pathogens and debris. They are a major water pollution concern for the approximately



Super T Series® self-priming pumps replaced submersible pumps in the plant's stormwater pump station making it safer, easier and more economical to perform routine pump maintenance.



Based on its proven durability and reliability, this Classic T Series® pump (installed in 1977), was a key factor in Shelby's decision to continue using Gorman-Rupp products throughout the treatment plant upgrade.

800 cities in the United States that have combined sewer systems, according to the U.S. Environmental Protection Agency (EPA).

Combined sewer systems transport wastewater to a treatment plant, where it is treated and then discharged into creeks, streams, rivers or bodies of water. During periods of heavy rainfall, however, the wastewater volume in a combined sewer system can far exceed the capacity of the downstream sewer system or treatment plant. For this reason, combined sewer systems have been designed to overflow when capacity is exceeded, and discharge excess stormwater and wastewater directly to nearby streams, rivers or other water bodies.

Driven by the Clean Water Act of 1972, communities that have CSOs are required to develop plans to mitigate their impacts on the environment. The EPA's CSO Control Policy, published in 1994 and later made into law, is the national framework for control of CSOs. The Policy provides guidance on how

communities with combined sewer systems can meet Clean Water Act goals in as flexible and cost-effective a manner as possible.

Need for Wastewater Treatment Plant (WWTP) Upgrade

The City of Shelby is located between Columbus and Cleveland in north-central Ohio, with a population of approximately 8,900. The City's wastewater treatment plant is a Class 3 facility that processes approximately 1.9 million gallons of wastewater per day. Servicing 3,787 residential customers, 260 commercial businesses and 20 industrial facilities, the plant uses an activated-sludge process supported by a collection system of more than 70 miles of sewer lines.

The WWTP's service area is subject to flooding with a significant amount of the system located within the flood plain of the Black fork of the Mohican River, which flows through the city's downtown. Consequently, the city's existing sewer system is susceptible to very high wet weather flows. These flows result in periodic sanitary sewer overflows (SSOs) and bypasses, and the existing treatment plant did not have sufficient capacity to treat very high flows during wet weather conditions. Infiltration and inflow into the collection system was estimated at 0.5 MGD, creating a serious problem during rain events.

The WWTP was aged with a number of outdated components, which contributed to wet weather bypasses at the plant. Although Shelby's original plant dates back to 1889, an activated sludge process was built in 1953, with subsequent upgrades in 1977, 1988 and 2005.

"The plant was designed to treat an average daily flow of 2.5 million gallons per day (MGD), and a maximum daily flow of 5.0 MGD," said Charlie Brown, City of Shelby Wastewater Treatment Plant Superintendent. "Flows in excess of 5.0 MGD would overflow to the plant's 2.0 million gallon (MG) storage basin for temporary holding until the WWTP has



available capacity. When that basin fills completely it overflows to a secondary 18 MG storage basin. And when that basin fills to capacity during a storm event it overflows, untreated, into the Black Fork of the Mohican River.

“Every four years, the Ohio Environmental Protection Agency issues a National Pollutant Discharge Elimination System (NPDES) permit for allowable levels of effluent discharge into the state’s waterways, including the Black fork of the Mohican River,” added Brown. “To meet the terms of the NPDES permit, the city was required to eliminate its wet weather bypasses and improve secondary treatment capacity.”

Facility Planning Addresses CSOs and Plant Capacity Improvements

To achieve this goal, in 2015 the city retained CT Consultants, a multidisciplinary architectural, engineering and planning firm, to prepare a comprehensive facility plan designed to identify existing plant shortcomings, review wet-weather treatment alternatives and develop an overall plant improvement plan.

“We reviewed five engineering firms and asked them how they would upgrade the plant,” continued Brown. “Based on their suggested plans, we selected CT Consultants. It took approximately two years to engineer because we wanted to review a number of equipment options. We visited many WWTPs in other cities within the state looking at installed equipment, talking with plant operators and maintenance crews before we settled on a system design.”

The resultant planning encompassed improvements to multiple plant processes, designed to enhance system capacity, operability and reliability:

- Replacement of old and outdated headworks equipment



In addition to the pumping equipment controls, Gorman-Rupp provided control technology overseeing complete operation of the plant.

- Replacement of storm and raw wastewater influent pumps
- Upgrade to primary settling tanks and aeration systems
- Adding a new final clarifier
- Replacement of digester recirculation pumps
- Replacement of floating digester covers
- Replacement of chlorination with UV disinfection
- Replacement of secondary RAS/WAS pumps
- Construction of a new septage receiving station



- Replacement of blowers with turbo and positive displacement blowers
- Implementation of a plant-wide SCADA system

“We took a holistic look at the plant in its current state to deal with wastewater and stormwater,” said Chuck Hall, Senior Business Development manager with CT Consultants. “One of the major issues was equipment that had long since outlived its useful life. Some of the pumps and blowers dated back to 1953. They were still running, but needed to be upgraded to handle higher capacity.”

“The Ohio EPA wanted the overflows stopped or significantly minimized,” added Hall. “To achieve this we increased the capacity of the stormwater intake pumps



The plant upgrade specified a variety of Gorman-Rupp products including multiple submersible pumps (this one used to transfer sludge), one ReliaSource® packaged pumping system and one general purpose, portable, engine-driven, priming-assisted dewatering pump.

to maximize use of the stormwater basins. We also added a 60-foot diameter third clarifier to increase the storm capacity of the plant, and had the existing two clarifiers rebuilt and upgraded.”

In 2019, a bid to perform construction for the upgrade to the plant was awarded to NorthBay Construction, a full-service mechanical, civil, electrical, engineering and general contracting company.

“NorthBay performed the electrical, mechanical, process mechanical, concrete work, site excavation and all equipment purchases, installation and commissioning,” said Peter Manns, President with North Bay Construction. “Essentially, the project was a full plant upgrade.”

Plant-Wide Replacement of Pumping Systems

“A critical aspect of the project was the pumping systems within the plant, which were all upgraded,” added Manns. “The original pumps were manufactured by Gorman-Rupp and all 18 new pumps installed in the plant were also provided by Gorman-Rupp.”

Gorman-Rupp has been manufacturing pumps for more than 85 years, and provides an extensive line of pump products for municipal WWTPs, as well as for applications in sewage, industrial, mining, construction, petroleum, OEM, government, agriculture and fire markets. Some of the 18 pumps in operation at Shelby WWTP had been in continuous operation since 1953 and the remainder since the plant’s 1977 upgrade.

“One of the biggest reasons why I pushed for Gorman-Rupp pumps to be specified in the bid was because our four major sewage and stormwater influent pumps, which were Gorman-Rupp pumps, had been running non-stop every day since 1977,” explained Brown. “The equipment was well maintained and the rear plates, rotating assemblies and impellers were routinely changed out, but if this rotary equipment lasted that long it has proven performance capability.”



Wastewater treatment facilities have their own brand of influent wastewater, a mixture of organic material, plastic, grit, rags, sand and other debris, notorious for clogging pumps in pump stations and plant headworks, requiring more robust pumps. The performance of pumps under these conditions is determined by the characteristics of the solids, their concentration, the viscosity of the liquid, the materials used in the construction of the pump and the operating conditions.

“Influent pumps are critical to WWTP operation because they control the flow of wastewater and stormwater into the plant,” explained Hall. “As design engineers, we would concur that these pumps running continuously for more than 40 years is testament to the design of the equipment and their proper maintenance.”

These four influent pumps were replaced with self-priming, centrifugal Super T Series® 10-inch pumps. The self-priming suction lift design of the pumps allows the design engineer to physically locate the pumps where access is a non-issue and routine maintenance can be completed quickly and easily. The pumps’ superior solids-handling capability makes them ideally suited for Shelby’s solids-laden influent.

“We were able to provide better control of the plant’s influent pumping by replacing and upsizing all of those pumps,” added Hall.

It is not just the influent pumps that have been replaced in the plant. Every process in the facility where wastewater and stormwater flows has been equipped with new pumps, and all of those pumps were manufactured and tested by Gorman-Rupp.

“Our pumps are installed at the WWTP’s new influent and stormwater pumping stations, as well as pumps in the clarifiers’ return activated sludge and waste activated sludge (RAS/WAS) systems,” said Vince Baldasare, Sales Manager for Engineered Systems at Gorman-Rupp. “We also installed sludge recirculating and transfer pumps in the anaerobic primary digester, and miscellaneous pumps throughout every process on the site where wastewater and stormwater flows.”



Charlie Brown, plant superintendent, with two of the new 18 Gorman-Rupp pumps installed during the upgrade.

“Gorman-Rupp was able to provide a complete mix of individual pumps for the plant’s specific processes, along with full, above-ground stormwater and activated-sludge pumping stations,” added Baldasare.

SCADA

Another improvement to the WWTP was the implementation of a plant-wide SCADA system. Designed and manufactured by Gorman-Rupp, the SCADA, for the first time, enabled an automated process capability of the plant’s operation.

“The difference is like night and day,” said Brown. “The operation of the plant has been transformed from 1950’s technology to state-of-the-art. We now have readouts in real time on what is occurring in the facility as far as DO and pH levels, what equipment is running and how well it is performing.”

Performance

Completed in 2019, these improvements have eliminated wet weather bypasses at the Shelby WWTP, addressed NPDES permit obligations, upgraded plant processes and infrastructure and improved treatment capacity.



Replacing the 1952-vintage blower turbines with new systems has resulted in a \$6,000 - \$8,000 monthly savings on electrical power usage.

“The quality of the effluent being discharged is definitely better,” added Brown. “Dissolved oxygen (DO) and total suspended solids, although within requirements prior, are now improved. The digestion rate has improved 25 percent, with less solids going out to landfill.”

Long-term water quality benefits associated with the reduction of a public and environmental health threat related to contact with untreated sewage bypassing the city’s WWTP has been achieved.

About Gorman-Rupp Pumps

For more than 85 years Gorman-Rupp Pumps USA has

manufactured pumps for municipal, sewage, industrial, mining, construction, petroleum, OEM, government, agriculture and fire markets.

The company’s extensive line of pump products include self-priming centrifugal pumps, standard centrifugal pumps, submersible pumps, rotary gear pumps, diaphragm pumps, engine-driven pumps, and priming assist pumps. In addition, Gorman-Rupp manufactures a complete line of state-of-the-art packaged lift stations and booster stations that include pumps, motors, controls, piping, accessories and enclosures.

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