There is No ‘One Size Fits All’ for Co-Digestion

by Dennis Clough and George Bevington

In recent years, the wastewater field has been challenged to redefine the role of wastewater treatment plants, elevating their importance through labels such as, “Utilities of the Future” and reclassifying the plants as “Water Resource Recovery Centers.” Confirming this need for wastewater treatment plants to evolve, the Water Environment Federation stated in October 2014:

“Resource recovery is an emerging societal need due to the ever increasing pressures on limited resources such as water, nutrients, and energy, and it is critical to recover these resources from waste streams.”

While this need is apparent, the method by which a wastewater treatment plant retools itself to recover these resources and to truly become a Utility of the Future is more complicated and can vary greatly from one facility to another. Highlighted here are the different methods being applied by three wastewater treatment facilities, which vary in size and are in different stages of the process of upgrading and enhancing their infrastructures. All have the common goal of becoming less dependent on fossil fuels via energy recovery, reducing their carbon footprints and, in one case, commencing nutrient recovery in order to provide the services required to become a Utility of the Future.

Large Wastewater Treatment Facility

Winchester, Virginia: The Frederick-Winchester Service Authority (FWSA) is an organization that has been a quiet anchor of the community. Since 1974, FWSA has provided reliable and effective sewage treatment for the citizens and businesses of Frederick County and the City of Winchester, VA. In recent years, FWSA has focused on becoming a more efficient organization, identifying ways to minimize costs to citizens and the community while providing new services and supporting local future economic development. In 2010, FWSA expanded its Opequon Water Reclamation Facility (WRF) to 12.6 millions of gallons per day (mgd) and upgraded for enhanced nutrient removal capabilities that met Virginia Department of Environmental Quality requirements.

Despite the expanded capacity of the facility, however, the 12.6 mgd enhanced nutrient removal facility was limited to aerobic treatment; no anaerobic treatment systems were present. Specifically, the liquid stream processes consisted of:
- Two headworks with screening and grit removal
- One influent pumping station
- Four primary clarifiers
- Five bioreactors
- One secondary anoxic/reaeration tank
- Six secondary clarifiers
- Two effluent filters
- Two chlorination basins
- Re-aeration cascade

The solids treatment processing included:
- Four gravity thickeners
- Four sludge holding tanks
- Sludge reaction tank
- Sludge retention tank
- Plate and frame filter presses with lime stabilization
- Landfill disposal for biosolids cake

FWSA, in keeping with its goals of minimizing costs to citizens and the community while providing new services and supporting local future economic development, sought to further expand the operations at this facility. Currently under construction, and preparing for full operations in May 2016, FWSA’s Opequon Water Reclamation Facility is being further improved through a $45 million facility-wide organics co-digestion, cogeneration and operational efficiency project. When completed, the Opequon WRF will be the first enhanced nutrient removal facility in the United States, with strict limits of nitrogen at 3 mg/L and phosphorus at 0.197 mg/L.
mg/L, to become a nearly net energy zero facility.

The centerpiece of the FWSA project is the Green Energy Facility – a new anaerobic digestion complex sized and designed, from inception, for high-strength organic waste co-digestion and electric cogeneration. The facility consists of three 1.25 million gallon digesters with a central digester control building, electrical cogeneration, and liquid/cake waste receiving. The high-strength organic waste receiving station allows tankers of pumpable waste to be unloaded at 400 gallons per minute to the storage/mix tank. The storage/mix tank provides a system waste wide spot allowing for intermixing via pumping of thickened WAS (waste activated sludge) with the trucked in organic wastewater and near constant digester feeding. At full operation the facility will have acceptance capability of 125,000 gallons per day of high-strength organic waste and co-digest this material with plant sludge in the primary anaerobic digesters. The identified organic wastes that will be accepted include trap grease, dairy processing waste, meat processing DAFT (dissolved air floatation thickener) sludges, beverage production wastes, and pretreatment/municipal biosolids cake. The biogas produced will run 848 kilowatts of electrical cogeneration that, at startup, will meet the majority of the treatment plant’s electrical needs.

Another unique aspect of this project is the installation of the Ostara Pearl® Process to recover and reduce phosphorus nutrient loading of anaerobic side streams to the liquid portion of the plant. The FWSA determined early in the design process that the receipt of organics could not consume any of the plants permitted liquid-side phosphorus treatment capacity. With dairy waste, which is high in phosphorus, forecasted to be a considerable portion of the incoming organic waste, this product was determined to be the most cost effective solution for side stream treatment. Since phosphorus is an element that may only be mined and is an essential ingredient for fertilizer and crop production, this process provides additional beneficial reuse.

Significant infrastructure renewal is part of the project as well, including aeration system improvements, new sludge conveyance and dewatering, primary electrical and emergency back-up systems, and facility improvements.

As a result of this innovative and multi-faceted project, FWSA has substantially increased its value to the community. Through increased revenue streams and enhanced efficiency, the facility has been able to self-funded needed infrastructure improvements without increasing costs to rate payers.

Medium Wastewater Treatment Facility

**Rome, New York:** The City of Rome, NY is located about 40 miles east of Syracuse in the Mohawk Valley. While rich in history, the City of Rome has experienced a decline in population growth since the 1970s and currently is home to 33,000. Changes in the local leather stocking industry and the closing of Griffith Air Force Base contributed to this diminished growth. In response to these events, the city’s leadership sought out opportunities to enhance the area’s existing assets, help drive economic development, and increase revenue resiliency. As a result, expanding Rome’s treatment plant facility in order to better serve the thriving dairy, food processing, and organics markets in upstate New York became a high priority.

Constructed in 1992, the Rome Water Pollution Control Facility (WPCF) was the first major treatment plant in the Mohawk Valley. The 12 mgd activated sludge plant facility has a long environmental treatment history and has undergone multiple improvement projects over the past several decades. The facility’s anaerobic diges-
increase in biogas generation which will drive an 800 kW generator system, sufficient for the Rome WPCF to become a net energy zero facility and export about 400 kilowatts back to the electric grid. Other improvements include dewatering, biogas storage, and miscellaneous items.

The second aspect of the feasibility study will determine if there is an adequate organics “wasteshed” within 100 miles of the Rome facility that can generate the tipping fees needed to justify the infrastructure investment. Preliminary discussions with haulers and generators indicate that there is in excess of 400,000 gallons per day of various types of organic wastes that would be suitable for acceptance at the Rome facility. Because this waste is within the acceptable distance for cost effective transportation, Rome is a desirable disposal option for these companies. The study will be completed in December 2015 with detailed design for the project beginning in early 2016.

Implementation of these measures is an essential step for the City of Rome as the community continues to seek out ways to increase economic development and provide essential services through its wastewater treatment facilities.

Relatively Small Wastewater Treatment Facility

Middletown, New York: The City of Middletown, NY has undertaken a citywide energy efficiency and sustainability project, looking to reduce operating costs and increase revenues through a variety of improvements across all city departments. A primary target for increased efficiency and added revenue opportunity is Middletown’s wastewater treatment plant because the plant is the city’s largest single user of energy and has an existing digester complex that is currently under loaded. Additional measures, such as building systems efficiency, LED traffic signals and streetlights, water meter replacements, and solar power systems, are also being addressed and will help the city fund needed improvements through utility and operational savings as well as enhanced revenue streams.

The wastewater treatment plant was designed to treat, on average, 8.5 mgd of sanitary wastewater from the City of Middletown and surrounding areas. The general process description is screening/grit removal, primary clarification, aeration tanks with activated sludge, final clarification and ultraviolet disinfection. Sludge is thickened – anaerobically digested in two 200,000 gallon primary digesters and one 300,000 gallon secondary digester – and dewatered by belt filter press. At present, biogas generated by the anaerobic digestion process is fired in a boiler to generate hot water to heat the digesters, and excess biogas is flared.

As part of the citywide efficiency project, the city plans to accept organic waste for co-digestion to increase biogas production and operate a cogeneration system to make the wastewater plant a net energy zero facility. Based on forecasted municipal flows, the Middletown facility has the capacity to accept 45,000 gallons per day of organic wastes, which makes this goal feasible.

The Middletown facility is smaller than the typical co-digestion plant, and is predominantly utilizing existing and repurposed infrastructure to become a Utility of the Future. The city does not want to build new digesters; rather, its officials want to maximize the functionality of their existing equipment. In order to accomplish the goal of operating a net energy zero facility, the city will embark upon a $15 million project, which is expected to begin construction in 2016. The scope of this project will include converting the existing secondary digester into a primary digester, converting an abandoned thickener tank into a digestate tank, installing two gravity belt thickeners, modifying and expanding the abandoned RAS/WAS (return activated sludge/waste activated sludge) building, replacing the gas flare, installing a 27,000 cubic feet biogas storage vessel, providing an organic waste receiving station, constructing a 180,000 gallon organic waste storage tank, and installing a 400 kilowatt biogas engine/generator with electrical interconnection and a biogas conditioning skid, along with miscellaneous piping and valves. No power export will occur. New odor control facilities will also be provided for the new sludge thickening and organic waste facilities.

Middletown’s comprehensive approach to increased efficiency with a focus on revitalizing the wastewater treatment plant will allow it to conserve resources, preserve funds, and enhance the livability of the community.

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What Ties All These Projects Together?

Each of the projects uses high-strength organic waste co-digestion as a tool to address their community’s needs. Issues concerning economic development, revenue resiliency, and operational efficiency will all be addressed without requiring additional funds from ratepayers. With so many significant benefits, however, one must ask why projects of this nature are not being implemented on a widespread basis.

According to the National Biosolids Partnership, there are 1,238 wastewater resource recovery facilities in the United States with operating anaerobic digesters. While the practice of organics co-digestion is widely discussed, it is not widely implemented, leading to the conclusion that clearly accepted technology and available infrastructure are not the issue.

The secret to the success of these projects is the people. Projects, like those highlighted, require commitment, determination, and a vision that goes beyond simple permit compliance. Developing a vision for what the utility can become – an integral part of the community and its economic structure – is the key to becoming a Utility of the Future.

Each of these projects was championed by dedicated, visionary leaders, and they are why the projects will be successful. In Winchester, FWSA Executive Director Jesse Moffett and Chief Operator Richard Wadkins ensure that their project gets top priority. In Rome, Department of Public Works Commissioner Frank Tallarino and Chief Operator Rick Kenealy serve as project advocates. In Middletown, Public Works Commissioner Jacob Tawil and Chief Operator Ben Brunning provide the vision for their utility’s future. These champions are advancing these projects and building support from the approval boards and the public to get the necessary financing to move forward.

Another common principle at the core of these projects is leadership’s desire to generate revenue from sources other than the ratepayers. Each currently raises revenue via wastewater charges at the head of the plant. The acceptance of high-strength organic waste that arrives by tanker will generate much needed new tipping fee revenue that will be used to pay for the necessary infrastructure, now and in the future. In addition, the New York facilities have applied for funding from the New York State Energy Research and Development Authority (NYSERDA) PON 2828, requesting financial assistance to install the necessary gas cleaning and engine generators required to make these facilities net zero. The NYSERDA grants have been instrumental in moving many New York State “green energy” projects forward over the past decade.

Co-digestion can work at many wastewater plants nationally with executive leadership vision, proper design, equipment selection and careful attention to understanding the organics wasteshed and securing sources of high strength organic waste for anaerobic digestion. Co-digestion can be one of the tools that wastewater facilities utilize to become a resource recovery facility similar to Winchester, Rome, and Middletown.

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Energy Performance Project Delivery

Each of the projects described here are being developed by Energy Systems Group via the energy performance contracting project delivery method. An energy savings performance contract is a contractual agreement with a company for the scope development, design, construction, and performance measurement of system and infrastructure improvements that will result in annual operational cost savings or new revenue generation.

These financial benefits are sufficient to cover some or all of the cost of the project. As part of the contract, the company provides a financial guarantee for the annual financial benefits for the life of the contract. This guarantee helps to minimize the owner’s financial project risk. This financial guarantee is different from the performance guarantees product manufacturers provide in order to insure their equipment meets a minimum output, result or set of characteristics. Energy savings performance contracting is a turn-key service, sometimes compared to progressive design/build contracting, with the addition of the overall project financial savings guarantee.