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THOUGHTFUL PLANNING AND OPERATIONAL EXCELLENCE PROVIDE AN AWARD-WINNING COMBINATION IN BLOOMINGTON-NORMAL, ILLINOIS

STORY: **Steve Frank** | PHOTOGRAPHY: **Bradley Leeb**

Matt Mink checks biosolids consistency in the gravity belt filter press (Komline-Sanderson) at the Bloomington-Normal Water Reclamation District Southeast plant site.

When the Bloomington-Normal Southeast Wastewater Treatment Plant won a 2018 Plant of the Year award from the Illinois Association of Water Pollution Control Operators, team members were ecstatic.

Randy Stein, executive director and sports fan, likened it to winning the "Stanley Cup of wastewater." On its way to the award (in Group 1 for plants larger than 7.5 mgd), the plant racked up 12 consecutive Gold Peak Performance Awards from the National Association of Clean Water Agencies.

The Bloomington-Normal Water Reclamation District was formed in 1919 and serves Bloomington, Normal, and the Village of Downs and subdivision of Crestwicke in central Illinois, with a total population of 134,000. The award recognizes safety, permit compliance, operations staff knowledge, and cleanliness and maintenance. A long-standing habit of excellence and effective planning set the plant up for the award.

CONVENTIONAL ACTIVATED SLUDGE PLANT

The Southeast plant (7.5 mgd design) began operating in June 2005. Jake Callahan, director of operations, describes it as a "conventional activated sludge plant." Preliminary treatment includes Spiralift screw pumps (Evoqua Water Technologies) and a Waste Tech Model 1300 bar screen with three-eighths-inch separation (Kusters Water, division of Kusters Zima Corp.) followed by a

Caitlin Raasch monitors secondary treatment air flows by way of the plant SCADA (GE Digital).

grit trap (Smith & Loveless) and grit washer (Parkson Corp.). The lift stations to the two primary clarifiers use three 125 hp Pentair - Fairbanks Nijhuis pumps. Each clarifier has a Toshiba sludge density meter.

Anoxic tanks are upstream of the five aeration tanks. "They help control the filaments in the activated sludge process," Callahan says. "We run a higher solids retention time and get good nitrification in winter when the biology slows down. And we don't observe any settling issues with the biological floc in our secondary clarifiers." The anoxic tanks have Environmental Dynamics International FlexAir mini-panel fine-bubble diffusers. Blowers are 300 hp Turblex Model KA10SV-GL210 operated with dissolved oxygen control.

Flow then goes to the two 115-foot-diameter center-feed secondary clarifiers for settling. Tertiary treatment consists of a traveling bridge filtration system. Media is anthracite coal on top, followed by coarse and then fine sand. Final effluent is disinfected by a TrojanUV UV4000 system. "This system has worked well, has been stable and is easy to maintain," Callahan says. Final effluent is discharged to the Little Kickapoo Creek.

Solids are anaerobically digested to Class B standards, thickened and dewatered. Employees apply the material to farmers' fields within about 30 miles of the plant. "We haul it and we spread it," Callahan says. "That way they know where it's been applied and the application rate is correct. Things are going pretty smoothly." One reason is the SCADA software: "A lot of thought was put into our WIN-911 software, which dials out to the on-call operator when there's a problem."

Bloomington-Normal (Illinois) Southeast Wastewater Treatment Plant

BUILT:
2005

POPULATION SERVED:
134,000

FLOW:
7.5 mgd design

RECEIVING WATER:
Little Kickapoo Creek

TREATMENT LEVEL:
Secondary

TREATMENT PROCESS:
Activated sludge

BIOSOLIDS:
Land-applied

ANNUAL BUDGET:
$2.5 million (West and Southeast plant operations)

The team at the Bloomington-Normal Southeast Plant includes, from left, Tyler Graf, Randy Stein, Tom Anderson, Matt Mink, Caitlin Raasch and Jake Callahan. The plant is named for Callahan's uncle.

Callahan checks the status of the TrojanUV4000Plus (TrojanUV) disinfection system.

The plant also has a unique post-disinfection treatment stage: An experimental constructed wetland removes nutrients from about half of the plant's discharge. The wetland has hiking trails and bird-watching sites that make it a getaway for area citizens.

Plant managers sent Jon Outlaw, operator, and Tom Anderson, chief mechanic, to run the plant when it started up in 2005. Stein notes that the plant was designed to run with just one operator and two maintenance people. The operator and maintenance person sent to run the plant in 2005 are now nearing retirement.

CRITICAL TRAINING

In 2019, the district began rotating three of its experienced operators to the Southeast plant two weeks at a time so they could learn the process. Six operators cover the Southeast plant and West plant, the larger of the district's two plants.

The West plant site has two treatment plants that discharge to Sugar Creek. One is a two-stage fixed-film plant with rock filters for BOD removal, nitrifying towers for ammonia removal, deep-bed sand filters and UV disinfection. The other is a conventional activated sludge plant with low-head traveling bridge sand filters, UV disinfection and post-aeration.

The district's operations and maintenance team, in addition to Outlaw and Anderson, includes:

- Josh Stevens, West plant chief operator
- Mason Willis, operations foreman, and wastewater operators Ian Magerl, Caitlin Raasch, Jason Beach, Matt King and Matt Mink
- Brian Romine, solids foreman
- Southeast plant maintenance staff members Brant Ladick and Tyler Graf.

The Southeast plant is a one-operator, five-days-a-week, eight-hours-a-shift gig. It has an advanced SCADA system — GE Digital with Allen-Bradley PLCs (Rockwell Automation) — that talks to the West plant via radio telemetry. Operations and maintenance staff are always on call for extreme weather or upsets. The SCADA system can alert the on-call operator when the plant is not staffed, and operators can respond to many alarms via their cellphones without having to report in.

In the first six months of 2019, the district hired three new operators and amped up its training. "We're trying the get some of the younger staff exposure

at the Southeast plant," Callahan says. "We want them to become familiar with the treatment systems there and have more opportunities to make decisions on their own." This is where the two-week rotations help.

COACHING THEM UP

The rotations and cross-training also help with communication and information transfer among operators. "Communication and collaboration have been important to our success," Callahan says. "They've taken ownership and strive to find information and work together. With three new operators hired in six months, our senior operators have taken the initiative to coach up new operators."

> "We run a higher solids retention time and get good nitrification in winter when the biology slows down."
> **JAKE CALLAHAN**

Caitlin Raasch uses a solids meter (YSI, a Xylem brand) to measure mixed liquor suspended solids levels in an aeration basin.

"They're all actively pursuing certifications, and continuing education is something they appear to enjoy. They're also rewarded when they get those certifications."

The staff is active in professional organizations. Stevens is past president of the Illinois Association of Water Pollution Control Operators; Magerl is president of the Central Illinois Professional Wastewater Operators organization. Stein and Callahan regularly attend meetings of the Illinois Association of Wastewater Agencies, a manager-level organization.

The district regularly sends operators offsite and even out of state for advanced training. "We encourage taking advantage of educational opportunities," Stein says. "We send people out all the time, including to the University of Wisconsin-Madison. Their programs typically last four to five days and cover topics of interest to the district. We're not afraid to spend money on education."

NATURAL NUTRIENT REDUCTION

Constructed wetlands for removing nutrients from effluent have been around for a while, but not all agencies that have the idea had the institutional foresight that the Bloomington-Normal (Illinois) Water Reclamation District did.

In 2006 — the year after the Bloomington-Normal Southeast Wastewater Treatment Plant came online — Kenneth Schroeder, district board chairman, opened the valve that allowed effluent to flow to 18 acres of experimental constructed wetland next to the plant. "The focus was to show the ability of wetlands to further clean effluent," says Jake Callahan, director of operations.

Schroeder believed the plant could coexist with nature and be a plus for the community. He supported the wetland idea and the 280 acres the district acquired around the plant as a buffer, now a wildlife refuge named for him. The wetlands comprise 18 acres, the plant sits on 15 acres and the remaining acres became the wildlife preserve, complete with trails, bird-watching stations, forest, prairie and savanna.

The district maintains the preserve, and citizens have access to it from dawn to dusk daily. The wetland post-disinfection treatment idea didn't work at first; it was far too popular with waterfowl, which ate all the plants.

A consultant diagnosed the problem. Now, the first two 18-inch-deep ponds (the original wetland ponds) are used as cooling ponds for effluent, which is discharged at about 55 degrees F during winter. Three final 12-inch-deep ponds host vegetation that performs nutrient removal during the growing season.

The final three shallow wetland ponds receive the cooled effluent in winter, freeze and get a sheet of ice. The plants in the shallow ponds thrive and pop up again in the spring, and nutrient removal works as planned.

Callahan observes, "We get about 90% nitrate-nitrogen removal from April through October and about 50% total phosphorus removal."

NUTRIENT REMOVAL

The Southeast plant was designed with a nutrient-removal-ready footprint. "We expect the Illinois EPA to issue a new permit in August 2020 with a compliance date of 2030," Callahan says. "Not as much construction will be required at the Southeast plant as at the older West plant to enable it to meet permit; it's newer and more ready to host new processes."

One useful new capability is an Orion 420 weather station (Columbia Weather Systems) at the Southeast plant and another at a pump station about 10 miles upstream. These stations record rainfall intensity and duration. The district has integrated real-time weather data into the SCADA system; that helps operators predict impacts on plant operations. Having weather data interfaced between SCADA and lab data software helps in post-event analysis and eliminates hand entry of data.

The staff has also reduced the electric power bill at the Southeast plant. As the local electric utility's largest customer, the district has worked with utility staff to find a win-win on high-demand summer days when power consumption for air conditioning is high and the electric utility wished the treatment plant would use less power.

> "We expect the Illinois EPA to issue a new permit in August 2020 with a compliance date of 2030."
>
> **JAKE CALLAHAN**

The district tied a 2 MW, diesel standby engine-generator (Caterpillar Inc., Electric Power Division) into its SCADA system. When the electric utility tells the district to shed the treatment plant's electric load for the next four hours, an operator enters the changeover times into the SCADA system.

RATE SAVINGS

At the appointed moment, SCADA fires up the generator and performs a closed-transition transfer of demand to it. At the predetermined time to switch back, SCADA returns the power draw back to the electric utility and shuts the generator down.

Using the standby generator for primary power for those four-hour peak demand periods gets the district a substantial electric rate reduction throughout the year. The district had to modify the standby generator to produce lower emissions and comply with air-quality regulations affecting primary power sources.

Bloomington-Normal Southeast Wastewater Treatment Plant PERMIT AND PERFORMANCE

	INFLUENT	EFFLUENT	PERMIT
CBOD	124 mg/L	< 2.0 m g/L	10 mg/L
TSS	225 mg/L	1.8 mg/L	12 mg/L
Ammonia nitrogen	23.09 mg/L	0.05 mg/L	1.6 mg/L

The district is considering a new blower system for the Southeast plant that will use less horsepower and allow operation with lower dissolved oxygen values. The flow train through the secondary process will also change. "We're parallel plug flow now, but we're capable of serpentine flow in series," Stein says. "We could possibly have a split serpentine flow through five aeration basins."

There are also plans to nitrify and denitrify in the aeration tanks. "We're already investigating the software our SCADA system will require to do this," Stein says. Some methods that might be used to remove phosphorus at the Southeast plant have been piloted at the West plant.

An innovative measure is in place to control influent at the Southeast plant. Although the plant's collections system is a separate sanitary sewer system, excessive inflow and infiltration during sustained wet weather has shown the potential to flood the plant grounds.

To prevent that, a 54-inch interceptor lies in a mostly flat grade approaching the plant for temporary influent storage. Flow travels from the three communities about 6 miles to the plant, and there are virtually no connections in the final 3 miles.

With the aid of a highly accurate electrohydraulic actuated sluice gate (REXA) for surge control in the almost-flat interceptor, roughly 1.23 million gallons of influent can be stored there and throttled slowly into the plant. "It works well," Callahan says.

Stein observes, "When we have a 3-inch rain overnight, I don't get nervous about flooded pump stations." tpo