top performer: **PLANT**

Ingenuity Saves

THE STAFF IN BAD AXE, MICH., COLLABORATED IN DESIGN OF A PLANT UPGRADE AND LATER MADE IMPROVEMENTS THAT CUT ENERGY USAGE AND DROVE DOWN COSTS

By Trude Witham

Operator Dennis McCabe checks ORP levels for the Envirodyne oxidation ditch at the Bad Axe treatment facility. (Photography by Samantha Jackson)

BACK IN 1861, TWO SURVEYORS CAMPING IN THE wilderness of what is now Huron County, Mich., found a badly damaged axe. The site became known as Bad Axe Camp.

Today, the city of Bad Axe is home to 3,400 people and a well-run wastewater treatment plant. But success didn't come easily. Built in the 1940s and upgraded in 1955 and 1984, the 610,000 gpd activated sludge plant was run down and nearing the end of its service life by 1997. Operators were having trouble handling BOD and ammonia loads.

"Our ammonia and BOD limits were tight, and the plant was prone to upsets," says Scott Boshart, director of public works. "We would violate our discharge permit limits, typically not by much, but often enough to make it a problem."

The plant went through a pair of five-year permit cycles to get to the upgrade that went online in late August 2007. "We had been through several superintendents, so we asked the Michigan Department of Environmental Quality to allow us to see what the plant was capable of – do the engineering study and agree to a compliance schedule to do the upgrades in the next permit cycle," says Boshart.

The $6.3 million upgrade included switching from conventional activated sludge to oxidation ditch treatment. Today, the plant consistently meets its permit requirements and operates much more efficiently than before. Annual cost savings from the upgrade and the operators' own innovations include:

- Potable water, $75,000.
- Natural gas, $20,400.
- Electricity, $3,000-4,000.
- Ferric chloride, $4,000-8,000.
- Biosolids, $15,500.
- Staff overtime, $20,000.

MULTIPLE IMPROVEMENTS

The 2007 upgrade reshaped the plant's process and equipment. It included a new clarifier and two rebuilt existing clarifiers (Envirodyne), a new raw sewage pumping station with ABS raw sewage, scum station and non-potable water pumps, and a preliminary treatment building with an automated 1/4-inch bar screen (Siemens) and automated grit removal (WesTech).

The new secondary treatment building includes electrical, SCADA, return activated sludge, waste activated sludge, and non-potable water systems, and the dechlorination system. The upgrade also included a 482,000-gallon Aquastore biosolids storage tank (Engineered Storage Products Co.), ITT

Panorama view of the Bad Axe (Mich.) Wastewater Treatment Plant.

profile

Bad Axe (Mich.) Wastewater Treatment Plant

BUILT:	1940s
POPULATION SERVED:	3,400
EMPLOYEES:	5
FLOWS:	0.61 mgd design, 0.4-0.5 mgd average, 2.4 mgd peak
TREATMENT LEVEL:	Secondary
TREATMENT PROCESS:	Oxidation ditch
RECEIVING WATER:	Bad Axe drain
BIOSOLIDS:	Dewatered, land applied
WEB SITE:	www.cityofbadaxe.com

Members of the Bad Axe clean-water team include, from left, director of public works and wastewater treatment plant superintendent Scott Boshart, and operators Dennis McCabe, Ken Nicholas and Jake Schumacher.

STAYING CONNECTED

The staff at the Bad Axe Wastewater Treatment Plant has made large strides to enhance performance and boost efficiency, but not without help.

Director of Public Works Scott Boshart notes that staff at the Michigan Department of Natural Resources and Environment (formerly called the Department of Environmental Quality) supported the plant's efforts before and after the major plant upgrade in 2007.

"The regulators, while pushing us to upgrade, have worked with us, and the operator training unit has always been there for us from education to troubleshooting," says Boshart. "Those guys have been a great resource."

The city is a member of the Michigan Rural Water Association (MRWA), which Boshart regards as another great resource. Boshart himself is a member of the Michigan Water Environment Association (MWEA).

"Our MWEA section holds quarterly meetings to get operators together for a short training session and lunch," he says. "A number of plants in our section have been through upgrades. We hold our meetings in those communities and tour the facilities."

Boshart stresses the importance of networking. "Don't be afraid to visit other facilities and talk to other operators," he says. "Ask for help or just talk about what's going on. The information can be priceless."

Water & Wastewater – Flygt return activated sludge pumps, ABB mag meters, Diadisk sludge transfer pumps (Fluid Tech Group Inc.), Stenner chemical feed pumps, Teledyne Isco samplers, and Generac backup generator. The old aeration tanks and primary settling tanks were abandoned in place, and the digester became the primary biosolids thickener.

Besides allowing the plant to meet its permit limits for BOD and ammonia, the oxidation ditch more effectively handles higher flows caused by infiltration when groundwater levels are high. The oxidation ditch from Envirodyne holds 835,000 gallons in three concentric rings, whereas the old aeration tank held 267,000 gallons.

Another plus was getting rid of the aeration blowers in favor of brush rotors in the ditch. "You could hear those things half a mile away, and now the plant sounds like a waterfall when you're in the park next door," Boshart says. "We have residents across the street, so there had to be some happy people when those blowers were shut off."

A bar screen system from Siemens is shown in the foreground with the WesTech grit removal system behind it.

HIGHLY QUALIFIED

Although the upgraded equipment makes a major difference, it's the staff that makes the plant successful, Boshart observes. Three full-time operators take care of the plant and 12 lift stations. They, along with Boshart and engineering consultants Fishbeck, Thompson, Carr & Huber designed the upgrade together. Plant personnel directed the engineers on the upgrade plans and asked for the most energy-efficient and cost-effective processes.

> "The preliminary treatment was one of the biggest improvements to the plant. We insisted on a top-notch headworks, and that's what we have."
>
> **SCOTT BOSHART**

Boshart started in wastewater treatment in 1989 and holds Class A and L1 wastewater licenses, as well as F2, D2, S2 water and A-1i stormwater licenses. He has been with the plant full-time for six years and was contracted as interim superintendent a few times since 1996.

Boshart's office is at the plant. He helps with some daily tasks and often walks through to monitor operations. Middle-seniority operator Dennis McCabe takes over when he is gone. He holds a Class B license and has been with the city for eight years.

Operator Ken Nicholas holds a Class D license and has been with the plant for 25 years. Jason Schumacher worked for the Public Works Department in other capacities for several years before becoming an operator four years ago. He holds a Class D license.

The operators rotate responsibilities for operations, laboratory and maintenance each week. They also rotate weekends to check the plant and lift stations.

"Everyone gets to know the whole plant, and that keeps things pretty versatile," says Boshart. "We do as much of the maintenance as we can, and we did a lot of the demolition of the old plant equipment, like removing the old blowers, raw sewage pumps and digester cover.

"We all worked together to learn the new equipment, and we have been working together to get the best biological nutrient removal results. Our goal is to keep perfecting this and keep the plant looking and functioning like

ABOVE: ITT Water & Wastewater – Flygt return activated sludge pumps and meters, and the non-potable water system tank (black, in back corner). RIGHT: Operator Dennis McCabe takes readings to monitor the aeration process.

this 15 to 20 years from now. The guys take very good care of the facility, and we've received numerous compliments from visitors that the place hardly seems like a wastewater treatment plant."

SOLVING PROBLEMS

The operations staff routinely steps up with ideas to fix process issues and to improve operating performance and efficiency. For example, shortly after the upgrade, a filamentous bacteria issue caused violations for solids, BOD and ammonia. But the problem was under control in a few days, and the staff made changes to the dissolved oxygen monitoring locations and levels so it wouldn't happen again.

"We have the ammonia removal well in hand, and we have fine-tuned the aeration process to get good phosphorus removal to meet the 1.0 ppm monthly average limit," says Boshart. The staff now keeps the first ring of the ditch at zero oxygen, and all return and raw sewage flow goes into that ring. In the next ring, the oxygen is raised to 2.0 ppm.

The staff found immediately that the new plant could meet its phosphorus limit with less ferric chloride addition. But by experimenting with the aeration setup, they were able to reduce the ferric addition by 25 percent, then 50 percent, and finally 100 percent.

"We used to get a new load of ferric every six months, and we pushed that to eight to nine months, with a goal of once a year," says Boshart. "Then last July, we were able to turn off our ferric feed and maintain effluent phosphorus levels within limits."

City of Bad Axe Wastewater Treatment Plant
PERMIT AND PERFORMANCE

	INFLUENT	PERMIT (MONTHLY)	PERMIT (7-DAY)	PERMIT (DAILY)	EFFLUENT (12-MONTH)
$CBOD_5$	264 mg/l	15 mg/l (Jan-Feb) 10 mg/l (Mar-Apr) 4.0 mg/l (May-Nov) 13 mg/l (Dec)	N/A N/A N/A N/A	23 mg/l 15 mg/l 10 mg/l 19 mg/l	3.5 mg/l
TSS	187 mg/l	30 mg/l (Dec-Apr) 20 mg/l (May-Nov)	45 mg/l 30 mg/l	N/A N/A	6.0 mg/l
Ammonia	24.6 mg/l	13 mg/l (Jan-Feb) N/A (Mar-Apr) 0.5 mg/l (May-Nov) 7.9 mg/l (Dec)	N/A N/A N/A N/A	N/A 11 mg/l 2.0 mg/l N/A	0.38 mg/l
Total P	4.5 mg/l	1.0 mg/l	N/A	N/A	0.5-1.0 mg/l

BIG SAVINGS

In total, the upgrade has paid off to the tune of $130,000 per year in operating cost savings. "We cut $1,700 a month in natural gas costs by eliminating the digester and the heating it required," says Boshart. "We are now using the primary digester as the primary sludge thickener, and we're using the secondary digester and new storage tank for final thickening of the biosolids. Final disposition is land application."

The plant had added the digester in 1955 and the secondary digester in the early 1980s. The 1984 upgrade was intended to provide for gas storage to heat the solids with digester methane, but the digester ended up being heated instead with natural gas.

Other changes have reduced costs, as well. A non-potable water system, along with some changes made before the upgrade, saves $75,000. Final effluent rather than city water is now used for purposes like chlorine feed and tank washing, which consumed 20,000 gallons of potable water per day. A submersible pump at the end of the chlorine contact chamber now feeds a bladder tank, which in turn feeds the chlorination system.

The plant switched to a lower primary electric rate structure by taking ownership of its power transformer and switchgear. The city is now responsible for maintenance and repairs on that equipment and delegates the work to a local electrical contractor.

"We also have a new backup gen-erator that can run our whole facility if the power goes off," says Boshart. "It has a 1,250-gallon diesel fuel tank, which we modified after the project to fuel our public works equipment."

Now that the plant can process high ammonia levels, the city accepts leachate from a local landfill containing 600 ppm of ammonia. That brings $30,000 to $35,000 in annual revenue. The leachate is delivered by tank truck to one of the old aeration tanks and is slowly fed to the head of the plant.

SAVING LABOR

The upgrade has made some tasks easier. For example, the automated bar screen and grit removal system replaced a comminutor and manually cleaned grit channel. The poor headworks caused excessive wear and constant plugging of pumps and piping. The staff now can focus on routine maintenance and getting the most out of the plant.

"The preliminary treatment was one of the biggest improvements to the plant," says Boshart. "We insisted on a top-notch headworks, and that's what we have."

With capable dedicated operators and efficient, energy-saving processes, the Bad Axe treatment plant looks to a bright future of quality service to its community. tpo

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