Wastewater Tunnel Repair

Hemer, Germany

Contractor / Applicator
BAWAX GmbH

Products Used
PATCH'N PLUG, CONCENTRATE

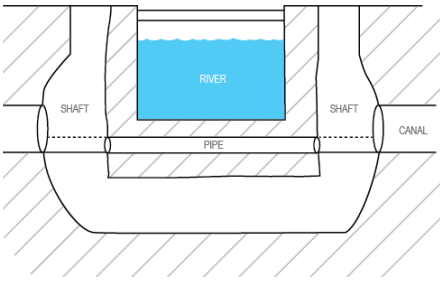
The leaking culvert is indicated by the arrow and yellow line on the aerial photo above. The culvert is located about 14 meters below ground and below the Oese River. About 30,000 vehicles per day pass through this major intersection in the city of Hemer. Complete replacement of the culvert was ruled out due to the extensive traffic disruption this would have caused, as well as a cost of approximately €400,000.

On its way to the North Sea—by way of the Rhine River—the Oese River meanders through scenic Hemer, Germany, passing through neighborhoods and under roads along its path. At one important junction, a key wastewater culvert passes under the Oese River at the same point where the river flows under a heavily travelled intersection.

In 2014, the Hemer department of waste water, as part of a routine inspection by remote camera, discovered that a large amount of water was leaking into the precast box culvert, known as a Düker in German. Each of the culvert's 16 precast segments were leaking profusely as a result of deteriorated seals and constant hydrostatic pressure imposed by the river flowing just above.

According to Hemer site manager Astrid Hanzen, who oversees the maintenance and repair of the city's wastewater infrastructure, the wastewater culvert under the Oese River was leaking approximately 20 liters (5.3 gallons) per second, amounting to more than 1.7 million liters (449,000 gallons) per day.

At that rate, the leaking culvert was costing the city tens of thousands of Euros per year in extra wastewater processing fees. The city considered a number of solutions to fix the culvert, including complete replacement, a spiral wound lining, and various repair coatings.



Built in 1979, the precast box culvert— known as a Düker in German—passes under the Oese River and serves to provide overflow capacity for stormwater.

Replacement ruled out

Replacement of the culvert, which had been installed in 1979, was ruled out for multiple reasons, including:

- Temporary rerouting of the river would be required;
- Traffic—more than 30,000 vehicles per day—would be disrupted for approximately four months; and a
- Cost of about €400,000 ($456,269 USD).

While relatively small at just 16 meters (52 feet) in length and 1 m x 2 m (3.3 ft x 6.6 ft) in cross section, the culvert's position under the Oese River and below a complex urban intersection made it a challenging repair project. Fortunately for Hemer, the ultimate solution had already been used to repair several of the city's leaking manholes.

"When Hemer came to us with this challenge, we had no doubt we could solve this problem using Xypex Crystalline Waterproofing products," says Georg Schae-

Every joint between segments of the precast box culvert was leaking prior to the repair project. It is estimated that more than 1.7 million liters per day was leaking into the culvert from the Oese River, which flowed just above the structure.

The Bawax applicator cleans an overhead joint between precast segments of the box culvert to provide a clean space for the application of Xypex Patch'n Plug.

Xypex Patch'n Plug was applied to 102 meters of leaking cracks and joints between segments of the precast box culvert. Here, as the Bawax applicator completes the first phase of the project, most leakage has been halted.

Culvert coated with Xypex Concentrate crystalline waterproofing.

fer, managing partner of Bawax GmbH, a structural waterproofing contractor based in Celle, Germany. "We had fixed some leaking manholes in Hemer using Xypex a few years ago. However, the location of the culvert four meters below ground and under the river posed a number of unique problems, including a continuous influx of water during the project, the tight working space, and need to manage heavy vehicle traffic around the work site."

Although Hanzen and her staff was aware that Xypex waterproofing products had been used on other smaller projects in the city, they carried out their due diligence to verify that it could solve the aggressive leaks in the culvert.

"We researched how Xypex had been used on other similar projects by studying journals and making phone calls to other communities that have already used the system, asking for their opinions and experiences," Hansen notes. "The results were consistently positive so we contracted with Bawax to make the repair."

Tight repair window opens

It was determined that the six-week school break in the summer of 2017 would be the optimal time to carry out the repair. Traffic would be somewhat reduced and the chance of rain would be less. The crew would still have to deal with the continuous inflow of water from the river; however, at least storm runoff would be less likely to be an issue. Or would it?

"Of course, we were hit with unusually heavy summer rain storms twice during the project," recalls Schaefer. The summer storms each set the project back several days. He notes that his firm deployed a three-person crew to carry out the repairs. Two traffic lanes had to be redirected around two manholes, which was managed by the city's traffic control officers.

"We opened manholes at either end of the culvert and used the manhole at the upper end of the culvert to provide work access and the manhole at the lower end to pump

out water and blow in fresh air," Schaefer explains. The culvert had to be cleaned of dirt and debris and pressure washed to provide a clean joints and surfaces.

Patch'n Plug stops the leaks

The first phase of the project required the Bawax applicator to fill in all of the joints between the precast culvert sections with Xypex Patch'n Plug fast-setting hydraulic cement compound. Patch'n Plug stops flowing water in seconds and is used to seal cracks and other holes or defects.

At only one meter high, the culvert was a tight space to work in. The applicator used a low dolly to move inside the culvert, which also kept him out of the ever-present water that continued to rush in. Excess water was pumped out from the lower end, using several pumps.

For particularly large cracks, primarily along the bottom of the culvert, the applicator used a rubber gasket strip pushed deep into the crack to reduce the water flow, thereby enabling him to fill the gap completely with Patch'n Plug. Xypex crystalline waterproofing technology is cement based so it permanently bonds to concrete and masonry. The active chemicals in the product diffuse into the substrate and react with moisture and the constituents of hardened concrete to generate a non-soluble crystalline formation that prevents the penetration of water from any direction.

Once the 102 meters (335 feet) of leaking joints were sealed, the applicator then coated the entire interior (approximately 96 m^2) of the culvert with Xypex Concentrate, which is a cementitious slurry consisting of Portland cement, finely graded sand and active proprietary chemicals. Xypex Concentrate, like Patch'n Plug, prevents the penetration of water and other liquids from any direction and can seal hairline cracks in concrete of up to 0.4 mm.

Bawax has provided structural waterproofing for new construction and renovations for more than 30 years. The firm was one of the first licensed applicators of Xypex in Germany and later became a distributor. Xypex Admix C-1000 NF was the first and remains the only admixture sealant approved by Germany's top certification organization, Deutsches Institut für Bautechnik (DIBt).

The culvert repair project was completed within the six-week school vacation window and the culvert remains leak free to this day. In fact, the Hemer public works department conducted a remote video assessment of the culvert in the summer of 2018, one year after culvert was repaired. The culvert showed no signs of leakage.

Fast payback

The successful repair of the culvert cost Hemer about €74,000 ($85,000 USD) and required about six weeks of minor traffic diversions. By contrast, a complete replacement of the culvert would have required a complete detour of traffic for up to four months at a cost of more than €400,000. In addition, the repair is saving the city tens of thousands of Euros per year in extra sewage processing fees.

"We continue to use this same repair process for other problem situations, such as leaking manholes and other wastewater infrastructure, particularly where other repair procedures or techniques have failed," notes Hemer's Astrid Hanzen. "The combination of Xypex waterproofing products and Bawax skilled applicators provides a cost-effective solution with minimal downtime."