

A Northern Kentucky utility demonstrates environmental stewardship through a multifaceted expansion of its headquarters complex

Teresa Zumwald

LEADING BY EXAMPLE

When Sanitation District No. 1 of Northern Kentucky (Fort Wright) began planning an expansion of its office and industrial complex, leaders didn't want a classic square building on a conventional site with a giant retention pond and acres of pavement. They asked, "Why not showcase one or two stormwater best management practices (BMPs) onsite instead?"

"As the region's stormwater utility promoting stormwater BMPs and water quality improvements, we could not miss an opportunity to demonstrate these BMPs ourselves," said Jeff Eger, the district's general manager.

Eger admitted that a site showcasing stormwater BMPs — funded primarily with ratepayer dollars — was a bold concept for the district, which collects and treats wastewater and manages stormwater in Northern Kentucky. "Some of the original engineers on the project were concerned



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Student scientists conduct experiments and make observations in the wetland classroom, located between the site's wetland and retention pond.



that these BMPs wouldn't work on our site," he said. "But we overcame the skepticism and the naysayers and surrounded ourselves with professionals who shared our vision and understood the paybacks. Then the project snowballed."

Today, the district is demonstrating a dozen stormwater BMPs at its headquarters, located 15 minutes from downtown Cincinnati. The \$3 million, 5.7-ha (14-ac) site, called Public Service Park, features a vegetated roof, an aboveground cistern to capture roof runoff for reuse, porous pavements (permeable asphalt, permeable concrete, and permeable pavers), an oil-water separator, an urban forest, a wetland forebay, a biofiltration ditch, a vegetated swale, a retention pond, and a detention basin. District leaders believe these demonstrations will encourage more widespread use of stormwater BMPs in the region.

"Were developers in Northern Kentucky ready to talk about vegetated roofs and porous pavements? No way," Eger said. "But if we hadn't put BMPs on our site, we'd be that much further behind today. We want developers to see these BMPs at work and incorporate some of these practices into their development plans."

Since its dedication in 2004, Public Service Park has become not only a BMP proving ground but also an environmental learning center with complementary public education programs about stormwater and water quality. For example, the district partnered with local school districts to develop an environmental curriculum, aligned with 24 academic Kentucky Core Content Standards, now being taught at nearly every public school in Northern Kentucky. The district also created a half-day guided tour, aligned with 17 content standards, which enables elementary

school students to follow the journey of a drop of water through the park. The tour leads students from a vegetated rooftop, across porous pavement, through a wetland, and ultimately to nearby Banklick Creek, where they can see how their everyday actions affect water quality. Similar tours are available for developers and other groups, and self-guided tours are available to the general public. The park is open from 8 a.m. until dusk daily, and admission is free.

"Besides just demonstrating stormwater BMPs, we wanted to create an interactive site that children would want to visit," Eger said. "Our goal is promoting environmental stewardship behaviors that we hope will last a lifetime."

What began as a modest plan for expanding an office and industrial complex evolved into a multifaceted, multipurpose initiative that demonstrates the efficiency of government, embodies the district's commitment to environmental stewardship, and encourages the public in Northern Kentucky to follow suit.

Evolution of a Stormwater Park

Besides collecting and treating wastewater for 33 municipalities in Boone, Campbell, and Kenton counties, with a total population of more than 320,000, the district manages a regional stormwater program to improve water quality. Gradually, the district will assume ownership and maintenance responsibilities for the public storm sewer systems serving 35 municipalities in the three counties. Before the district became the region's stormwater utility in 1998, these 35 municipalities found it difficult and expensive to implement and enforce separate stormwater regulations.

"Northern Kentucky has experienced tremendous growth over the last decade, and there's no letup in sight," Eger said. "We knew the region could not continue developing land in the same way without significant water quality and quantity problems in our downstream communities. By implementing stormwater BMPs, we can develop land in a way that minimizes impacts on our creeks and streams. The district wanted to demonstrate this through our site expansion and lead by example."

The concept had unwavering support from the district's board of directors and political leaders in Northern Kentucky. "They saw our vision right away and weren't afraid to take a risk, because they liked the public benefits that would come from the park," Eger said.

Nevertheless, technical challenges existed. The team knew the vegetated roof technology



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Hands-on experiments are part of the district's award-winning environmental unit, which inspires students to make changes in their community.

had to be applied properly to avoid compromising the facility's structural integrity and prevent leaks. "After we finally got everyone's buy-in, we agreed to double the size of the vegetated roof by installing it atop the main office building, not the smaller maintenance garage, to gain even more environmental benefits," Eger said.

Some of the earliest porous pavement test samples weren't porous enough. When water poured on one sample ran off the edges, contractors were sent back to the drawing board. "Because we spent time developing and testing different mix designs, developers who want to use porous pavement don't have to do R&D," Eger said. "This makes it easy for developers to implement these BMPs and still make money."

Eger said another challenge was siting a larger office complex, sufficient parking, and a dozen BMPs on a fairly landlocked site. But the district persisted. Because a massive right-of-way existed, district leaders asked for and received an encroachment permit from the state. "Suddenly, the palette for the site got a lot larger," Eger said.

Developing an Award-Winning Environmental Unit

After construction of Public Service Park began in 2003, the district's community education manager, Sara Zepf, began planning a five-lesson environmental unit for fourth- and fifth-grade students. "Because teachers can relay important messages about water quality and the environment, we wanted to reward schools that taught this unit by giving them credit toward their stormwater user fees," Zepf said. "This appealed to school administrators."

After district staff identified key messages for the unit — which focused on water pollution, point and nonpoint source pollution, watersheds, land use, water quality, environmental audits, wetlands, water, household hazardous wastes, erosion, vegetation, BMPs, and permeability — Zepf did the research, roughed out lessons, and outlined experiments. Thirteen teachers, one per school district in Northern Kentucky, served as volunteer advisers, reviewing lessons and testing experiments. "This got teachers excited about teaching the unit," Zepf said.

Because state-mandated core content — what students must know about a particular subject — was cross-referenced throughout the unit, teachers were eager to teach the lessons. "This unit isn't an add-on, since it helps teachers deliver core content," said Earl W. Hughes, director of elementary education for the Kenton County Board of Education. "If the district hadn't tied les-



sons to core content, we might have been unable to teach the unit."

District staff even offered professional development training to familiarize teachers with the material. "Training was important, since some teachers may not know anything about BMPs or stormwater," Zepf said.

Teachers say the hands-on experiments enable students to make discoveries about water quality as they construct clay models of BMPs, use nontoxic household ingredients to develop a model of polluted water, and build a model to see how wetlands filter water.

"The kids 'make it rain' on a hillside they create, and together we monitor the effects of erosion by measuring the quality and quantity of runoff," said DeAnna Poling, a fifth-grade teacher at Beechgrove Elementary in Kenton County. "After they design erosion control for their hillside using sticks, leaves, and rocks — whatever

Aesthetics were a consideration for each stormwater BMP. The district's cistern has been called "stormwater art."



Students who walk atop the vegetated roof learn how it acts like a giant sponge to decrease runoff.

designs they come up with — they make it rain again, and we measure again. By getting their hands wet and dirty, they're learning, and science becomes real for them."

Mary Beth Feldmann, a fifth-grade teacher at A.J. Lindeman Elementary School, part of the Erlanger-Elsmere Independent School District, called the lessons relevant. "When we audited our school grounds, the children told the custodian that cans, wrappers, and cigarette butts shouldn't be near storm drains," Feldmann recalled. "Then the children helped the custodian pick up all this litter."

The Sanitation District now provides all unit workbooks and teacher kits — which contain 33 household items needed for the experiments — at no cost. "Teachers often pay out of their own pockets to buy materials for delivering core content," Hughes said. "By providing these kits, the district has made it very easy for teachers to teach these lessons."

Zepf said results from the unit have exceeded expectations:

- Students are retaining the material. Students in 2004–2005 scored an average of 60% on the unit pretest, but after completing the unit, scored an average of 82% on the post-test — an increase of 22 percentage points.
- The unit is in demand. During the 2005–2006 school year, 380 teachers in Northern Kentucky taught the unit to 6000 students. Currently, 68 of the 70 elementary schools in the district's service area are teaching the unit. "By conveying environmental messages important to the district, teachers are becoming an extension of our staff," Zepf said.
- The unit has received national recognition. It won the 2003 National Environmental Achievement Award in Public Information and Education from the National

Association of Clean Water Agencies (Washington, D.C.), formerly the Association of Metropolitan Sewerage Agencies.

Hughes said he's found few initiatives comparable to the unit. "The closest thing I've seen is the Junior Achievement program," Hughes said, "and the district has come up to that level of quality in just 2 years' time."

Behavior changes are perhaps the most significant outcome, Zepf said, noting that many schools — 13 in 2004–2005 — are going above and beyond the unit by implementing environmental projects with significant community impact. Schools that do so are eligible for the district's annual Protecting the Environment Awards, which give cash prizes to the three top-performing schools. For example, students have gone on litter walks, marked storm drains, written and read public service announcements on protecting the environment, and cleaned up creeks and schoolyards.

"This unit inspires students to make changes in their community," said Poling, whose school received a second-place award in 2005. "These children know which human activities positively or negatively affect our waterways."

Following the Journey of a Drop of Water

Even before construction of Public Service Park was complete, district leaders began planning a half-day guided tour, seeking input from the same 13 teachers who helped develop the environmental unit. The greatest challenge involved logistics. "Because the district has just two staff members in community education, we needed help getting 100 children a day through the site," Zepf said.

The solution was training teachers and parents to be tour guides — not merely chaperones — for their group. "These adults are trained before the tour to lead activities at every station, which has made the program very manageable and enhanced our adult education," Zepf said. "Now, more than 3000 students a year can take the tour, and we have a waiting list of schools that want to bring their students here."

Armed with a backpack of supplies — a magnifying glass, pen, poncho, and test tube — students follow the district's *Public Service Park Field Notebook* to complete 10 scientific missions, which reveal how BMPs can improve water quality. Following are some examples:

- Students atop the vegetated roof learn how the roof acts like a giant sponge to reduce runoff. By pouring water on a conventional roof and then on a vegetated roof, students

see how runoff flows quickly through the downspout off the conventional roof, while lesser amounts of runoff trickle through the downspout off the vegetated roof.

- Students discover that the parking lot's bio-filtration swale helps remove certain pollutants. They learn how sheet flow, directed to the swale from both edges of the lot, seeps down and into a rock chamber for cleansing. Students also learn that the vegetated swale, which replaces a conventional concrete drainage system, filters oils and greases.
- Students pour water on the district's parking lot, watching as water soaks into the porous pavement but runs off the regular pavement. Sections of permeable asphalt and permeable concrete are demonstrated at the park.
- A relief map of the Banklick Creek Watershed — a winding vein of fieldstone embedded into the park's pavement — reveals how creeks and branches lead to the Banklick Creek, the Ohio River, and ultimately the Mississippi River and Gulf of Mexico. In a simple but powerful simulation of creek flow through this map, students learn that when they toss a yellow ball (representing oil) into Banklick Creek, a blue ball (representing pet waste) into Moser's Branch, and a green ball (representing litter) into Horse Branch, all three pollutants float into the nearest creek, then into the nearest river, after it rains.
- Students observe how an aqueduct collects and funnels roof runoff to the cistern, where water is oxygenated and a solar-powered pump keeps water circulating. They learn that large cisterns can reduce the size of detention basins and also help homes and businesses recycle and reuse water. Water from the district's cistern is used for site demonstrations, the retention pond, and irrigation during dry weather.
- During the "runoff race," students predict which surfaces — pavement, a lawn, or a heavily vegetated area — will slow down or speed up runoff. After the tour guide "makes it rain," students see if their predictions are correct.
- In the wetland classroom, located between the site's wetland and retention pond, student scientists test the pH of the water to see if it is safe for the wetlands ecosystem, observe how wetlands slow runoff rates and filter and improve water quality, and watch

as a solar-powered water pump circulates water in the retention pond.

- Students learn how the park's grassy detention basin holds runoff after a storm and recognize why these basins are dangerous for children. They discover that the park's urban forest supplies shade to lessen "heat island" effects of asphalt, provides pockets of habitat for wildlife, and helps control the quantity and quality of stormwater.
- By using test tubes to separate oil from water, students learn how the oil-water separator, located underground where oil might leak from heavy equipment and vehicles, separates greases and oils from runoff so these pollutants don't enter creeks and streams.
- After pouring environmentally safe dye into a storm drain at the creek overlook, students walk down to Banklick Creek and are surprised to see the dye flowing into the water. Through this experiment, students make the connection between storm drains and natural waterways.

Feldmann said her students couldn't get enough of these activities. "We went on a rainy day and thought about cutting the tour short, but my group visited every station, because the kids did not want to stop," she said. "Everything they learned in the environmental unit, they [also] saw in action at the park."

The district's tour programming and *Public Service Park Field Notebook* recently earned the 2004 National Environmental Achievement Award in Public Information and Education from the National Association of Clean Water Agencies. In 2005, the U.S. Environmental Protection Agency

Students observe how wetlands slow runoff rates, and filter and improve water quality.





Sections of permeable asphalt and permeable concrete are demonstrated at Public Service Park.

(EPA) honored the district with the U.S. Children's Environmental Health Award for its outreach, education, and intervention activities, and for leadership in protecting children from environmental health hazards. Most recently, the district received the 2005 A.D. Albright Award for its environmental education program, which promotes educational excellence in Northern Kentucky.

"Public Service Park gives our students an excellent learning environment for applying concepts taught in the classroom," said Susan Cook, Kenton County Schools superintendent. "They not only learn the terminology but also have a real working understanding of the concepts."

And so do parents, Zepf said, since students often bring their families back on evenings and weekends for self-guided tours of the park. "We see people eating lunch here and bringing grandma and grandpa," she said. "It's not a park with soccer fields and playgrounds, but people are here, walking the site and reading the signage. They're taking real advantage of the park."

That's important, because there's a great need to educate both children and the general public about stormwater, said Karen Raver, a local resident. Raver said she knew "virtually nothing" about stormwater and water quality until the lake behind her property gradually filled in because of runoff, erosion, and sedimentation. She soon discovered that no catch basins existed for the 16 ha (40 ac) that drained into her lake and that much of the residential, commercial, and roadway construction upstream was occurring without proper sediment and erosion control.

"At one point, I was pulling insulation and other building materials from my lake," Raver said. "I'd go for walks, and the street would be filled with mud from the runoff."

Raver believes that better education would go a long way toward changing people's attitudes and behaviors about the environment. "The children who've been through the district's programs are telling their parents, 'Don't change the oil in our driveway,' and 'Don't pour oil or put leaves down the storm sewer,'" she said. "The more educated children are, the more in tune they'll be with their actions when it comes to water and the environment. Right now, the biggest hurdle is adult education."

Daniel J. Murray, division director of the Technology Transfer and Support Division at EPA's National Risk Management Research Laboratory

in Cincinnati, said citizens need to understand more about stormwater quantity and quality issues. "Impervious surfaces bring direct runoff into urban streams," he said. "When it rains in Cincinnati, the macro invertebrates and the bugs are halfway to Louisville [Ky.] before they realize what hit them. It's up to all of us to make sure the ecosystem is protected, but we have a long way to go. Certainly what the district is doing will accelerate education in the region and make people aware of what's happening in their own neighborhood."

Gearing Up for BMP Performance Monitoring

The district is planning a BMP monitoring, testing, and evaluation program that will generate local performance, cost, payback, and maintenance data that developers need to design and install BMPs in Northern Kentucky. Those that do will pay reduced stormwater user fees. "This program will take our site to the next level and truly make this an outdoor laboratory," said Jim Gibson, a project manager in the district's Storm Water Department.

Numerous sampling locations and monitoring wells, already installed, will generate BMP performance data, said Gibson, who expects to perform event-based analysis by collecting and analyzing samples when it rains, starting with the vegetated roof and the porous asphalt. EPA has expressed interest in the program. "We will concentrate on one or two BMPs at a time, and then move on to other BMPs," Gibson said.

Jennifer Zielinski, program manager at the nonprofit Center for Watershed Protection (Ellicott City, Md.) is interested in performance data for the vegetated roof. "There's a big move-

ment toward green roofs, but we need data to determine how effective they really are," she said. "The district can monitor runoff from the green roof and the conventional roof to get a sense of how well this works."

Gibson said the district plans to make performance data available on its Web site in the future. "We want to advance the science of stormwater BMPs and adjust our specific BMPs as needed," he said. "This data may be incorporated into national databases and presented at conferences so others can learn from our experiences."

Spreading the Word

Since fall 2004, Public Service Park has seen more than 10,000 visitors from all over the Midwest, the country, and even the world. Visitors have included developers, school district administrators and teachers, university professors, EPA officials, and Girl Scout and Boy Scout troops, as well as representatives from conservation districts, watershed groups, day camps, youth groups, government agencies, the media, and many other organizations.

Zielinski toured the park last year. "I was impressed that a local government organization would put forth so much effort to demonstrate newer stormwater management practices," she said. "But this is something local governments can and should be doing, since all too often we hear practitioners say, 'That BMP may work in Maryland or California but not in my locale.' Now, practitioners have local examples in Northern Kentucky."

Aesthetics were given a high priority at the site, and rightly so, Zielinski said. "The district's cistern is almost like stormwater art," she said. "People who think of stormwater management devices as ugly nuisances may change their mind once they tour Public Service Park."

Virginia Russell, associate professor of architecture at the University of Cincinnati, has taken her graduate and undergraduate students on the guided tour. "This site is like a Disneyland for stormwater management," she said. "It's very imaginative — a way to teach people and entertain them at the same time."

Mark Quarry, Hamilton County (Ky.) Stormwater District chairman, said he saw a vegetated roof for the first time during his recent visit to the park. "I was impressed how the district could take complicated stormwater issues and present them in a manner so easy for people to understand," he said.

One BMP at the district, a cistern, was implemented at Kenton County's new Twenhofel

Middle School. Superintendent Cook said the cistern is one of several high-performance energy concepts designed into the building. "We use water in our cistern for flushing toilets and irrigating athletic fields," she said. "It's another way we're able to educate our children about conserving energy and protecting the environment."

Chris Gilbert, development services director for Springfield Township near Cincinnati, recently toured Public Service Park, since the township is planning a similar site with both educational and recreational features. The master plan for Warder Regional Stormwater Park and Educational Center includes stormwater BMPs, a public education and outreach center, technology labs, and stormwater monitoring stations, as well as green space for athletic and recreational events. The public will learn about stormwater pollution prevention through field trips, lectures, and hands-on activities. "We want to expound on some of the things we've seen at the district," Gilbert said.

Shaping a Whole New Generation

District leaders know that before Northern Kentucky can begin to achieve its long-term environmental goals, people must change their behavior. Educating the public about stormwater BMPs is a huge step forward, Eger said.

"If the public changes its behavior, we won't have to target our very limited resources to fix problems that could have been avoided in the first place," Eger said. "Instead, we'll be able to use ratepayer dollars to fix legacy issues — such as combined sewer overflows — that behavior changes cannot affect."

Eger believes that the district's educational initiatives — key elements for National Pollutant Discharge Elimination System Phase 2 permit compliance — will enable the district to shape a new generation of environmental stewards. "We believe that when these children are ratepayers some 10 or 15 years from now, we'll be facing a whole different public dynamic than we face today," he said. "We are building a foundation for people to support water quality and the environment in general, and to change traditional approaches to development."

EPA's Murray noted, "Hopefully, other local governments will look at the district's site and these educational programs and say, 'Hey, this is a pretty good idea. Maybe we ought to do something like this.'"

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