

Like “CSI,” they search for clues. Their suspect: It’s often sewage

With a little technology and a lot of determination, team hunts down sources of water pollution



STEVE EARLEY | THE VIRGINIAN-PILOT

By Dave Mayfield
The Virginian-Pilot

NORFOLK

JUST AFTER the dawn of a bone-dry September day, Kyle Curtis and Jack Denby started their expedition.

The mission: Find the source of bacteria that has been fouling Knitting Mill Creek.

Beneath them as they walked the streets of Colonial Place were networks of sewer and water pipes. Curtis and Denby were reasonably sure as they followed the manholes that

somewhere down there they'd soon locate the problem.

In years past, a keen sense of smell might have been their only hope. But Curtis and Denby now have an arsenal of detective tools straight out of “CSI.”

DNA lab work on water samples they'd taken a few days earlier had helped them plot out some potential paths of the contamination. Guided by a GPS-enabled iPad with a map of the underground lines, they honed in on stretches where they'd do more-intensive sampling.

With any luck, in the next several

weeks they'd find a culprit for the human fecal bacteria oozing into the creek.

It's unlikely there'll be a TV show called “CSI: Sewage,” but it's almost certain that the Hampton Roads Sanitation District's year-old microbial source-tracking program will be duplicated elsewhere.

HRSD is one of a handful of U.S. wastewater treatment authorities that have committed to the technology for such investigations. The agency's \$400,000 investment already has

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Jack Denby, left, and Kyle Curtis from the Hampton Roads Sanitation District take a water sample from a lawn drain near Knitting Mill Creek in Norfolk.



COURTESY OF THE UNIVERSITY OF VIRGINIA

Nat Turner's rebellion happened in Southampton County in 1831.

Film brings a revisiting of Turner's legacy

Movie from Norfolk native sheds light on brutality of slavery

By Rashod Ollison
The Virginian-Pilot

When the sun seemed to change from gold to green to blue, Nat Turner saw it as a sign that he had to make a move.

A solar eclipse in February 1831, and another strange appearance of the sun six months later, galvanized Turner to round up seven other slaves in Southampton County, a 600-square-mile area west of Suffolk bordering North Carolina. They retreated deep into the woods the night of Aug. 21 and strategized what would become one of the bloodiest slave revolts in American history that, in two and a half days, left 60 white people dead. Some sources estimate that more than 200 slaves and free blacks were

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mostly cloudy and cooler



High in the mid-70s.

Details on page 15 of Sports



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SOURCE

HUNTING POLLUTION BY TESTING DNA

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helped pinpoint and eliminate long-troublesome bacterial pollution in several localities.

“We’re unraveling mysteries,” said Danny Barker, a longtime HRSD environmental scientist who helped set up the program.

Curtis and Denby, 30-year-olds with science master’s degrees, do much of the field work. They take their fair share of ribbing about it back at HRSD headquarters in Virginia Beach.

Mostly that’s because they often load up their Chevy pickup with kayaks before heading out. Then there’s the ever-ready chest filled with ice.

They know what the joke is, Curtis said: “Yeah, we’re just gonna throw some fishing lines out.”

The truth is that by paddling the creeks and rivers, they can sometimes spy potential problems they wouldn’t find otherwise.

The ice? To keep any bacteria in the samples from growing before they get them back to the lab for processing.

Most of the time, they’re trudging city streets in all kinds of weather, early and late. Curtis carries a pickax (to pry off manhole covers) and Denby wields a painter’s extension pole (to which he attaches the plastic bottles he dips to get the samples).

Like a couple of detectives working a criminal case, their conversation on a couple of recent outings around Knitting Mill Creek was about tracking clues and eliminating suspects. It was all monotonous and matters of fact.

“If we sample right here, we can hopefully pinpoint anything that’s coming from this way, or at least maybe cross off that leg,” Curtis said as he stood near a storm grate along Mayflower Road.

Later that morning, after Curtis lifted a manhole cover at 43rd Street and Colley Avenue, Denby got down on his knees to peer into the depths. Water was trickling into the stormwater pipe, but nothing on their maps indicated it should be entering there.

Residue from a recent rain? Or maybe a leak from a nearby sewer line?

Hard to tell, but suspicious enough to warrant a sample, which Denby sniffed before screwing a lid on the bottle. “Smells like the road,” he said.

Raul Gonzalez is in charge of the HRSD program.

He grew up in south-central Los Angeles, the son of Salvadoran and Guatemalan immigrants. Since the day a scientist visited his elementary school to give a talk about the water cycle, Gonzalez said, he’s been fascinated by science and nature. A few years after graduating from UCLA, he headed to the University North Carolina-Chapel Hill for a Ph.D. His doctoral dissertation in 2013 was on tracking fecal bacteria.

A year later he landed at HRSD.

While Curtis and Denby tend toward taciturnity, Gonzalez is a chatterbox when it comes to source tracking. There’s no containing his enthusiasm for the hunt:

“Every time we find something, we say, ‘You know, that probably would have stayed there forever if we hadn’t gone in and tracked it down.’”

Gonzalez’s first source-tracking assignment with HRSD was Wayne Creek in Norfolk. The creek, near where Interstate 64 crosses Tidewater Drive, had long registered bacteria levels above state standards for recreational water use. Norfolk officials wondered how much – if any – was due to humans and how much came from other animals.

Human waste is a much bigger concern since it carries pathogens – bacteria, viruses and protozoa – that are far more likely to make people sick.

Unfortunately, the state’s method for measuring enterococci in tidal waters doesn’t tease out the origin. The bacteria are common in the guts of other warm-blooded animals: geese, gulls, raccoons, possums, dogs, cats. That made all of their feces suspects as well.

After lab workers filtered the samples to net out the bacteria and then extracted



Kyle Curtis, left, and Jack Denby from the Hampton Roads Sanitation District use kayaks to look along the shoreline of Knitting Mill Creek in Norfolk. Below: Hannah Thompson, left, and Allison Meier of HRSD prepare samples for DNA analysis. The samples were collected from storm drains in Colonial Place near the creek.



their DNA, the next step was what’s known as a qPCR machine. That stands for quantitative polymerase chain reaction: a process that can super-rapidly amplify even a single copy of DNA – a building block of all living things – to detectable levels.

The underlying technology won its inventor a Nobel Prize for chemistry in 1993. It revolutionized everything from disease screening to the study of evolutionary history, not to mention paternity testing and crime-scene investigations.

It has also proven excellent in helping track down sewage leaks.

After the qPCR results signaled bacteria excreted by humans in some of the Wayne Creek samples, Gonzalez and his team began the really hard work: trying to figure out where, in the miles of often-overlapping sewer and stormwater pipes, a leak or leaks had occurred.

They tested seven more times over the next six months, narrowing in on concentrations of HF183 – a genetic marker for bacteria specific to human waste – in a couple of connected legs of a stormwater line. The source trackers wondered whether septic tanks still in use by some homes might be at least partly to blame. But the largest hits were detected near one of the city’s sewage pump stations.

Could there be a break there?

Yes, it turned out. In early 2015, within a few months of the pump station repair, HF183 was no longer detected.

Jamie Heisig-Mitchell, HRSD’s chief of technical services, said the Wayne Creek success gave agency

officials the confidence to commit to an ongoing program in source tracking.

The program was launched July 1, 2015, and nine employees now work full- or part-time in it.

They’ve investigated eight watersheds so far – in Chesapeake, Newport News, Norfolk, Suffolk and Virginia Beach. Two more are scheduled to begin soon: along Indian River in Chesapeake and Mill Dam Creek at the Beach.

The localities own most of the underground pipes, including the sewage lines that funnel toward HRSD’s treatment plants. They’re responsible for repairs to their own systems.

Some projects have been a breeze. In the Southeast community of Newport News, HRSD’s detectives pinpointed a sewage leak within a few weeks. Even more impressive was that they rooted out the problem in February – when bacteria in waterways react to the cold by descending into what’s essentially a survival mode, making them undetectable under standard techniques.

With the technology that HRSD now uses, Gonzalez said, “even when the water’s cold, you can still detect the DNA.”

The Hilton Beach area of Newport News has been on the other end of the spectrum.

State health officials frequently have ordered closures, because of bacterial contamination, of a public swimming area on the James River there. Gonzalez said finding the sources of the bacteria has been a “needles in a haystack” project: “There’s no big, glaring smoking gun.”

After months of sampling in one direction and then another, the HRSD team finally narrowed in on a bank branch and an auto-repair shop, both of which unknowingly had breaks in lines running to the street. What they flushed down their toilets was ending up in stormwater pipes instead.

In the case of the auto shop, “Those guys said they used theirs, like, twice a day,” Gonzalez said. Yet it was enough to cause a problem all the way down to the river.

The source trackers still are closing in on one last trouble spot in that area.

Gonzalez stressed that the goal of source tracking isn’t to get rid of all bacteria. A healthy waterway needs bac-

teria – not from humans, but the kinds that are “part of the natural biological food chain,” he said. “If the wa-

ter was like drinking water, nothing would survive in it.” In Norfolk, Knitting Mill Creek has a healthy share of beneficial bacteria. But it has an unhealthy dose of the other kind as well. Despite extensive efforts by the nonprofit groups Lafayette Wetlands Partnership and Elizabeth River Project to rejuvenate it, it’s the last tributary of the Lafayette River – itself a branch of the Elizabeth – still listed by state environmental regulators as “impaired” by bacterial contamination.

That means it’s officially not deemed safe even for casual contact by kayakers and other recreational users, though plenty of people spend time on it.

“We want to get rid of that asterisk,” said Justin Shafer, an environmental engineer in Norfolk’s Public Works Department.

HRSD’s first round of samples along the creek were

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Raul Gonzalez, Hampton Roads Sanitation District

encouraging. Tests for the marker of human waste came back negative.

But those samples were taken near high tide, when saltwater that had rushed up into the stormwater pipes diluted the wastewater flowing from homes and businesses. So Curtis and Denby took more samples the next week around low tide, and got indications of a human cause. A third round of samples confirmed the finding.

The good news was that the levels of HF183 were low and confined to an area south and southeast of the creek, Gonzalez said during a meeting last week, where he delivered the results to Shafer and representatives of the environmental groups.

“It seems like it’s going to be a somewhat straightforward process” for HRSD to pinpoint the source with more sampling in the stormwater network, said John Stewart, a member of the Lafayette partnership.

“It’s kind of astonishing what they can isolate,” he said. “I’m bowled over by the level of knowledge, experience and equipment that they’ve put together.”

Gonzalez said the source trackers are looking forward in the not-distant future to coming back with samples indicating the creek’s problem has been eliminated:

“Really, that’s always what we’re hoping for.”

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