Maryland jurisdictions consider transforming their wastewater into drinkable water

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Facing a limited supply of drinking water, Carroll County's Westminster, Maryland, plans to draw from a surprising source—its own sewage.

This winter, the city of 20,000 will begin constructing a new building at its wastewater treatment plant, where already-treated wastewater will be purified with an array of special membranes and UV light, and sent into the city's drinking water reservoir—rather than discharged into a creek.

Named PUREWater Westminster, it would be Maryland's first project to reuse wastewater for drinking water, an already common practice in water-poor parts of the United States, like the Southwest, that is spreading elsewhere as a changing climate and burgeoning development threaten the availability of water.

A second Maryland water reuse project could come in Anne Arundel County, which is studying injecting purified wastewater into its groundwater aquifer, its principal source of fresh water.

Both projects would be classified as "indirect potable reuse," since they would send purified water into the natural environment before sending it to residents' taps.

The practice is gaining popularity on the East Coast, thanks to aging sewage treatment plants, as well as increased demand caused by population growth and a growing drought threat, said Patricia Sinicropi, executive director of industry group WateReuse.

"People are ready to look at a system that provides more reliability, gives them more control. They don't have to worry about population growth, because they have a base system that can provide the amount of potable water—and other water—that they need," Sinicropi said.

Because such reuse is foreign to Maryland, getting Westminster's project started required a new state law—as will Anne Arundel's, officials say. Westminster also undertook a careful public information campaign, to prevent an "ick factor" from stirring resident resistance.

Mayor Mona Becker, who is also the science department chair at Westminster High School and holds a doctoral degree in geochemistry, has become the project's de facto spokesperson, bringing demonstrations to community meetings around the city.

The campaign, which also included notes on water customers' bills and on doors around the city, is aided perhaps by the fact that the purified water will be treated again by the city's drinking water plant after it hits the Cranberry Reservoir, even though it will already exceed drinking water standards.

"Sometimes, these facilities—when people argue against them—they call it toilet-to-tap, which just sounds gross, and that's not what it is," Becker said. "We wanted to avoid that sort of angst among our residents that this was going to be something like that."

For Becker, the project's story starts back in 2002, when a drought laid bare the inadequacy of the city's water supply. The city issued mandatory water use restrictions and had to truck in drinking water.

In 2007, a consent decree with Maryland environmental regulators required Westminster to more carefully manage its drinking water, since it had promised more water to homes and businesses than it could provide consistently, particularly during extreme droughts.

"Maryland's been blessed as a water-rich state. Unlike states, say, out in the West, we haven't had to deal with critical water shortages, except in a few key areas—Westminster being one of them," said Les Knapp, government relations director at the Maryland Department of the Environment. "However, now we are seeing more and more jurisdictions facing water issues, mostly due to climate change and continued population growth."

Westminster doesn't sit next to a large river or a spring-fed lake. So, it relies on groundwater wells and a small reservoir, both dependent on rainwater, Becker said.

"The water situation in Westminster—it's sort of our Achilles heel," she said.

Water scarcity hasn't prevented development in the city, but it's an added barrier, Becker said. Westminster's water system provides service to about 20,000 additional properties outside the city limits, but the municipality now requires new construction to be annexed into the city—and pay city taxes—to receive water service, Becker said.

"We want your tax dollars to come to the city, especially if we're providing you with this—really—this scarce resource that we have," Becker said.

The idea of reusing wastewater to supplement the water supply in Westminster first arose about eight years ago, championed by the city's then-director of public works, Becker said. The first step was to set up a small-scale pilot version of the purification technology at the city's wastewater plant—and test the water that came out of it.

The four-step system, designed by Gaithersburg-based WATEK Engineering, starts with treated wastewater, which can be released into the environment because most solids and contaminants have been removed.

It filters that water first through a round of membranes, removing particles as small as 1,000th the diameter of a human hair. Then comes a process called reverse osmosis, which forces the water under high pressure through another even tighter membrane, rejecting other dissolved contaminants.

A combination of ultraviolet light and oxidant chemicals like hydrogen peroxide neutralize the remaining pollutants. Finally, a granular activated carbon filter removes any trace oxidant chemicals or contaminants.

The pilot program ran for about nine months, said WATEK President Ben Movahed. Thousands and thousands of samples showed the purified water met and often surpassed federal standards—results positive enough that Becker and the scientists sipped the water themselves.

"The conclusion was: This is exactly the technology that we're going to design," Movahed said.

PUREWater's pilot also produced water with a bonus: It met the federal government's stringent new drinking water standards for PFAS, harmful "forever chemicals" that are difficult to remove from water. In fact, testing returned "non-detect" results for the relevant PFAS, said Movahed, crediting the use of reverse osmosis.

"Why are we using reverse osmosis? I would say that reverse osmosis removes contaminants that you probably don't know yet. And that's exactly what happened with PFAS," Movahed said.

The idea of treating wastewater to drink may shock some, particularly those familiar with the failings of Baltimore's two massive wastewater plants. For years, peaking in 2021 and 2022, the facilities frequently discharged water containing excessive amounts of bacteria, solid particles and nutrients into the Patapsco and Back Rivers, resulting in a $4.75 million state fine and a consent decree for the city.

But automatic safeguards within the PUREWater system would shut the reuse system down if similar mechanical issues struck at Westminster's far smaller sewage treatment plant, Movahed said.

"Even if it happens at two o'clock in the morning, that valve will shut down, the equipment will go through a wash cycle, and we'll get ready for the operator to come and see what's going on," he said.

The membranes in the PUREWater facility also are designed to prevent contaminants of a certain size from passing through, regardless of how many are present, Movahed said.

The system will be housed in a new building at Westminster's wastewater plant, which will include an observation area for visitors to learn about the technology.

Construction is expected to begin by January, and the team aims to have the facility, which will treat about 10% of the city's wastewater, online 12 to 14 months later, Movahed said. The project is estimated to cost $14 to $16 million.

By comparison, Anne Arundel's project began with the goal of addressing an entirely different problem—reducing pollution sent into the Chesapeake Bay, said Chris Murphy, engineering administrator for the county's public works department.

Traditionally, when water leaves a wastewater treatment plant, it is discharged into a nearby body of water, in this case the Little Patuxent River. The water must meet standards for the amount of bay-polluting nitrogen and phosphorus it contains, but it still adds some of those nutrients to the bay, which fuel damaging algae blooms.

If you take some of that treated wastewater, purify it and then pump it into the groundwater, the amount of pollution added to the bay decreases.

As an added bonus, the project supplements the county's drinking water

supply, which faces high demand. On average, the county pulls 36.5 million gallons per day from the aquifer, the largest quantity of any jurisdiction in the state, said Beth O'Connell, deputy director of the bureau of engineering at the county's public works department.

"If you can imagine, the aquifer has a whole bunch of straws in it. You've got the straws sucking out water. You've got it from private wells, you've got it from (county) wells," O'Connell said. "When the aquifer loses pressure, the soils consolidate, and at a certain point, they no longer rebound—meaning you could no longer put more water into the aquifer."

"In certain parts of the county, as they have to replace their well, or do a new one, they have to go into a different aquifer," O'Connell said. "They have to go deeper."

If the reuse project is completed, the water entering the aquifer may not show up in consumers' taps. Studies show it wouldn't stray far from the site of the wastewater treatment plant, even as years pass, Murphy said. But it would help the aquifer by adding pressure to it, which also could minimize intrusion from the nearby Chesapeake Bay's saltier water. As the climate changes, and water levels rise, the pressure from that salty water will grow stronger.

To begin recharging the aquifer, Anne Arundel needs a new state law. A first attempt during last year's session was withdrawn after disagreements between the county and the Maryland Department of the Environment, O'Connell said.

MDE wanted the county to use a membrane treatment system, similar to Westminster's, but the county prefers to continue using granular activated carbon technology, which has proven successful based on intensive sampling, including exceeding standards for PFAS compounds.

The county is in talks with the agency and hopes to advance legislation next session.

Once authorizing legislation is passed, it still could take about eight years for the county to construct its facility and bring it online, Murphy said.

In the meantime, in October 2022, the county began operating a pilot project at its wastewater treatment plant in Crofton, Maryland. It's a small building filled with five sets of humming machinery, which cost about a million dollars to construct, and treats about 10 gallons of water per minute. A larger facility, which could handle 500,000 gallons per day, would cost in the tens of millions.

The process begins when a coagulant is added to treated wastewater to more easily separate out any extra sediment. Then, in a step called ozonation, purifying chemicals are added. Then comes two steps involving granular activated carbon filters, like the filters in Brita water pitchers, said Ramola Vaidya, a water and wastewater engineer from the engineering firm HDR, which monitors the Anne Arundel project. Finally, the water is treated with UV light.

"Imagine having a water treatment plant at the end of a wastewater treatment plant," Vaidya said.