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In Flint's Aftermath, Water Will Run by New Rules.

The water crisis in Michigan highlighted major problems with not just federal regulations but the way localities enforce them. That's all likely to change soon.

For years, Denver Water, like many other drinking water utilities, would refer its customers concerned about the lead content in their water to state-approved labs that could collect and analyze samples from the homeowners' faucets. This summer, Denver Water made the process much easier: Now if a resident is concerned, the agency will send out a testing kit, analyze the water in its own labs and report the results back to the customer — all for free. More than 100 homeowners used the new service in its first month.

Perhaps this should have been done earlier. But it wouldn't be happening now had it not been for Flint, Mich. The Flint water crisis, which exposed adults and children to dangerous levels of lead in their drinking water, is reverberating throughout the country.

The Denver agency, which serves 1.4 million people in the city and nearby communities, has also started automatically replacing lead service lines as it finds them in its normal maintenance work. The service lines, which connect water mains under streets to individual buildings, are the main source of lead contamination in water systems. But they usually have split ownership. In many cities, the utility owns everything up to the sidewalk, while homeowners and other landlords own everything on their property. The divided ownership makes it difficult to replace the pipes. In Denver, the property owner actually owns the entire service line. Nonetheless, Denver Water is offering to do the replacements for free, at least in places where it's already digging to do other work.

"Since the tragedy in Flint, people are more aware of what could be happening in their own plumbing and in their homes," says Travis Thompson, a Denver Water spokesman. "But now with people paying attention, how can we use that to get the lead completely out of our community?"

It's a clear-cut goal, but not an easy one to achieve. Just a handful of cities have actually eliminated all the lead in their drinking water systems, and then only through a years-long process. Local officials who want to replace lead pipes completely still have to ensure that the lead plumbing already in the ground is safe until the day, however distant, when those lead pipes are finally removed.

Lead in drinking water has been an issue for decades. Thirty years ago, Congress banned the use of plumbing that contained lead after research showed that any exposure to it can be dangerous, particularly to pregnant women and children. It can damage the brain, red blood cells and kidneys, and can cause lifelong developmental problems.

The disaster in Flint reminded the country, though, that lead pipes are still in operation in many water systems. There are approximately 7.3 million lead service lines throughout the U.S. that connect water mains to buildings. And service lines aren't the only source of lead in water. Lead can leach into the water supply from old plumbing fixtures and drinking fountains. Galvanized steel

pipes, which were used frequently for service lines before the 1960s, can also cause lead poisoning. While national attention has focused on Flint, dangerous lead levels have surfaced, among other places, in schools in Newark, N.J., and Portland, Ore.; state homes for the disabled in Texas; and even the drinking fountains in the U.S. Capitol.

The reason why stories like those are not more common — with so many lead pipes still in use — is that water utilities treat their water with chemicals that form a protective layer on the surface of lead pipes. The chemical barrier prevents lead from leaching into the water. In fact, the federal government required drinking water systems to use that approach when the U.S. Environmental Protection Agency (EPA) issued the regulations known as the Lead and Copper Rule in 1991. The rule requires drinking water utilities to take water samples from high-risk homes or buildings every six months. If 10 percent of those samples contain more than 15 parts per billion of lead, the utility must take steps to address it, including the use of anticorrosive chemicals.

The problem with this approach, though, is that the protective coating is fragile. It can be damaged when the pipe is moved or connected to another pipe made of a different metal, or when there is a change in the water source. In Flint, the water system and individual homes have had lead plumbing for decades. Residents didn't report anything out of the ordinary until April 2014, when the city, under a state-appointed emergency manager, switched the source of its drinking water from Detroit's Lake Huron to the Flint River. Because Flint failed to add anticorrosive chemicals to the river water — as required by the EPA — the new water source corroded the pipes, and the toxic metal entered the drinking water.

It's to prevent disasters like the one in Flint that the EPA requires water systems to conduct tests in homes regularly for high levels of lead. Local and state officials in Flint broke those rules. For example, the water samples are supposed to be taken from homes most at risk of lead poisoning, ones which the utility knows or suspects are served by lead service lines. But in Flint, more than half of the samples submitted by the city after the switch to river water were taken from homes with service lines made of copper, rather than lead. Flint's water utility also told customers to run their water for several minutes before taking a sample. The practice, known as "pre-flushing," can lower lead levels in samples submitted for testing.

The testing violations in Flint were particularly egregious, and three officials from the city and Michigan's Department of Environmental Quality face criminal charges for the apparent deception. But environmental and health activists have long complained that the EPA's testing protocol is too lax and ambiguous.

As news of the Flint water crisis spread, it became clear that utilities weren't all conducting their tests the same way. Some, as in Flint, recommended pre-flushing. Others told customers to remove aerators before collecting the sample. Most wanted samples of the water that first came out of the faucet; some asked for samples after the water changed temperature. "One thing that the water utility industry wants is specific instructions on how we do things," says Scott Potter, the director of the Nashville Metro Water Service and the president of the Association of Metropolitan Water Agencies. "If you have specificity, then the entire industry is doing it one way — the way scientists say is the best way — and we can all trust the data."

New rules to address these issues could come as soon as next year, as the federal agency wraps up a six-year effort to rewrite the Lead and Copper Rule. In light of Flint, the new rules could require major changes for water utilities. The federal government could require them to test homes more often. It could lower the threshold of lead in water that requires utilities to respond. And it could even push water utilities to replace lead service lines altogether.

Activists say it's not just the rules that matter, but the way they are enforced. They hope the EPA and the state agencies charged with administering its rules will become more aggressive in making sure they're followed. "Flint is an extreme example of governmental indifference and callousness," says Eric Olson, the director of the health program at the Natural Resources Defense Council. "But I do believe it highlights a more systemic problem with a lack of attention to and, frankly, political will for enforcement and for stepping in and insisting on compliance."

Only 11.2 percent of the 8,000 violations of the Lead and Copper Rule throughout the country resulted in any sort of enforcement action in 2015, according to Olson's analysis of EPA data. Even in those cases, which mostly involved small water systems, regulators operated with a soft touch, typically just prodding the utilities to fix their systems. It's the regulatory equivalent of being let off at a traffic stop with a written warning. Regulators sought or assessed penalties in only 3 percent of the reported violations. There is also evidence that suggests states are underreporting violations. Flint isn't even included in the list of Michigan water systems that broke the rule in 2015. Only government regulators, not individual residents, can start the enforcement process, so if the regulators fail to do their jobs, nothing happens. "There is," Olson says, "no cop on the beat."

Regulators don't usually penalize water utilities because state and federal regulators try to act as "partners" to the water agencies they oversee. "Yes, it's true, you want collaboration. You want partnerships if the folks are doing their jobs," Olson says. "But if the water utility is simply failing to comply with the law, that's where enforcement is legally required."

Diane VanDe Hei, the CEO of the Association of Metropolitan Water Agencies, admits that a "handful" of states have trouble regulating drinking water. "I don't think it's a secret that some states do not have the resources to do all of the things they're supposed to do," she says. "They have a lack of funds or personnel."

A slow response from utilities and their regulators — or no response at all — is another problem. About a decade ago, Virgil Bernero, then a Michigan state senator, grew increasingly frustrated when he and his office tried to track down information about lead levels in Lansing's water. Bernero started looking into it when a constituent raised the issue. It became more urgent when he learned about a major lead-in-water crisis in Washington, D.C., where the local water agency tried to minimize the extent of its problem. At a recent congressional hearing, Virginia Tech engineering professor Marc Edwards, one of the first people to identify the high levels in both Washington and Flint, said the crisis in Washington in the early 2000s had been "20 to 30 times worse" than that of Flint. As many as 42,000 children were affected before the crisis was resolved. The district's problems started when its water utility switched from using chlorine to chloramine as a disinfectant, making the water more corrosive.

Bernero — energized by what he learned about Washington's lead-in-water crisis — wasn't satisfied with the answers he was getting from his local water utility, so he set up a legislative task force that invited Edwards and others to testify about Lansing's water, and particularly about the utility's testing methods. Bernero said the utility's responses amounted to "patting us on the head and saying, 'We're the experts, don't worry about it.'" But Edwards had a different message, Bernero recalls: "Don't buy that. You can't leave this to the so-called experts."

So Bernero didn't. When he became mayor of Lansing, the city did what very few others in the country have done: It embarked on a decade-long program to replace all of the lead service lines in the city. By next year, all of the lead service lines in Lansing will be gone.

The reason so few cities have done what Lansing is doing, though, is that swapping out lead pipes isn't easy. Or cheap.

The first major task for many utilities is to find all of the lead service lines in their system. That sounds much simpler than it often is. It can require water operators to go back through old documents and make their best guess about what kinds of pipes are in the ground, based on historical records. That's because, until the last few decades, water utilities often didn't track what kind of materials their service lines were made of. It's especially true for the portion of the service lines on private property, which typically are the responsibility of the property owner rather than the utility.

The service lines are usually installed during building construction, explains David LaFrance, the CEO of the American Water Works Association, which represents 4,000 water utilities. "Just as the water utility doesn't know whether a house has hardwood floors or linoleum, they wouldn't naturally have an inventory of what the material is for the service line," he says. "When the general public hears that the utility doesn't know, it's surprising. But for the utility it isn't really part of the infrastructure that they put into the ground and they maintain. That's where the problem comes."

Incomplete and inaccurate information has already frustrated Flint's efforts to replace its lead and galvanized steel pipes. When the crisis started, most of Flint's records on the kinds of pipe it had were still on index cards. The state helped the city convert those records into a GIS database to track which properties had which types of service lines. More than half of the active service lines were made of copper pipe. But that still left nearly half of the lines as candidates for replacement: Eight percent of the lines were made of lead, 18 percent were made of galvanized steel and the remaining 21 percent were unknown.

And that's assuming the records were even accurate. A contractor hired by the city to replace the service lines of 30 homes throughout the city, in order to gauge the feasibility of a much larger replacement program, found that the records of sites chosen for the new lines were correct only 64 percent of the time.

A second major hurdle for replacing service lines, of course, is cost. Estimates vary greatly on how expensive it is to switch out the pipes, but the most common estimate is near \$5,000 a line. As Lansing replaced its pipes, it developed a method, which the city is considering patenting, that speeds up the process and lowers costs. Lansing crews can replace pipes without digging long trenches. They attach the new pipe to the back of the old pipe, and then pull the old pipe out to the street, leaving the new one in place. Lansing officials say the technique can lower the cost of replacing a service line to between \$2,000 and \$3,000. But that may not hold true for other cities. When Flint started replacing lines, even with help from Lansing crews, their average cost was \$7,500 apiece.

Split ownership remains a financing complication for almost any locality trying to do line replacement. In Madison, Wis., which also removed all of its lead service lines, it was a major hurdle. State regulators blocked Madison from using taxpayers' money to pay for the replacement on private property, so the city had to find other creative revenue sources — such as income from renting out space on its water towers to cellular providers — to help subsidize the water pipe replacement costs for homeowners.

Lansing paid for its program with rate increases, but that's not an option for most cities. "We can't just do that," says Michael Deane, the executive director of the National Association of Water Companies, because private utilities — and some public utilities, like Madison's — need to have their rate increases approved by state public utility commissions. "We have to work with our economic regulator on how we pay for it. How do we get the capital to make this? How do we earn a return on that capital investment?"

The list of thorny issues goes on, but it's clear that an increasing number of communities are interested in getting rid of lead service lines, whether the EPA ends up requiring it or not. There is a growing consensus in the water industry, too. Even the American Water Works Association, which once blocked EPA regulations making it easier to replace the private portion of service lines, now supports the goal of taking out the lead service lines. To share their expertise with localities, major water industry groups have joined with environmental and public health groups to form an organization called the Lead Service Line Replacement Collaborative.

As sensible as it might seem to replace every single lead service line in the U.S., there are plenty of reasons to be cautious.

One is that replacing lead service lines doesn't always solve lead poisoning issues. The Flint water crisis first came to light in part because residents called on Edwards, the Virginia Tech professor, to investigate their situation. Through independent testing, he showed that lead levels in the industrial city were far beyond the federal thresholds. Of the 271 houses Edwards and his team tested, the worst belonged to Elnora Carthan, on the city's north side. Her water registered readings of 1,000 parts per billion of lead, or 67 times higher than the federal maximum of 15 parts per billion. But when crews in Flint came to replace the service line in Carthan's home, they found out the line was made of copper, not lead. The lead in her water had to be coming from somewhere else, likely her home's internal plumbing.

"I'm all for getting the lead pipe out," Edwards said when the discovery was made. "I want Flint to become the model for replacing lead pipe, but it's not necessarily going to get rid of the lead problem. We're still going to have a lead problem if corrosivity is not controlled."

And ultimately, there is the question of opportunity cost. How wise is it to prioritize lead pipe replacement over other water system needs? Water utilities have many other pressing concerns, such as removing other harmful, corrosive chemicals from drinking water or just trying to maintain and improve decrepit infrastructure. "If you spend \$300 million on lead service lines," says VanDe Hei of the Association of Metropolitan Water Agencies, "what are you not doing? What are you not doing that has perhaps more risk?"

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