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Dear Readers..... 7

Regulatory Gaps May Increase Risks of Lead in Drinking Water with Service Line Replacements

■ by Michael Blackhurst

This article summarizes regulatory gaps that may increase lead exposure in drinking water. Since ownership of drinking water service lines is split between public water agencies and private property owners, each entity can act independently to replace only their portion of lead service lines.

While partial replacement may remove lead sources, lead levels have been observed to increase for months or longer when only part of lead lines are replaced. These lead spikes may be responsible for negative health effects.

Currently, two common regulatory situations increase the likelihood of partial lead line replacements. First, public water agencies are required to annually replace 7% of publicly owned lead service lines when high lead levels persist. Where private property owners are unable

or unwilling to coordinate replacement of their portion of the lead service line, a partial replacement will occur.

Second, a partial lead line replacement can also be initiated by private property owners. Regulatory oversight of private plumbing is often distinct from public water agencies and often does not include measures to make property owners aware of the risks of a partial lead line replacement. Simple precautionary steps by regulators can mitigate this risk through better disclosure, coordination with private customers, and the use of plastic connectors when making lead line replacements.

What follows is a primer on these risks and some incremental policy changes that can reduce risks with a particular focus on the current regulatory context in Pittsburgh, PA.

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Bridging the Digital Divide: Libraries Become All-Purpose Education Hubs

■ by Julia Fraser

Public libraries, a piece of the region’s educational mosaic, are reinventing themselves in response to the demands of new technologies and changes in how Americans consume information. No longer viable simply as repositories of books and periodicals, they’re becoming multifaceted community education hubs, using data to better understand their users and gaining popularity by offering classes ranging from photography to video game design.

The digital divide

A key aspect of this transformation is helping to bridge the digital divide through free Internet access and digital literacy, both of which have become increasingly important to doing everything from homework and social networking to finding a job, applying to college, and buying health insurance.

But opportunities from the digital revolution are not evenly distributed. U.S. Census Bureau data suggest that

20 percent of households in the seven-county Pittsburgh Metropolitan Statistical Area lacked Internet access in 2015. Though an improvement over 2013, when 23 percent of households in the region did not have Internet access, the rate of local residents without Internet access remains greater than the national average of 18.5 percent.

Across the nation, many remain without access to digital technologies. A 2015 Pew Research Center study found that 68 percent of Americans have smartphones, while 45 percent have tablet computers. Today, computer ownership remains at the same level as where it was a decade ago.

The City of Pittsburgh has attempted to narrow the digital divide in recent years, as have private Internet providers, such as Comcast, by expanding Internet access through a number of new initiatives.

In 2015, for example, Pittsburgh launched the Roadmap

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Bridging the Digital Divide: Libraries Become All-Purpose Education Hubs

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for Inclusive Innovation, a plan to improve access to the Internet and technology, which includes expanding public Wi-Fi access in parks, senior centers, and other public areas.

The city is in the early stages of building mesh networks with partners throughout the city, neighborhood by neighborhood. Mesh networks allow large companies and organizations to share a portion of their bandwidth with the community network for little or no cost.

Broadcasting and cable television giant Comcast is working in partnership with the U.S. Department of Housing and Urban Development to improve Internet access for low-income families in Comcast's network through Internet Essentials, a low-cost, high-speed Internet adoption program for families with school-aged children eligible for a free or reduced-price school lunch.

Meanwhile, as libraries in Pittsburgh and around the country recognize the importance of Internet access in American life and closing the digital divide, they are rethinking their role in communities to better address the needs of a more technology dependent public. The Carnegie Library is centered in these advances.

The times demand change

A 2016 Pew Research Center study found that 80 percent of Americans believe public libraries should offer programs and services to help people develop digital skills and 50 percent feel libraries should help patrons learn how to use technologies, such as 3-D printers.

Visitor data from the Carnegie Library support these findings. According to the Carnegie Library, there were 2.9 million visits to the library's network of 19 branches in 2016. One of the most used services was their Wi-Fi network. Public access to the wireless network in the Carnegie Library was up 26 percent in 2016 from the previous year, with more than 48 million minutes of Wi-Fi use by patrons.

In Pittsburgh, such programs are becoming increasingly popular among young people, Carnegie Library data suggest. Attendance of the library's teen outreach programs, for example, grew by 33 percent over the past year.

Adapting

The Carnegie Library's current evolution can be traced to past financial troubles and a 2009 RAND study, which recommended that the library needed to find new sources of funding, evaluate its services, and increase innovative activities to engage patrons.

Library finances stabilized after 2011, when City of Pittsburgh voters approved a referendum raising the real estate tax by .25 mills with the proceeds dedicated to funding the library.

The library developed a strategic plan in 2012 with technology at its core. "We needed to make technology a focus and develop a strategy and purpose around it that everyone understands," said Mary Frances Cooper, president and director of the Carnegie Library of Pittsburgh. "It couldn't just be random things that people are doing in parts of the organization. It had to be intentional."

As part of that plan, the library created a department for outreach programs and partnerships, as well as the office of digital strategy, which looks for effective ways to use and apply technology to improve customer service and access to information as publishing and media evolve.

The library began collecting data on how the library is used, including its technology offerings, such as the volume of Internet and computer use. In addition, the library added workshops and training sessions to help residents access and use public data.

"If we want people to be engaging in civic discussions around data and policy and we don't want them to be left out, it's not just about 'Hey here's some Internet,'" said Eleanor Tutt, the library's open data and knowledge manager. "It's about how do we support them? How do we demystify data? Because there's so many people who just say, 'I'm not a data person.'"

Initiatives in the public realm have expanded. The Carnegie Library and the University of Pittsburgh Center for Social and Urban Research partnered on "Data Day" at Carnegie Library Main last October. Data Day



provided an open event for people to drop in and experiment with data in many forms.

"In Pittsburgh, it's not so much that people have a hard time accessing hardware—a smart phone or a smart device," said Debra Lam, the former City of Pittsburgh's chief innovation and performance officer. "The bigger issue is that once you have that smart device, what do you use to connect it?"

Connecting the dots through technology

Toby Greenwalt, director of digital strategy and innovation at Carnegie Library of Pittsburgh, says the library is taking a long-range perspective in strategic planning, looking to "connect the dots between our age-based programming" so that programming themes and skills follow childhood into adulthood. With children, the library is integrating more technology in its programs with activities such as interactive story times and learning basic computer programming with toy cars that must navigate a maze.

Teens have access to recording equipment, gaming software and other technologies, which they can master with the help of mentors and workshops at The Labs program for teens in the Oakland and East Liberty

library branches and the Allegheny branch on the city's North Side.

The Labs have been around for four years, modeled on YouMedia, a digital learning space at the Chicago Public Library. "People think that kids nowadays know how to use technology because they grew up around it," said Corey Wittig, digital learning librarian and program manager of The Labs at Carnegie Library of Pittsburgh. "A lot of kids aren't growing up around it or it's not at their school. The fluency flows from there—what experiences are they having or not having?"

The Labs seek to bridge that gap between the ability to navigate technology, such as playing a video game or watching a video online, to understanding how those programs work and what's necessary to create something of their own. It's free of charge, which Wittig said is important. And teens are exposed to the expertise of local organizations in the field, such as the nonprofit 1Hood Media, which has helped them learn to write, produce, and record their own music.

Such new wrinkles are changing the library's image among young people, even to the point that, for some, it's becoming part of their social network. "Usually, I'd come to the library and sit with my sister," said Hope Legrande, 17, of Highland Park. "Since we started this project, we've met other teens here. Other kids from my school I'd never talk to. And we've become friends. Now, we hang out more in school. It's cool."

For more on this, see <http://pittsburghtoday.org/news/pittsburgh-today-tomorrow-2017/>



Regulatory Gaps May Increase Risks of Lead in Drinking Water with Service Line Replacements

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What are sources of lead that can get into your drinking water?

The primary sources of lead in drinking water are lead service laterals and lead soldering. As shown in Figure 1, a drinking water service lateral is the underground pipe that connects a building's drinking water plumbing to the main drinking water system.

Before the health effects of lead were known, lead was the preferred material for service laterals due to its malleability and corrosion resistance. Historical estimates suggest about half of U.S. homes built by year 1900 were constructed with lead service laterals.

As the health effects of lead became increasingly clear, many municipalities banned its use by the 1920s. However, the

lead industry successfully defended its use by arguing benefits outweighed any negative health effects, and some lead service laterals were installed beyond the 1920s. While lead's use in plumbing declined in the latter half of the 1900s, lead pipes were not banned outright until 1986 when the U.S. Environmental Protection Agency (EPA) amended the Safe Drinking Water Act. Additional amendments reduced the amount of lead allowed in interior plumbing fixtures and soldering. Since drinking water service laterals and lead soldering last for decades if not longer, many older homes may still contain original lead plumbing.

How does lead get from plumbing into drinking water?

Lead from older plumbing can leach into drinking water. Over time, chemical and physical interactions between drinking water and plumbing coat the inside of lead pipes with a film that reduces lead leaching. However, this film is sensitive to chemical and physical changes to water, such as

shifts in temperature and water chemistry. As a result, physical and chemical changes, including changes to water treatment, can effect this film and the amount of lead leaching into water.

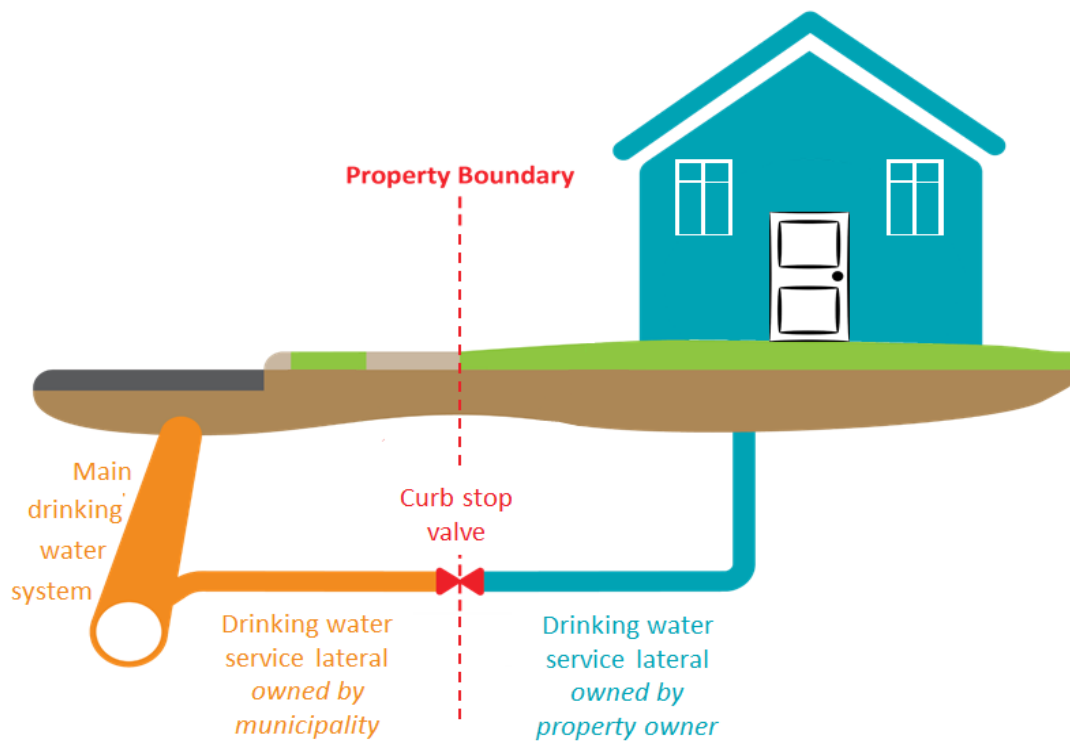
What are the health effects of lead?

The risks of lead exposure vary for different populations. The primary known health effects of lead are impaired learning ability in children and hypertension and cardiovascular disease in adults. Unborn children are particularly at risk. Studies have not found evidence of diminishing health effects with lower lead levels, suggesting there are no safe lead levels.

What are the regulatory requirements for lead?

The Safe Drinking Water Act gives the EPA federal authority to set drinking water standards. Most contaminants are regulated by limiting their amount in drinking water, where compliance is solely controlled by municipal treatment, storage, and distribution.

Figure 1: Drinking water service laterals connect a building's interior plumbing to the main drinking water system. In most jurisdictions, ownership of the drinking water service lateral is split between the local public water agency and the property owner. (Modified from the City of Cincinnati, OH 2017.)



However, current interpretations of state laws often prohibit water municipalities from spending municipal resources on private plumbing, thereby limiting their ability to replace lead sources on private property. Within this constraint, the EPA enacted the Lead and Copper Rule to prioritize monitoring, customer notification, and select municipal interventions within municipal control.

The Lead and Copper Rule requires water agencies to annually monitor the amount of lead at their customers' faucets. Water agencies are required to prioritize sampling water in homes more likely to have lead. If more than 10% of these samples exceed the action level (0.015 milligrams per liter), municipalities are required to notify customers, attempt treatment techniques that may reduce lead exposure, and monitor water supplies and lead at customers' faucets. If ongoing monitoring demonstrates that more than 10% of customers exceed the action level, water agencies are required to annually replace 7% of publicly owned lead service laterals until monitoring indicates lead falls below the action level.

In December 2016, the Pittsburgh Water and Sewer Authority (PWSA) exceeded the action level for lead and is now required to annually replace 7% of known lead service lines until ongoing monitoring demonstrates compliance with the action level.

What are the challenges of replacing lead drinking water service lines?

Records describing the installation of lead service lines are often missing; so locating them can be difficult. Thus the basis for meeting the 7% replacement mandate is uncertain or may change with increasing discovery of lead lines.

Even when lead lines are successfully located, their ownership is split between municipalities and private property owners. That means replacing an entire lead service line (the best practice) requires both municipalities and property owners to jointly agree on replacement and coordinate their work. Of course, the owners and the municipality can always act independently and replace only their portion of lead service lines.

This is called a "partial lead service line replacement."

When water agencies initiate a lead line replacement, EPA rules require the agencies to notify customers and provide them with ample opportunity to coordinate replacing their portion. However, replacing a drinking water service line is expensive. Typical costs range from \$2,000 to \$5,000 but can exceed \$10,000. As a result, most property owners opt not to replace their portion of lead lines when given the choice.

When it is the property owner who initiates a replacement, the overseeing permitting authority may not be the water agency. For instance, in Allegheny County, the Plumbing Section of the Allegheny County Health Department, not the PWSA, oversees permitting and inspection of plumbing on private property. As of April 2017, the Plumbing Division does not coordinate lead line replacements with the PWSA nor does it suggest property owners do so during current permitting and inspection.

Is there a problem with replacing only part of lead drinking water service line?

While replacing lead service lines does remove the primary source of lead in drinking water, there are significant risks to lead line replacements.

Studies have shown that a partial lead service line replacement can increase lead levels. The increase occurs as a result of both physical disruption of lead and the change in water chemistry that occurs when joining lead to copper. A slight electrical current is formed when water contacts the connection of lead to copper. This current increases the rate of corrosion of lead, a process known as galvanic corrosion, which, in turn, increases the lead that dissolves in water.

Studies differ with respect to the increase in lead observed following a partial line replacement and duration of increase. A 2011 EPA Science Advisory Board concluded that:

"The quantity and quality of the available data are inadequate to fully determine the effectiveness of [partial lead service line replacements] in reducing drinking water lead concentrations...Nevertheless...the

[advisory board] concludes that [partial lead service line replacements] have not been shown to reliably reduce drinking water lead levels in the short term and even longer. Additionally, [a partial lead service line replacement] is frequently associated with short-term elevated drinking water lead levels for some period of time after replacement, suggesting the potential for harm, rather than benefit during that time period. Available data suggest that the elevated tap water lead levels tend to then gradually stabilize over time following [a partial lead service line replacement]."

One study reviewed by the EPA Science Advisory Board found that children in homes served with partially replaced lead service lines were three times more likely to have elevated blood lead levels (above 10 micrograms per deciliter) than those without replaced lines.

Table 1 summarizes several studies of partial lead line replacement that have been published since the EPA's science advisory board completed their review. The weight of evidence suggests that lead levels at the faucet increase, perhaps significantly, for a period of weeks to months following a partial lead line replacement. While nearly all studies suggest initial spikes decreased over time, one study found elevated lead levels persisted four years after replacement. Some evidence also suggests that connecting lead to copper pipes with plastic, as opposed to brass, can reduce lead increases following a partial lead line replacement.

Unlike other water contaminants, where compliance with federal standards can ensure the protection of public health, the Lead and Copper Rule provides no such assurances on lead. Given the risks of a partial lead line replacement, the EPA's approach essentially leaves it to local public agencies to protect their constituents. These responsibilities are heightened when water agencies exceed the EPA action level for lead and thus have no choice but to initiate replacements. Since the EPA's mandate does pose potential risks, it may place local water agencies in legally difficult situations that

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deserve more focused discussion with the legal community.

How can local authorities protect public health?

Here I present incremental changes that could protect residents from the risks of a partial line replacement. Longer-term, structural policy changes to address the risks of lead are more important but outside the scope of this article.

When lead lines are replaced, local authorities have unique opportunities not only to inform residents but also to coordinate full replacements. Where PWSA initiates replacement, they do indicate that lead levels may increase following a partial replacement and recommend a complete line replacement.

While the Plumbing Section of the Allegheny County Health Department

oversees permitting and inspection of plumbing on private property, as of April 2017, the Plumbing Section does not inform residents of risks of lead line replacements nor does the Plumbing Section independently recommend homeowners coordinate complete replacements with water agencies. Coordination with water agencies can both increase complete lead line replacements and also avoid the costs of locating lead lines.

Publishing information that informs the community of lead risks is critical to protecting public health. Helpful information includes not just direct observations of lead pipes—such as inspections—but also proxies for lead pipes such as drinking water sample results and plumbing permits.

Where publicly owned partial lead line replacements are mandated, plastic connectors, as opposed to the brass connectors typically used, have been shown to reduce, though not eliminate, the spike observed following a partial lead line replacement.

Given the current regulatory context for lead in drinking water and the cost of

protection, residents with limited means, such as renters and low-income households, are at greater risk of lead exposure. In working to meet the EPA’s 7 percent per year replacement mandate, PWSA must exercise care to ensure specific populations are not put at disproportionate risk.

One clear short-term solution is to provide residents with point-of-use filters approved for lead. The recent joint effort by the City of Pittsburgh, Peoples Natural Gas, and PWSA to provide pitcher-style filters to City residents is a helpful step in not only providing short-term protection to public health but also increasing awareness of the health risks of lead in drinking water.

See the full report at: ucsur.pitt.edu/wp-content/uploads/2017/05/Partial-lead-service-line-replacements-Early-Release-Draft-.pdf

PWSA provides free lead water tests for Pittsburgh residents: pgh2o.com/lead-testing-kits

Table 1: Summary of Select Studies of Partial Lead Drinking Water Service Line Replacements (published since 2011)

Reference	Summary of primary finding(s)
Trueman, B.F., et al. (2016). Evaluating the Effects of Full and Partial Lead Service Line Replacement on Lead Levels in Drinking Water. <i>Environmental Science & Technology</i> 50/14: 7389–96.	Partial lead line replacements increased observed lead levels at the faucet for first-flush samples collected within 3 months of the replacement. Samples collected 3 days and 3 months after a partial lead line demonstrated a 289 percent and 124 percent increase in lead, respectively, relative pre-replacement levels. Lead levels decreased to below pre-replacement conditions (fully lead lines) over time and with increasing flushing during sampling.
Edwards, Marc. (2013). Fetal Death and Reduced Birth Rates Associated with Exposure to Lead-Contaminated Drinking Water. <i>Environmental Science & Technology</i> 48/1: 739–746.	Fetal death rates in Washington DC increased 21-42 percent during a period of active lead service line replacement (years 2007-2008) and subsequently declined following the elimination of partial lead service line replacements. The increase in fetal death rates was similar to that observed in year 2001 when changes to water treatment also increased lead exposure.
St. Clair, J. et al. (2015). Long-Term Behavior of Simulated Partial Lead Service Line Replacements. <i>Environmental Engineering Science</i> 33/1: 53–64.	Simulated partial replacement of lead lines with copper demonstrated a 140 percent increase in lead concentrations relative to a fully lead pipe 14 months after replacement for high flow rates. For moderate flow rates, lead concentrations from a partially replaced line were similar to a fully lead line 48 months after replacement. Relative to joining the lead and copper lines with plastic, brass and copper connections significantly increased lead released from a partial lead line replacement.
Water Research Foundation (2013).	In a lab test of partial lead line replacement, two identical simulated replacements led to different lead releases over time for unknown reasons. Relative to joining the lead and copper lines with plastic, brass connections significantly increased lead released from a partial lead line replacement. Pilot experiments with excavated lead lines, actual drinking water supplies, and typical household flow conditions demonstrated an increase 2 to 3 month increase in lead following a partial replacement for all types of connectors, including plastic connectors.

Dear Readers:

We have changes coming to the Urban and Regional Analysis program at UCSUR this summer.

This will be my last issue of *Pittsburgh Economic Quarterly* in my role as editor. Over the past fifteen years, we've proudly presented articles on our research and work in the Urban and Regional Analysis program, along with the exciting work of our students and colleagues here at the Center, across the University and beyond. I hope that the work has been valuable and informative for you.

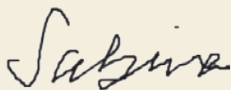
I have been the beneficiary of the skilled hand and eye of PEQ's Assistant Editor Anna Aivaliotis over these years. Chris Markle at Communications Services has helped to steer design and production each quarter. Anna and Chris, so great to work with both of you—many thanks!

Starting in September, Chris Briem will be taking over as editor of PEQ. This marks Chris's return to this role, since he was the founding editor of PEQ in 2000, as it was conceived by the late Steve Manners. PEQ will also be developing and improving its digital presence and format—look for an announcement of the new digital PEQ coming this summer.

And, more changes at UCSUR. Beginning this summer, Mike Blackhurst, Regional Development Manager, will be joining me as codirector of the Urban and Regional Analysis program. Mike joined us two years ago (see PEQ June 2015) and has been a frequent contributor to PEQ—in this issue, he writes on regulatory gaps evident in current water provision policy.

It's been a pleasure serving as editor of *Pittsburgh Economic Quarterly*. We look forward to PEQ continuing and expanding under Chris Briem!

All the best,



Sabina Deitrick



University of Pittsburgh
 University Center for Social and Urban Research
 3343 Forbes Avenue
 Pittsburgh, PA 15260

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- Integrated Data to Predict Chronic Absence* (2015)
- State of Aging in Allegheny County* (6/14)
- Pittsburgh Regional Environmental Survey* (2013)
- Hilltop Housing Market Analysis* (2013)
- Report on Undergraduate Withdrawal with an Emphasis on Freshman Withdrawal after the First Term: 2007–08 to 2012–13* (2013)
- Marcellus Shale Series* (2012-2013)
- The Pittsburgh Regional Environment Survey* (2013)
- The STEM Gap* (2013)
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- Young Adults Report* (8/12)
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University of Pittsburgh
 University Center for Social and Urban Research
 3343 Forbes Avenue
 Pittsburgh, PA 15260
Phone: 412-624-5442
Fax: 412-624-4810
E-mail: ucsur@pitt.edu
Web site: ucsur.pitt.edu
Twitter: twitter.com/ucsur

Pittsburgh Economic Quarterly Editor
 Sabina Deitrick
Assistant Editor
 Anna Aivaliotis

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