American Water Works Association
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March 8, 2018

Peter Grevatt
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USEPA Headquarters
Mail Code: 4601M
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Washington, DC 20460

RE: Long-Term Lead and Copper Rule Federalism Consultation (Docket ID No. EPA-HQ-OW-2018-0007)

Dear Mr. Grevatt,

The American Water Works Association appreciates the opportunity to participate in the U.S. Environmental Protection Agency's 2018 federalism consultation on potential long-term revisions to the Lead and Copper Rule. The body of research and experience with lead has grown since the initial federalism consultation on Long-Term Lead and Copper Rule in 2011, and AWWA commends the Agency for its decision to undertake this second consultation.

The primary mission of community water systems is to protect the health of the people they serve. Revisions to the LT-LCR should advance strong customer protections today while we work for a future where lead is no longer in contact with the water we drink. Systems must provide this protection within the means provided by their communities and the constraints of what is operationally and financially feasible. AWWA recommends that the revised LT-LCR result in water systems engaging in:

1. **Development of an inventory of lead service lines**: The inventory should begin with an estimate of the number of lead service lines in each system's service area based on the information available and improve over time through ongoing water system operations, improved detection technology, and community engagement.

2. **Development of plans for the complete removal of lead service lines through a long-term, shared commitment** – Replacing remaining lead service lines is an important, societal undertaking and will require long-term commitments from many partners and a recognition of shared responsibility. Lead service line replacement strategies must consider other water and non-water improvements and customer affordability challenges. Locally developed programs, responsive to local circumstances, are essential. Communities will need to navigate numerous legal and implementation challenges that require time and resources in the face of competing demands.

3. **Application of process control to reduce corrosivity of water reaching customers' homes:** Corrosion control should be robust, and deviations from target conditions should trigger investigation and corrective steps.

4. **Public outreach on lead risk and lead risk mitigation:** Systems should actively and transparently communicate with their customers, particularly customers with lead service lines, about lead risks and steps households can take to evaluate and reduce lead in drinking water.

The proposed LT-LCR is more than a decade in preparation for at least two reasons. First, managing lead in water involves many challenging policy decisions. And second, the science is still evolving to support those decisions. Many of the issues utilities face, in particular how to control particulate lead release, remain poorly understood. Consequently, to move forward quickly, the LT-LCR revisions must focus on improvements to the current rule that provide cost-effective risk reduction with minimal risk of unintended consequences or misallocation of resources.

The LT-LCR revisions represent an opportunity for meaningful health risk reduction by further reducing lead materials in contact with drinking water, encouraging water systems to enhance current corrosion control practice, and bolstering ongoing public education on lead in drinking water. One of the significant developments since the 2011 federalism consultation was the National Drinking Water Advisory Council recommendations. The NDWAC recommendations provide a sound starting point for the LT-LCR revisions, though more recent information should also be considered. Key aspects of rule revisions that can be drawn from the NDWAC report in the near term include:

Individuals and communities need to be empowered to act – Blood lead levels in the U.S. population continue to decline. Still, communities need to better understand lead risks from all sources, including potential exposure from water. Individuals should be empowered to take effective steps to protect their households, and communities should seek to integrate lead risk reduction activities.

Fully removing all lead service lines will require a long-term, shared commitment – Neither individual homeowners nor water systems alone can remove lead service lines. Replacement is a shared responsibility among utilities, customers, government at all levels and other community partners. It will require a long-term commitment and policies to accelerate removal through opportunities such as property transfers. Communities will need to navigate numerous legal and implementation challenges that require time and resources in the face of competing demands. Customers and utilities will face affordability challenges. Locally developed programs, responsive to local circumstances, considering opportunities to reduce lead exposure from all sources, will be essential.

Corrosion control should be carefully evaluated, and if modified, changes should be based on system-specific information using sound process-control practices and system-specific studies -- Each system has specific local water quality and treatment characteristics, so the nation's water supplies are not amenable to a one-size-fits all approach to treatment selection. One thing that has become clear since the initial promulgation of the LCR is that unintended consequences of treatment changes can be catastrophic. The lesson of the successful implementation of the Long Term 2 Enhanced Surface Water Treatment Rule and revised Total Coliform Rule is that tailoring actions to the particulars of each local system yields public health protection at an appropriate cost. Ongoing process control for corrosion control should be robust and trigger investigation and corrective steps, by:

1. Integrating system-specific water quality parameter monitoring with other ongoing distribution system and water treatment process control monitoring.
2. Applying statistical process control strategies to ensure noncorrosive water reaches customers.
3. Flagging deviations from target water quality conditions for investigation and corrective actions.

Corrosion control is a practical, effective and long-term action available to reduce exposure to lead. AWWA encourages EPA to focus on providing utilities the tools, knowledge, and flexibility to select appropriate corrosion control practices for their individual local water quality and treatment characteristics.

The NDWAC recommendations were substantial, and it is not clear if EPA can propose a rule that addresses all of them by August 2018, the anticipated date for a proposal. NDWAC recommendations the Agency has not yet shown that it can complete in a timely manner include:

1. Identify a level of lead in drinking water of public health concern (i.e., NDWAC's proposed household action level).
2. Substantiate the benefit of revising the rule with respect to copper.
3. Identify corrosion control changes that will reduce lead levels further for systems already reliably below the action level while also not leading to undesirable unintended consequences.
4. Dramatically change the method in which tap samples are collected.

As EPA pointed out in its October 2016 white paper, the elements of the LCR are very intertwined. The information available to the public, including EPA's January 8 briefing, do not describe potential rule revision options. Consequently, it is not clear how EPA intends to maintain a balance between the rule elements.

AWWA appreciates the outreach EPA is undertaking to involve states and local government. Actual rule implementation and the burdens associated with it will fall in part on water systems, local communities and state regulators, and more importantly, on individual households. AWWA urges EPA to organize one or more stakeholder meetings that allow the experiences and concerns of advocates for impacted households to be better understood.

AWWA is fully committed to educating systems on the current and revised LCR, assisting systems with evaluating and improving their corrosion control practices, promoting public communications on lead, and advancing full lead service line replacement practice nationwide. Attached are more detailed comments addressing the questions posed by the Agency in its Federalism briefing and comments prepared by Dr. Crawford-Brown on development of a health-based lead concentration of concern. If the EPA LT-LCR team has any questions regarding these comments or would like to become more engaged in our outreach efforts, please contact me or Steve Via at 202.628.8303.

Best regards,

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Executive Director – Government Affairs

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Attachments: 1

Who is AWWA

The American Water Works Association (AWWA) is an international, nonprofit, scientific and educational society dedicated to providing total water solutions assuring the effective management of water. Founded in 1881, the Association is the largest organization of water supply professionals in the world. Our membership includes more than 4,000 utilities that supply roughly 80 percent of the nation's drinking water and treat almost half of the nation's wastewater. Our 51,000-plus total membership represents the full spectrum of the water community: public water and wastewater systems, environmental advocates, scientists, academicians, and others who hold a genuine interest in water, our most important resource. AWWA unites the diverse water community to advance public health, safety, the economy, and the environment.

Attachment 1

Addressing Questions Posed in Federalism Consultation
Long-Term Lead and Copper Rule Federalism Consultation

(Docket ID No. EPA-HQ-OW-2018-0007)

prepared by

American Water Works Association

for the

U.S. Environmental Protection Agency

submitted

March 8, 2018

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Addressing Questions Posed in Federalism Consultation

Introduction

Revisions to the Lead and Copper Rule should advance strong customer protections today while we work for a future where lead is no longer in contact with the water we drink.

Systems must provide this protection within the means of the communities they serve and within the practical limitations of what is operationally feasible. AWWA suggests that the revised LT-LCR include the following elements:

1. Development of an inventory of lead service lines.
    - Be based initially on available information.
    - Improve over time through ongoing water system operations and community engagement.
2. Development of a strategy for lead service line removal.
    - Develop and initiate in a timely fashion and proceed at a community-specific pace.
    - Recognize that shared responsibility is necessary for successful, sustainable lead service line replacement initiatives.
    - Follow ANSI/AWWA C810-17, Replacement and Flushing of Lead Service Lines.
3. Application of process control to reduce corrosivity of water reaching customers' homes.
    - Implementing changes in corrosion control based on system-specific information using sound process-control practices and system-specific studies.
    - Integrating system-specific water quality parameter monitoring with other ongoing distribution system and water treatment process control monitoring.
    - Applying statistical process control strategies to ensure noncorrosive water reaches customers' services.
    - Flagging deviations from target water quality conditions for investigation and corrective actions.
4. Public outreach on lead risk and lead risk mitigation.
    - Actively and transparently communicating with their customers, particularly customers with lead service lines, about lead risks and steps they can take to evaluate and reduce lead in drinking water in their home.

The Safe Drinking Water Act provides a sound decision-making framework. Revision of the Lead and Copper Rule is challenging, and the selected solution will have implications for community water systems of all sizes in every state. Which and how many sources of lead are present in the plumbing of a home depend on historical development patterns in that community, not whether the community today is large or small, urban or rural, poor or affluent. Moreover, as we seek to further reduce lead exposures, this rulemaking encounters larger societal questions such as who has a duty to pay for achieving lead risk reduction and when does a public entity like a water system have the right to intrude on private property. The Safe Drinking Water Act allows the Agency to make tough policy decisions, but it also sets the expectations that such decisions will be based on sound science and reflect opportunities for achieving meaningful risk reduction in a cost-effective manner.

Community Water Systems efforts already substantially control lead exposure through drinking water. The next step in additional risk reduction must be financially prudent and not create unintended consequences. In its most recent Six-Year Review data call in, EPA compiled more than 808,000 sample values from 42 states for the period 1998 to 2005.[1] AWWA's initial analysis of that data reflects data from approximately 23,100 CWSs serving a combined population of 167 million with LCR data in the database for 2003 to 2005 (for CWSs serving populations >500 using surface or groundwater sources). We found that there were 4,100 systems serving an estimated 23.2 million people where all observed values were less than 1 µg/L, and 90% of systems serving more than 10,000 persons have median lead levels below 5 µg/L.

Compliance data is a limited sample and the sampling protocol and sample pool are not representative of community wide exposure, but the Six-Year Review dataset illustrates that nationwide the water supply community is providing water with low lead concentrations. The question at hand is what is the prudent next step to take to further advance lead risk reduction.

Lead is a multi-exposure pathway challenge. Drinking water is one of many potential sources of exposure to lead. The multi-media nature of lead exposure reduction complicates public education and communication. It also involves numerous responsible parties, many of which are not engaged through the LCR. While the burden of lead health risk should not fall disproportionately on any one group, neither should the burden for achieving lead risk reduction. There is a shared responsibility which is both essential to success and complicates finding timely and affordable solutions.

Reasonable action now is needed. It is desirable but unrealistic to achieve zero exposure to lead in a short period of time. Thus, significant reduction in risk are the appropriate goal. By continuing to debate instead of acting on reasonable rule strategies, as outlined by the National Drinking Water Advisory Council, we continue to delay achieving these risk reductions.

Technical capacity must be built. Nationally, after an initial surge in capacity following promulgation of the LCR, the expert capacity in corrosion control treatment selection has not been adequately developed through academia, maintained in the water system or consulting engineering community, or retained in the regulatory community. EPA and AWWA have roles in supporting the rebuilding of this expertise in the sector. The public health community must also be engaged and educated about lead in water.

Research is needed to support major changes in corrosion control practice aimed at small incremental improvements without causing unwanted unintended consequences. To move forward quickly the LT-LCR revisions must focus on improvements to the current rule that provide cost-effective risk reduction with minimal risk of unintended consequences or significant misallocation of scarce resources for individual homeowners, water systems, or the communities water systems serve.

Lead Service Lines

The most significant barriers to full lead service line replacement are (1) divided ownership / responsibility and (2) the cost of replacement. In drafting the rule revisions, EPA must recognize the limitations these two factors have on (1) the quality of data available to guide action, (2) allocation of the cost of replacement, and (3) the time required for all lead service lines to be fully removed. AWWA is actively engaging its members to foster advancing full lead service line replacement. EPA should avoid setting unrealistic regulatory expectations or creating bureaucratic obstacles to community-specific solutions.

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[1] Note, the Six-Year lead concentration data reflects first-draw samples following at least a 6-hour period of stagnation. Samples are taken from homes that are prone to higher levels of lead, e.g., lead service line, older brass, and copper with lead solder plumbing.

Create an Inventory

An important step in creating a future without lead in contact with drinking water rests on developing a sound understanding of the locations of lead service lines in communities. Having an inventory aids in developing a strategy for removing those lines during ongoing main replacement, service line repairs, home remodeling and sale, home rentals and focused outreach and engagement of households with lead services.

An exact inventory describing the use of lead pipes under both water utility and customer ownership is not feasible. At present, estimates of the number of lead service lines in community water systems in the United States range between 6.1 and 10 million. These lead service lines exist within a larger universe of service lines totaling 96.7 million. These estimates are imperfect, and there are anecdotal reports of underestimates and overestimates from individual systems. Where systems are excavating to identify lead service lines (currently being tested as a tool of last resort for confirming the presence of a lead service line), systems are noting that fewer than expected numbers of lead lines are found.

While research is ongoing, at present there is not an accepted field procedure for identifying if a service line is made of lead without physically seeing the whole line. This is important in several respects. These lines are very old and have been repaired; such repairs may have removed portions of an existing lead line. Also, if EPA includes lead goosenecks within the definition of lead service lines for purposes of an inventory, visual inspection requires digging down to the water main, which is often in the street. An exact inventory would necessitate certain knowledge about all 96.7 million service connections in the United States, not simply the 6.1–10 million that are more likely to be lead. Moreover, while lead service lines are typically measured in tens of feet in length, goosenecks are, by definition, typically less than 3 feet long (both Mueller and Hayes goosenecks were manufactured at lengths of 18, 24, 30 and 36 inches in length).[2, 3, 4]

An exact inventory is not, however, needed for the tasks at hand (i.e., guiding sampling efforts, targeting communication initiatives, preparation for construction activities, and tracking elimination of lead services). Therefore, it is important that inventory development move forward with the tools at hand, recognizing their weaknesses. Moreover, use of ongoing activities to improve the lead service line inventory can be framed as a win-win opportunity for such activities as automated meter reading installations, identification of gutter – stormwater connections, backflow prevention device inspection and other initiatives.

If EPA were to craft regulatory language requiring utilities to prepare lead service line inventories, the Agency would need to recognize several challenges:

1. Lead service lines were installed during the 1800s and early – mid 1900s. Consequently, the primary record of installed material selection, tap cards, are decades if not a century or more old. In subsequent years, there have been changes in practice that impact the fidelity of the data, loss of records, and unrecorded changes in installed materials as repairs and other construction have occurred.
2. Service lines are owned in part by the water system and in part by the customer in most communities. Customers do not always advise the water system of improvements to the portion of the service line the customer owns. In many communities, plumbers have not been an active

[2] Mueller Company. Catalog, November 1, 1961, p. 4-3.
[3] Hayes Water Service Products Catalog, p. 18.
[4] Lead Industries Association, Lead in Modern Plumbing, p. 8.

stakeholder in lead service line identification, homeowner awareness or updating utility service line material records.

3. Not all community water systems are villages, towns, or cities where the water system service area is the same as a municipal subdivision. “Municipal” records used to compile an inventory (e.g., building and plumbing permits, tax records, mapping, etc.) will be harder to compile in rural areas served through public service authorities and areas served by investor-owned water companies). Even where the water system and municipal government are the same, there are often extra-territorial service areas where the water system is not able to rely on other municipal departments within the same government entity.
4. Absent the threat of loss of water service, water systems do not have the authority to require customers to cooperate in acquiring data about the service line material on the customer’s property. Turning off water presents a health and public safety concern. There are also concerns about social inequity where water shutoffs disproportionately impact segments of a community’s households.
5. While water system staff sometimes enter customer premises (e.g., to set or repair meters, respond to water quality complaints, etc.), such contact is minimized for the convenience of customers and for the safety of water system staff (e.g., need for a two-person crew and customer scheduling).
6. Systems are transitioning to new asset management platforms that will, over time, facilitate infrastructure renewal, including lead service line replacement. As EPA is aware from its own software platform transitions, these transitions can complicate data acquisition and present unanticipated challenges that effect timely delivery of expected products.
7. Current technologies used to examine service lines that are buried under yards, sidewalks, and streets requires excavation. Excavation only allows inspection of the exposed pipe length, is costly, and has its own associated risks including the integrity of service lines that are not lead and unnecessarily disturbed.

Given these limitations, it is important that EPA rule requirements and associated guidance set reasonable expectations that:

1. Allow the development of the initial inventory based on existing records, historical practice and utility field experience.
2. Provide sufficient time to allow the initial inventory to be developed, recognizing that in many communities, utilities will be supplementing in-house records with data from other departments and oftentimes other entities.
3. Expect that the inventory will be improved over time as additional information can be incorporated through ongoing water system activities (e.g., meter replacement, water quality visits, etc.) and community outreach (e.g., home inspections when buildings are sold, instructions to homeowners, plumbing permits).[5]
4. Expect that water systems will have practices in place to appropriately address previously unrecognized lead service lines when they are discovered.
5. Improve public information and education so that homeowners can be active stakeholders.
6. Utilize opportunities like the sanitary survey for the primacy agency to review the system’s practices to maintain and improve the inventory.

[5] Example customer outreach, “Help us update our records,” DC Water, Available 1/25/2018 at https://www.dcwater.com/servicemap.

Public access to information, including the presence / absence of lead service lines, is important to advancing replacement and a natural part of public outreach. Rule requirements for public access should assist property owners without creating unintended harm. EPA may be contemplating a requirement that water systems make inventories publicly available (e.g., on the water utility website, through a database query, or other means). Data compiled by municipal water systems, including information on service lines on private property, may be subject to freedom of information requests. Investor-owned water systems are not necessarily subject to FOIA. Some systems have encountered legal concerns when considering releasing what can be viewed as private information.[6]

Since water systems do not typically own the whole service line and since it may be impossible to determine the material of the whole length of the line, water systems cannot make absolute, always-current statements about the status of a home's service line. Systems that provide a map or database that allows public searches of this data typically use a strong disclaimer statement to users.[7] Some have posed the idea of a state-based or national repository of service line material inventory. The above described data quality and liability considerations are similarly challenges to building such a repository. The burden on EPA, states, and water systems to develop and keep such a data system current warrants careful consideration. On first reflection, managing this data at the local level appears to be the more immediate opportunity for advancing lead service line replacement and educating customers.

FULL LEAD SERVICE LINE REPLACEMENT

Fully removing lead service lines will require a long-term, shared commitment. Water systems and their customers will not be able to replace lead service lines overnight. It will take time to complete a robust inventory, prioritize lead service line replacement among other water system improvements (and other non-water system needs in the community), and identify funding mechanisms to assist in payment for the work. Communities will need to navigate numerous legal and implementation challenges that require time and resources in the face of competing demands. Customers will face affordability challenges. Locally developed programs, responsive to local circumstances, will be essential, and shared federal and state support also will be necessary to facilitate fully removing lead services.

Reducing environmental exposures is a long-term, challenge that must address multiple paths of exposure. EPA has no means at present to understand if a community would benefit most by expanding its lead paint abatement program, targeting lead sources in rental housing, removing lead service lines, or pursuing other sources of lead. This point is best described by other participants in the federalism consultation. From the viewpoint of a water system, this balance must be struck locally so that the water system receives the support and coordination needed from all the partners it needs to effectively engage customers in full lead service line replacement.

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[6] Association of Metropolitan Water Agencies, State FOIA Laws: A Guide to Protecting Sensitive Water Security Information, July 2002, Available 1/25/2018 at https://deq.utah.gov/Permits/drinkingwater/docs/2014/07Jul/StateFOIA.pdf.

[7] Example disclaimer, "DISCLAIMER: The maps provided by the Boston Water and Sewer Commission (BWSC) are based on property surveys conducted during the installation of the Automated Meter Reading system, as well as information directly provided by customers and acquired during physical inspections. BWSC does not guarantee the accuracy of these records and maps, which shall be used for the sole purpose of providing property owners and residents with information regarding their private water services, and not for any commercial, legal or other use. These records will be updated on a monthly basis, or at such alternate times as BWSC designates. BWSC reserves the right to alter, amend or terminate at any time the display of these maps and records." Boston Water and Sewer Commission, Available 1/26/2018 at http://www.bwsc.org/COMMUNITY/lead/leadmaps.asp#TOP_PAGE.

ANSI/AWWA C810-17, Replacement and Flushing of Lead Service Lines should be incorporated by reference as the protocol for lead service line replacement. AWWA developed a management standard for when a water system anticipates or incidentally encounters lead service lines in the course of construction.[8] This standard addresses identification of lead services, notification of impacted customers, and protective measures to reduce the potential for exposure to lead due to the replacement. As with all ANSI standards, C810-17 was developed by a committee selected with a balance of perspectives in mind and was made available for public comment. This standard will be reviewed periodically and improved based on system experience and new research. It is worthwhile to note, that "*The National Technology Transfer and Advancement Act of 1995 directs [federal] agencies to use voluntary consensus standards in lieu of government-unique standards except where inconsistent with law or otherwise impractical*."[9] EPA Region 5 has recommended the City of Flint, Michigan follow C810-17 when replacing lead service lines.

EPA should not make replacing all lead service lines in a specific timeframe a rule requirement. AWWA is actively urging its members to integrate lead service line replacement into their current distribution system operations and capital programs now, because it is going to take a substantial, long-term effort to replace the 6.1 – 10 million installed lead services. The NDWAC recommendation, which AWWA endorsed, recognized the challenges associated with setting a fixed deadline and focused on establishing strategies to move forward with available authorities and funding. AWWA is urging systems to start as soon as possible to work with the communities they serve to develop a local strategy and begin to fully remove lead service lines. These community-specific strategies consider local circumstances, particularly locally-appropriate approaches to shared responsibility for accomplishing full replacements. There are numerous potential strategies for funding full service line replacement; developing state and local policies to address this challenge of paying for full replacement will take time and solutions will need to be locally appropriate.[10]

In contemplating a timeframe for completing all lead service line replacements, it is important to look at the housing sector for the frequency with which opportunities to engage homeowners arise. Nationwide, approximately 5.4 million existing homes were sold in 2016, and a similar level of sales occurred in 2017.[11] In 2013 the National Association of Home Builders estimated that the typical buyer of a single-family home can be expected to stay in a home approximately 13 years.[12] It is also worth noting that 35% of households in the U.S. rent rather than own their home.[13] The U.S. Census tracks how frequently people move in the U.S. Looking at data from 2013 and 2014, 24.5% of all people living in renter-occupied housing units lived elsewhere one-year prior. [14] As expected, the Census data illustrates that renters move much more frequently than people in owner-occupied housing (roughly 5 times as often).

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[8] AWWA, ANSI/AWWA C810-17, Replacement and Flushing of Lead Service Lines, Available 1/26/2018 at https://www.awwa.org/store/productdetail.aspx?productid=65634922.

[9] EPA Website, Available 1/26/2018 at https://19january2017snapshot.epa.gov/data-standards/federal-national-and-international-data-standards_.html.

[10] Environmental Financial Advisory Board, Financing Lead Risk Reduction, October, 2017, Available 02/22/2018 at .

[11] Lawrence Yun, Residential Real Estate Economic Issues and Trends Forum at the REALTORS® Conference & Expo in Chicago, IL, November 3, 2017, Available 1/26/2018 at https://www.nar.realtor/presentations/november-2017-economic-housing-outlook-lawrence-yuns-presentation-slides .

[12] National Association of Home Builders, Latest Calculations Show Average Buyer Expected to Stay in a Home 13 Years, 2013.

[13] U.S. Census, 2016 American Community Survey, 1-Year Estimates, US Census Bureau. Updated 9/2017 (Note, 53% of households that live in rental housing rent structures with 4 or fewer units).

[14] U.S. Census, Press Release. U.S. Mover Rate Remains Stable at About 12 Percent Since 2008, Census Bureau Reports, January 2015. Available 02/21/2018 at https://www.census.gov/newsroom/press-releases/2015/cb15-47.html.

The Census's mover rate for people living in owner-occupied housing units of 5.0 percent is also comparable to the HAHB typical expected stay statistic.

Opportunities to replace lead service lines require coordination with state and local government beyond the water department / separate utility associated with changes in housing and other events include:

1. Identification/confirmation and replacement at time of title transfer.
2. Identification/confirmation and replacement at as a condition of occupancy post vacancy.
3. Identification/confirmation and replacement prior to rental.
4. Identification/confirmation and replacement as a condition of water service (initial turn on for a new customer or return to service if there is lapse in service).
5. Identification/confirmation and replacement in conjunction with a major remodeling of a current structure.
6. Identification/confirmation and replacement in conjunction with main replacement.
7. Identification/confirmation and replacement rather than repair following a leak or break.
8. Integrating lead service line identification and removal into lead-free facility approval processes for businesses seeking an operating license (including childcare facilities).

The average useful life of water mains varies with the material, the method of manufacture, and the conditions where the pipe is installed.[15] The oldest cast iron mains are quite long-lived with average useful life of about 120 years, while cast iron from the 1920s is expected to fail 20 years more quickly, and pipes installed post-World War 2 are expected to last just 75 years.[16] What is important to note is that the rehabilitation and replacement of these mains is a demographic echo of their initial investment. Today, in 2018, water system capital programs are at the beginning of the resulting wave of capital infrastructure re-investment.[17]

Service lines have a finite useful life, and as older lines fail, there is an opportunity to replace them completely. Lead service lines frequently do not fail for decades, but since those lines were often installed more than 70 years ago, failures are increasingly likely.[18]

Another opportunity for lead service line identification and replacement exists when plumbers engage with homeowners for routine work. Hot water heaters, for example, have a useful life of 8 – 12 years,[19] and installing a new one typically involves a visit from a plumber.

Lead service line replacement programs entail:

1. Identifying and actively engaging homeowners with lead service lines to coordinate full lead service line replacement.
2. Actively coordinating with other utilities engaged in infrastructure renewal (e.g., wastewater, stormwater, electric, gas, telephone, cable, etc.).

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[15] AWWA, Buried No Longer: Confronting America's Water Infrastructure Challenge, 2012. Available 02/21/2018 at http://www.awwa.org/portals/0/files/legreg/documents/buriednolonger.pdf.
[16] AWWA, Dawn of the Replacement Era: Reinvesting in Drinking Water Infrastructure. 2001.
[17] AWWA, Buried No Longer: Confronting America's Water Infrastructure Challenge, 2012. Available 02/21/2018 at http://www.awwa.org/portals/0/files/legreg/documents/buriednolonger.pdf.
[18] Lee, Juneseok; Meehan, Myles. Survival Analysis of US Water Service Lines Utilizing a Nationwide Failure Data Set. Journal AWWA, Vol. 109, Number 9: 13-21. September 2017.
[19] DOE, 2010 Water Heater Market Profile, U.S. Department of Energy. September 2010.

3. Timing construction to reduce disturbing neighborhoods and respond to local policies that prohibit construction in recently repaved roads.[20, 21]
4. Doing service line replacements concurrent and preferably in coordination with other capital infrastructure investment (e.g., replacing mains that have high break rates, repairs to improve water quality or reduce water loss and maintain pressure etc.).
5. Replacing service lines as part of a community's efforts to revitalize its economy and jobs base (e.g., new or renovated facilities to deliver adequate water supply to new or expanding businesses).

If EPA evaluates lead service line replacement over a specific period of time, it must account for the cost and economic consequences of the timeframe selected. The shorter the period of time, the greater the burden associated with the above elements. There are also secondary impacts, including:

1. Increased failures of other infrastructure and consequent economic harm to the community as other necessary infrastructure improvements are delayed.
2. Disruption and potentially repeated and protracted disruption of neighborhoods and business districts as lead service line replacement would be occurring increasingly on a schedule separate from ongoing capital projects.
3. There is a practical limit as to how many streets can be disrupted in a community at any one time.
4. Larger numbers of households facing the prospect of immediately bearing the cost of replacing the portion of the service line they own. As a consequence, a larger number of households would not have access to financial assistance programs, given limited resources for these programs (or if assistance programs are expanded to meet the required pace, there would be an associated impact on fiscal health of the community).
5. Setting an arbitrary deadline of any length will be a disincentive to action in communities where the goal is unrealistically short given local circumstances, and also where a lengthy timeframe is not needed.

A recurring top concern in AWWA surveys of water sector leaders is the ability to convince ratepayers to fund infrastructure renewal and replacement.[22] An important aspect of building ratepayer trust is establishing a systematic process for prioritized infrastructure investments, or in other words, asset management.

It is also worthwhile to consider the overall management of drinking water infrastructure. EPA has described best practices for asset management as a core element of timely renewal of drinking water infrastructure.[23] An embedded tenet of asset management is the development of a system-specific path from the current state to the desired level of service, considering both the conditions of existing assets and the community's ability to find funding mechanisms -- particularly raising water rates.

One of the purposes of this consultation is to consider the unfunded mandate implications of the proposed rule. While EPA may identify some funding, such as through the state revolving loan fund, that can assist in replacing lead service lines, the demand for SRF funds is already larger than the available state and federal loan dollars. In 2017, total disbursements from state drinking water SRFs total less than

[20] Sacramento County, Available 02/15/2018 at http://www.sacdot.com/Pages/Trenchingandroadcutmoratorium.aspx
[21] City of Portland, Available 02/15/2018 at https://www.portlandoregon.gov/article/437990.
[22] AWWA, 2017 State of the Water Industry Report. April 2017.
[23] EPA, Asset Management: A Best Practices Guide, April 2008, Available 1/26/2018 at https://www.epa.gov/sustainable-water-infrastructure/asset-management-water-and-wastewater-utilities.

$3 billion dollars. So, if all SRF funds were applied to lead service line replacement without respect how much SRF funds were available in any one state vs another, it would take 10 – 16 years to replace the estimated 6.1 – 10 million lead service lines. Importantly, the SRF is almost always a loan, meaning that the households in a community ultimately pay for the lead service line replacement program, with associated interest.

None of the existing federal or state infrastructure funding programs (e.g., SDWA SRF, Community Development Block Grant, Rural Utility Service, etc.) are positioned to provide grant programs sufficient to meet the $30–50 billion expense often cited for replacing existing lead lines in their entirety.

PARTIAL LEAD SERVICE LINE REPLACEMENT

The current LCR requirement to conduct lead service line replacement should be removed.[24] The most important change with respect to lead service line replacement that EPA can make in the LCR revisions is to change the regulatory construct from punitive to one of building capacity. The current rule requirements replacing lead service lines at a time when corrosion control is either not in place or not optimal. The timeframe for action in this provision is such that partial replacements are an inevitable result. As previously stated, the LCR revisions should reflect the NDWAC recommendation that water systems develop a proactive replacement strategy and work with their communities and other partners to implement that strategy.

It is important that practice in the sector emphasize full lead service line replacement but recognize that partial replacement will occur. In developing AWWA C810-17, the consensus view was reached that it was possible to reduce the number of partial lead service line replacements but there are multiple scenarios where partial replacements will continue to occur, and remain in place for indeterminant periods of time. A few example situations include:

1. An after-hours repair that disturbs a lead service line (e.g., a main or service line repair that occurs outside of typical work hours so as to reduce disturbance to community, provide access to personnel or equipment, etc.).
2. An emergency repair that disturbs a lead service line (e.g., a main or service line repair where water leakage presents a hazard to life or property).
3. A lead service line is recognized during ongoing work and the affected property owner is not available to coordinate full replacement.
4. A partial replacement by a customer's plumber occurs and the water system must schedule and mobilize equipment to address the utility portion.
5. The customer's plumber must schedule or re-schedule replacement of the customer's portion of a lead service line.
6. A customer does not want to or cannot afford to participate in a full-lead service line replacement.

EPA should use the rulemaking to emphasize full lead service line replacement as a routine practice. In lieu of full replacement, there should be a record explaining that either (1) the customer was unwilling or unable to pursue full replacement or (2) the status of the pending actions that will ultimately lead to full replacement. When partial replacement occurs, there is an opportunity for recurring customer notification of the need to complete the lead service line replacement.

Water systems are not the only utilities with buried infrastructure. Electric, sewer, gas, cable, telephone, stormwater, and fiber lines are installed, repaired, and replaced by other utilities and their contractors.

[24] 40 CFR Part 141.84

To the extent possible, utilities coordinate so that one does not harm the others installed assets. Water systems can provide other utilities with standard operating procedures for how to coordinate around lead service lines, but the rule should recognize that the water system has limited influence over other utilities and their contractors.

PITCHER FILTERS POST LEAD SERVICE LINE REPLACEMENT

A single-choice risk mitigation measure should not be written into regulation. No other federal SDWA regulation specifies a single-choice treatment option. This is a deliberate policy because situation-specific solutions are necessary. An apt comparison for pitcher filters is the specific risk mitigation used following a nitrate maximum contaminant level violation. While states will often advise the use of bottle water with such a violation, other options like the use of an RO device maybe a better solution for some households.

This observation applies equally to plumbed in POU devices.

Pitcher filters are only one of several risk reduction options after lead service line replacement. AWWA Standard C810-17 includes (1) flushing (i.e., running water through) the new or replaced service line immediately after installation, (2) flushing the water lines in the home, and (3) providing instructions to the occupant to flush taps used for drinking or cooking periodically. The standard also recognizes that some situations may warrant using point-of-use filters, or customers may desire to use POU filters.

A number of systems have distributed pitcher filters after either exceeding the lead action level or as part of lead service line replacement protocols. To-date, "maintenance" of the pitcher filters in these systems has been limited to provision of (1) instructions to the customer on POU use, (2) a supply of replacement filters for the pitcher, sufficient for the intended period of performance, and (3) a point-of-contact for assistance. The experience of systems with this level of maintenance and research by other systems considering providing pitcher filters have identified several challenges:

1. Confirming delivery of the pitcher to the intended recipient – When pitchers are left behind by field crews or delivered by third-party providers, there are instances of theft, failure to deliver, failure to deliver in a timely manner, and other issues one would associate with leaving a package on a doorstep.
2. Adequate supply of NSF certified devices – At times, the available supply of NSF-certified filter products has been limited. Surges in demand that are unanticipated by the available manufacturers can lead to shortages and delays in filter delivery to the water system (or fulfillment center) for subsequent delivery to customers.
3. Potential legal liability for failure of the customer to properly use the device – It is conceivable that claims could be brought against a water system if a customer failed to adequately maintain the pitcher filter and subsequently claimed an illness was attributable to the water from the pitcher.
4. Impact on household behavior – It is not clear to what degree households will take seriously a recommendation to use and properly maintain a pitcher filter.

Benefit of providing pitcher filters is no more certain than benefit from routine flushing. Based on EPA's comments, the use of a pitcher filter in this situation would not trigger current guidance for maintaining and guaranteeing the performance of pitcher filters as described by EPA guidance.[25] As with flushing,

[25] EPA, Point-of-Use or Point-of-Entry Treatment Options for Small Drinking Water Systems, EPA 815-R-06-010, April 2006. Available 1/26/2018 at https://www.epa.gov/sites/production/files/2015-09/documents/guide_smallsystems_pou-poe_june6-2006.pdf.

AWWA is not aware of any research demonstrating the effectiveness of pitcher filters reflecting actual customer behavior.

Introducing as regulatory requirement creates a new barrier to implementation. With respect to primacy agency oversight of such a requirement, a traceable record to demonstrate delivery of pitchers within the specific criteria included in the rule language would be required. A regulatory requirement to provide filters, therefore, has the unintended impact of creating a new set of bureaucratic requirements that are a distraction and barrier to timely situation-specific risk mitigation.

The Water Research Foundation is currently sponsoring research into managing lead in drinking water and related issues.[26] This research agenda includes an ongoing effort to better understand flushing protocols around lead service line replacement

1. WRF # 4584, Evaluation of Flushing to Reduce Lead Levels and
2. WRF # 4713, Full Lead Service Line Replacement Guidance.[27, 28]

AWWA's standard review process will consider the information from these projects in the regular review and updating of AWWA Standard C810-17.

COST OF LEAD SERVICE LINE REPLACEMENT

EPA's proposed estimate, $4,700 per individual lead service line replacement, is too low.[29] There is substantial system-to-system and home-to-home variability in the cost of lead service line replacement. Replacement cost includes two components. The first is the administrative infrastructure (e.g., personnel time, business systems and field work) to identify and engage individual customers in lead service line replacement. As water systems make these systems more customer-focused, the cost of this administrative infrastructure rises. Engagement during a replacement may include dialogue with both a property owner and a resident, both of whom have a role throughout the preparation, execution and follow-through on a service line replacement. Water systems do not typically track administrative costs in a manner that supports quantifying administrative infrastructure. One partial example is the lead service line replacement program oversight contract for Flint, Michigan's ongoing program. Available program data from the 2017 Flint replacement program puts the administrative cost per service line removed at roughly $760.[30] Preliminary data presented by Denver Water in November 2017 on its lead service line replacement program suggests that the administrative cost per service line removed is approximately $600.[31] These two estimates illustrate (1) that administrative is a significant element of replacement program cost that must be considered, (2) there is program-to-program variability due to program structure, elements, and maturity, (3) best estimates at present are imperfect and likely underestimate actual program start-up costs and financial burden on departments beyond the water utility, and (4)

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[26] WRF, Lead and Copper Corrosion: An Overview of WRF Research, October 2017, Available 1/26/2018 at http://www.waterrf.org/resources/StateOfTheScienceReports/LeadCorrosion.pdf.

[27] WRF, Evaluation of Flushing to Reduce Lead Levels, Available 1/26/2018 at http://www.waterrf.org/Pages/Projects.aspx?PID=4584.

[28] WRF, Full Lead Service Line Replacement Guidance, Available 1/26/2018 at http://www.waterrf.org/Pages/Projects.aspx?PID=4713.

[29] EPA, Presentation to Federalism Consultation, January 8, 2018, Available 02/22/2018 at https://www.epa.gov/dwstandardsregulations/lcr-federalism-consultation.

[30] Mlive, Flint lead pipe replacement program to switch hands in 2018, December 1, 2017. Available 02/22/2018 at http://www.mlive.com/news/flint/index.ssf/2017/12/flint_lead_pipe_replacement_pr.html.

[31] Price, Steve, From 0 to 60,000: Denver Water Gets a Leadfoot, AWWA, Water Quality Technology Conference, November 2017.

current estimates represent “low hanging fruit” of easy replacements. Over time, remaining lead service lines will entail increasingly costly outreach and coordination.

The second component is the cost of replacing the lead service. This latter cost is what is typically reported, and the cost per replacement varies based on many factors including:

1. Steps that can be taken to reduce mobilization cost (e.g., integrate into a larger construction project, execute in a systematic program, utilize existing crews during other operations and maintenance tasks).
2. Level of collaboration with customer (e.g., the number of field teams required to complete the entire replacement rather than coordination among multiple teams, including the customer’s plumber and electrician, involved).
3. Site-specific constraints (e.g., the built environment in which the replacement is occurring)

Looking just at the field work costs associated with lead service line replacement, $4,700 is likely a low estimate (see Figure 1).[32] When estimating the cost of field work, EPA needs to be sure the estimates capture:

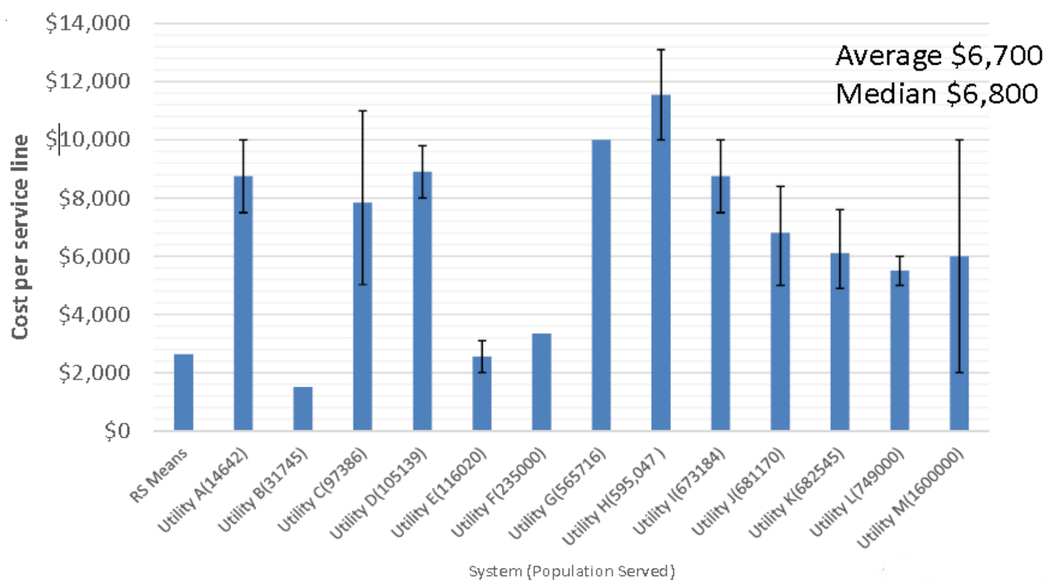

Figure 1 – Cost of full lead service line replacement fieldwork[33]

1. Both the replacement of the water system and the customer owned portions of the service line (these values may be tracked separately),
2. Mobilization costs, as well as time and materials costs, while on site at a specific house, and
3. Troublesome replacement and ideal replacement scenarios.

[32] AWWA, Ongoing data collection effort. Data as of 02/22/2018 reflecting information from 14 community water systems.
[33] Ibid.

Corrosion Control

The NDWAC recommendations could form the basis for LT-LCR revisions with respect to improving corrosion control practice. Today, under the current LCR, all systems may not install "optimized corrosion control" but all systems implement practices that reduce corrosion. The specific practices on which EPA and the sector rely when active corrosion control treatment for lead is needed are (1) pH and alkalinity adjustment and (2) phosphate addition. The current regulatory framework requires these specific treatments at systems that serve more than 50,000 persons and smaller systems that exceed the action level. When revising the LCR EPA should acknowledge that thousands of systems have made choices that reliably maintain 90th percentile lead levels below 15 µg/L. Systems are, in fact, taking corrosivity into account:

1. When selecting water sources,
2. In selecting treatment processes,
3. In making changes to water chemistry during treatment or adjusting treatment practice, and
4. Through the application of corrosion inhibitors and sequestration agents.

The rule framework and guidance should recognize the connections between distribution system operation and maintenance practices and corrosion control benefits, e.g., managing water age, lining of cast iron mains, unidirectional flushing programs, maintaining water quality in finished water storage, flushing stagnant water, etc. These and other practices contribute to limiting conditions that exacerbate corrosivity and complicate chemical corrosion control treatment.

It is important to incentivize sound practices for maintaining distribution system water quality and infrastructure. The NDWAC recommendations recognized that it was important for water systems to more explicitly explore how current practice was impacting corrosion control for lead and to use that information to improve corrosion control over time. This is in contrast with a regulatory model that focuses on either regulatory bright lines or treatment requirements rather than considering the underlying principles behind the regulatory requirements. The following NDWAC recommendations for improving corrosion control should form the basis for LT-LCR revisions, in which:

1. Corrosion control remain a central water system responsibility under the LCR.

2. Water quality parameter monitoring is expanded to include more frequent monitoring and monitoring at a more extensive set of locations, by integrating water quality parameter monitoring with monitoring in the distribution system for other regulations.

   While WQPs cannot predict the lead level at the tap, this is not their primary purpose. A water system sets WQPs to guide operational practices that produce water quality conditions which minimize corrosivity. Monitoring WQPs is used to ensure the system is operating within those target conditions. As with any process control strategy, there should be an ongoing feedback loop through which the system evaluates the data collected and continues to refine its performance.

3. Statistical control charts of WQP data are used for analysis to inform target conditions.[34, 35]

4. Improving and refining WQP parameter selection and target conditions should be supported by special studies to understand system-specific factors influencing corrosion control (e.g., stability

[34] Cornwell, David; Brown, Richard; McTigue, Nancy, Controlling Lead and Copper Rule Water Quality Parameters, Journal AWWA Vol. 107:2 p. E86-E96, http://dx.doi.org/10.5942/jawwa.2015.107.0011.
[35] AWWA, Manual 58. Internal Corrosion Control in Water Distribution Systems, Second Edition, 2017.

of existing scales, impact of historical sequestering agent use, corrosion of existing materials of construction, etc.).

The NDWAC framework also provides a viable strategy for advancing corrosion control practice among smaller and consecutive water systems.

SYSTEMS TARGETED TO INSTALL AND OPTIMIZE CORROSION CONTROL

The framework should focus first on improvement of systems that are only marginally compliant to fully evaluate and address gaps in their corrosion control practices. EPA's question might be restated to ask, "Which systems warrant the most attention now, as we revise the LCR?" A regulatory framework is not efficient if it focuses on systems which are already reliably compliant in documenting and enhancing their corrosion control practices.

SYSTEM SIZE THRESHOLD

NDWAC's proposed approach to improving corrosion control offers a viable path for expanding corrosion control to all systems over time. The NDWAC recommendation was intended, in AWWA's view, to overcome the primary barriers associated with increasing expectations on small systems. The NDWAC proposal focused on actions that:

1. Are based in known science and sound water system practice,
2. Utilize data streams that are readily acquired with available staff and expertise,
3. Foster use of good process control practice and improvements in technology available to small systems at an affordable cost,
4. Provide system-specific information that the system and state can utilize to make changes over time, and
5. Provide a vehicle to build awareness and practice in systems of all sizes around ensuring consistent water quality for all customers.

If EPA pursues a definition of corrosion control that emphasizes installation of active corrosion control treatment, then the Agency will need to stage rule implementation around primacy agencies' ability to manage the large number of small systems that would need to modify treatment. There currently are less than 1,000 water systems serving more than 50,000 persons; in total there are 10,600 systems of all sizes with optimized corrosion control under the current LCR.[36] In contrast, there are more than 5,700 medium-sized systems (population served between 3,300 and 10,000) without optimized corrosion control treatment, and roughly 63,600 smaller systems subject to the LCR that do not have optimized corrosion control treatment, e.g., a total of 69,300 systems that would need to develop and install OCCT per the rule requirements.[37] While some small systems are in suburban areas, many of these small systems serve rural communities.

Typical Agency practice follows one of several approaches:

1. An across-the-board requirement applied equally to all systems at the same time, typically three years after promulgation with the potential for a two-year extension for capital construction if approved by the primacy agency.
2. An across-the-board requirement, with implementation beginning with larger systems and moving over time to smaller system size categories.

[36] EPA, Analysis of Impacts of Corrosion Control Treatment on Lead and Copper Levels over Time, (prepared by Cadmus Group; provided to NDWAC Workgroup), July 2010.
[37] Ibid.

3. A requirement limited to sizes or a combination of sizes and types of systems.
4. Triggered action, where monitoring is conducted and systems that exceed a trigger then initiate evaluation steps or proceed to installing treatment.

Variances are available under all the above approaches. However, as a practical matter, they are used infrequently. When they are used, they have the effect of adding workload on state primacy programs and complicating communication with customers in the impacted service area.

Treatment technique requirements should be appropriate to the type of public water system. AWWA's comments are primarily focused on community water systems, but the current LCR also applies to nontransient, noncommunity water systems. EPA could distinguish between CWSs and NTNCWSs (approximately, 17,800 NTNCWSs serve less than 10,000 persons) with respect to corrosion control / treatment technique compliance options. CWSs are most often responsible for delivering water to a customer, whose plumbing system contributes the lead that ultimate reaches the drinking water tap. In contrast, all potable water piping and fixtures associated with an NTNCWSs are owned by the same entity. "Appropriate" should also take ease of implementation into account. Drinking water is an ancillary activity for NTNCWSs and consequently few have dedicated staff that are expert in operating water treatment, consequently complex treatment that requires close attention is not a sound compliance option for these systems.

Oversight of Corrosion Control Optimization

Current OCCT decision-making framework is not feasible for state primacy agencies to oversee if applicable to all small systems. As noted previously, optimized corrosion control is defined as a few chemical treatments, and when framed as such, corrosion control treatment changes require extensive evaluation, time, resources and state oversight. Currently, EPA is recommending a year or longer pipe loop study to support installation of a new corrosion control treatment.[38] Under an "across-the-board requirement" regulatory approach, systems of all sizes would require state approval of the following within a three to five-year time window:

1. Identify a preliminary set of corrosion control options (e.g., combinations of pH, alkalinity, phosphate dose, etc.),
2. Develop a pilot loop test plan,
3. Execute the pipe loop test plan,
4. Develop a summary report and recommendations,
5. Conduct an evaluation of potential for unintended impacts as currently required by the LCR,
6. Develop test plans/recommendations to respond to impacts on system operation, particularly compliance with other regulatory requirements,
7. Prepare necessary plans and specifications for construction,
8. Engage in necessary public outreach around the treatment changes, construction, financing, etc.
9. Identify and obtain necessary funding,
10. Develop a test plan for new treatment start-up,
11. Execute the start-up test plan, maintain routine communication with state throughout, and adjust treatment to fix issues identified during start-up,
12. Prepare final as-builts and operations plan.

[38] EPA, Correspondence from Bryce Feighner to Karen Weaver, February, 2017, Available 1/26/2018 at https://www.epa.gov/sites/production/files/2017-02/documents/letter_to_honorable_karen_weaver_and_bryce_feighner_regarding_city_of_fl_0.pdf.

It is reasonable to expect that accomplishing these steps will require substantial training and state engagement directly with smaller systems. A query of the most recent posting of SDWIS found more than 6,300 substantive violations related direct to installation and operation of OCCT.[39] Less than 3% of those violations were associated with large systems; the largest group of violations were associated with very small systems (<3,300 persons served) – both community and noncommunity water systems. These violations suggest that the level of state oversight required for applying the current OCCT decision-making process to thousands of small systems will overwhelm state primacy agencies.

LEAD SERVICE LINES AS TARGET FOR CORROSION CONTROL

Corrosion control has been demonstrated to be effective reducing soluble lead. AWWA has sought input from experts in the field of corrosion control on several occasions to assess whether phosphate addition or pH/alkalinity adjustment would reliably control particulate lead. As recently as November 2017, the response has been that there is not a body of data supporting this conclusion.[40] EPA staff have acknowledged this point. Therefore, targeting water systems with lead service lines in order to control particulate lead is not appropriate.

Because corrosion control is well documented as a means of controlling soluble lead and, thereby, reducing elevated lead levels, EPA might prioritize systems based on the distribution of observed lead levels or consistency of system performance relative to the action level. Such a prioritization approach could inform the pace of state-system engagement on corrosion control described above using the NDWAC framework.

PLUMBED IN POINT-OF-USE DEVICES

Requiring water systems to install and maintain POU devices in customers' homes is not a viable regulatory option for addressing lead from lead service lines in community water systems. There are implementation considerations associated with utilizing plumbed-in POU devices beyond the burden imposed by the standard of performance described in EPA Guidance for SDWA compliance by installing POU devices. [41] They include:

1. Inability to gain access to 100% of homes with lead service lines to install, maintain and monitor filter performance.
2. Liability for harm to customer's property when installing devices (a frequent anticipated risk when installing POU devices on existing faucets and countertops).
3. Personnel safety when installing, maintaining and monitoring filter performance.
4. Inability to assure coordination with customer and consistent, adequate maintenance of the installed device.

Water systems do not own or maintain any plumbing components on customer property that entail as frequent entry into the home for maintenance as POU devices. Such entry presents both coordination challenges and risk to utility personnel.

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[39] EPA, Safe Drinking Water Act Information System, Available 1/26/2018 at https://ofmpub.epa.gov/apex/sfdw/f?p=108:9:::NO::P9_REPORT:VIO.

[40] AWWA, AWWA Expert Workshop-Sampling Fit for Purpose / Corrosion Control Treatment Going Forward, Washington, DC, November 12-13, 2017.

[41] EPA, Point-of-Use or Point-of-Entry Treatment Options for Small Drinking Water Systems, EPA 815-R-06-010, April 2006. Available 1/26/2018 at https://www.epa.gov/sites/production/files/2015-09/documents/guide_smallsystems_pou-poe_june6-2006.pdf.

A single-choice risk mitigation measure should not be written into regulation. No other federal SDWA regulation specifies a single-choice treatment option.

Installed POU devices are only a viable solution when the number of homes being treated is small and the inhabitants cooperate. As noted previously, EPA guidance for the use of POU devices describes a standard of care that includes proper selection and installation, ongoing maintenance and regular monitoring of performance. Historically, EPA has recognized that this treatment strategy was not a cost-effective risk reduction strategy compared to centralized treatment, other than for very small communities.

In Flint, Michigan, there was an extensive installed POU program. The teams responsible for outreach to customers on POU operation and performance were not able to access a significant number of homes for follow-up visits once the devices were installed. In March 2017, the program manager for the Flint outreach effort characterized the situation as follows:

> *"To date, CORE teams have attempted nearly 84,000 visits and connected with around 24,000 residents. We want to get that number up," Weaver said. "Our goal is for CORE workers to connect with a resident at every home in the city. We know some residents are leery about opening their doors to people they don't know, so we asked the workers and the CORE program director, Paul Newman, a long-time Flint resident himself, to come today so residents can see who they are and learn more about what it is they have been hired to do."*[42]

The City of Flint website hosts a video describing this extensive community-based outreach program, the challenges they see implementing the program, and the steps they are taking to overcome them. This program is an exceptionally strong outreach effort; the lack of customer engagement is not due to a lack of effort by the program.[43] Recently, Flint Neighbors United released a survey of Flint households capturing household understanding of POU devices, including maintenance. The survey illustrates that even with a substantial program to provide and support installation of POU devices, 15% of homes that responded to the survey (282 of 1,894 responses) did not have an installed POU. More than 9% of respondents with installed filters appear to not be maintaining the filter correctly. There is a separate question in the survey on when lead in tap water was most recently tested at respondent's homes; roughly 21% had not been tested in the last year.

The CORE program employed 160 field workers and 16 supervisors at hourly wages of $10 and $12 respectively, plus benefits.[44] This amounts to a personnel cost, plus estimated overhead cost of $8,985,600 per year. Assuming each of the 43,000 homes with active accounts in Flint received one filter and 3 replacement cartridges each year ($20 each) the cost for the filters per year is $3,440,000. An estimated annual cost for the CORE program is over $12.4 Million. While a remarkable, community-based effort supported by substantial state and federal subsidies (subsidies, which are unlikely to be available to other community water systems), the Flint POU program would not meet the requirements of EPA's current guidance for SDWA compliance using an installed POU program.

Requiring the water system to install and maintain a POU device to address a defect resulting in whole or in part by the property owner is not sound public policy. Mandatory installation of installed POU devices

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[42] City of Flint Press Release, March 22, 2017, Available 2/16/2018 at https://www.cityofflint.com/2017/03/22/video-released-to-inform-flint-residents-about-core-program-and-workers/.

[43] Ibid.

[44] Mlive.com, Officials say they want Flint residents to fill 160 water crisis jobs, 12/3/2016, Available 02/21/2018 at http://www.mlive.com/news/flint/index.ssf/2016/12/officials_looking_for_flint_re.html.

on taps in buildings would be an unwise national precedent that would have far-reaching consequences well beyond lead.

Optimal Corrosion Control

A DEFAULT CORROSION CONTROL TREATMENT

Water chemistry and pipe materials differ among water systems, so corrosion control strategies must be system-specific. As a practical matter, if EPA establishes a one-size-fits all default corrosion control treatment requirement, that will be the installed treatment. Few if any water systems will be able to successfully demonstrate "equivalent" treatment in the eyes of state regulators or regional EPA staff. One can look at a lack of innovation in both primary disinfection and filtration practice as examples of how conservatively primacy agencies will view a default corrosion control treatment strategy.

EPA has not described what a default corrosion control treatment might be. Most previous EPA statements about a default corrosion control treatment have been based on data reflecting soluble lead levels and limited consideration of particulate lead release.

For community water systems in the United States, corrosion control is more complex than simply complying with the LCR. Systems must:

1. Balance water qualities from multiple water sources,
2. Manage corrosivity to protect buried infrastructure,
3. Anticipate corrosive water impacts on a variety of materials in building plumbing,
4. Provide a stable water quality for industrial, manufacturing, and commercial, as well as residential uses,
5. Reduce the potential for scales interfering with system and plumbing component operation,
6. Reduce exposure to unwanted aesthetic issues such as iron and manganese, and
7. Collaborating with receiving wastewater treatment authorities with respect to the contribution of phosphate and metals reaching publicly owned treatment works.

Regulatory requirements must be achievable while all other aspects of water system operations are realized.

CONSEQUENCES FOR RECEIVING WASTEWATER SYSTEMS

The Office of Water cannot develop SDWA and CWA policies that are in conflict. Mandating the use of phosphorus for corrosion control and requiring elevated doses will have local consequences. At present, where phosphate is used for corrosion control in the U.S., it contributes 10–35% percent of the phosphorus loading to the wastewater treatment facility (based on 10 drinking water–wastewater system pairs).[45] As phosphorus limits become more stringent, the use of phosphate becomes not only a cost consideration for the wastewater treatment facility, but equally importantly, an issue of credibility in the relationship between the utilities and local governing bodies. As more communities partner to achieve economies of scale in water and wastewater service provision, the number of governing bodies impacted by this credibility dynamic also grows, further complicating efforts to develop regional partnerships.

For decades EPA has identified nutrient pollution as a significant challenge for natural water bodies and phosphate as a nutrient of concern for inland water, particularly lakes. Over the past two years EPA has emphasized nutrient control as a key tool in preventing harmful algal blooms, including blooms that

[45] Rodgers, Impact of Corrosion Control on Publicly Owned Treatment Works Water Quality Technology Conference, New Orleans, LA. 2014.

produce cyanotoxins. In 2016 EPA released health advisories for microcystins and cylindrospermopsin. When levels of these toxins are elevated in drinking water, the water system is expected to issue a "do not consume" order, which has significant implications for the community served by that water system. When evaluating the cost implications of phosphate addition on wastewater treatment plants, phosphate corrosion inhibitor addition leads to an incremental increase in wastewater treatment cost. It can also result in some wastewater treatment facilities facing a "cost wall" because it triggers a shift to a new wastewater treatment train design.

Currently, EPA's ATTAINS database indicates that almost 2 million acres of lakes and 55,000 miles of rivers and streams are impaired by phosphorus alone.[46] EPA estimates that by 2020, half of the states will have numeric nutrient water quality criteria for phosphorus under the Clean Water Act.[47] In addition to developing statewide nutrient criteria, EPA is working with states to develop practice around "interpreting" narrative nutrient criteria to set loading limits for nutrients.[48] Implementation of this latter effort appears to be proceeding even more rapidly than state adoption of statewide numeric nutrient criteria. It seems likely that this tension between the addition of phosphate and subsequent removal will only become more frequent with time and will take place where both the water system and wastewater treatment system are both attempting to make ever smaller marginal improvements in performance. Impacts on wastewater discharges is a constraint that should factor into optimized corrosion control treatment selection.

EXPECTATIONS MUST HAVE SOUND PREMISE

Benchtop and pipe loop studies are informative but not perfect predictors of full-scale success. Data from benchtop and pipe loop studies is a key tool in guiding corrosion control, but these test systems are not sufficiently accurate in their predictions as to fine tune corrosion control based on this data alone. Further research is needed to better relate test system results to full-scale performance and to understand variances in test data when interpreting full scale application.

More research with actual pipe scale formation is needed to justify high, sustained levels of phosphate addition. The principle justification for higher orthophosphate levels are solubility curves for a lead phosphate compound. Those curves for required orthophosphate dose are generally a function of an alkalinity (or inorganic carbon). The curves show that at higher alkalinity levels that orthophosphate doses of 1 mg/L as P (3 mg/L as PO_4) or above may be needed. While useful guidance, solubility curves do not fully describe the electrochemical reactions or coatings involved in corrosion. In fact, often the compound modeled is not often found in pipe scales.

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[46] EPA, National Summary of State Information, Available 02/15/2018 at https://ofmpub.epa.gov/waters10/attains_index.control#causes.
[47] EPA, State Progress Toward Developing Numeric Nutrient Water Quality Criteria for Nitrogen and Phosphorus, Available 02/15/2018 at https://www.epa.gov/nutrient-policy-data/state-progress-toward-developing-numeric-nutrient-water-quality-criteria.
[48] 2013, Correspondence Chris Hornback to Nancy Stoner, March 7, 2013. Available 2/15/2018 at https://www.nacwa.org/docs/default-source/default-document-library/letter-to-n-stoner-on-narrative-nutrient-criteria-3_2013.pdf?sfvrsn=0.

Although this analysis is preliminary, we are finding that the solubility models in common use overestimate the amount of phosphate needed. For example, the graph in Figure 2 shows the solubility curves often cited and the data points are from actual lead coupons at steady state.[49] As seen, inorganic carbon values in the mid-range of around 20 mg C/L fall close to the curve for a dissolved inorganic carbon of 5 mg C/L while the data for the DIC of 15 mg C/L is actually below the curve for a DIC of 5 mg C/L. These results are not surprising given experience in the field but point out a difficulty with making decisions for the rule (e.g., the necessity of high orthophosphate doses) and individual treatment decisions based largely on an understanding of corrosion based on the available solubility curves.

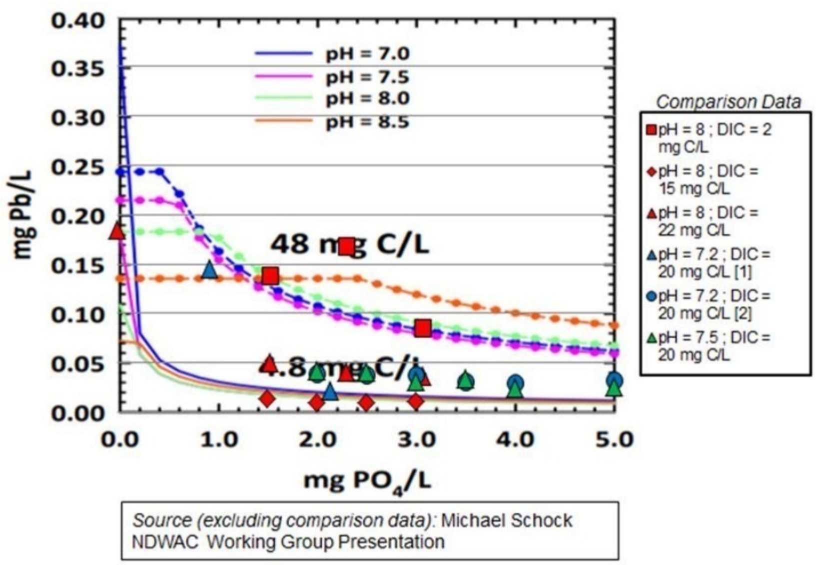

Figure 2: Theoretical lead solubility curves compared to benchtop tests using actual pipe materials.

The above example is not novel. Much earlier work came to a similar conclusion using a different methodology.[50] As Edwards et al. points out, other factors can have system-specific relevance. This point can also be extended to include the over use of corrosion control indices. Generalized corrosion control models are an important aspect of managing scaling and initial evaluations of water stability, but, alone, they are not sufficient to guide adjusting corrosion control.[51]

REFERENCING PRACTICE IN UNITED KINGDOM

EPA cannot reference guidance for treatment in the United Kingdom without a complete understanding of actual practice. The view that elevated phosphate doses (e.g., 1.3 - 2 mg/L as P [4 – 6 mg/L as PO_4] or higher) are critical to effectively manage lead often cites corrosion control practice in the United Kingdom. Unlike the United States, the bulk of the U.K. is served by 12 water companies. After contacting water systems and U.K.-based drinking water treatment consultants, there is good reason to believe that

[49] Cornwell Engineering Group, Personal correspondence February 14, 2018.
[50] Edwards, Marc; Jacobs, Sara; Dodrill, Donna. Desktop Guidance for Mitigating Pb and Cu Corrosion By-Products. Journal AWWA Vol. 91, Num. 5. P. 66-77. https://www.awwa.org/publications/journal-awwa/abstract/articleid/14051.aspx.
[51] Hill, Christopher. Importance of Corrosion Indices and How to Use Them. Water Quality Technology Conference, 2017.

the levels of phosphate applied in the U.K. are not as different from those currently used in the U.S. as typically described. Our survey efforts are not complete, but to-date, it seems that as an ongoing target, systems tend to focus on 1 mg/L as P (3 mg/L as PO_4), though the target can range from 0.4 – 1.5 mg/L as P (1.2 – 4.6 mg/L as PO_4) on a site-specific basis. Observations to-date emphasize the use of orthophosphate over other forms of phosphate primarily based on cost considerations. This is not markedly different from the range of orthophosphate addition here in the U.S. 0.2 – 1.0 mg/L as P (0.5 – 3.0 mg/L as PO_4).

PERIODIC RE-EVALUATION OF CORROSION CONTROL

Corrosion control has and should continue to evolve based on science and field experience. The NDWAC recommended a periodic re-evaluation of corrosion control as a mechanism to respond to new knowledge acquired through research and practice. As a practical matter, AWWA has a Manual of Practice for Internal Corrosion Control in Water Distribution Systems.[52] That manual is updated periodically to reflect new developments. Like AWWA standards, it is developed through a consensus process, but it is not an ANSI document. Historically, EPA has revised guidance relevant to the LCR, and that guidance has been considered by states and systems (e.g., guidance published in 1992, 1995, 1999, 2001, 2003, 2007, and 2016.)[53]

One of the underlying tenets of corrosion control is a commitment to and consistent execution of a strategy. If EPA were to expect systems to re-evaluate current corrosion control practice periodically with an affirmative decision by the State that the system is using the appropriate strategy, then that state review must:

1. Be grounded in a sound understanding of corrosion control,
2. Consider sufficient system-specific information to facilitate sound decision making,
3. Lead to changes in practice when there are substantial opportunities for additional reductions in observed lead release, and
4. Include explicit consideration of unintended consequences from change.

Because changing corrosion control should be done carefully. The revised LCR should incentivize water systems to continually evaluate corrosion control rather than focus on rote regulatory compliance.

Sanitary surveys could serve as a mechanism for periodic review of corrosion control practice. All public water systems are required to have period sanitary surveys. For community water systems, these reviews must occur at least once every three years. These regularly occurring reviews of system practices, could include a review of ongoing corrosion control. And, as with other items evaluated in the sanitary survey, the primacy agency could identify potential revisions to evaluate and initiate as warranted based on a more substantive evaluation, necessary consultation, and appropriate permitting.

SUSTAINABLE OPERATIONS

In costing corrosion control, EPA needs to recognize the need for additional changes in treatment that are triggered by substantial changes in corrosion control. "Optimized corrosion control treatment" is a phrase that EPA appears to be preparing to re-define in the LT-LCR. EPA and state interpretation of the current rule allow for the considerations beyond simply reducing lead and copper concentrations. That same

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[52] AWWA, M58 Internal Corrosion Control in Water Distribution Systems, Second Edition, 2017.
[53] EPA, Compliance Guidance Documents available 1/26/2018 at https://www.epa.gov/dwreginfo/lead-and-copper-rule#additional-resources.

flexibility is necessary in the LT-LCR. Examples of additional considerations in EPA's most recent guidance include:

1. "black or red water complaints due to oxidation of iron and manganese in the distribution system"[54]
2. "potential to form scales on the interior of piping systems that may reduce the effective diameter of the pipes, resulting in loss of hydraulic capacity and increases in system headloss and operational costs"[55]
3. "disinfection performance and compliance with Surface Water Treatment Rules and possibly the Ground Water Rule"[56]
4. "raising the pH and DIC may cause calcium carbonate to precipitate in the distribution system, clogging hot water heaters and producing cloudy water.[57]
5. "… there are limitations to their application. Two factors that could limit the use of phosphate-based corrosion inhibitors are (1) reactions with aluminum, and (2) impacts on wastewater treatment plants."[58]

Recognizing considerations beyond regulatory compliance when selecting optimal corrosion control treatment for a system is critical to the sustainability of community water system efforts to reliably assure water quality within a matrix of multiple objectives, and simultaneous efforts to maintain and improve system performance on multiple topics.

Reliable supply of affordable treatment chemicals required. Phosphate addition is a treatment strategy that, if pursued, must be maintained into the future. At present phosphate is an international commodity for which the primary sources are off-shore and dependent on unencumbered trade.[59] There are mines in the United States, but the principal sources from a global perspective are Morocco and China.[60, 61] Water systems only account for a small fraction of phosphate use in the United States (about 3%); the most significant use and international driver for commodity pricing is agricultural applications, which is not only a much larger use but also a less challenging product to deliver.[62] While currently there are not any shortages in supply, drinking water systems have seen periods of dramatic price increases in phosphate and some supply disruptions at individual utilities.[63] For example, a survey of 47 U.S. water systems found that these systems experienced an average phosphoric acid cost increase of 233% over the period from January 2008 to January 2009.[64]

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[54] EPA, OCCT Evaluation Technical Recommendations for Primacy Agencies and Public Water Systems, EPA 816-B-16-003, March 2016, p. 19.
[55] Ibid, p. 19.
[56] Ibid, p. 41.
[57] Ibid, p. 42.
[58] Ibid, p. 43.
[59] SEI, Sustainable Use of Phosphorus, October 2010.
[60] IFDC, World Phosphate Rock Reserves and Resources, 2010.
[61] USGS, Mineral Commodity Summaries 2017, Available 1/26/2018 at https://minerals.usgs.gov/minerals/pubs/mcs/2017/mcs2017.pdf.
[62] WRF, Supply of Critical Drinking Water and Wastewater Treatment Chemicals – A White Paper for Understanding Recent Chemical Price Increases and Shortages, 2009.
[63] Ibid
[64] Ibid

CONSECUTIVE SYSTEMS

Consecutive systems will bear costs of change to corrosion control practice as well as the wholesaler installing treatment. In organizing cost consequences for the LT-LCR, EPA faces a challenge like that presented by the disinfection byproducts and ground water rules. There are substantial dependencies between water wholesalers and consecutive systems. While each public water system (each PWSID) "stands alone" with respect to compliance, decisions made to optimize corrosion control for one system may or may not be the most cost-effective solution for other systems in the same extended network due to differences in home construction materials, condition of distribution systems, water age, and other factors. "Optimizing" for reducing lead and copper must be balanced across this extended network of systems on a local basis. Consequently, not only should the rule provide the necessary flexibility, but the Agency's economic analysis should reflect the associated costs for preliminary analysis, treatment, transition preparation, monitoring, customer outreach and oversight.

FINDING AND FIXING PROBLEMS IN CORROSION CONTROL

Exceeding community action level should trigger assessment and correction. One aspect of the current rule that has proved problematic is that systems that exceed the action level are triggered into a long list of action items. This list includes preliminary evaluation of corrosion control treatment. It appears that, at least in some instances, this lengthy process provides a window for the system to return to lead levels below the action level without having to complete an evaluation of corrosion control changes and make necessary corrections. The NDWAC recommendation that if investigation is triggered by the rule, then the evaluation should be fully completed, and the lessons learned be applied in corrective actions.

The details of the rule are important. The trigger for system-level evaluation and correction may exist separate from triggers for evaluation / additional support to individual homeowners who experience elevated lead levels. This concept of find-and-fix could be tied to system-specific water quality parameter monitoring plans, which are based on distribution system and water treatment process control monitoring. These plans would utilize statistical process control strategies to flag deviations that warrant investigation and corrective steps. It could also be triggered by multiple in-home tap samples exceeding a community "action level."

The framework utilized in the Revised Total Coliform Rule for assessment and correction of sanitary defects provides a useful parallel to find-and-fix under the LT-LCR. As with the RTCR, the process would begin with in-home sampling triggering a tiered response that first focuses on levels of lead in the structure, and based on the data, expands to include evaluation of system-wide issues.

Public Education

EPA should provide resources to support public outreach on lead risk and lead risk mitigation. Water systems should actively and transparently communicate with their customers, particularly customers with lead service lines, about lead risks and steps households can take to evaluate and reduce lead in drinking water. The NDWAC recommendations include development of a comprehensive resource to support communication with the public about lead and lead risk mitigation across all environmental exposures. Households need clear, holistic guidance on how to identify and reduce lead risks from all environmental exposures. Communicating to the public that lead risks need to be addressed and require action, while also helping the public recognize the timeframes and limitations of environmental exposure reduction strategies is a challenging task. Well-grounded and consistent communication materials that reflects the best information from CDC and other authoritative sources, is necessary to support revision of the LCR.

TARGETED OUTREACH TO CUSTOMERS WITH LEAD SERVICE LINES

Outreach to customers with lead service lines will need to use multiple delivery channels appropriate to that community as part of an ongoing communication program. The challenges associated with targeted outreach vary as a function of existing data systems, customer communication infrastructure, nature of the system's service area and customer behavior. Consequently, the NDWAC recommends the use of a comprehensive ongoing communication program. Some of the challenges of outreach targeted to customers with lead service line include:

1. Organizing outreach so that it reaches customers who are prepared to act, e.g., at the time of home purchase, when a home inspection report is available, when a new homebuyer is reviewing needed improvements. Unfortunately, the water system will not start a relationship with the new customer with respect to that address until after transfer of title.
2. Utilizing existing delivery mechanisms like bill stuffers, consumer confidence reports, and similar routine communication tools requires messaging that recognizes most customers do not have lead service lines.
3. Targeted messaging around lead service lines has two audiences: those who live in the home and those who own the home. Due to rentals and other housing situations, the primary point of contact for the water system may be different from the individuals in the home. Therefore, messages related to removing lead service lines may reach the appropriate individual but information about taking protective measures may not reach inhabitants.

NOTIFICATION OF EXCEEDING ACTION LEVEL

Notification under the WIIN Action should be to individual homes at which the water system has data that lead levels are elevated. EPA is required by the WIIN Act to address public notice. The WIIN Act does not have any accompanying report language that informs how to interpret its provisions, but it is clear from the resulting edits to SDWA that the 24-hour timeframe is limited to instances when there is a "potential to have serious adverse effects on human health as a result of short-term exposure."[65] This criterion is not consistent with the basis for the current LCR action level (i.e., communitywide 90^{th} percentile concentration greater than 15 µg/L). It is not clear how EPA will utilize the ongoing analysis to identify a level of lead in water consistent with a short-term exposure scenario. Regardless of level, the implications of a 24-hour notification requirement include the following:

1. Ongoing water system public education programs about lead, currently only required of water systems that have exceeded the lead action level, will be necessary to provide context for households that receive this notice recommending immediate action, if such notices are to be impactful.
2. Water systems will need support from both state and local health experts to communicate the health effects of short-term exposures to lead and the appropriate action steps to take.

An alternative approach would be to focus on communicating with individual homes when observed lead concentrations are above the action level (i.e., homes in the compliance sample pool must be notified of elevated lead levels). This interpretation of the WIIN Act revisions would facilitate more targeted dialogue with occupants regarding observed lead levels in their home; a potentially more effective conversation.

Regardless of the numeric value of the action level, the implementation challenges include:

[65] SDWA, Sec. 1414(c)(2)(C)

1. An administrative burden on meeting notification requirement (e.g., assuring notice is provided, documenting successful notification, and backstopping primary mode of notification) limits when systems can take samples, thus prioritizing notification over collecting data in a timely or informative manner.
2. Need for additional administrative procedures, systems, and personnel to assure notice in time frame is achieved.
3. Close coordination with local public health staff with expertise in lead risk communication. Such coordination can be challenging in communities where the water and health departments exist within the same governing structure; it becomes increasingly difficult with separation in governance: e.g.,
    a. County health department, with town or village operated community water system,
    b. County or state health department with subdivision community water system,
    c. County subdivision with rural community water system owned or operated by a third-party provider (non-profit, cooperative, or investor-owned entity).
4. Notification by priority mail may not be possible within 24-hour timeframe, necessitating state acceptance of phone contact, email or other electronic media notification to affected households.
5. Rural and suburban communities have less access to priority mail delivery services requiring additional personnel hours to backstop documented delivery of required notice.
6. Administrative expectation for documenting notification limits the tools available for notification (e.g., a phone call, text message, or drive by interaction with customer absent further documentation may not suffice for regulatory compliance) and requires administrative systems and personnel time.

PUBLIC ACCESS TO INFORMATION

Results from In-Home Tap Sampling

Data should be readily available to the public without revealing exact address where sample was drawn. Tap samples need to be drawn by residents to (1) assist the water system with compliance monitoring, (2) assist the water system in evaluating potential changes in treatment and (3) inform households of potential risks and protective actions. However, making data from sampling available to the public and connecting it to a specific structure may dissuade homeowners from collecting samples. Making all data from sampling available to the public is challenging, because the protocols for sampling may vary and lead to results that should not be compared directly. In Flint, individual addresses were revealed, but in presenting the data, considerable effort was taken to segregate it into comparable datasets.[66] It was necessary to (1) present pre-POU and post-POU data independently, (2) show compliance data monitoring separately, and (3) not present some data (for example, to-date lead service line profile data has not been presented in a readily accessible format).

Currently individual tap sample results are available to the public upon request. Beyond a local interest in transparency, the federal Freedom of Information Act as well as state and local policies require information release by publicly-owned water systems. Investor-owned water systems may have less certain legal requirements for release of information. In states where water systems submit individual LCR sample results, the data from all water systems is available through FOIA of the state program. What is often not made available under current practice is the exact street addresses associated with individual

[66] State of Michigan, Taking Action on Flint Water website, Available 2/1/2018 at http://www.michigan.gov/flintwater/0,6092,7-345-76292_76294_76297---,00.html.

sample results. This is primarily due to homeowner privacy concerns, and the need to recruit customers to participate in compliance monitoring.

EPA indicates it will be implementing PRIME in 2018. PRIME has been described as a vehicle for public access to individual observations submitted in compliance monitoring. It is not clear when EPA intends to fully implement PRIME in this manner. Currently, not all states maintain a Safe Drinking Water Information System record of actual observed lead values. In either a state or federal public data access strategy, the regulatory community would not only need to acquire and upload the data in a timely fashion, but it would also need to determine if the Agency (EPA or state) would take responsibility for publicizing lead and copper observations associated with particular addresses (e.g., privacy concerns, liability for imperfect data being presented, etc.).

Water systems currently summarize LCR compliance data in consumer confidence reports. CCRs are already viewed as dense technical documents by many members of the public, and adding tens to hundreds of individual lead observations would be at odds with ongoing efforts to improve them.

Water systems or states could make compliance monitoring data available through local websites, as the State of Michigan did and continues to do for Flint. Michigan posted both tabular data and maps of observed lead levels. EPA could engage Michigan to determine how much the state invested in developing and maintain public access to lead data through that website. It is worth noting that not all smaller water systems maintain a website or have access to the website for their local jurisdictions.

One of the failings of the current LCR is it may discourage sampling by the water system to facilitate diagnosis of water quality problems, particularly lead issues, in individual homes. Systems that take samples that:

1. Meet the general criteria for compliance data may be added to the compliance dataset by the State, even if multiple samples are from the same structure during an investigation of that structure.
2. Do not meet the criteria for use as compliance data, are expected to be judged by some as being deliberately drawn in an effort to misrepresent or hide lead occurrence.
3. Do not have a robust chain of custody and quality assurance prior to acceptance by the laboratory for analysis, can be added by the state into a system's compliance dataset.

Under the current rule, a few samples lead to (1) aggressive public education systemwide and (2) revisiting the fundamentals of corrosion control practice. Neither are insignificant challenges for a water system, hence an inability to directly assist individual homeowners. If the rule mandates public access to non-compliance data, then the rule will further discourage testing for lead by water systems and efforts by water systems to effectively engage customers.

Water Quality Parameter Monitoring

Providing the public WQP data should not be allowed to become a barrier to water systems expanding WQP monitoring. Water systems frequently provide basic information to customers, including generalized WQP data. This is data the public does find useful when caring for aquariums, deciding to install home treatment devices, planning the design of commercial / industrial process equipment, and other applications.

It is not clear what WQP data EPA anticipates providing to the public as a regulatory requirement. WQP monitoring as required by the current rule is infrequent and limited to a few locations. Providing the currently required data to the public in summary form would be feasible, particularly where the system has a website. This data as well as more frequent monitoring of relevant parameters are submitted to the state in regular reports. The submitted data is available to the public currently through FOIA of the state or local water system. There are potentially security concerns with releasing detailed process control data to the public (e.g., ongoing chlorine concentrations if oxidation reduction potential was a WQP, etc.), so the provision of enhanced WQP monitoring as described by NDWAC may present challenges.

Other barriers and cost considerations that EPA will need to consider:

1. There is an opportunity to expand use of on-line monitoring devices, but
    a. Data from on-line instruments must be handled appropriately, with appropriate quality control and quality assurance prior to use by the water system or provision to the public.
    b. Presenting on-line monitoring to the public complicates the primary goal of increasing use of on-line devices for process control by placing an administrative focus on public access rather than utilization of the data stream.
    c. Effective use of on-line instrumentation for process control, regulatory triggers, and public awareness requires a commitment to instrument maintenance that is significantly higher than what might be employed for an initial demonstration of capability or a short-duration research project.
2. If WQPs (grab sample or on-line) are provided to the public, then information must be provided to illustrate the relevance of the data. Simply providing a data point at a given time and location is not informative unless one has a clear notion of what portion of the service area that data represents. Modelling and analysis necessary to present WQP data to the public in a manner that is informative to individual households would distract from the initial goal of gaining more understanding and control of WQPs in the distribution system.
3. Providing basic information to the public requires effective risk communication. Consumers face an array of do-it-yourself home treatment device options and ongoing news stories of studies and advocacy reports. In the absence of a cohesive public communication effort about what WQP data means, there is ample opportunity for consumers to misunderstand the implications of the data to which they would now have access.
4. Each of the above considerations has an associated cost component to overcoming.

Tap Sampling

The revised LCR should incentivize sampling and special studies to better understand corrosion control and make informed decisions about treatment changes.

Dramatic changes to the current in-home tap sample protocol will substantially delay revision of the LCR. The current sampling protocol is not consistent with modern standards for quality laboratory systems (e.g., inadequate chain-of-custody procedures, inability to know if samplers are employing proper sampling technique, and consequently lack of legal defensibility for the compliance laboratory).[67] Consequently, there is interest in changing the sampling protocol to address the current failings. Moving away from customer collected samples is not likely if the rule revision:

1. Continues to use the current LCR sample protocol (or an alternative stagnation sample),
2. Revises the sampling protocol to target water from the lead service line, or
3. Increases the number of required samples required and thus requiring access to more customers' kitchen taps to obtain the requisite number of samples.

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[67] EPA, Manual Certification of Laboratories Analyzing Drinking Water 5th edition, Available 2/2/2018 at https://www.epa.gov/dwlabcert/laboratory-certification-manual-drinking-water.

If the purpose of compliance monitoring is solely to inform residents of lead levels at their taps, then these concerns are less troubling.

If the purpose of the sampling is consistent with the current LCR -- to trigger re-evaluation or installation of corrosion control treatment -- AWWA is not aware of any peer-reviewed studies to show how a new sampling protocol/increased sample pool would compare to the current protocol/sample pool.

EPA must clearly describe any required tap sample protocol. Samplers should be able to follow any tap sample monitoring and the protocol should be sufficient to eliminate "gaming" and forestall accusations of gaming sample results.

CURRENT SAMPLE PROTOCOL

Retaining current sample protocol as recently refined by EPA, may be the most expeditious option for EPA to pursue. The current sampling protocol, first liter following at least 6 hours stagnation, data has served community water systems well as a tool to reduce lead levels. The reductions in lead levels over the years has been well documented.[68]

Many water systems have been able to adjust their corrosion control program by assessing historical first liter samples. The sample procedure allows the system to compare data collected consistently over time and spatially because the samples are always collected the same way. Specific instructions bring some uniformity to the data facilitating this comparison. Multiple rounds of monitoring over time provides a historical benchmark for future actions. This historical data allows systems to spot changes either positive or negative and to make appropriate actions. Comparisons are relatively easily made between systems within a state when regulators want to make relative assessments of lead release across systems with similar water qualities.

First liter samples have also served to alert systems to major upsets. For example, the Flint 90th percentiles for first liter samples went over 100 µg/L. As orthophosphate and other WQ controls went into pace the improvements in first liter samples could be tracked and improvements seen as the 90th levels dropped to the current 6 µg/L level. A similar recognition, response, and downward trend occurred when Washington DC experienced elevated lead levels following its transition to chloramines.

While the first liter sample may not be the highest lead level found in samples from homes with lead lines, many homes and many cities do not have lead lines. Homes can still experience lead due to old brass, galvanized plumbing and lead solder. The first liter sample is actually very useful for sampling interior sources of lead.

Tap sample protocol representative of exposure

The current LCR sample protocol is not designed to be representative of exposure. Representing exposure will required more than changing when customers draw a one-liter sample. "Exposure" for risk assessment purposes occurs at three levels: individual, building and community. EPA has not provided information to understand which of these types of "exposure" this sampling framework would address. Consequently, it is not clear what combination of sample protocol, sample number, sample site location, and sample frequency the Agency is considering. As EPA considers presenting an LT-LCR monitoring plan as representative of exposure, it should:

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[68] Richard A. Brown, Nancy E. Mctigue, And David A. Cornwell, Strategies for assessing optimized corrosion control treatment of lead and copper, Journal AWWA Vol. 105 No. 5 pages 62 – 75, May 2013.

1. Appropriately match the sampling requirements to the objective for the monitoring (e.g., a sample to inform customers about lead levels in their water should be geared toward taking a sample of water likely to be consumed).
2. Clearly present how the data would be used in the regulation in a manner consistent with SDWA (e.g., not create a duty on community water systems that is beyond the bounds of water system ownership).
3. Identify opportunities to shift the new compliance monitoring requirement to one that can be executed by trained technicians within the framework outlined by EPA's laboratory certification guidance.

AWWA is not aware of any new guidance from EPA or others to provide insights into how sampling at a structure can best inform risk reduction steps by homeowners or landlords.

Households sample when consuming water

AWWA is reluctant to comment on a single aspect of tap sampling monitoring in isolation. Instructing consumers to take a tap sample when they are preparing food or getting a drink of water could substantially alter the LCR routine compliance monitoring dataset by reducing the period of stagnation prior to sampling.

It is not clear from EPA's comments how changing the sampling protocol in this way would be accompanied by other considerations in the rule revision:

1. How large an increase in the sample pool size to "make up for" the lack of certainty in minimum stagnation period?
2. A change in the actual protocol (e.g., is a first-draw, one-liter sample anticipated)?
3. A change in the households targeted for sampling (e.g., all homes in pool being homes with lead service lines)?
4. A single sample for lead and copper observations?
5. A change in the evaluation metric (e.g., 90^{th} percentile value of 15 µg/L)?
6. A change in the implications of exceeding the evaluation metric?

All these considerations are relevant to the effectiveness of the compliance monitoring regime. Consequently, AWWA is reluctant to comment on a single aspect of monitoring. If EPA proceeds with evaluating this option, it is important for the Agency to communicate to the public:

1. That lead levels vary and a single observation from a tap does not adequately represent exposure to that household.
2. A community-wide assessment of lead levels does not mean that homes with lead sources (e.g., old brass fixtures, lead service lines, lead solder, etc.) will not observe higher levels, even if the LCR monitoring program is biased toward more challenging homes.

While communication around the current LCR sampling protocol is very challenging, there are similar challenges associated with this sampling protocol:

1. Risk management by the household should occur regardless of observed value in water and include basic steps to mitigate risk from other exposures (e.g., dust, paint, etc.)
2. The water system is taking steps to manage the corrosivity of the water, but absent removal of all sources of lead in contact with water, some risk remains.

LOCATION OF TAP SAMPLES

Tap sampling and the questions of number, location, frequency and protocols all stem from the purpose of sampling required under the rule. There are several acknowledged uses for tap samples:

1. As a check on the need for / adequacy of corrosion control treatment,
2. Understanding the nature of lead release in a system to inform improvements to corrosion control, and
3. To inform / motivate customer action.

There is general agreement that no one sampling strategy and protocol is ideal for all three of these objectives.

There is also broad agreement that sampling for copper at locations identified solely to maximize the opportunity to find elevated lead levels is unlikely to recognize higher copper levels that can be associated with very new structures containing copper plumbing.

Each of the specific sampling strategies about which EPA requested input represent a balance among competing objectives for mandatory compliance monitoring. When evaluating any of these approaches, it is important to realize:

1. Intra-structure variability in observed lead levels can be substantial—observed lead levels vary as a function of water use patterns in the structure and other factors,
2. Inter-structure variability is also observed -- lead levels vary as a function of plumbing materials used, workmanship of that installation, presence of water treatment devices, and other factors, and
3. Variability of samplers contributes to cumulative variability in dataset – the degree samplers adhere to protocols.

Homes with Lead Solder

Eliminate date range criteria in current rule for homes with lead solder that may be included in in-home tap sample pool. The current LCR specifies sampling from Tier 1 homes followed by Tier 2 and Tier 3 homes. To be in Tier 1 and 2, the home must either have a lead service line or "copper pipes with lead solder installed after 1982 (but before the effective date of your State's lead ban)."69 Tier 3 homes must have solder installed before 1983. These date ranges are now more than 35 years old and their use is no longer consistent with the underlying logic for their inclusion in the rule.

Customer Requested Tap Samples

Customers should have access to reliable sources of tap samples. Water systems can provide this service or direct customers to reliable laboratories. At present, there are entrepreneurs offering water tests that provide inadequate results. These tests could lead customers to make poor decisions and waste money. EPA should provide clear national guidance for consumers on analytical methods and laboratories with appropriate skills and processes to provide reliable lead test results.

Customers are not requesting samples to understand corrosion control. They are interested in questions about their exposure and their plumbing. EPA should prepare a guide for fit-for-purpose sampling to inform households and assist water systems communicate with their customers.

[69] EPA, Lead and Copper Rule Monitoring and Reporting Guidance for Public Water Systems: EPA 816-R-10-004, March 2010.

Tap Samples at Schools

The Lead Contamination Control Act is an existing statute that directs the management of lead in schools. The LCCA "*Directs each State to establish a program, within nine months of this Act's enactment, to assist LEAs* [local education agencies] *in testing for, and remedying, lead contamination in school drinking water from coolers and from other sources of lead contamination. Requires that testing results be made available for public inspection in LEA administrative offices.*"[70] EPA has developed extensive guidance to schools on lead in schools.[71] But, the EPA website indicates that currently "*There is no federal law requiring testing of drinking water in schools and childcare facilities, except for those that have and/or operate their own public water system …*"[72] The website does not provide a basis for this last statement.

If EPA were to modify the LCR to require monitoring of lead in schools, it would have to (1) describe the purpose for the sampling, (2) the sampling program required to achieve that purpose, and (3) the responsible party for that sampling program.

With respect to these three tasks before the Agency:

1. Community water systems will not be able to use the data acquired through sampling in school buildings as a useful gauge for managing system-wide corrosion control. Rather, sampling in schools is an opportunity to (1) identify fixtures that warrant active flushing or replacement, (2) assess the success of in-building / in-campus water quality management, and (3) gather information to provide for parents, students, and staff.
2. Taking a single sample from a school is not informative and, importantly, can be misleading. For this reason, the current EPA guidance outlines testing of all outlets in a school in a prioritized fashion and follow-up sampling to facilitate diagnosis and remediation. The purpose and utility of such sampling is much different from SDWA compliance sampling.
3. Most school buildings are large, and consequently, they are very unlikely to have lead service lines. Therefore, it seems unnecessary to include school structures in a water system's LCR sampling pool.
4. As schools are large buildings, their inclusion in the sample pool raises the question of what sampling protocol is appropriate, further complicating rule implementation and data analysis.
5. "Schools" is not limited to public schools. It includes private and religious schools of all sizes, financial stability, staffing levels, and instructional setting (e.g., owned or rented space, stand-alone or integrated into another structure, etc.).

EPA should update its guidance on managing lead in schools as part of its support for schools. Given the likely use of the data, it seems the responsible party for monitoring will be schools. This has implication for (1) preparedness of school staff and contractors, (2) development of state primacy agency systems to track school compliance, and (3) school budgets.

It is important to note that individual states have initiated monitoring for lead in schools and in most instances, have decided to focus on sampling initiatives for schools and/or childcare facilities through direct oversight of the schools. States are taking a number of different approaches that best fit their circumstances. Recent examples include California, Illinois, Massachusetts, New Jersey, New York, Utah,

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[70] Summary: H.R.4939 — 100th Congress (1987-1988), Available 2/2/2018 at https://www.congress.gov/bill/100th-congress/house-bill/4939.
[71] EPA, Lead in Drinking Water in Schools and Childcare Facilities, Available 2/2/2018 at https://www.epa.gov/dwreginfo/lead-drinking-water-schools-and-childcare-facilities.
[72] Ibid

and Washington.[73, 74, 75, 76, 77, 78, 79] None of the approaches initiated include sampling in schools as a component of LCR compliance monitoring.

NUMBER OF TAP SAMPLES

If EPA anticipates changing compliance monitoring, including increasing the number of tap samples required, it will need to communicate how the increased monitoring will advance the health risk reduction. The sampling burden even under triennial monitoring is significant. These data represent only "compliance" samples and do not include observations from:

1. Special studies to inform corrosion control practice,
2. Lead service line replacement, or
3. Customer assistance samples.

Anecdotal reports and AWWA members' experience are that:

1. Small system waivers are available to systems with fewer than 3,300 persons, but these waivers are seldom granted.
2. Many community water systems are now on triennial monitoring, though some states like New Jersey have re-emphasized LCR monitoring and instituted a new round of annual monitoring in 2017.[80]

The NDWAC advised improvement of corrosion control would be best achieved through more water quality parameter monitoring both at the water treatment plant(s) and in the distribution system, rather than modifying the sampling protocol. Recent EPA compliance assistance has emphasized the role of special studies to improve system/state understanding of lead release in order to evaluate changes in water treatment or water supply. The WRF has funded research to better understand observed lead release after lead service line replacement, and the utility of monitoring in that specific context.[81]

Household action level

EPA has not demonstrated that it is able to undertake the required task based on the available information. The NDWAC recommended development of a household action level. The presentation of EPA's analysis and the peer-review comments illustrate that developing a household action level continues to be challenging for the Agency (see Appendix A). It is clear EPA is finding it difficult to set a level that is consistent with the NDWAC recommendations, e.g., a level of lead in water that warrants action by a

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[73] 2017. California. Available 2/15/2018 at https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/leadsamplinginschools.html.

[74] 2017. Illinois Public Act 99-0922. Available 2/15/2018 at http://www.dph.illinois.gov/content/school-water-testing.

[75] 2016. Massachusetts. Available 2/15/2018 at http://www.mass.gov/eea/agencies/massdep/water/drinking/lead-and-copper-in-school-drinking-water-sampling-results.html.

[76] 2016. New Jersey State Board of Education. Available 2/15/2018 at http://www.state.nj.us/education/lead/.

[77] 2016. New York Department of Health. Available 2/15/2018 at https://www.governor.ny.gov/sites/governor.ny.gov/files/atoms/files/LeadTestingRegs.pdf.

[78] 2017. Utah. Available 2/15/2018 at https://deq.utah.gov/Compliance/compliance/drinkingwater/lead-copper-rule/lead-sampling-in-schools.htm.

[79] 2016. Washington, Governor's Directive on Lead, 16-06 Department of Health Recommendations. Available 2/15/2018 at https://www.doh.wa.gov/CommunityandEnvironment/DrinkingWater/Contaminants/LeadinSchools.

[80] PROVIDE CITATION

[81] WRF, Evaluation of Flushing to Reduce Lead Levels – 4584, Project progress can be tracked at http://www.waterrf.org/Pages/Projects.aspx?PID=4584.

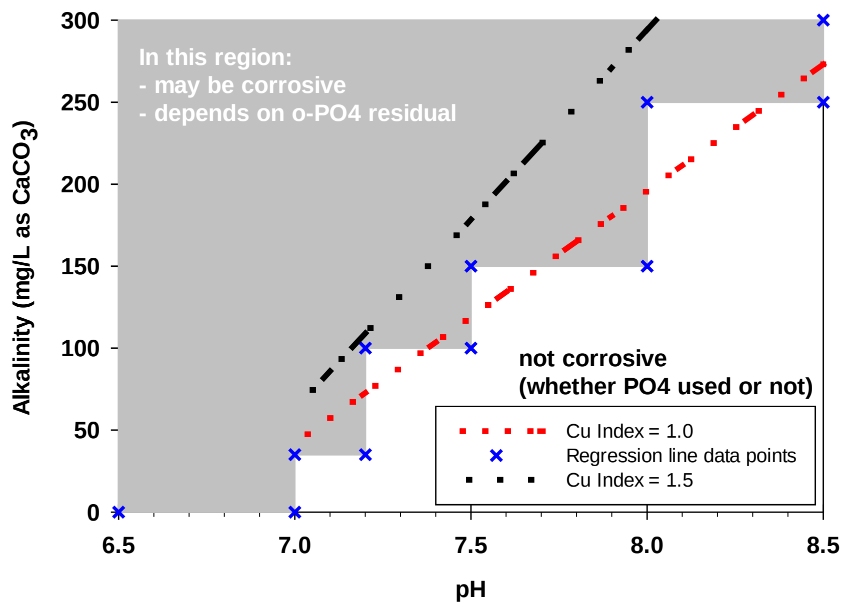
specific home above and beyond ongoing protective measures (i.e., corrosion control, lead service line replacement or other actions already being taken by home owner). While our societal goal is and should continue to be no exposure to lead, as a practical matter, parents and landlords need to know when lead levels in water represent an elevated risk to households, especially children. In the absence of a sound EPA analysis, using of "zero," "detectable lead," or a number below the community-wide action level as a household action level is not consistent with the balance of the LCR framework.

Copper

SCREEN FOR WATER AGGRESSIVE TO COPPER

Basing rule on a screen for water aggressive to copper will require different criteria than those proposed by NDWAC. During the NDWAC process, a preliminary classification of what water qualities would be corrosive to copper was developed with the idea that EPA would finalize the classification. Two preliminary classification charts were developed, one for strictly pH and alkalinity and one for systems using orthophosphate. The idea was that if a utility was classified as non-corrosive to copper, it would be relieved of many regulatory testing and sampling requirements. It was anticipated that most systems would be classified as non-corrosive to copper.

Figure 3 shows an example of the corrosivity classification that was developed for NDWAC. All pH and alkalinity combinations to the right of the shaded area would not be corrosive to copper. This figure also provides a basis for a simple index to determine a specific water quality's corrosiveness. The index is shown below the figure with any values having a Cu index < 1 being corrosive.



Note: Cu Index > 1 is defined as conducive to copper corrosion; For pH <7, water is corrosive to copper (irrespective of alkalinity); Cu Index = Alkalinity/regression = Alk/((A × pH) - b); A = 154.17 mg/L as CaCO3 / pH; b = 1,037.3 mg/L as CaCO3

Figure 3: Copper corrosivity index

AWWA conducted a survey of utilities to obtain water quality data and estimate the number of systems that would be classified as corrosive to copper. [82] The survey found that at the point of entry to the distribution system 50% of all systems (groundwater and surface water) and 70% of ground water systems surveyed would be classified, using the index, as corrosive to copper. That seemed like a large percentage and somewhat unrealistic since the U.S. generally does not have widespread copper problems. There was some concern if the survey was accurate.

Recently, the U.S. Geological Survey collected data on well water quality throughout the U.S. [83] The data base was for private and public wells. There was sufficient water quality data collected to allow calculation of the copper corrosion index for the wells. Figure 4 is a map by EPA region showing the results for the percentage of utilities on GW that are corrosive to copper according to the index as compared to the USGS results. The two are quite comparable. As seen in Table 1 by population size and totals, the overall U.S. corrosivity to copper by the survey was 70% and by USGS data it was 79%. Note that the survey is based on point-of-entry or distribution system and therefore represents treated groundwater, while the USGS data is raw well water. Treatment did not appear to alter the percentage significantly.

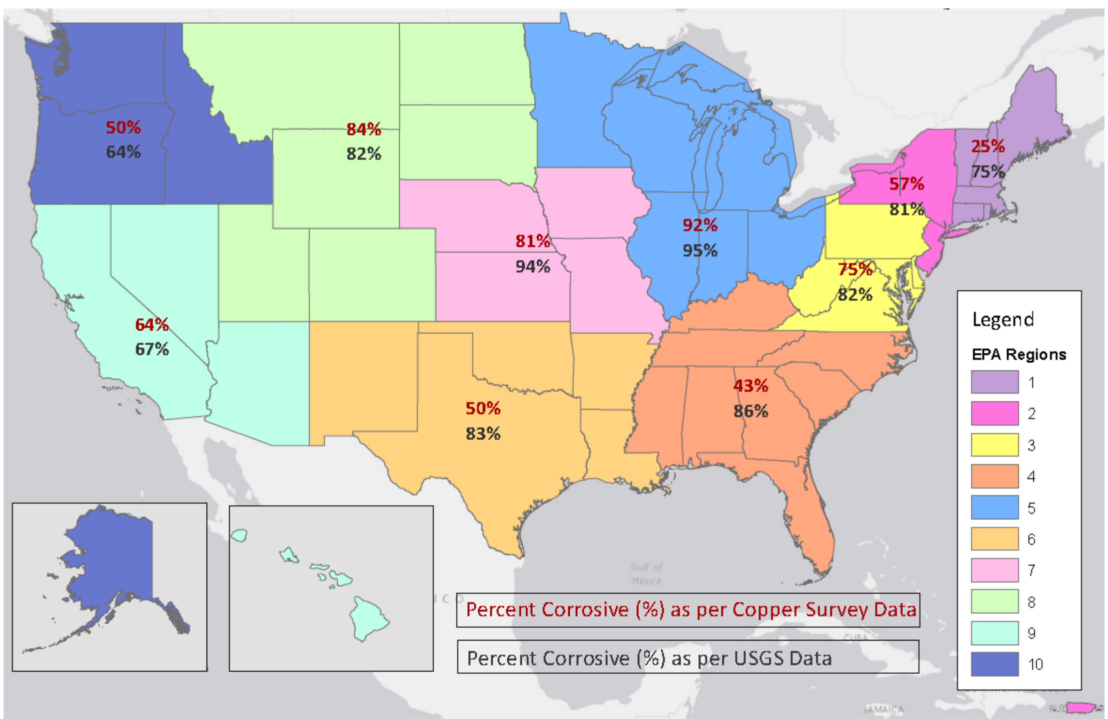


Figure 4: Groundwater Corrosive to Copper Using NDWAC Criteria (from Roth et al. and an analysis of data underlying USGS

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[82] Roth et al., Copper Corrosion Under the Lead and Copper Rule Long-Term Revisions, Journal AWWA, April 2016, http://dx.doi.org/10.5942/jawwa.2016.108.0062.

[83] Belitz, Kenneth, Jurgens, B.C., and Johnson, T.D., 2016, Potential corrosivity of untreated groundwater in the United States: U.S. Geological Survey Scientific Investigations Report 2016–5092, 16 p., http://dx.doi.org/10.3133/sir20165092.

Population Class	Percent Corrosive (Cu - Index)			
	<10K	10-50K	>50K	Total
	Impact of PO_4 not included			
Cu Survey - POE	80%	56%	48%	71%
Cu Survey - DS	78%	53%	45%	69%
USGS				79%

Table 1: Percent Corrosive per Population Class for Copper Survey and USGS Data

The Roth et al. and USGS data raise an important question: "Is the NDWAC corrosivity classification correct, since it is not realistic that this many systems are experiencing high levels of copper?" The index is based on the solubility of Cu(II) for either cupric hydroxide or malachite. While solubility diagrams can be important in understanding reactions and interactions, they do not model the electrochemical reactions of corrosion or the scales that form on the pipe and reduce further copper release. Although preliminary in nature, a database on copper levels from fresh copper in various water qualities offers insight into utility of making decisions based solely on the current classification approach. Figure 5 is an example of two results. The smooth curves are the solubility values, and the two orange boxes are the experimental data. The experiment giving a copper level of 0.14 mg/L would be predicted to result in copper of about 5 mg/L, and the 0.09 data point would be predicted to be about 1.2 mg/L. Additional work will be needed to fully develop a reliable indicator of copper corrosivity, but it may be the current approach based on available solubility curves is overestimating potential copper levels.

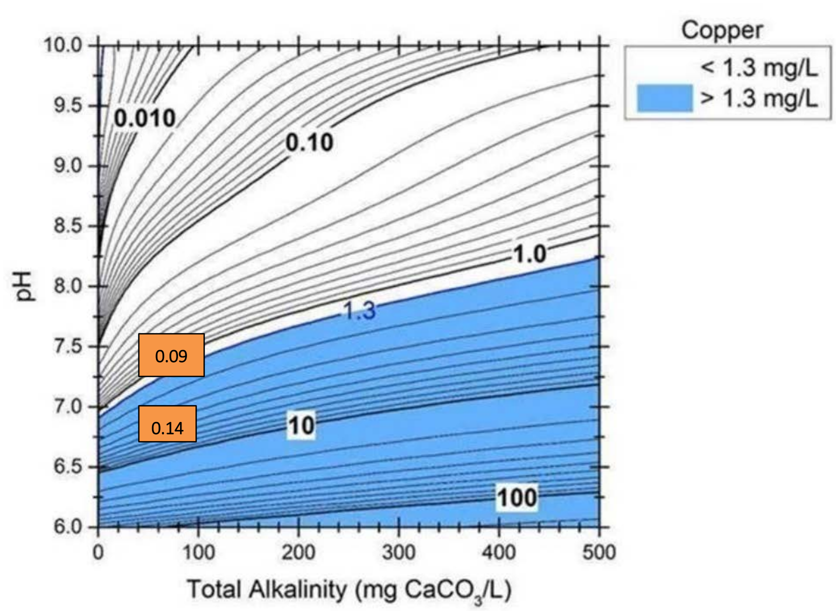

Figure 5: Theoretical copper solubility diagram with overlaid observations

While the USGS analysis suggests that the most corrosive ground waters are limited to the southeastern U.S., Mid-Atlantic and New England, the NDWAC criteria would classify the overwhelming majority of groundwater systems in all regions of the U.S. as corrosive to copper. Also, roughly 40% of systems that are corrosive in the Roth et al. were already applying phosphate and still considered corrosive, according to the NDWAC index. Implications of this analysis for EPA's analysis of LT-LCR are multiple:

1. The proposed change would require thousands of small water systems, many of which are located in rural areas, to re-evaluate corrosion control to control the corrosivity of their water to copper.
    a. A significant number of small systems with corrosion control in place would be directed to change corrosion control practice.
    b. A large number of small systems would be required to add corrosion control.
2. State programs would need to evaluate:
    a. Current decision-making processes to understand why current practice is leading to non-optimal corrosion control practice for copper as well as lead.
    b. A very large number of corrosion control studies, corrosion control treatment installations and permit revisions, with associated oversight of implementation schedules and compliance metrics.
    c. Oversight practices and staffing to an increased number of small water systems employing active treatment, particularly where addition of corrosion control becomes a threshold treatment that sets the stage for additional unit operations (e.g., manganese or iron removal, disinfection, etc.).
    d. Changes to operator certification for small systems to ensure adequate training to oversee more complex groundwater treatment.

AWWA supports the NDWAC recommendation to focus efforts to prevent release of copper into water where the water is corrosive to copper. However, when we consider the above two analyses in the context of observed copper levels from compliance monitoring, the data illustrate that the assumptions underpinning the NDWAC corrosivity criteria are very conservative and warrant refinement before such a framework is included in regulation.

COPPER – TRIGGERED ACTIONS

The marginal return in public health benefit must be sufficient to warrant new triggered requirements under the LCR. If a system's water is deemed to be corrosive, then required actions could take one or more forms, including public education, additional monitoring and corrosion control treatment. The NDWAC recommendations ask a threshold question: Is there a substantial opportunity for additional risk reduction by contemplating changes to the copper requirements? The NDWAC workgroup discussion also focused on aligning the final lead and copper monitoring and response framework in the rule so that it did not create conflicting objectives, undue burden or oversight challenges.

From a community water system perspective, both metals should be adequately managed. Moving forward, implementation challenges include:

1. Implementing and communicating to customers about a compliance monitoring dataset drawn from "fresh" copper (e.g., new homes), particularly in small rural communities where the number of "new" homes can be very limited.
2. Coordinating with local municipal building permit programs where a water system (public, investor owned/operated, non-incorporated rural subdivision) does not have an immediate governmental tie to that department.

3. Absence of local government planning/building permit information systems that align street addresses with water system service area boundaries.
4. Effectively identifying new-home buyers/renters of newly constructed homes that have copper plumbing and reaching them in a timely fashion with information on the importance of allowing copper to passivate and how to improve water quality in new homes.

PUBLIC EDUCATION ON COPPER

Providing informational material to new customers, plumbers, and developers on the release of copper prior to passivation is an educational opportunity for EPA and water systems. There are opportunities to provide general communication materials on copper passivation. NDWAC recommended a strong reliance on public education as the next step in improving copper risk reduction. Given the nature of the sensitive subpopulation for copper, the need to include a public education requirement on copper in drinking water in the LCR revisions will depend on the initial evaluation of the threshold question as to the risk reduction opportunity afforded by increased focus on copper in the LCR.

MODIFY TAP SAMPLING TO REQUIRE SEPARATE SAMPLING SITES FOR COPPER

The appeal of a workable copper corrosivity index is that it reduces the challenge of developing a separate tap sampling protocol for copper. Answering the question of whether a dedicated sample pool is necessary for copper is highly dependent on the balance of the rule option being considered. If the rule option requires weighting the sample pool heavily toward structures with lead service lines, then unpassivated copper is less likely to be present than in other alternatives. Again, the threshold question is whether there is a need for a more sensitive copper monitoring sample in most systems given the opportunity for health risk reduction:

1. Not all systems have significant numbers of lead service lines,
2. There is the opportunity to enhance risk reduction through public education targeting structures with fresh copper piping, and
3. The amount of installed copper pipe has decreased substantially since LCR was first promulgated (see Figure 6, tons of tube sold to all uses as a surrogate for use in plumbing alone).

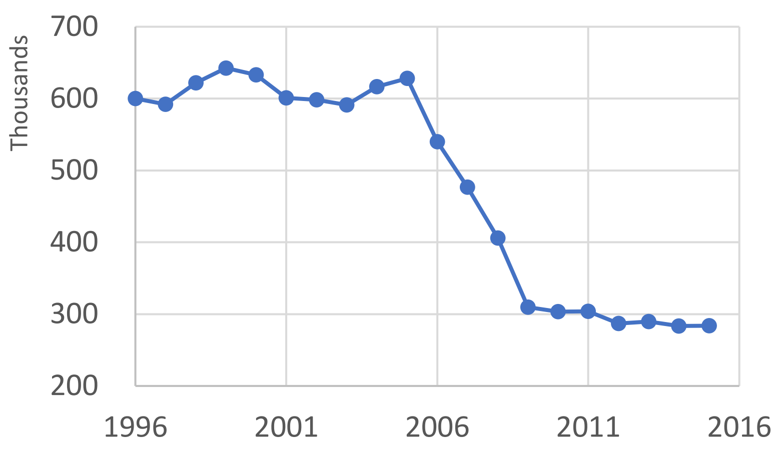

Figure 6: Tons of copper tube consumption in end-use markets[84]

[84] Copper Development Association, Annual Data 2017, Copper Supply & Consumption — 1996–2016. 2017, Available 2/16/2018 at www.copper.org/resources/market_data/pdfs/annual_data.pdf.

Appendix A. Observations on EPA Modelling to Calculate a Household Action Level

The following are observations regarding EPA's development of a household action level, prepared by Dr. Douglas Crawford-Brown.

RELIANCE ON LCR COMPLIANCE MONITORING DATA

I assume here that some variant of Figures 4A and 4B from the EPA's Environmental Health Perspectives paper would form the basis of any proposed health-based benchmark. If Figure B is used – since it involves aggregate exposure assessment and not only exposure via water – The water concentration corresponding an aggregate BLL value of 5 ug/dL in the 97.5th percentile is approximately 4 ugPb/Lwater.

However, this figure relies on use of the Six-Year review data on Pb in water. This is not a representative sample of the US population, but rather a sample of first draw results in a subpopulation identified by water providers as being most at risk from waterborne Pb. The three approaches being considered by the EPA in establishing a health-based benchmark, however, all rely on the national exposures.

Data presented by the EPA in the supporting documents for the EHP paper suggest a ratio of first draw concentration over daily average water concentration of between 2 and 4. It is unknown how biased (high) the sampled population of homes is within the overall distribution of homes. At the least, therefore, the 4 ugPb/Lwater value mentioned above should be raised to between 8 and 16 ugPb/Lwater based solely on the issue of using a database of first draw samples. This range encompasses the value of 15 ugPb/Lwater currently forming the basis of risk mitigation decisions under the LCR.

RELIABILITY OF ESTIMATE AT EXTREMES OF EXPOSURE DISTRIBUTION

Additionally, Figures 4Aand 4B reflect exposures at the 97.5th percentile. While it would be highly protective to use such a high percentile value, Figure 2 demonstrates that the curve of percentile versus BLL is characterized by a very high slope above the 90th percentile, being almost vertical. Very small errors in the curve, introduced by small errors in the uptake rates for the different pathways, would result in very large shifts in the water concentration associated with a given BLL (3.5 or 5 ug/dL) at this percentile. Use of the 95th percentile would increase the benchmark concentration further above the range of 8 to 16 ugPb/Lwater mentioned above (see Table 1 of the EHP paper, comparing the 95th and 97.5th percentile values).

This issue, coupled with that in item 1 above, suggests that the current value of 15 ugPb/Lwater as an 'action level' of some kind is already protective of the 'representative child' mentioned directly in Approaches 1 and 2 of the Modeling Review Panel charges.

REPRESENTATIVE CHILD OR ANOTHER TARGET SUBGROUP

Continuing with the issue of the nature of the Six-Year review water data, it is not defined anywhere in the EPA risk assessment (including the EHP paper mentioned above) what specific subpopulation is represented by those data in regard to waterborne exposures. Again, the values in the database are clearly dominated by first draw samples (known to be higher on average than a true nationally representative sample) in homes suspected of being at greater-than-average risk of waterborne Pb exposures. This is not consistent with the idea of using a 'representative child' in Approaches 1 and 2, and does not produce an accurate probabilistic analysis under the methods in the EHP paper.

While the AWWA has been able to fully reproduce the results of the EHP paper, including the Monte Carlo (probabilistic) analysis, the EHP paper does not describe the nature of the subpopulation exposed to water at these levels, or the percentile of the US population of children represented in the probabilistic results in the paper. Instead, the EHP paper provides the 95th and 97.5th (and other) percentiles for the SAMPLED population under the Six-Year review data, which is not the same as a nationally representative sample. In establishing a health benchmark based on any of the three proposed Approaches, the EPA should consider how it will enhance the database of water exposures to reflect the nationally-representative population characteristics mentioned in the three Approaches.

TRANSLATING BLOOD LEAD LEVEL TO IQ DECREMENT

The underlying health concern for Pb exposure of children is the impact on IQ during development. The epidemiological studies cited by the EPA use BLL value and IQ as the regression variables. However, the IQ measure is in children at the upper end of ages considered in the current analyses (including the EHP paper), as is the exposure (or dose) measure of BLL.

From these epidemiological studies, one can discern the value of the BLL that corresponds to a given increment of IQ, relative to very low BLL values. That is scientifically sound methodology. However, the EHP paper (and related documents) calculate the BLL at other, younger, ages, such as 0 to 6 months and 1 to 2 years.

Based on usual regulatory practice, there will be a tendency to use the value of the BLL associated with a given IQ decrement (as determined from the higher childhood ages noted above), and apply this limiting value to the two younger age groups, keeping all age groups below the assigned BLL. This would not be correct because the impact of BLL on IQ is cumulative over the period from birth (in fact, from fetus) to the age at which the BLL-IQ relationship was measured. This relationship already includes the impact of exposures at the younger ages. It is more scientifically correct, therefore, to assess the BLL throughout the period from birth (or fetus) to the age of measurement of IQ in the epidemiological studies.

COMPARING BENCHMARK APPROACHES

Continuing with the issue of the non-representative nature of the current water concentration database used in EPA analyses, consider the three health benchmark Approaches under consideration at the EPA:

The level of lead in drinking water that results in an individual infant or child’s probability of an Elevated Blood Lead Level (EBLL) being increased by 1 or 5 percent.

The level of lead in drinking water that results in an individual infant or child’s BLL increasing by 0.5 or 1 µg/dL.

The level of lead in drinking water that results in the 95th or 97.5th percentile of predicted BLLs in the U.S. population of infants or children being equal to 3.5 or 5 µg/dL.

Note that Approach 3, which is the Approach used in the EPA’s EHP paper mentioned above, requires the representative national distribution (which is not currently available). However, Approaches 1 and 2 do not, as they seek a maximum water Pb concentration consistent with the stated aim. In addition, Approach 1 formulates the benchmark in terms of a percentage increase in BLL, which has little scientific basis and would be difficult to justify publicly as it is not related to any specific health outcome. Approach 2 is therefore the only one of the three that is both scientifically defensible (being related to a numerical decrease in IQ amongst a nationally representative population) and avoids the need for a representative water concentration distribution.

Approach 2 also comes closest to the recommendation of the NDWAC if one considers a ‘representative’ or ‘average’ child’s increase in BLL. Using the regression equations underlying Figure 4A of the EHP paper, the water concentration that produces an increment of 1 ug/dL at the 97.5^{th} percentile is 7.4 ugPb/Lwater (3.7 ugPb/Lwater for 0.5 ug/dL). However, these two values are for an individual at the 97.5^{th} percentile, and therefore not ‘representative’. Table 1 of the EHP paper displays the BLL values calculated for the 50^{th} (representative) and 97.5^{th} percentiles in the case of aggregate exposure. The ratio of these two values ($97.5^{th}/50^{th}$) is approximately 4.6/1.3 or 3.5. The water concentration corresponding to a 1 ug/dL increment in the 50^{th} (representative) percentile is therefore 26 ugPb/Lwater (13 ugPb/Lwater for 0.5 ug/dL increment). If one considers only variability due to water uptake, these values are approximately 20 ugPb/Lwater (10 ugPb/Lwater for 0.5 ug/dL increment).

USE OF RESULTING VALUE

Bear in mind also that all of the above potential target values refer to a volume-weighted average of water concentration in exposed individuals, and not a ‘first-draw’ sample. This is consistent with the nature of the exposure index in the epidemiological studies. The target value (or health benchmark, or whatever term is used in the end) of water concentration therefore should be compared against this volume-weighted average rather than a ‘first-draw’ value.

Prepared by Dr. Douglas Crawford-Brown

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