Developing Effective Funding Strategies for Compliance With the Lead and Copper Rule Revisions

Christopher Hill, Quirien Muylwyk, and John Konkus

The Lead and Copper Rule Revisions (LCRR) were finalized in January 2021. In June, the U.S. Environmental Protection Agency (EPA) affirmed the rule requirements and extended the effective date of the LCRR to Dec. 16, 2021, and the compliance date to Oct. 16, 2024. The LCRR includes a number of key provisions that will impact water systems, including changes in compliance monitoring, service line inventories, and lead service line replacement (LSLR) plans.

Understanding the potential impacts of the LCRR to a particular water system and having an effective compliance and funding strategy in place to address the impacts of the rule are critical to meeting the LCRR requirements.

Overview of the Lead and Copper Rule Revisions

The copper requirements under the rule remain unchanged; however, it's not the case for lead. Though EPA opted not to lower the lead action level (AL) from its current value of 15 µg/L, the revisions establish a new lead trigger level (TL) of 10 µg/L. Compliance and associated actions by a water system are based on the 90th percentile of lead monitoring results in comparison to the AL and TL.

The revised compliance monitoring requirements increase the focus on single-family structures (SFS) with lead service lines (LSL). Under the current rule, SFS with LSL only comprise up to 50 percent of a system's sampling pool, with the remaining samples coming from SFS with copper service lines and lead solder installed before 1982. The revised rule requires that all sampling be conducted at SFS with LSL if enough sites exist. In addition, the current rule requires collection of a first liter sample after 6 hours stagnation. Under the revisions, an additional fifth liter sample will be collected at homes served by LSL with the intention of collecting water from the LSL.

Compliance with the copper requirements, and for those systems that do not have LSL, will be based on first liter samples. In those systems that have LSL, compliance with the lead requirements will be based on the fifth liter sample at homes that have LSL.

The rule includes "find-and-fix" provisions for locations where individual samples exceed the AL. When an individual sample exceeds 15 µg/L, water systems are required to collect follow-up samples at the monitoring location and in the distribution system in the vicinity of the AL exceedance. The purpose of the sampling is to determine the source of the elevated lead concentration. Based on the determination of the cause of the elevated lead concentration, water system requirements will range from "no action" by distribution system management to replacement of sources of lead in the home (e.g., a plumbing fixture) and adjustment of corrosion control treatment (CCT).

Based on a system's size and current CCT status, exceeding the AL or TL triggers certain actions. Generally, if a system has previously established optimal corrosion control treatment (OCCT) with the state and exceeds the TL or AL, it must re-optimize CCT; however, if a system exceeds the TL and has not previously established CCT, it must conduct a study to evaluate options and recommend OCCT. The OCCT would be required to be implemented if that water system exceeds the AL in subsequent sampling.

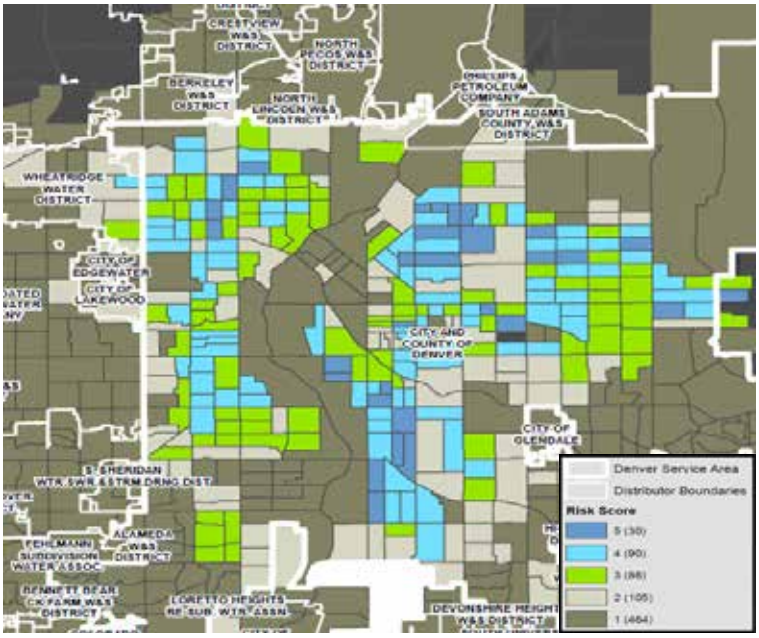
The revisions also require targeted sampling at elementary schools and childcare facilities on a regular basis as a part of the increased focus on public education. Water systems must conduct sampling at 20 percent of elementary schools per year, 20 percent of childcare facilities per year, and at secondary schools on request for five years. After the first five years, water systems must conduct sampling at schools and childcare facilities on request.

Christopher Hill is drinking water market sector leader with AECOM Technical Services in Tampa. Quirien Muylwyk is water quality technical director with AECOM Technical Services in Toronto, Ontario. John Konkus is senior manager of government affairs with AECOM Technical Services in Tallahassee, Fla.

The LCRR contain several public education elements, including customer notifications "as soon as practicable but no later than three days" following a TL exceedance at a sampling site and providing public education at schools and childcare facilities on the risks of lead in drinking water. While the water system is responsible for conducting the sampling at these facilities, the results are not considered in the water system's compliance determination. Further, the water system is only required to provide the sampling results and remediation information to the facility within 30 days of receipt of the sampling results. Neither the water system, nor a school or childcare facility, is required to act if results exceed the TL or AL. The requirements to sample these facilities can be waived if a state or local program to sample these facilities already exists.

Finally, water systems are required to conduct a materials inventory of all service lines by Oct. 16, 2024, and make that information publicly available (via a website or other means). In addition, all water systems with LSL will be required to develop an LSLR plan. The rule does not require mandatory LSL replacement unless a system exceeds the AL or TL; however, replacement of the publicly owned portion at an individual property is required when replacement of the privately owned portion is initiated by a customer.

A water system that exceeds the AL must implement its LSLR at a rate of 3 percent per year; a water system that exceeds the TL must implement LSLR at an annual rate approved



Machine learning can be an effective means of identifying lead service line locations and prioritizing replacement.

Lead service line replacement plans are due by October 2024. Though replacement may not be required, the availability of funding should make lead service line replacement a priority.

by the state. In both scenarios, LSLR can be discontinued after two consecutive years of monitoring below the TL.

Developing a Service Line Inventory

As stated, all water systems, including those that do not have LSL, are required to create a publicly accessible service line inventory by Oct. 16, 2024. Service lines will be given one of four possible designations:

- Known LSL will be labeled as "lead service lines."
- Galvanized service lines that are or were previously downstream of LSL will be designated "galvanized requiring replacement."
- Service lines of unknown material are to be labeled "lead-status-unknown service lines."
- Those known to be "nonlead" can be designated as such.

A "nonlead" designation does not require the water system to identify the exact material of a service line, such as plastic or copper, if it's not LSL or galvanized and requiring a replacement service line. It's also worth mentioning that the LCRR does not require water systems to investigate or inventory lead connectors (i.e., goosenecks or pigtails) because records identifying their location are anticipated to be very poor and investigation is expected to be difficult due to their location (under pavement). Further, the replacement of lead connectors is expected to be undertaken opportunistically, as part of LSL work or water main renewal.

The inventory must be updated over time to reflect changes, such as verification of lead-status-unknown service line material compositions or LSL that have been replaced.

Water systems with only nonlead service lines are required to conduct an initial inventory, but they are not required to provide inventory updates and they may fulfill the requirement to make the inventory publicly accessible with a statement that there are no LSL, along with a general description of the methods used to make that determination.

Developing an inventory will be an iterative process due to the availability of records that may be incomplete or erroneous, the presence of lead-status-unknown service lines, and the need to update the inventory over time.

Helping multiple utilities find and document lead services has allowed deployment of a range of techniques, such as:

- Desktop reviews of historical data (city building codes and ordinances, housing build dates, water main tap dates, property cards, etc.), maintenance records, staff knowledge, and other sources of asset data, such as geographical information systems (GIS) and asset management data. Experience has shown that the rules used to assign an initial material designation can change as better information is developed, and that conflicts in the data will exist and logical prioritization of record types is necessary to designate the material.
- Field investigations, such as interior observations at the meter and pothole investigations. Experience has shown a single pothole may not be sufficient to confirm a nonlead service line. Multiple pothole excavations on each side of the curb stop and/or near the meter may be necessary, particularly where there is a history of partial LSL replacement or where there is evidence of a service line repair.
- Indicators of lead based on water quality sampling.

When considering the use of water quality data to identify possible LSL locations, it's important to consider any CCT employed and its potential impacts on water quality. For example, a water quality profile can be used to observe changes in lead concentrations from the tap to the water main. An increase in lead concentrations in samples from the water main can be indicative of the presence of LSL; however, a system utilizing an orthophosphate inhibitor might see little variation in lead and should be cautious about assuming a service line is nonlead based solely on water quality. When using water quality sampling, the lead concentration used to indicate LSL must be calibrated for each water system.

Confirmation of Nonlead Status

One of the most-challenging things about the LCRR may be confirming nonlead status for an individual site or water system.

Continued on page 42

Continued from page 41

As EPA has not yet released guidance related to conducting a service line inventory, a recommended first step is to meet with the state or primacy agency to establish expectations for the LSL inventory. An important part of this discussion will be confirmation of what is required to demonstrate that a service line is nonlead or the lead status is unknown. While there is no deadline to investigate the material composition of all lead-status-unknown service lines, water systems must create a strategy in their LSLR plans for investigating lead-status-unknown service lines in their inventory. This strategy, coupled with the incentive to investigate unknowns to ease future LSLR burden, will encourage water systems to verify all unknown service line materials in a timely manner.

In the LCRR it's stated by EPA that service lines installed after a state or federal ban on the use of lead may be designated as nonlead, but provides no real guidance beyond that. In the absence of additional guidance, a pragmatic approach is to balance the risk of lead exposure and the cost to conclusively determine that there is no lead (e.g., conduct water quality sampling, perform interior and pothole inspections, etc.), and prioritize service line material confirmation based on that risk. For example, a household childcare facility located in an area where LSL are known to exist might be a high priority for confirmation of service line material. On the other hand, a service line at a home near an area where a water main was recently replaced and all of the homes were observed to have copper service lines might be of lower priority (or even be designated nonlead based on discussions with the state or primacy agency).

Lead Service Line Replacement Planning to Manage the Risk of Lead Exposure

Water systems with LSL are required to submit an LSLR plan by Oct. 16, 2024. The rule does not require mandatory LSL replacement unless a system exceeds the AL or TL; however, replacement of the publicly owned portion of the service line is required when replacement of the privately owned portion is initiated by a customer. As such, water systems should develop service line replacement policies and procedures, inclusive of construction materials and methods, customer guidance, and funding strategy before October 2024. A water system that exceeds the AL must implement its LSLR at a rate of 3 percent per year; a water system that exceeds the TL must implement LSLR at an annual rate approved by the state. In both scenarios, LSLR can be discontinued after two consecutive years of monitoring below the TL.

Service lines are typically replaced in one of five ways, the combination of which determines the overall cost and efficiency of the program:

- Emergency replacements due to water main or service line repairs.
- Replacements as part of planned water main rehabilitation or replacement project.
- Individual replacements to address a property where high lead levels are measured (i.e., find-and-fix) or when the occupants are at high risk of lead exposure (i.e., household with young children or a private childcare facility).
- Individual replacements by third parties (i.e., a property owner or developer).
- Groupings of replacements, whereby an area of the water system is targeted for replacement.

The most-appropriate approach to LSL replacement will be system-specific. Preparation of the LSLR plan will include consideration of the following:

- Geographic distribution of LSL in the water system.
- Proportion of properties in the system or an area of the system at risk of or exceeding the TL or AL.
- Age of the occupants (for example, neighborhoods with many young families).
- Ability of the water system to complete the replacements with its own staff or the need for outside (e.g., contractor) assistance.
- Cashflow projections to complete the replacement and funding commitments.

All LSL replacement should be prioritized based on risk; however, risk is relative. A water system with relatively few LSL may prioritize individual replacements based on lead levels at a particular home and/or based on the age of the occupants. On the other hand, a system with a significant number of replacements may take a slightly different approach, prioritizing both individual sites and geographic areas based on risk. In all cases, it's recommended that water systems have policies and procedures in place to replace LSL when there is a known risk at a particular site; for example, a single-family residence where lead levels exceed the TL (or AL) on a recurring basis and it can be determined that the lead is the result of LSL.

The LSLR plan must describe how replacement is prioritized. It's recommended that the following factors be considered to prioritize replacements:

1. Location, distribution, and density of LSL to help plan the work.
2. Sociodemographic factors that reflect the likelihood and consequence of lead exposure from drinking water.
3. Construction constraints and construction opportunities to manage community disruption.

When all three are considered, a delicate balance between public health protection and construction efficiencies can be realized. Experience suggests that LSL occurrence often coincides with household income, and therefore, sociodemographic indicators for poverty, education, and other factors specific to the water system can be used with the

Continued on page 44

Table 1. Lead and Copper Rule Revisions Sample Site Tiering Criteria

Tier	Definition
Tier 1	SFS served by LSL
Tier 2	Buildings, including multifamily residences served by LSL
Tier 3	SFS served by galvanized service lines that are/were downstream of an LSL
Tier 4	SFS service by copper service line with lead solder
Tier 5	Representative sites

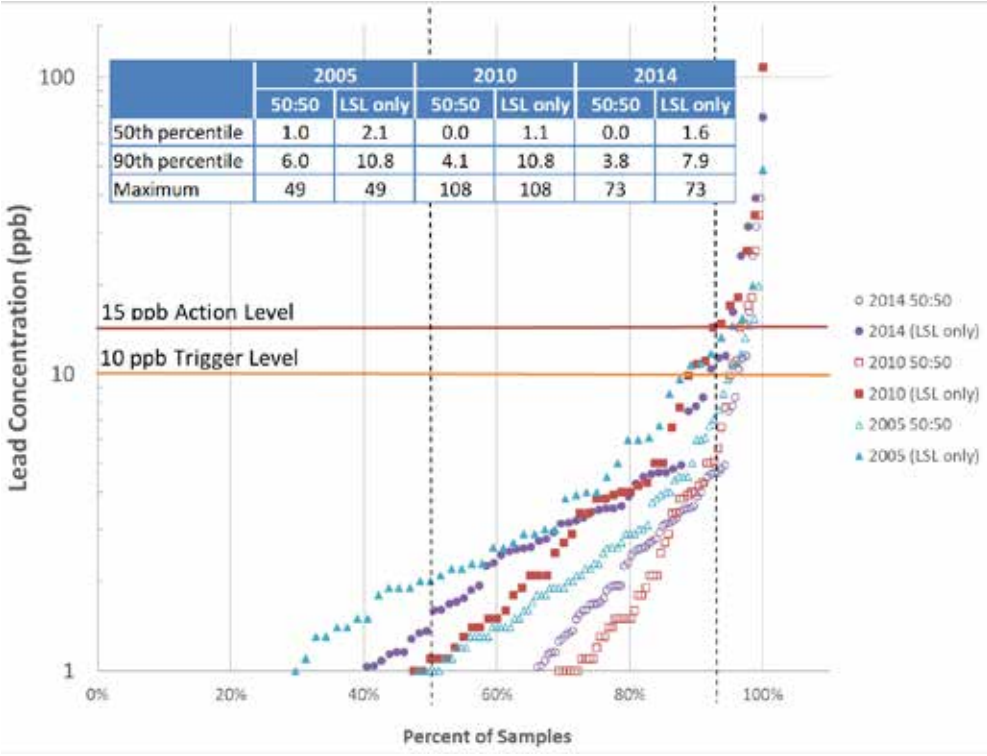


Figure 1. Comparison of Lead Statistics Under Current and Lead and Copper Rule Revisions Monitoring Protocols
(Data from 50 percent LSL sites and 50 percent copper with lead solder sites indicated by "50:50" data from only SFS served by an LSL indicated by "LSL only.")

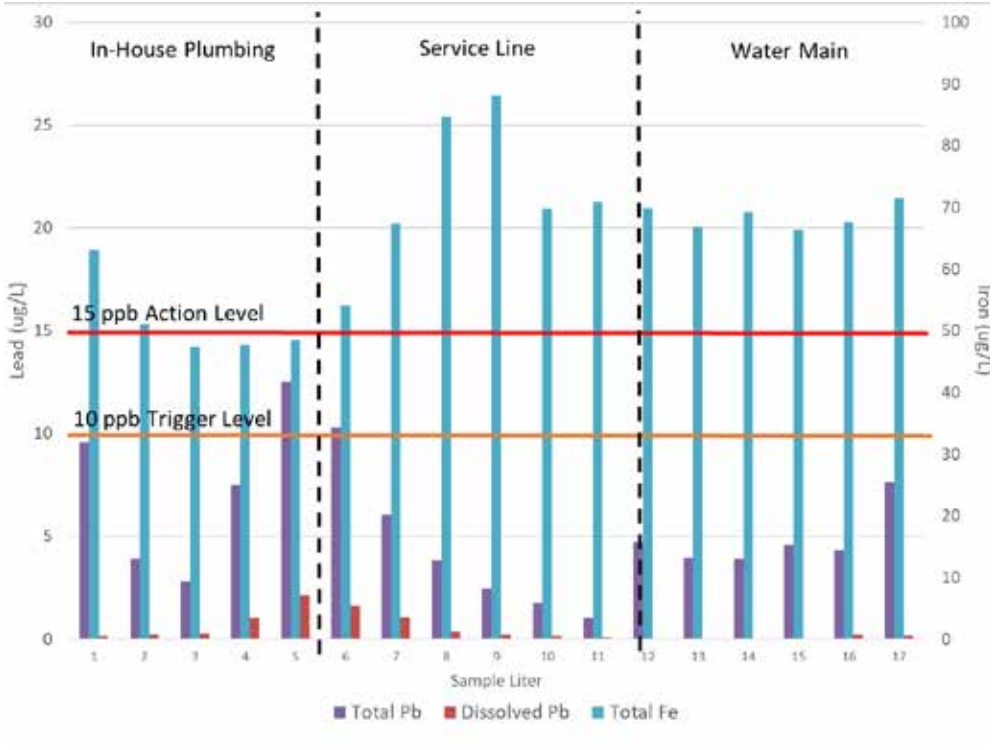


Figure 2. Typical Water Quality Profile for a Home With a Lead Service Line

Continued from page 42

lead inventory to determine which areas of a water system would benefit the most from replacements early in a multiyear lead replacement program.

Consideration should also be given to construction constraints and opportunities (e.g., water main rehabilitation projects) to realize cost efficiencies. A prioritization framework that is transparent can be shared with the public and city leaders so that customers know when the lead in their neighborhood will be replaced and why.

The success of any replacement program depends on the participation by property owners. No credit is given for partial LSL replacement that results in lead remaining in the ground, and partial LSL replacement should be avoided if possible. Customer participation is promoted when the barriers to participation are reduced, which includes both financial and communication barriers. Financial barriers can be addressed through grants or loans to cover the cost of private-side replacement and are discussed in the "funding strategies" section presented later.

Communication barriers can be addressed by targeted and well-thought-out public outreach, communication, and education programs. Sometimes providing "proof" of LSL is necessary for owner engagement, and traditional "scratch tests," water quality sampling, and in-home inspections by utility staff or contractors can help address this.

The communications strategy must address every interaction customers have, from finding out the material of their service lines to post-LSLR sampling and filter use. The Lead Service Line Replacement Collaborative (https://www.lslr-collaborative.org/) provides information of experiences from other water systems that can be leveraged when developing an LSLR plan and communications strategy.

Using the Lead Service Line Inventory: Impacts of Changes in Monitoring Requirements

Sample site selection under the LCRR will be in accordance with a new set of tiering criteria (Table 1) that prioritize structures at locations served by LSL. For LSL sites, a first liter and a fifth liter must be collected and analyzed; the first liter will be analyzed for copper and the fifth liter for lead. For water systems without LSL sites, a first-draw 1-liter sample will be collected and analyzed for lead and copper. Galvanized service lines that are/were downstream of an LSL are not

considered LSL from a sampling perspective and only first liter samples are required at those sites.

The prioritization of sampling at sites served by LSL could result in significant increases in the statistics used to analyze lead sampling results. Figure 1 compares lead statistics for a system that collects 100 samples twice per year under the current Lead and Copper Rule (i.e., minimum of 50 percent SFS served by LSL and 50 percent SFS served by copper service line with lead solder installed prior to 1982) and LCRR (SFS served by LSL only).

The results show quite significant increases in lead statistics when only homes served by LSL are considered. Under the current sampling protocol (see columns labeled "50:50" in Figure 1), the 90th percentile lead concentration in this system is well below the AL and would appear to be comfortably below the TL; however, exclusion of the copper service line sites (see columns labeled "LSL only" in Figure 1) results in a 90th percentile lead concentration that exceeds the TL in each of the first two years of data evaluated and a 90th percentile value approaching the TL in the third year. When additional LSL sites are added (i.e., new LSL sites are substituted for the copper service line sites), it's possible that this system may be at even more risk of exceeding the TL, and perhaps the AL.

Figure 1 only considers the impacts of the change in the selection of sample sites based on the revised tiering of Table 1 and does not include the impact of collecting a fifth liter sample on lead concentrations at homes served by LSL. The impact on the lead concentration due to the fifth liter sample in homes with LSL can be seen in Figure 2. In this particular instance, the increase in total lead concentration was not significant (maybe 20 to 30 percent), but it was sufficient to push the value at this home over the TL.

When considered together, the focus on locations with LSL and the shift to a fifth liter sample could significantly impact a water system's compliance status, resulting in the need to optimize or study corrosion control treatment and/or initiate LSL replacement.

Funding Strategies: How to Pay for Lead Service Line Replacement Planning and Lead Service Line Replacement

The EPA estimates that the average cost to replace a single service line is approximately $4,700, resulting in costs of between $28 and $47 billion to replace all LSL in the United States. (2019); however, costs can vary significantly from system to system and could be as high as $10,000 to $15,000 or more per service line when all costs (public outreach, household filters, etc.) are considered. For those communities with a significant number of LSL, the financial burden of replacement could be quite significant. Further, disadvantaged homeowners may be unable to afford LSL replacement if the water system is unable to pay for the full cost of replacement.

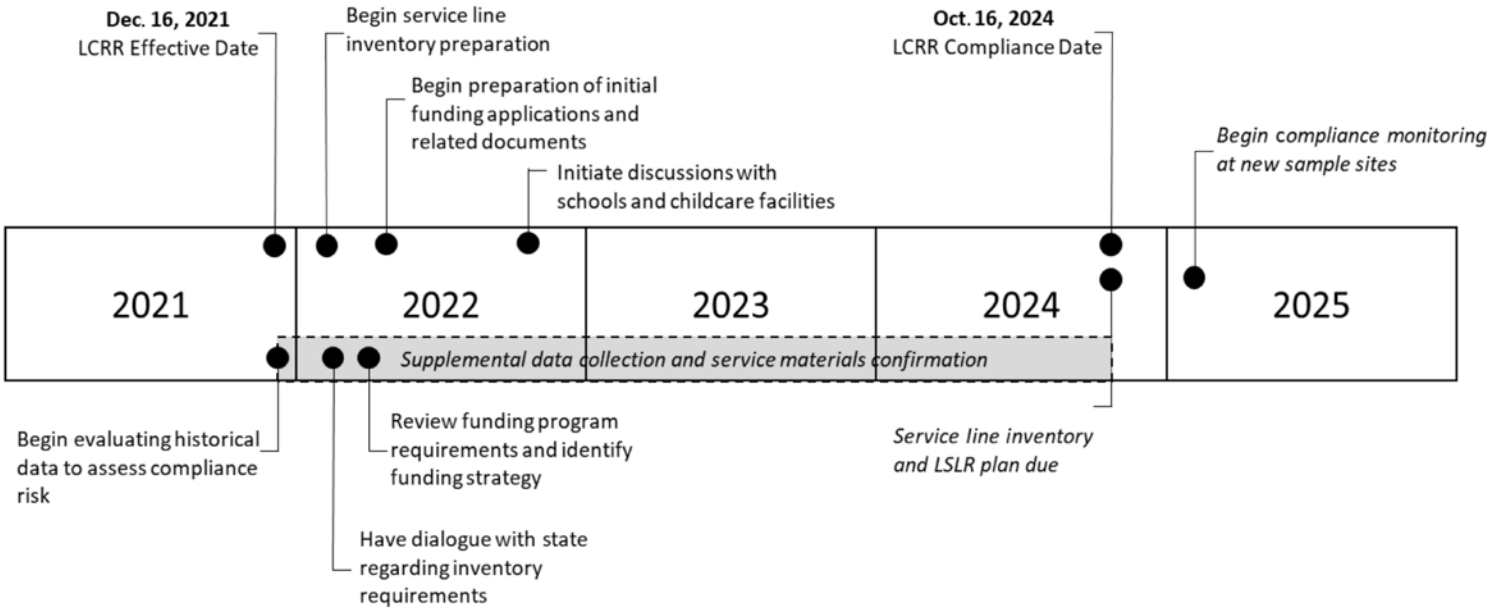
Fortunately, state and federal funds may be available to assist with LSL replacement. There are a number of existing grant and loan programs available and a number of agencies that may fund LSL replacement, including the Drinking Water State Revolving Fund (DWSRF), Water Infrastructure Finance and Innovation Act (WIFIA), U.S. Department of Housing and Urban Development (HUD), Federal Emergency Management Agency (FEMA), and U.S. Department of Agriculture (USDA) Rural Development, as well as state and federal earmarks and other programs.

The federal government is currently negotiating a U.S. infrastructure plan. Though the details continue to emerge, one priority remains a center of any future bill—funding for LSL replacement. Most iterations of the draft bill have included funds ". . .to replace every lead service line in the nation." While the details regarding funding distribution are still unclear, DWSRF, WIFIA, and federal earmarks are likely to be used as vehicles to provide funding to water systems.

It's important to understand how these programs work and what it will take to apply for and administer funds received under those programs. For example, securing of DWSRF funds typically requires submission of a facility plan (i.e., an LSLR plan) and other commitments by the water system. It's worth

Continued on page 46

Figure 3. Recommended Funding and Compliance Timeline



Continued from page 45
noting that the cost of plan preparation can be recovered under DWSRF. Similarly, the first gate for WIFIA funding is the submission of a letter of interest, and although there is no deposit required with the submission of the letter (other than the costs associated with any pre-engineering work to support the application), the owner will need to provide a deposit of $100,000 with the application approximately one year after submitting the letter. Further, the financing side for EPA requires an additional fee that is determined for each successfully funded project, and the amount may range up to $250,000, which may be waived by EPA if conditions warrant. The WIFIA may also require the water system to fund 50 percent or more of the replacement as a condition for further money.

If and how DWSRF or WIFIA requirements may change when it comes to funding LSL replacement is unclear, but water systems should begin developing a strategy to apply for and administer federal funds for LSL replacement. Understanding current DWSRF and WIFIA requirements is an important first step to determining which funding model is best suited for a particular water system. For example, DWSRF might be a better option for smaller systems due to the priority given to small systems with the greatest funding needs. Once made available, there are likely to be deadlines to apply for, and perhaps, more importantly, use funds to replace LSL. Having an answer to the question "How and what will it take for a system to replace all lead service lines in my system as quickly as possible?" will be key to preparing a LSLR plan and determining the most-appropriate funding strategy for the system.

Compliance Timeline

The LCRR are complex, and the revisions are the most-significant change to drinking water regulations in the U.S. in more than a decade. Water systems will be required to meet the requirements of the LCRR by December 2024. Changes in sampling requirements have the potential to significantly impact systems with LSL. For systems without LSL, demonstration of their nonlead status may be their most-significant challenge.

Figure 3 provides a suggested timeline to assure that systems meet the requirements of the LCRR by the compliance deadline and have a funding strategy in place for LSL replacement.

A few key elements of the proposed timeline are:

- Begin reviewing historical data now to determine how changes in monitoring requirements could impact future compliance. In the absence of fifth liter samples at homes with LSL, collect some samples to trial performance.
- Meet with a state or primacy agency as soon as possible to understand the service line inventory expectations and what they will require for designation of nonlead status.
- Begin preparation of the service line inventory and have a plan for implementation of the public interfaces.
- Review current funding program requirements (e.g., DWSRF or WIFIA) and identify which funding model is best suited for the system. Monitor federal legislation to understand how funding for LSL replacement will be distributed to water systems and what the associated administration and utility-provided funding commitments will be.
- Assess funding program eligibility to cover the cost of service line inventory and LSLR plan preparation. For example, DWSRF can be used for engineering design fees after submittal of the facilities plan. Preparing the facilities plan in such a way that it identifies the steps that will be taken to prepare the LSL replacement plan, including field verification and additional testing, may make those costs eligible for funding. Similarly, the WIFIA funding may be used for "[d]evelopment-phase activities, including planning, preliminary engineering, design, environmental review, revenue forecasting, and other preconstruction activities." The WIFIA funds can be used to reimburse the cost of these activities if they are carried out under certain federal guidelines. Utilities can align previously incurred costs with federal guidelines to ensure that eligible activities can be submitted for funding, and continue to monitor federal legislation to assess the eligibility of service line inventory and LSLR planning for funding assistance.
- Prepare funding applications and other required program documents in 2022 (e.g., DWSRF facilities plan or WIFIA letter of interest).
- Use the time available between now and December 2024 to collect additional data to assess the potential impacts of changes in monitoring the system to avoid surprises when the first round of new compliance data is gathered in 2025.
- Verify service lines of unknown status now. The requirements for nonlead sites and systems are substantially less than those with LSL or lead-status-unknowns. Use the time between now and December 2024 to verify service line materials in accordance with state or primacy agency expectations and reduce the number of lead-status-unknown service lines in the system. This can have significant financial impact on a water system. For example, if a system has a thousand known LSL and 4000 lead-status-unknown LSL, and is required to implement LSL replacement, the required 3 percent per year is 150 LSL. The number of required replacements could be reduced significantly by verifying that those unknown-status services are nonlead. Further, the cost of verifying service line materials will be lower than the cost of replacement.
- Review data from previous sampling efforts at schools and daycare facilities, if available. It's important that schools and childcare facilities not be caught off guard by the monitoring or public education requirements of the rule and that they have a plan to communicate with their customers about the risks of lead in drinking water. Water systems should initiate discussions with school districts and childcare facilities in their service areas as soon as possible.

Summary

The LCRR will be challenging for many water systems for a variety of reasons. Understanding how the rule might impact a utility and how it develops an effective funding strategy for LSL replacement will be the key to achieving compliance with the new rule.

Water systems should begin an evaluation of their compliance and potential financial risk and exposure and then formulate a strategy to address those risks immediately. The suggestions presented can serve as a road map to initiate that assessment.