Preventing Toxic Lead Exposure Through Drinking Water Using Point-of-Use Filtration

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Summary

Lead exposure through drinking water is an acute and persistent problem in the United States. The Flint, Michigan, water crisis brought national attention to this problem, but every city is at risk where lead-containing materials are present in water infrastructure and building plumbing. Preventing childhood exposure to lead is the consensus policy in the medical community and exposure costs the U.S. tens of billions of dollars annually, but the federal Lead and Copper Rule requires remediation only after lead is present at levels considered medically unsafe, and relies on an inherently unreliable testing program. Recent federal and state efforts to reduce exposure focus resources on lead pipe replacement and testing to identify lead risk; neither course adequately protects the public. This Article recommends promoting point-of-use filtration to remove lead, an approach that has received little attention despite the fact that filtration technology is inexpensive and very effective. It specifically recommends that Congress provide a refundable tax credit for individuals to acquire a filtration system and replacement filters, and require all non-residential buildings to use best available technology for filtration in drinking fountains. Promoting filtration is consistent with primary prevention, will provide individuals a means to protect themselves, and will effectively and efficiently remove toxic lead currently present at the tap.

> *If you were going to put something in a population to keep them down for generations to come, it would be lead.*
>
> —Dr. Mona Hanna-Attisha[1]

> *One of the recent lessons of Flint, Chicago, Pittsburg[h], and other cities is that we should never again consider water that passes through a lead pipe safe.*
>
> —Dr. Marc Edwards[2]

> *If they get a good test, it doesn't prove water is safe relative to lead . . .*
>
> *What proves water is safe is if the filter is there and installed properly.*
>
> —Dr. Marc Edwards[3]

For more than one year, reports of lead contamination in drinking water dominated the news cycle in a city where 4,075 of 6,118 residences exceeded the U.S. Environmental Protection Agency (EPA) action level for lead in drinking water of 15 parts per billion (ppb).[4] Testing found lead levels of 50 ppb in 2,287 residences and 300 ppb in 157 residences.[5] The raw water supply quickly corroded lead-containing materials in the drinking water distribution infrastructure, and allowed lead to leach into the drinking water supply.[6] The Water and Sewer Authority (WASA) for the city was aware of lead contamination for more than one year but did not timely inform the public, which learned

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1. Mona Hanna-Attisha, *Quotation of the Day*, N.Y. Times, Jan. 30, 2016, https://www.nytimes.com/2016/01/30/todayspaper/quotation-of-the-day.html.
2. Adele Peters, *This Activist Is Still Fighting to Get Clean Water*, Fast Company, May 1, 2018, https://www.fastcompany.com/40565190/this-activist-is-still-fighting-to-get-flint-clean-water.
3. Marta Jewson, *School Drinking Water Will Be Tested for Lead—After Filters Are Installed to Remove It*, Lens, Oct. 27, 2017, https://thelensnola.org/2017/10/27/school-drinking-water-will-be-tested-for-lead-after-filters-are-installed-to-remove-it/.
4. David Nakaruma, *Water in D.C. Exceeds EPA Lead Limit; Random Tests Last Summer Found High Levels in 4,000 Homes Throughout City*, Wash. Post, Jan. 31, 2004, at A1.
5. *Id.*
6. *Id.*

about the lead contamination from newspaper reporting.[7] Up to 42,000 children were exposed to alarming levels of lead through drinking water and are now at serious risk of reduced intelligence, behavior problems, and other adverse health effects.[8] During the lead crisis, late-term miscarriages and spontaneous abortions occurred at an unusually high rate.[9] The lead crisis resulted in congressional hearings and an independent four-month investigation producing a 143-page report finding fault from the WASA to the Department of Public Health to EPA.[10]

This lead crisis occurred in Washington, D.C., from 2001-2004. A similar water crisis occurred in Flint, Michigan, from 2014-2016. Dangerous lead persists in drinking water across the United States today.[11] And another crisis could occur in any city that has lead-containing material in its drinking water infrastructure and privately owned plumbing materials.

Exposure to lead through drinking water is a persistent problem in the United States that poses a serious health risk anywhere lead is present in drinking water infrastructure or privately owned plumbing. The threat that lead in drinking water poses to entire communities is the product of a legacy of lead-containing materials in drinking water infrastructure and private buildings; the significant, permanent, and irreversible health effects of low-level lead exposure; the inherent difficulty of regulating lead; the specific failings of the federal Lead and Copper Rule (LCR)[12] to protect public health; and government incompetence and misconduct. Lead infrastructure, including up to 6.1 million lead service lines (LSLs) in drinking water infrastructure and 81 million housing units in the United States constructed prior to 1986, poses a risk of releasing lead and contaminating drinking water at any time.

Lead causes significant, permanent, and irreversible neurological damage in children at very low levels of exposure. Once ingested, low-level lead exposure in children is associated with significant adverse neurological health effects, such as lower IQ, behavioral problems, and attention-deficit disorders; and adverse effects in the immune, cardiovascular, and reproductive systems. Public health experts agree that there is no safe level of lead exposure in children. They also agree that a primary prevention program is the only scientifically defensible policy and the only policy that will protect children from dangerous lead exposure. Preventing childhood exposure to lead rather than reacting when children have measurable blood lead levels (BLLs) therefore is now the primary medical policy for lead exposure in children. Significant economic, societal, and personal costs result from low levels of lead exposure, costs that disproportionately fall on low-income and minority communities.

The current regulatory approach of the federal LCR is insufficient to protect the public from lead in drinking water because the inherent difficulty of regulating lead and specific limitations of the LCR allow lead to be present at the tap. Lead is difficult to regulate because it enters drinking water after the water leaves the treatment plant primarily through corrosion of lead-containing materials, and cannot be effectively removed by the public water system (PWS) before consumption. The LCR thus addresses lead in water by requiring PWSs to control corrosion, monitor corrosion control efficacy through testing lead levels in water at representative taps, and take remedial measures like LSL replacement based on an action level of 15 ppb. This regulatory structure does not effectively protect the public from lead in drinking water because lead can leach into drinking water at any time, even with corrosion control treatment, and testing for lead in drinking water is inherently unreliable.

Beyond the inherent difficultly of regulating lead in drinking water, the LCR imposes requirements that further threaten public health, like testing for lead in water with first-draw samples and using an action level not based on health effects. Regulatory gaps allow PWSs and states to show compliance with the LCR even when lead contamination is widespread. And perhaps most problematic, government incompetence and misconduct has dramatically increased the risk of lead exposure in drinking water and caused dangerous lead exposure across entire cities like the crisis in Flint.

Recent legislative efforts to reduce lead in drinking water have focused on funding lead pipe replacement programs and testing drinking water for lead. These programs are inadequate to protect public health. Lead pipe replacement is a massive infrastructure project that will take several decades to complete even under the best-case scenario. Lead will continue to be present at the tap in the interim,

7. *Id.*
8. Carol D. Leonnig, *High Lead Levels Found in D.C. Kids; Numbers Rose During Water Crisis*, Wash. Post, Jan. 27, 2009, at A1.
9. Carol D. Leonnig, *Increase in Miscarriages Coincided With High Levels of Lead in D.C. Water, Study Finds*, Wash. Post, Dec. 9, 2013, https://www.washingtonpost.com/politics/increase-in-miscarriages-coincided-with-high-levels-of-lead-in-dc-water-study-finds/2013/12/09/22b4fe72-60f9-11e3-8beb-3f9a9942850f_story.html?utm_term=.be6175cebfec.
10. David Nakamura, *4-Month Probe Cites Disarray Within WASA; Communication Failures Hurt Response to High Lead Levels*, Wash. Post, July 16, 2004, at A1; James W. Moeller, *Legal Issues Associated With Safe Drinking Water in Washington, D.C.*, 31 Wm. & Mary Envtl. L. & Pol'y Rev. 661, 706-08 (2007).
11. *See*, *e.g.*, Kris Maher, *Schools Across the U.S. Find Elevated Lead Levels in Drinking Water*, Wall St. J., Sept. 5, 2018, https://www.wsj.com/articles/schools-across-the-u-s-find-elevated-lead-levels-in-drinking-water-1536153522?mod=searchresults&page=1&pos=2&ns=prod/accounts-wsj; *see also* Michael Hawthorne & Cecilia Reyes, *Brain-Damaging Lead Found in Tap Water in Hundreds of Homes Tested Across Chicago, Results Show*, Chi. Trib., Apr. 12, 2018, http://www.chicagotribune.com/news/watchdog/ct-chicago-water-lead-contamination-20180411-htmlstory.html.
12. 40 C.F.R. §§141.80 et seq.

exposing another generation of children. Federal and state policies that react to the confirmed presence of lead in drinking water through testing are inconsistent with a primary prevention approach and conflict with current scientific research on the adverse health effects of childhood lead exposure at very low levels. Resources would be better used on programs that actually reduce the risk of lead exposure rather than funding water testing programs that are inherently unreliable and can justify inaction when significant risk of lead exposure exists.

Any serious policy to limit lead in drinking water must implement a primary prevention strategy that includes efforts to reduce lead present at the tap using point-of-use (POU) filtration. POU filtration has received little attention as a national policy solution despite the fact that it is inexpensive and highly effective at removing lead. Health experts and governments already recommend filtration as the first line of defense when there is a known lead risk in drinking water. Recognizing that lead can leach into drinking water at any time if drinking water is exposed to lead-containing materials and testing does not adequately quantify the risk of lead exposure, a primary prevention policy applied to drinking water should assume that lead is present at the tap.

Consistent with primary prevention, in order to mitigate the widespread risk of lead exposure through drinking water across the United States, the U.S. Congress should enact a refundable tax credit for individuals to acquire a filtration system and replacement filters certified for lead reduction under National Sanitation Foundation (NSF) International/American National Standards Institute (ANSI) Standard 53, and require all nonresidential buildings to include the best available technology (BAT) for water filtration in drinking fountains. A federal refundable tax credit would fill the gap in government efforts to reduce lead exposure through drinking water and provide individuals the opportunity to protect themselves and their families from significant lead exposure. Requiring BAT for filtering water from drinking fountains in nonresidential buildings will efficiently protect the public from lead in water outside the home.

Part I of this Article addresses how lead enters drinking water, the health effects and costs of lead exposure, and current medical policy of preventing lead exposure in children. Part II provides a comprehensive discussion of relevant sections of the Safe Drinking Water Act (SDWA)[13] and specific requirements of the LCR to address the threat of lead in drinking water. Part III discusses how the LCR is inadequate to protect public health, including the inherent difficulty of regulating and testing for lead, and the specific shortcomings of the LCR. Part IV discusses government incompetence and misconduct when implementing the LCR, and presents the Flint water crisis as an illustration of how that can exponentially increase and lengthen the already significant risk of lead exposure through drinking water. Part V recommends a robust POU filtration program to reduce the risk of lead exposure through drinking water, financed with a refundable tax credit for individuals and requiring nonresidential buildings to install BAT for filtration. Part VI concludes.

I. Lead in Water, Health Effects, and Primary Prevention

This part will discuss how lead enters drinking water, the adverse health effects of lead and attendant costs, and the medical consensus that preventing exposure to lead is the primary policy for children based on its significant, permanent, and irreversible adverse health effects. This part will provide context for why removing lead from water is critical and why current regulatory efforts that allow lead to be present at the tap pose a serious health risk. Understanding how lead enters drinking water and the attendant health risks will also provide support for funding a robust private filtration program and requiring filtration in nonresidential buildings.

A. *How Lead Enters Drinking Water*

Lead is a heavy metal constituting 0.002% of the earth's crust, to which humans had little exposure prior to extracting it for use.[14] Humans have used lead pipes in drinking water infrastructure for millennia.[15] Lead pipes were so common in ancient Rome that the word "plumbing" comes from the Latin word for lead, "plumbum."[16] Using lead pipes for service lines was a common practice in the United States until the 1950s because of lead's natural flexibility and resistance to subsidence and frost.[17]

The Reduction of Lead in Water Act banned the use of lead plumbing materials in large part,[18] but the United States has a legacy of lead-containing materials in drinking water infrastructure and the use of lead in plumbing and fixtures in buildings.[19] There are at least 6.1 million LSLs in drinking water infrastructure serving 15-22 mil-

13. 42 U.S.C. §§300f-300j-26, ELR Stat. SDWA §§1401-1465.

14. World Health Organization (WHO), Childhood Lead Poisoning 15-16 (2010).

15. Dartmouth Toxic Metals Superfund Research Project, *Lead: A Versatile Metal, Long Legacy*, https://www.dartmouth.edu/~toxmetal/toxic-metals/more-metals/lead-history.html (last visited Sept. 28, 2018) [hereinafter Dartmouth Research].

16. Jack Lewis, *Lead Poisoning: A Historical Perspective*, EPA J., May 1985, https://archive.epa.gov/epa/aboutepa/lead-poisoning-historical-perspective.html.

17. Simoni Triantafyllidou & Marc Edwards, *Lead (Pb) in Tap Water and in Blood: Implications for Lead Exposure in the United States*, 42 Critical Revs. Envtl. Sci. & Tech. 1297, 1300 (2012).

18. The Reduction of Lead in Water Act (RLWA) prohibits the use of "any pipe, any pipe or plumbing fitting or fixture, any solder, or any flux . . . in the installation or repair of (1) any public water system or (2) any plumbing in a residential or non nonresidential facility providing water for human consumption that is not lead free." 42 U.S.C. §300g-6(a)(1)(A). The RLWA defines "lead free" as "not containing more than .2 percent when used with respect to solder and flux, and not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures." *Id.* §300g-6(d)(1).

19. Triantafyllidou & Edwards, *supra* note 17, at 1302-03.

lion people.[20] The 81 million housing units in the United States constructed prior to 1986 are certain to have lead solder.[21] Housing units constructed after 1986 are likely to have brass plumbing materials, 1.5%-8% lead by weight.[22] The total number of lead pipes and solder in the United States drinking water infrastructure is unknown, as is the amount of lead-containing materials in privately owned buildings.[23]

Lead exposure through ingestion is a significant risk when drinking water infrastructure and private plumbing materials contain lead. Lead enters drinking water primarily through corrosion and all water is corrosive to varying degrees.[24] Lead leaches into water as dissolved lead or detaches into water as particulate lead.[25] Lead can leach or detach into drinking water from any lead-containing material: pipes in the water distribution system, building plumbing systems, solder connecting pipes, and even brass and bronze (copper alloys that contain lead) faucets and fixtures.[26] Once lead-containing materials have corroded, lead can leach into water indefinitely.[27]

Exposure to lead in drinking water contributes to elevated BLLs.[28] Children, especially infants fed formula, and pregnant women are at particular risk of exposure to lead from drinking water.[29] Recent studies suggest that the risk of lead exposure through drinking water can be significant and greater than previously thought.[30]

The specific public health crisis in Flint, Michigan, has shown a national spotlight on the problem of lead in drinking water, but the risk of exposure to dangerous levels of lead in drinking water is a national problem. In 2004, the *Washington Post* reported that 274 utilities serving 11.5 million people found dangerous levels of lead in the water.[31] Since then, little has changed as residents in city after city are exposed to lead through drinking water. In 2005, lead contamination in drinking water was found in Columbia, South Carolina.[32] In 2006, testing in Durham and Greenville, North Carolina, found lead contamination.[33] In 2015, the Natural Resources Defense Council (NRDC) reported that 1,100 community water systems serving 3.9 million people reported lead contamination.[34] A USA Today Network investigation found that from 2012-2015, approximately 2,000 water systems servicing six million people across all 50 states had lead-contaminated water.[35]

Communities threatened by lead-contaminated water continue to accumulate. In January 2016, schools in Sebring, Ohio, were temporarily closed, and the city manager warned children and pregnant women not to drink tap water because of lead contamination.[36] In the five years prior to 2017, lead contamination has been found in more than two dozen South Carolina communities.[37] In 2016, lead was still contaminating the water in the Calumet neighborhood of East Chicago, Illinois, seven years after EPA identified the neighborhood as a lead Superfund site.[38] And schools across the United States have drinking fountains providing lead-contaminated water.[39] The reported cases of lead contamination and high-profile crises are almost certainly just the tip of the iceberg of lead-contaminated water.[40] And the national problem of lead exposure through drinking water is especially acute because of the significant, permanent, and irreversible adverse health effects of lead exposure.

20. David A. Cronwell et al., *National Survey of Lead Service Line Occurrence*, 108 J. Am. Water Works Ass'n 182, 182 (2016).
21. Triantafyllidou & Edwards, *supra* note 17, at 1302-03.
22. *Id*.
23. U.S. Government Accountability Office (GAO), Drinking Water: Additional Data and Statistical Analysis May Enhance EPA's Oversight of the Lead and Copper Rule 1 (2017); Triantafyllidou & Edwards, *supra* note 17, at 1302.
24. Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, 56 Fed. Reg. 26460, 26466 (June 7, 1991).
25. Triantafyllidou & Edwards, *supra* note 17, at 1302-03.
26. 56 Fed. Reg. at 26466.
27. *Id*.
28. *See* Mona Hanna-Attisha et al., *Elevated Blood Lead Levels in Children Associated With the Flint Drinking Water Crisis: A Special Analysis of Risk and Public Health Response*, 106 AJPH Res. 283, 285-87 (2016); Simoni Triantafyllidou et al., *Reduced Risk Estimation After Remediation for Lead (Pb) in Drinking Water at Two US School Districts*, 466 Sci. Total Env't 1011, 1020-21 (2014); Triantafyllidou & Edwards, *supra* note 17, at 1328-35; Marc Edwards et al., *Elevated Blood Lead in Young Children Due to Lead-Contaminated Drinking Water: Washington D.C. 2001-2004*, 43 Envtl. Sci. & Tech. 1618, 1621-22 (2009); Rebecca Renner, *Out of Plumb: When Water Treatment Causes Lead Contamination*, 117 Envtl. Health Persp. 542, 544 (2009).
29. U.S. Department of Health & Human Services, Toxicological Profile for Lead 220-24 (2007) [hereinafter HHS Toxicological Profile]; Simoni Triantafyllidou et al., *Assessing Risk With Increasingly Stringent Public Health Goals: The Case of Water and Blood Lead in Children*, 12 J. Water & Health 57, 67 (2014).
30. Triantafyllidou et al., *supra* note 29, at 67.
31. Carol D. Leonnig, *Lead Levels in Water Misrepresented Across U.S.*, Wash. Post, Oct. 5, 2004, at A1.
32. Michael Wines & John Schwartz, *Unsafe Lead Levels in Tap Water Not Limited to Flint*, N.Y. Times, Feb. 8, 2016, https://www.nytimes.com/2016/02/09/us/regulatory-gaps-leave-unsafe-lead-levels-in-water-nationwide.html.
33. *Id*.
34. Erik Olson & Kristi P. Fedinick, What's in Your Water? Flint and Beyond 4 (2016).
35. Alison Young & Mark Nichols, *Beyond Flint: Excessive Lead Levels Found in Almost 2,000 Water Systems Across All 50 States*, USA Today, Mar. 11, 2016, https://www.usatoday.com/story/news/2016/03/11/nearly-2000-water-systems-fail-lead-tests/81220466/.
36. Jessica Mendoza, *Flint, Part Two? Ohio Town's Pipes May Be Contaminated With Lead*, Christian Sci. Monitor, Jan. 25, 2016, https://www.csmonitor.com/USA/2016/0125/Flint-part-two-Ohio-town-s-pipes-may-be-contaminated-with-lead.
37. Sammy Fretwell, *Lead Tainted Water in SC Communities*, State, Mar. 17, 2016, http://www.thestate.com/news/local/article61283287.html.
38. Craig Lyons, *"It's a Disaster": East Chicago Still Reeling From Lead Crisis, and EPA Can't Say If Water Is Safe*, Chi. Trib., July 21, 2017, http://www.chicagotribune.com/suburbs/post-tribune/news/ct-ptb-east-chicago-one-year-later-st-0723-20170721-story.html.
39. *See*, *e.g.*, Maher, *supra* note 11; *see also* Christopher Heimerman, *Water in DeKalb, Sycamore Schools Tests Positive for Lead Contamination*, Daily Chron., Jan. 12, 2018, http://www.daily-chronicle.com/2018/01/12/water-in-dekalb-sycamore-schools-tests-positive-for-lead-contamination/an9bdl0/; Malini Ramaiyer, *6 Berkeley Schools Shut Off Water Source Because of Lead Contamination*, Daily Californian, Jan. 26, 2018, http://www.dailycal.org/2018/01/24/lead-contamination-water-sources-six-schools-berkeley-unified-school-district/; Matt Rocheleau, *High Lead Levels Found in Water at Hundreds of Schools*, Boston Globe, May 2, 2017, https://www.bostonglobe.com/metro/2017/05/01/high-lead-levels-found-hundreds-massachusetts-schools/bflx2ZXaLYLSl10r0Hvj7L/story.html; Sara Roth, *99% of Portland Schools Have High Lead Levels*, KGW8, Sept. 6, 2016, https://www.kgw.com/article/news/health/99-of-portland-schools-have-high-lead-levels/283-268102018.
40. *See* discussion *infra* Sections III.B, III.H.

B. Health Effects of Lead

Lead is extraordinarily toxic to humans.[41] BLLs[42] greater than 100 micrograms per deciliter (μg/dL) (1,000 ppb) can cause protracted vomiting, encephalopathy, and even death.[43] Children are particularly vulnerable to the harmful effects of lead even at very low levels.[44] Children are exposed to lead in greater quantities from age-appropriate hand-to-mouth behavior and they adsorb lead more efficiently than adults.[45] Lead is significantly more toxic to a child's developing brain than an adult's.[46] BLLs of less than 5 μg/dL (50 ppb) are associated with significant adverse neurological effects: decreased intelligence, lower academic performance, attention-deficit disorders, and behavioral problems.[47]

Women exposed to lead as children can expose a fetus from lead stored in bone.[48] Lead exposure in utero is correlated with increased instances of fetal death, lower birth weight, and cognitive impairment.[49] It is now well-established that there is no known safe level of lead exposure in children.[50] Making matters worse, the substantial adverse neurological health effects of lead exposure in children are permanent, irreversible, and most significant at BLLs less than 10 μg/dL (100 ppb).[51]

C. Economic and Social Costs of Lead Exposure

The adverse health effects of lead, particularly the neurological effect of reduced intelligence and behavioral problems, have significant economic, social, and personal costs in the United States. By conservative estimates, each point of lost IQ "represents a loss of $17,815 in the present discounted value of lifetime earnings."[52] When controlled for inflation, children in the United States who turned two years old in 2000 are expected to earn $110-$318 billion more in present value of future earnings than children who turned two in the mid-1970s based on the significant reduction of average BLLs over time.[53] The economic cost in lost earnings remains massive today. For children under six years old from 2003-2006 with BLLs 2-10 μg/dL, the total loss in lifetime earnings is estimated to be $165-$233 billion.[54] The estimated present value of economic losses for children who were five years old in 1997 is estimated to be $43.4 billion.[55] With hundreds of thousands of children identified with BLLs greater than 5 μg/dL every year,[56] massive economic losses accrue annually.[57]

Medical studies identifying reduced intelligence, attention-deficit disorders, and behavioral disorders as adverse health effects of lead exposure prompted research into the relationship between lead exposure and crime rates. Cross-sectional studies have identified a strong correlation between childhood lead exposure and increased adult crime rates.[58] There is a particularly strong correlation between childhood lead exposure and murder rates.[59] Confirming cross-sectional study findings, prospective longitudinal studies have found prenatal and childhood lead exposure associated with adolescent delinquent behavior,[60] and a significant predictor of later adult criminal behavior.[61]

Researchers estimate that every 1 μg/dL reduction in BLLs in preschool-age children "results in 116,541 fewer burglaries, 2,499 fewer robberies, 53,905 fewer aggravated assaults, 4,186 fewer rapes, and 717 fewer murders."[62] Some researchers now believe that the reduction of lead exposure in children in the late 1970s and early 1980s contributed significantly to the precipitous drop in crime rates in the 1990s.[63] In addition to the obvious personal and social

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41. *See generally* U.S. EPA, Air Quality Criteria for Lead Vol. I ch. 6 (2006) [hereinafter Air Criteria].
42. The half-life of lead in blood is approximately 35 days. Theodore Lidsky & Jay Schneider, *Lead Neurotoxicity in Children: Basic Mechanics and Clinical Correlates*, 126 Brain 5, 10 (2003). BLLs, the most common measure of exposure, therefore reflect relatively recent exposure. *Id*. The half-life of lead in the brain is approximately two years and, when stored in bone, decades. *Id*.
43. HHS Toxicological Profile, *supra* note 29, at 22-23. Recent research suggests that the number of deaths attributable to lead exposure is significantly higher than previously thought at levels much lower than 100 ppb. *See* Bruce P. Lanphear et al., *Low-Level Lead Exposure and Mortality in US Adults: A Population-Based Cohort Study*, 3 Lancet Pub. Health e177 (2018).
44. *See* Air Criteria, *supra* note 41, at 6-1, 7-8; HHS Toxicological Profile, *supra* note 29, at 220-24.
45. HHS Toxicological Profile, *supra* note 29, at 220-21; WHO, *supra* note 14, at 18.
46. HHS Toxicological Profile, *supra* note 29, at 220-24.
47. National Toxicology Program, HHS, NTP Monograph: Health Effects of Low-Level Lead xviii-xxi (2012).
48. Lidsky & Schneider, *supra* note 42, at 9.
49. *See generally* Marc Edwards, *Fetal Death and Reduced Birth Weights Associated With Exposure to Lead Contaminated Drinking Water*, 48 Envtl. Sci. & Tech. 739 (2014); Lidsky & Schneider, *supra* note 42, at 9-10.
50. *See, e.g.*, American Academy of Pediatrics Council on Environmental Health, *Prevention of Childhood Lead Toxicity*, 138 Pediatrics 1, 1-2 (2016) [hereinafter CEH]; HHS Toxicological Profile, *supra* note 29, at 31.
51. Bruce P. Lanphear et al., *Low-Level Environmental Lead Exposure and Children's Intellectual Function: An International Pooled Analysis*, 113 Envtl. Health Persp. 894, 895-96 (2005).
52. Elise Gould, *Childhood Lead Poisoning: Conservative Estimates of the Social and Economic Benefits of Lead Hazard Control*, 117 Envtl. Health Persp. 1162, 1164 (2009).
53. Scott D. Grosse et al., *Economic Gains Resulting From the Reduction in Children's Exposure to Lead in the United States*, 110 Envtl. Health Persp. 563, 567 (2002).
54. Gould, *supra* note 52, at 1164.
55. Phillip J. Landrigan et al., *Environmental Pollutants and Disease in American Children: Estimates of Morbidity, Mortality, and Costs for Lead Poisoning, Asthma, Cancer, and Developmental Disabilities*, 110 Envtl. Health Persp. 721, 724 (2002).
56. *See* Centers for Disease Control and Prevention (CDC), *Lead—CDC's National Surveillance Data (2012-2016)*, https://www.cdc.gov/nceh/lead/data/national.htm (last updated June 29, 2018).
57. Landrigan et al., *supra* note 55, at 726.
58. *See, e.g.*, Rick Nevin, *Understanding International Crime Trends: The Legacy of Preschool Lead Exposure*, 104 Envtl. Res. 315, 330 (2007); *see also* Jessica Reyes, *Environmental Policy as Social Policy? The Impact of Childhood Lead Exposure on Crime*, 7 B.E. J. Econ. Analysis & Pol'y 1, 33 (2007).
59. *See* Nevin, *supra* note 58, at 330; Paul B. Stretesky & Michael J. Lynch, *The Relationship Between Lead Exposure and Homicide*, 155 Pediatric Adolescent Med. 579, 580-82 (2001).
60. Kim N. Dietrich et al., *Early Exposure to Lead and Juvenile Delinquency*, 23 Neurotoxicology & Teratology 511, 514-17 (2001).
61. *See* Brian B. Boutwell et al., *The Intersection of Aggregate-Level Lead Exposure and Crime*, 148 Envtl. Res. 79, 81-84 (2016); John Wright et al., *Association of Prenatal and Childhood Blood Lead Concentrations With Criminal Arrests in Early Adulthood*, 5 PLoS Med. 732, 735-37 (2008).
62. Gould, *supra* note 52, at 1165.
63. *See, e.g.*, Reyes, *supra* note 58, at 36.

costs of crime, the estimated direct economic cost of crime attributable to childhood lead exposure is $1.8 billion for every 1 μg/dL increase in the average preschool BLL.[64]

The economic and social costs of lead follow from the personal tragedies individuals and families suffer from lead poisoning. The case of Freddie Gray is a poignant example of the personal and familial cost of childhood lead exposure. Freddie was born in August 1989 into a home with peeling and flaking lead paint.[65] In June 1991, at only 22 months old, Freddie's BLL tested at an astonishing 37 μg/dL.[66] Freddie developed attention-deficit disorder, was in special education classes his entire academic career, and failed to graduate from high school.[67] Freddie's struggles with self-regulation and aggression were clear with frequent school suspensions and more than a dozen arrests.[68]

In 2010, the Gray family received a structured settlement from a lead poisoning lawsuit filed in 2008, but the settlement money was insufficient to put Freddie's life back on track.[69] On April 19, 2015, Freddie died in police custody after sustaining injuries while being transported in the back of a police van without a seat belt.[70] Freddie Gray's death while in police custody caused severe anger and mass protests in Baltimore.[71] Freddie's tragic death received significant news coverage, but it is Freddie's troubled life after severe childhood lead poisoning that is the silent tragedy that children and families face across the United States every day.

Lead poisoning from exposure to lead-contaminated water can similarly ruin lives and terrify communities for years. In Flint, the entire city was traumatized as a result of the water crisis. Residents felt deep fear from drinking the water, profound guilt from providing lead-contaminated water to children, physical pain as manifestations of stress, and profound anxiety that the damage and disability from lead exposure will never end.[72] Some parents of children exposed to lead have suffered nervous breakdowns and contemplated suicide as a result of the crisis.[73] The lead-contaminated water in Flint not only was a direct public health crisis, but also a mental health emergency.[74] The personal, familial, and community cost of a contaminated water system only begins with drinking the water.[75]

The tragic life of Freddie Gray and drinking water catastrophe in Flint highlight the inequitable reality that the significant adverse health effects, social and economic costs, and personal and community burden of lead exposure are not evenly distributed. Poor communities and minority children have the most lead exposure.[76] Freddie Gray was African American and grew up in one of the poorest neighborhoods of Baltimore.[77] Flint's current population is approximately 57% African American and has struggled with poverty for decades.[78] During the water crisis, Flint was one of the poorest cities in America, with a median household income of $25,650 and per capita income of $14,923 from 2012-2016.[79] In 2015, Flint had the highest poverty rate for a city of its size.[80]

National data confirm anecdotal evidence of lead's disproportionate effect on poor and minority communities. The most recent National Health and Nutrition Examination Survey (NHANES) found BLLs remain high in children from poor communities and non-Hispanic black children despite steadily declining BLLs generally.[81] The recent NHANES documented disparity in lead poisoning is consistent with historic data.[82] Racial disparities in lead exposure are the result of racism and discriminatory policy and practice.[83] Toxic lead exposure is an almost insurmountable impediment to economic advancement perpetuating poverty.[84] In short, lead exposure is a clear and present public health danger, particularly for children, leading to significant social and economic costs and perpetuates economic inequality and the legacy of racism in the United States.

D. Preventing Childhood Lead Exposure as Primary National Policy

The medical and scientific community agree that, based on the significant, permanent, and irreversible adverse health

64. Gould, *supra* note 52, at 1165.
65. Terrence McCoy, *Freddie Gray's Life a Study on the Effects of Lead Paint on Poor Blacks*, Wash. Post, Apr. 29, 2015, https://www.washingtonpost.com/local/freddie-grays-life-a-study-in-the-sad-effects-of-lead-paint-on-poor-blacks/2015/04/29/0be898e6-eea8-11e4-8abc-d6aa3bad79dd_story.html?utm_term=.c1a3bcda4c2a.
66. *Id.*
67. *Id.*
68. *Id.*
69. *See id.*; Mark Puente & Doug Donovan, *The Truth About Freddie Gray's "Pre-Existing Injury From Car Accident*," Balt. Sun, Apr. 29, 2015, http://www.baltimoresun.com/news/maryland/bs-md-gray-settlement-20150429-story.html.
70. John W. Cox et al., *Who Was Freddie Gray? How Did He Die? And What Led to the Mistrial in Baltimore*, Wash. Post, Dec. 16, 2015, https://www.washingtonpost.com/local/who-was-freddie-gray-and-how-did-his-death-lead-to-a-mistrial-in-baltimore/2015/12/16/b08df7ce-a433-11e5-9c4e-be37f66848bb_story.html?utm_term=.a49fd29b73de.
71. *Id.*
72. *See* Abby Goodnough & Scott Atkinson, *A Potent Side Effect to the Flint Water Crisis: Mental Health Problems*, N.Y. Times, Apr. 30, 2016, https://mobile.nytimes.com/2016/05/01/us/flint-michigan-water-crisis-mental-health.html.
73. *Id.*
74. *See id.*
75. *See NOVA: Poisoned Water* (PBS television broadcast, May 31, 2017).
76. *See* Emily A. Benfer, *Contaminated Childhood: How the United States Failed to Prevent the Chronic Lead Poisoning of Low-Income Children and Communities of Color*, 41 Harv. Envtl. L. Rev. 493, 504 (2017).
77. McCoy, *supra* note 65.
78. Flint Water Advisory Task Force, Final Report 15 (2016) [hereinafter FWATF Final Report].
79. U.S. Census Bureau, *Quick Facts: Flint City, Michigan*, https://www.census.gov/quickfacts/fact/table/flintcitymichigan/PST045216 (last visited Sept. 28, 2018).
80. Press Release, Michigan League for Public Policy, Census Data Shows Flint and Detroit Poverty Worst in Nation, People of Color Still Struggling Statewide (Sept. 15, 2016), http://www.mlpp.org/census-data-shows-flint-and-detroit-poverty-worst-in-nation-people-of-color-still-struggling-statewide.
81. Advisory Committee on Childhood Lead Poisoning Prevention, CDC, Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention 15 (2012) [hereinafter Advisory Committee].
82. *See* Benfer, *supra* note 76, at 504.
83. *See id.* at 505-13.
84. *See id.* at 504-05; Hanna-Attisha, *supra* note 1 ("If you were going to put something in a population to keep them down for generations to come it would be lead.").

effects of low-level lead exposure, preventing childhood exposure must be the primary policy to protect children (primary prevention).[85] "Once an elevated blood lead concentration has been detected, it is too late to prevent lead's deleterious effects on the developing brain."[86] The Centers for Disease Control and Prevention (CDC) used to recommend individual intervention for childhood lead exposure based on a specified blood lead "level of concern," which lowered over time from 60 μg/dL to 15 μg/dL.[87] In 2012, the CDC's Advisory Committee on Childhood Lead Poisoning Prevention recommended eliminating use of the term "level of concern," and adopting a primary prevention policy based on overwhelming scientific and medical evidence that there is no known safe level of lead exposure in children and that the adverse health effects of lead exposure are permanent and irreversible.[88] The Advisory Committee noted that "setting a 'level of concern' for lead has always failed to include consideration of uncertainty or the inclusion of a margin of safety."[89]

The CDC has adopted the primary prevention approach to childhood lead exposure and has eliminated the use of blood lead "levels of concern" in children.[90] The CDC now uses a reference level of 97.5th percentile of the NHANES' blood lead distribution to determine which children have BLLs that are much higher than the average child.[91] The reference level is not a health-based standard but rather an identifier updated every four years to determine where primary prevention programs and direct intervention resources are most needed.[92] Primary prevention is now the policy of the CDC, American Academy of Pediatrics, and World Health Organization, and widely recognized as the most important policy to protect children from lead.[93]

It is no surprise that lead is extraordinarily toxic to humans and requires primary prevention for children. Humans evolved in an environment with only trace amounts of lead.[94] The lead burden of humans today is 500-1,000 times greater than pre-industrial humans.[95] Taking into account lead's widespread use for several millennia, efforts to reduce human exposure to this toxic metal are fairly recent.[96] The primary regulatory effort in the United States to reduce lead exposure at the tap, and subject of the next part, is the LCR that was promulgated pursuant to the SDWA.

II. Regulation of Lead in Drinking Water

This part discusses how the LCR, which implements the SDWA, regulates lead in drinking water. The statutory structure of the SDWA and the specific requirements of the LCR are necessary context for understanding how the LCR is insufficient to protect public health from lead in drinking water. This part discusses first the SDWA generally and next the relevant provisions of the LCR.

A. The SDWA

The SDWA requires EPA to establish maximum contaminant level goals (MCLGs) and promulgate primary drinking water regulations for contaminants[97] if EPA determines that

> (i) the contaminant may have an adverse effect on the health of persons,
>
> (ii) the contaminant is known to occur or there is a substantial likelihood that the contaminant will occur in public water systems with a frequency and at levels of public health concern, and
>
> (iii) in the sole judgment of the Administrator, regulation of such contaminant presents a meaningful opportunity for health risk reduction for persons served by public water systems.[98]

National primary drinking water regulations (NPDWRs) promulgated under the SDWA apply only to PWSs.[99] The SDWA defines a PWS as "a system for the provision to the public of water for human consumption through pipes or other constructed conveyances, if such system has at least fifteen service connections or regularly serves at least twenty-five individuals."[100] EPA is required to review and revise NPDWRs every six years.[101]

An MCLG is the maximum contaminant level (MCL) "at which no known or anticipated adverse effects on the health of persons occur and which allows an adequate margin of safety."[102] MCLGs are aspirational goals to protect public health, not federally enforceable standards.[103]

NPDWRs are implemented as an MCL or a treatment technique.[104] When an MCLG is established for a con-

85. CEH, *supra* note 50, at 5; Lidsky & Schneider, *supra* note 42, at 15.
86. Lidsky & Schneider, *supra* note 42, at 15.
87. Advisory Committee, *supra* note 81, at 3.
88. *Id*. at 3-5.
89. *Id*. at 4.
90. CDC, CDC Response to Advisory Committee on Childhood Lead Poisoning Prevention Recommendations 5-6, 8 (2012) [hereinafter CDC Response]; CDC, *Lead—What Do Parents Need to Know to Protect Their Children?*, https://www.cdc.gov/nceh/lead/acclpp/blood_lead_levels.htm (last updated May 17, 2017).
91. CDC Response, *supra* note 90.
92. *Id*. at 7; Advisory Committee, *supra* note 81, at 6.
93. CDC Response, *supra* note 90; CEH, *supra* note 50, at 5; WHO, *supra* note 14, at 54.
94. WHO, *supra* note 14, at 16.
95. *Id*.
96. *See* Dartmouth Research, *supra* note 15.
97. "Contaminant" is defined under the SDWA as "any physical, chemical, biological, or radiological substance or matter in water." 42 U.S.C. §300f.
98. *Id*. §300g-1(b)(1)(A), (E).
99. *Id*. §§300f(1)(A), 300g. The SDWA also provides in 42 U.S.C. §300g for a narrow, limited exception for certain PWSs.
100. *Id*. §300f(4)(A). Regulatory requirements applicable under the SDWA vary based on the size and type of a PWS. The SDWA divides PWSs into community water systems, which serve users year-round, *id*. §300f(15), and water systems, which is any PWS that is not a community water system, *id*. For NPDWRs, EPA has further defined non-community water systems into transient non-community water systems, systems that do not regularly serve at least 25 of the same persons over six months per year, and non-transient non-community water systems, systems that regularly serve at least 25 of the same persons over six months per year. 40 C.F.R. §141.2 (2017).
101. 42 U.S.C. §300g-1(b)(9).
102. *Id*. §300g-1(b)(4)(A).
103. *Id*. §§300(f)(1), 300g, 300g-1(b)(4)(A); 40 C.F.R. §141.2.
104. 42 U.S.C. §300g-1(b)(3)(C)(i)-(ii), (4)(B), (7).

taminant, the MCL must be as close to the MCLG as is "feasible" under the SDWA.[105] "Feasible" means the use of the best technology, treatment technique, or other means available that EPA finds after examination for efficacy under field conditions and considering costs.[106] EPA must conduct a comprehensive cost-benefit analysis for each proposed MCL.[107] When EPA sets an MCL as an NPDWR, a PWS may not provide water that exceeds the MCL.[108] EPA has promulgated numerous MCLs.[109]

EPA may use a treatment technique rather than an MCL for an NPDWR if "it is not economically or technologically feasible to ascertain the level of the contaminant."[110] When using a treatment technique, EPA must identify treatment techniques that "would prevent known or anticipated adverse effects on the health of persons to the extent feasible," and must conduct the same cost-benefit analysis required for an MCL.[111]

EPA is required to identify technologies that will meet MCLs.[112] For small PWSs, EPA must identify technologies that comply with MCLs and treatment techniques.[113] Like other major environmental legislation, however, PWSs are not required to use a specific technology to meet the contaminant levels required under an MCL.[114]

The SDWA utilizes cooperative federalism to enforce the SDWA. States have primary enforcement authority of the SDWA when a proper application is made to EPA.[115] States must adopt drinking water regulations at least as stringent as NPDWRs and provide for adequate enforcement of state regulations, among other requirements, in order to assume enforcement responsibility.[116] The SDWA does not prohibit states from further regulating drinking water or PWSs.[117] All states have assumed primary enforcement authority except Wyoming and the District of Columbia.[118]

B. *The LCR*

EPA's LCR was first promulgated in 1991 and remains largely unchanged in its substantive requirements.[119] The LCR established a health-based MCLG of zero for lead[120] and a treatment technique relying primarily on corrosion control but also includes source water treatment, LSL replacement, and public education.[121] PWSs are generally required to "install and operate optimal corrosion control treatment."[122] The LCR requires source water treatment and public education about lead risks and mitigation when a PWS exceeds the "action level" for lead.[123] The LCR requires LSL replacement when a PWS exceeds the lead "action level" after applying required corrosion control and source water treatment.

The "action level" for lead is 0.015 milligrams per liter (mg/L) (15 ppb), which is met when the 90th percentile[124] from sampling required under the LCR is greater than 0.015 mg/L (15 ppb).[125] The action level for lead is *not* a health-based standard, but rather reflects "a level that is generally representative of effective corrosion control treatment."[126] Selecting a lead "action level" based on the efficacy of corrosion control is the natural result of using a treatment technique relying primarily on corrosion control.[127]

Large PWSs (serving greater than 50,000 people) are required to install and operate optimal corrosion control treatment while small (serving at most 3,300 people) and medium (serving between 3,300 and 50,000 people) PWSs are required to do so only when sampling exceeds the lead action level.[128] When testing exceeds the lead action level despite optimal corrosion control treatment, the PWS must replace per year at least 7% of the LSLs under PWS control.[129] The PWS is not required to replace any LSL from which water samples test under the lead action level and may stop replacing LSLs when required testing is under the lead action level for two consecutive six-month monitoring periods.[130] As part of an LSL replacement program, the PWS must offer to replace privately owned LSLs but is not required to pay replacement costs.[131] When an owner of a privately owned LSL declines the PWS offer to replace the LSL or the PWS is prohibited to do so by state or local law, the PWS must do a partial LSL replacement.[132]

105. *Id.* §300g-1(b)(4)(B). EPA may establish an MCL at a level other than "feasible" if the technology or process used to determine the feasible level would increase the concentration of other contaminants or interfere with complying with other NPDWRs, or if the benefits of the MCL would not justify the costs. *Id.* §300g-1(b)(5), (6).
106. *Id.* §300g-1(b)(4)(D).
107. *Id.* §300g-1(b)(3)(C).
108. *Id.* §300g-3(a), (b), (g).
109. 40 C.F.R. §§141.60-.66 (2017).
110. 42 U.S.C. §300g-1(b)(7).
111. *Id.* §§300g-1(b)(3)(C)(ii), (7).
112. *Id.* §300g-1(b)(4)(E)(i).
113. *Id.* §300g-1(b)(4)(E)(ii)-(iii).
114. *Id.* §300g-1(b)(4)(E)(i).
115. *Id.* §300g-2.
116. *Id.* §300g-2(a).
117. *Id.* §300g-3(e).
118. Mary Tiemann, Congressional Research Service, Safe Drinking Water Act (SDWA): A Summary of the Act and Its Major Requirements 17 (2017).
119. 40 C.F.R. §§141.80-.91 (2017); Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, 56 Fed. Reg. 26460 (June 7, 1991).
120. 40 C.F.R. §141.51(b). Optimal corrosion control treatment is defined at *id.* §141.2. Further requirements for optimal corrosion control under the LCR are contained in *id.* §§141.81-.82, with a primary focus on alkalinity and pH adjustment, calcium hardness adjustment, and the addition of phosphate or a silicate-based corrosion inhibitor.
121. *Id.* §141.80(b).
122. *Id.* §141.80(d).
123. *Id.* §141.80(e)-(g).
124. The 90th percentile sample is the product of the total number of samples and 0.9 when samples are arranged and numbered in ascending order from least to greatest mass concentration. *See id.* §141.80(c)(3). For 30 samples (30 × 0.9 = 27), sample number 27 is the 90th percentile sample. If the 27th sample of 30 samples is greater than .015 mg/L (15 ppb), the sample batch exceeds the lead action level.
125. *Id.* §141.80(c)(1).
126. 56 Fed. Reg. at 26490.
127. *Id.*; EPA Office of Water, Lead and Copper Rule Revisions White Paper 6 (2016) [hereinafter EPA White Paper].
128. 40 C.F.R. §141.81(b).
129. *Id.* §141.84(b).
130. *Id.* §141.84(c), (f).
131. *Id.* §141.84(d).
132. *Id.*

The LCR relies on testing to determine whether a PWS exceeds the lead action level, and for medium and small PWSs, whether corrosion control is required. All PWSs are required to identify sources of lead in the water distribution system as well as water quality information "indicating locations particularly susceptible to high quantities of lead concentrations."[133] Community water systems are required to identify whether lead materials are present in the water distribution system and home plumbing.[134] PWSs are generally required to collect testing samples from buildings that contain lead materials in privately owned plumbing or use an LSL unless no qualifying sources are available.[135] For community water systems, the PWS must use water samples from single-family structures when available.[136] Taken together, these testing requirements attempt to require testing from sources of drinking water most likely to leach lead.[137]

Sample collection techniques are proscriptive and specific.[138] Testing samples must generally be one-liter first-draw samples after water stands motionless in the plumbing system for six hours.[139] PWSs may allow residents to collect samples after providing proper instruction, which can be written.[140] The number of samples a PWS must collect varies based on the number of people served, ranging from five samples for PWSs serving at most 100 people to 100 samples for PWSs serving greater than 100,000 people.[141] Samples collected in addition to required samples must be included in the sample set for determining the 90th percentile sample.[142] States may, but are not required to, invalidate samples only for (1) improper laboratory analysis causing inaccurate results, (2) draws from sites that do not meet the selection criteria, (3) container damage in transit, and (4) substantial evidence of tampering.[143] States may not invalidate a sample solely because a subsequent sample tested at a different level.[144] States also are not allowed to invalidate a resident-collected sample because of collection errors.[145]

PWSs must collect and test the required number of samples from the required sources every six months.[146] Any PWS that has two consecutive monitoring periods meeting the lead action level and within the permissible water quality control range may reduce testing to once per year and reduce the number of required samples generally by half.[147] Small and medium PWSs meeting the action level for lead and copper for three consecutive years may reduce testing from annually to once every three years.[148] PWSs that meet 0.005 mg/L (5 ppb) for lead and .65 mg/L for copper for two consecutive six-month monitoring periods based on the 90th percentile test may reduce testing to once every three years.[149] The LCR provides for specific months when PWSs must draw samples for reduced monitoring.[150] Small PWSs may test once every nine years if the system can show that there are no plastic pipes or service lines with lead plasticizers; pipes, service lines, solder joints, and fixtures are lead-free unless they meet any standard under 42 U.S.C. §300g-6(e), and the 90th percentile of lead does not exceed 0.005 mg/L (5 ppb).[151]

The LCR is inconsistent with current medical and scientific knowledge about the health effects of lead exposure. Noting that the goal of the original LCR was to limit lead exposure in sensitive populations, specifically young children, EPA justified the 0.015 mg/L (15 ppb) action level based on models predicting the number of children with BLLs greater than 10 µg/dL (100 ppb) would drop from 3.5% to 1.6% when excluding lead paint and contaminated soil risks.[152] EPA's use of children with BLLs greater than 10 µg/dL (100 ppb) to measure benefits is fundamentally flawed given the medical and scientific consensus that significant and irreversible adverse health effects occur when BLLs in children are less than 10 µg/dL (100 ppb).[153] Moreover, the LCR's primary reliance on reducing lead content in water through controlling corrosion measured by testing is inconsistent with a primary prevention approach to lead exposure.[154] Requiring corrosion control and possibly LSL replacement at a specified action level is precisely the kind of reactive policy of years past now rejected in the medical community.[155] Regulating lead at the tap based on a health standard, however, poses special challenges not present for other contaminants, a problem addressed in the next part.

III. The Inadequacy of the LCR

This part discusses why the LCR is inadequate to protect public health from lead in drinking water. The LCR's inability to protect public health is necessary to understand why Congress should promote POU filtration with a refundable tax credit for individuals and require filtration in drinking fountains in nonresidential buildings. Lead poses a unique regulatory problem based on how and when

133. *Id.* §141.86(a)(2).
134. *Id.* §141.42(d).
135. *Id.* §141.86(a).
136. *Id.* §141.86(a)(3).
137. U.S. EPA, Lead and Copper Rule—Clarification Requirement for Collecting Samples and Calculating Compliance 2 (2004) [hereinafter EPA Clarification].
138. *See* 40 C.F.R. §141.86(b).
139. *Id.* §141.86(b)(3).
140. *Id.* §141.86(b)(2); EPA Clarification, *supra* note 137, at 2; *see* Michigan Department of Environmental Quality (MDEQ), Drinking Water Lead and Copper Sampling Instructions (2016).
141. *See* 40 C.F.R. §141.86(c).
142. *Id.* §141.86(e).
143. *Id.* §141.86(f)(1).
144. *Id.* §141.86(f)(3).
145. *Id.* §141.86(b)(2); EPA Clarification, *supra* note 137, at 6.
146. 40 C.F.R. §141.86(d)(1).
147. *Id.* §141.86(d)(4)(ii). Small and medium PWSs must meet only the lead and copper action level to qualify initially for annual testing. *Id.* §141.86(d)(4)(i).
148. *Id.* §141.86(d)(4)(iii).
149. *Id.* §141.86(d)(4)(v).
150. *Id.* §141.86(d)(4)(iv) (states can approve different draw times).
151. *Id.* §141.86(g).
152. 56 Fed. Reg. at 26491.
153. *See* discussion *supra* Section I.B.
154. *See* discussion *supra* Section I.D.
155. *See id.*

lead enters drinking water and because testing for lead is inherently unreliable.

Additionally, the LCR has specific provisions and gaps that exacerbate the inadequacy of the LCR: (1) the LCR action level is not a health-based standard, (2) reduced monitoring allows lead contamination to go undetected for years, (3) allowing residents to collect samples increases the risk of inaccurate samples, (4) requiring partial LSL replacement increases lead exposure, (5) required first-draw samples significantly underestimate the amount of lead in drinking water most of the time, and (6) PWSs can game the LCR testing requirements to reduce the amount of lead to show compliance. The inherent limitations of the LCR and specific inadequacies are discussed in turn below.

A. *The Unique Nature of Lead as a Drinking Water Contaminant*

Most contaminants are removed from source water at the water treatment plant prior to distribution to the tap.[156] Lead is rarely in source water, however, and the vast majority of lead that enters drinking water occurs from corrosion of lead-containing materials after treated water leaves the water treatment plant.[157] Lead can leach into drinking water from any lead-containing material from treatment to the tap.[158] Once lead-containing materials have corroded, lead can leach into water indefinitely.[159]

The amount of lead that leaches into drinking water is highly variable and depends on the amount and age of lead materials; the surface area of the lead-containing materials; the duration that water is in contact with lead-containing materials; nitrification; biofilm formation and microbial growth; and, most significantly, the corrosivity of the distributed water.[160] Total alkalinity, pH, dissolved inorganic carbonate, calcium, hardness, temperature, free chlorine, total dissolved solids, and dissolved oxygen all contribute to the corrosivity of water.[161] It is difficult to identify the extent to which any particular factor contributes to corrosion and, in turn, lead leaching; in fact, lead leaching can vary even when water quality is constant.[162] All water is corrosive to some degree and will corrode lead-containing materials over time.[163]

EPA recognized the difficulty inherent in regulating lead with an MCL.[164] An MCL measured at the tap would hold PWSs responsible for lead entering drinking water from privately owned plumbing material, which are beyond the reach of the SDWA.[165] An MCL measured when drinking water leaves the water treatment plant would remove little to no lead in drinking water.[166] An MCL measured when drinking water leaves the control of the PWS would fail to protect consumers from lead entering drinking water from privately owned plumbing materials.[167] And the variability of lead at the tap and source water quality across PWSs make applying a single MCL applicable to all PWSs infeasible.[168] The U.S. Court of Appeals for the District of Columbia (D.C.) Circuit thus found in a challenge from the NRDC that EPA's use of a treatment technique for the LCR was reasonable and that "[a] single national standard (i.e. an MCL) is not suitable for every public water system."[169]

EPA cannot regulate lead to a level consistent with a health-based standard using corrosion control. Instead, the EPA action level attempts to regulate as low as possible given the technological limits of corrosion control with LSL replacement required only when corrosion control fails based on testing samples drawn from locations most at risk for lead exposure. Testing for lead, however, is complicated, inherently unreliable, and can be used to justify inaction when lead poses a serious risk to children.

B. *The Unreliability of Testing for Lead in Drinking Water*

The LCR uses monitoring through testing lead in drinking water from representative taps drawn from high-risk locations to determine whether corrosion control treatments are effective and, for small PWSs, required.[170] Relying on testing for lead at the tap, however, is insufficient to measure the individual and systemic risk of lead exposure. Testing for lead is inherently unreliable and the circumstances under which samples are drawn can significantly affect the lead content of the sample. Particulate lead is a particular problem because testing cannot predict the risk of particulate lead at the tap. Finally, a lack of inventory of the lead-containing materials in PWSs further undermines the utility of testing for lead.

Testing for lead at the tap to measure the risk of future lead exposure is inherently unreliable because lead can enter drinking water at any time even with corrosion control treatment.[171] A single test for lead provides reliable information about the lead content of water at the tap only for the specific sample.[172] Subsequent tests could yield sig-

156. *See* 56 Fed. Reg. at 26471.
157. Sheldon Masters et al., *Inherent Variability in Lead and Copper Collected During Standardized Sampling*, Envtl. Monitoring & Assessment, Feb. 20, 2016, at 1; Miguel A. Del Toral et al., *Detection and Evaluation of Elevated Lead Release From Service Lines: A Field Study*, 47 Envtl. Sci. & Tech. 9300, 9300 (2013); 56 Fed. Reg. at 26463.
158. 56 Fed. Reg. at 26466; *see* discussion *supra* Section I.A.
159. *Id*.
160. Masters et al., *supra* note 157, at 2; 56 Fed. Reg. at 26463, 26466.
161. 56 Fed. Reg. at 26466.
162. *Id*. at 26473.
163. *Id*. at 26466.
164. *Id*. at 26471.
165. American Water Works Ass'n v. Environmental Prot. Agency, 40 F.3d 1266, 1269, 25 ELR 20335 (D.C. Cir. 1994); 56 Fed. Reg. at 26476.
166. 56 Fed. Reg. at 26475.
167. *Id*. at 26472-73.
168. *See id*. at 26472-77, 26487.
169. *American Water Works Ass'n*, 40 F.3d at 1271.
170. *See* discussion *supra* Section II.B.; Del Toral et al., *supra* note 157, at 9304.
171. Masters et al., *supra* note 157, at 2; Yanna Lambrinidou & Marc Edwards, Opinion, *Five Myths About Lead in Water*, Wash. Post, Feb. 26, 2016, https://www.washingtonpost.com/opinions/five-myths-about-lead-in-water/2016/02/26/a3279d26-d686-11e5-9823-02b905009f99_story.html?utm_term=.54c4e2f1404c.
172. *See* Masters et al., *supra* note 157, at 2; Del Toral et al., *supra* note 157, at 9304.

nificantly different results even when water quality does not change.[173] Multiple field studies have found highly variable lead concentrations in sequential drinking water samples from the same tap and across taps in a PWS using different corrosion control techniques.[174]

One controlled study concluded that the variability of lead concentration attributed to sampling error is probably "dominated by the *inherent variability* in lead released from the plumbing materials themselves."[175] To reliably measure the risk of systemwide lead exposure in a PWS, thousands more tests would be necessary than required under the LCR and at greater frequency.[176] Even then, reliability would be far from assured.[177] What can be assured, however, is that one-time testing from multiple taps in a system is insufficient to determine whether water is safe.[178]

Testing is also unreliable because collection techniques, system conditions, and timing can have significant effects on the lead concentration of the sample. Variables that can affect lead concentrations include stagnation time, draw time, flow rate, flushing, the distance water travels in an LSL, physical disturbance of LSLs, water usage, and the time of year samples are drawn.[179] Some variables increase the lead concentration in water at the tap. For example, LSLs that have been disturbed—including partial replacement, lead repair, meter installation, shut-off valve replacement, and significant street excavation—can significantly increase the lead concentration of drinking water.[180] Some variables artificially reduce the amount of lead delivered at the tap. For example, pre-flushing—running the tap prior to the stagnation period—can remove lead already present in the water and result in lower lead concentrations.[181]

Individual sample collection generally underestimates significantly the peak lead level in water. One study of five sampling techniques designed to determine the best collection procedure[182] found that none of the techniques were proficient.[183] The best method came within 70% of the peak lead concentration only 48% of the time but was less than 30% of peak lead concentration 30% of the time.[184] For example, a lead test measuring .010 mg/L (10 ppb) or less would miss a peak lead level of .033 mg/L (33 ppb) on 30% of lead tests. First-draw samples—samples collected immediately after a stagnation period without first running the tap—were within 70% of peak lead only 30% of the time.[185] The unreliability of the first-draw method is consistent with prior studies.[186]

Lead testing cannot determine risks posed by particulate lead in water because current lead sampling, testing, and exposure models often assume that dissolved lead predominates in drinking water.[187] Making matters worse, particulate lead release is particularly erratic, and it is close to impossible to identify particulate release risk through testing.[188] The inability of testing to identify lead risks from particulate lead are particularly concerning because current corrosion control techniques do not address the problem of particulate lead.[189] The process that causes lead to flake off into water is different than leaching and lacks sufficient research to prevent particulate lead release.[190] Even under the best-case application of the LCR, particulate lead poses a substantial and unknown risk to children.

Even if there were an implemented testing procedure that reliably identifies peak lead in drinking water at the tap, local testing would fail to predict the risk of lead exposure because many states have no idea who is at risk of lead exposure. The LCR monitoring program relies on samples drawn from sources at the highest risk of lead exposure.[191] Low-risk sources are not expected to leach lead and thus do not provide useful data on whether corrosion control is working or necessary across a PWS.

Many PWSs have failed to perform the materials evaluation for lead required under the LCR.[192] This is no surprise with respect to community PWSs required to identify lead materials in private plumbing because it is difficult to comprehend how a PWS could possibly satisfy this requirement. But even the location of LSLs is woefully incomplete. Many states have identified challenges in locating LSLs and nine explicitly rejected an EPA request to make LSL locations public information based on these difficulties.[193]

Flint had not completed a materials evaluation prior to its water crisis.[194] As a result, Flint did not know which homes were at risk for lead exposure or even how many homes were affected.[195] As the governor of Michigan stated in the aftermath of the lead crisis in Flint: "A lot of work is being done to even understand where the lead services [sic] lines fully are, so I would say any numbers you're hearing at this point are still speculation."[196] Even if states do have a full materials evaluation, the LCR does not require states report this information to EPA, and 13 states have refused to provide this information even if it were avail-

173. *See* Masters et al., *supra* note 157, at 2; Brandi Clark et al., *Profile Sampling to Characterize Particulate Lead Risks in Potable Water*, 48 Envtl. Sci. & Tech. 6836, 6837 (2014); Del Toral et al., *supra* note 157, at 9304.
174. *See* Del Toral et al., *supra* note 157, at 9304 (finding high variability in lead concentrations in sequential samples from the same tap and across the PWS in a field study of the Chicago Department of Water Management and citing studies with similar results from other PWSs).
175. Masters et al., *supra* note 157, at 12 (emphasis added).
176. *Id.*
177. *See id.*
178. *See id.*; Del Toral et al., *supra* note 157, at 9304.
179. *See generally* Del Toral et al., *supra* note 157.
180. *Id.* at 9304-05.
181. *Id.* at 9303.
182. Peak lead levels were determined by using a sequential-draw procedure testing at least 12 one-liter sequentially collected samples. Water Research Foundation, Evaluation of Lead Sampling Strategies xv (2015).
183. *Id.* at 48-49.
184. *Id.*
185. *Id.* at 48-49, 51.
186. Del Toral et al., *supra* note 157, at 9302-03.
187. Triantafyllidou & Edwards, *supra* note 17, at 1316-18.
188. *Id.* at 1317.
189. *Id.* at 1318.
190. *Id.*
191. *See* 40 C.F.R. §141.86(a).
192. *See* GAO, *supra* note 23, at 26-27.
193. *Id.* at 27.
194. FWATF Final Report, *supra* note 78, at 44.
195. *See id.*; Arthur Delaney, *Lots of Cities Have the Same Lead Pipes That Poisoned Flint*, Huffington Post, Feb. 22, 2016, https://www.huffingtonpost.com/entry/lead-pipes-everywhere_us_56a8e916e4b0f71799288f54.
196. *Id.*

able.[197] Where high-risk taps are unknown, testing cannot serve as a proxy for the efficacy of corrosion control even if testing were reliable.

The unreliability of testing for lead in drinking water to determine the risk of lead exposure is not a new insight; it has been known for decades. In fact, it is one of the reasons that EPA promulgated an NPDWR as a treatment technique instead of using an MCL.[198] EPA found that "data indicate that the variability in tap [lead] levels can persist even in cases where water quality conditions are kept relatively constant."[199] It therefore is "technologically infeasible to ascertain whether the lead [ ] level at a tap at a single point in time represents effective application of the best available treatment technology."[200]

The unreliability of testing is one of the many ways the LCR does not adequately protect public health. The next six sections address specific deficiencies of the LCR.

C. The LCR Action Level Is Not a Health-Based Standard

The most significant shortcoming of the LCR is that the lead action level of 0.015 mg/L (15 ppb) is not a health-based standard. A PWS testing under 15 ppb at the 90th percentile does not mean that the PWS is delivering water safe to drink, it means only that additional corrosion control, LSL replacement, and public education requirements, as applicable, under the LCR are not required at that time.[201] All of these regulatory protections are tied to the capability of corrosion control technology, not rooted in scientific and medical understanding that there is no safe level of lead exposure in children.[202]

Many states, municipalities, and school districts advertise the lead action level as a health-based standard. For example, almost every PWS in Arkansas in the most recent lead monitoring period had lead present in the water for the 90th percentile test.[203] Eight PWS 90th percentile tests were above 15 ppb and one PWS tested at 110 ppb.[204] Another 16 PWS 90th percentile tests were 10 ppb or greater.[205] Arkansas nevertheless advertises the safety of the state's drinking water and compliance with the SDWA without qualification and even recommends that Arkansas residents not use water filters.[206] The city of Philadelphia, Pennsylvania, also advertises the EPA action level as a safety standard.[207] Philadelphia touts its record of testing below the EPA lead action level and safety of drinking water delivered to homes in meeting water quality standards for lead.[208]

Providing a false sense of security by advertising the EPA action level as a safety standard is particularly misleading for lead exposure risks at individual taps because the LCR monitoring requirements are not meant to identify lead exposure risks at individual taps.[209] Setting the action level at the 90th percentile allows individual taps to test above the action level with no limit. Table 1 is a chart of hypothetical monitoring results at and above the 90th percentile from a community water system that would not trigger additional corrosion control, LSL replacement, or public education requirements.

Table 1. Hypothetical Lead Monitoring Results

Sample Percentile	Lead Concentration (ppb)
100	100,000
99	75,000
98	25,000
97	15,000
96	7,000
95	4,000
94	3,000
93	1,500
92	1,000
91	500
90	14

Although LCR-compliant, this hypothetical example would be a clear and present health danger to the 10 highest testing samples. Considering the unreliability of testing and the number of samples taken during a monitoring period being a small fraction of the total taps,[210] the risk of lead exposure throughout a PWS based on this hypothetical sample could be a crisis to which the LCR does not require a response.

D. Reduced Monitoring

The LCR allows PWSs to test for lead under monitoring requirements once every three years after initial compliance, which is a significant regulatory gap that allows dangerous lead levels in drinking water for years.[211] Reduced monitoring has resulted in delayed responses to toxic lead

197. GAO, *supra* note 23, at 26.
198. 56 Fed. Reg. at 26473.
199. *Id.*
200. *Id.*
201. 40 C.F.R. §141.80(d)-(g).
202. *See* discussion *infra* Section II.B.
203. Arkansas Department of Health, Lead Test Results, http://www.healthy.arkansas.gov/images/uploads/pdf/drinking-water-LeadMonitoringResults.pdf.
204. *Id.*
205. *Id.*
206. Arkansas Department of Health, *Public Water System FAQS*, http://www.healthy.arkansas.gov/programs-services/topics/drinking-water-public-water-system-faqs (last visited Sept. 28, 2018).
207. City of Philadelphia, *Lead in Drinking Water*, http://www.phila.gov/water/wu/drinkingwater/pages/leadinfo.aspx (last visited Sept. 28, 2018).
208. *Id.*
209. U.S. EPA, 3Ts for Reducing Lead in Drinking Water in Schools, Revised Technical Guidance 12 (2006) [hereinafter EPA 3T Revised Technical Guidance].
210. *See* 40 C.F.R. §141.86(c).
211. Del Toral et al., *supra* note 157, at 9305.

exposure in drinking water. In 2011, two homes in Brick Township, New Jersey, which qualified for triennial testing, tested over 15 ppb.[212] Three years later at the next monitoring period, a shocking 16 of 34 homes exceeded 15 ppb, with one home testing over 12 times the EPA action level.[213] Brick Township is a striking example of how pipes can corrode quickly and with little warning, exposing the danger of triennial monitoring. Brick Township's pipes corroded quickly because of the city's increased use of salt treatment on roads in the winter.[214] Treating roads with salt increased chloride in Brick Township's source water, which in turn caused pipes to corrode.[215] Corrosion went undetected because of reduced monitoring and caused the alarming amounts of lead to leach into Brick Township's drinking water.[216]

The water crisis in Washington, D.C., also highlights the potential danger of triennial monitoring. Lead pipes corroded quickly after changes in the quality of the source water. In November 2000, Washington, D.C., changed the disinfectant for the drinking water supply from chlorine to chloramine.[217] Using chloramine to disinfect had the unintended consequence of corroding the water distribution system and caused lead to leach into the drinking water. Within eight months, the 90th percentile sample in Washington, D.C., exceeded 15 ppb.[218] By December 2001, the 90th percentile sample was almost 80 ppb,[219] with some homes testing at 20 times the EPA action level.[220]

Lead-contaminated water persisted in Washington, D.C., for three years, during which fetal death rates rose and BLLs rose above 10 μg/dL in approximately 859 tested children in Washington, D.C., and likely thousands more due to lack of blood lead testing in vulnerable populations.[221] In total, 42,000 children in Washington, D.C., from 2001-2004 are at risk of lifelong health consequences from lead exposure through drinking water.[222] The Washington, D.C., water crisis, which was 20-30 times worse than Flint,[223] shows directly the disastrous consequences of not acting on lead contamination for three years. Every PWS on triennial testing is at risk of a Washington, D.C.-type crisis.

E. Resident Collection

The LCR allows PWSs to rely on residents to collect samples for LCR compliance, and PWSs almost exclusively do so.[224] PWSs satisfy this requirement with an instruction sheet accompanying testing materials,[225] which materially differ between PWSs.[226] Using residents to collect water samples with little more than an instruction sheet as a guide decreases the likelihood that samples are collected correctly using current sampling protocol required under the LCR.[227] Many PWSs face challenges getting properly collected samples from residents and lack the resources necessary to ensure proper sampling.[228] Compounding this problem, studies show that in order to capture peak lead levels, more sophisticated procedures are necessary,[229] which will increase the likelihood of collection errors from resident sampling.[230] If researchers with expertise in corrosion and water sampling have difficulty capturing peak lead concentration from water samples,[231] using residents to collect samples further undermines the reliability of testing.

The LCR compounds resident collection error by prohibiting PWSs from excluding a sample based on collection error.[232] This part of the rule was intended to prevent PWSs from excluding samples with high lead concentrations to lower the 90th percentile.[233] EPA interprets this rule strictly and does not let PWSs exclude samples even if it is likely that sampling error would result in underreporting lead concentration.[234] A sampling procedure designed to capture peak lead would leave little room for error and result in underreporting lead content in most cases.[235] Even under the current testing protocols, errors like collecting samples after flushing the tap would result in underreporting lead concentration of the water.[236] Including incorrectly collected samples that underreport lead concentration will lower the 90th percentile sample and potentially not trigger remedial action under the LCR otherwise required.

F. LSL Replacement

The LCR's LSL replacement provision has two critical deficiencies. The LCR allows PWSs to stop a required LSL replacement program as soon as the 90th percentile test for two consecutive monitoring periods is under the lead

212. Wines & Schwartz, *supra* note 32.
213. *Id.*
214. *Id.*
215. *Id.*
216. *Id.*
217. Edwards et al., *supra* note 28, at 1618.
218. *Id.* at 1619.
219. *Id.*
220. Wines & Schwartz, *supra* note 32.
221. Edwards et al., *supra* note 28, at 1618, 1621; Edwards, *supra* note 49, at 741-42.
222. Leonnig, *supra* note 8.
223. Katherine Shaver & Dana Hedgpeth, *D.C.'s Decade-Old Problem of Lead in Water Gets New Attention During Flint Crisis*, Wash. Post, Mar. 17, 2016, https://www.washingtonpost.com/local/dcs-decade-old-problem-of-lead-in-water-gets-new-attention-during-flint-crisis/2016/03/17/79f8d476-ec64-11e5-b0fd-073d5930a7b7_story.html?utm_term=.66b85d1b135e.
224. Del Toral et al., *supra* note 157, at 9301.
225. *See*, *e.g.*, MDEQ, *supra* note 140; Illinois Environmental Protection Agency, Lead/Copper Sample Collection Instructions (2016).
226. Del Toral et al., *supra* note 157, at 9301.
227. Water Research Foundation, *supra* note 182, at xv.
228. *Id.*
229. *Id.*; *see generally* Del Toral et al., *supra* note 157.
230. Water Research Foundation, *supra* note 182, at xv.
231. *See generally* Water Research Foundation, *supra* note 182.
232. 40 C.F.R. §141.86(b)(2).
233. EPA Clarification, *supra* note 137, at 2.
234. *Id.* at 6.
235. *See* Water Research Foundation, *supra* note 182, at xv.
236. EPA Clarification, *supra* note 137, at 2.

action level.[237] Allowing a PWS to pause an LSL replacement program based on unreliable testing is an unacceptable risk to public health when lead has leached into water despite corrosion control efforts in the past.

The LCR's partial LSL replacement mandate presents a known risk of increased lead exposure to individual homeowners. The LCR LSL replacement program requires the PWS to replace the PWS-owned portion of an LSL even if a homeowner elects not to replace the privately owned portion of the LSL.[238] Disturbance of LSLs causes a sharp increase in lead leaching into drinking water and can persist for years.[239] A PWS is required to offer to replace at homeowner expense the privately owned portion of an LSL when replacing the publically owned portion.[240] Homeowners are unlikely to pay for an expensive LSL replacement project if unaware of the full extent of increased lead exposure because of partial replacement. Partial LSL replacement therefore is likely not to mitigate lead exposure but rather increase lead exposure.[241]

G. First-Draw Samples

EPA requires one-liter, first-draw tap samples under the LCR monitoring program and recommends that schools and day-care centers collect first-draw samples.[242] First-draw samples usually are not effective in determining the risk of lead exposure at the tap.[243] First-draw samples significantly underestimate peak lead levels in drinking water about 70% of the time.[244] Even after the first one-liter draw, any particular one-liter sample significantly underestimates peak lead concentration most of the time when compared to 12 one-liter sequential samples from the same tap.[245]

Sequential sampling and testing multiple liters of water after stagnation is the only way to measure peak lead with any reliable accuracy.[246] The LCR essentially requires that PWSs collect samples that significantly underestimate peak lead most of the time and recommends schools and day-care centers serving the most vulnerable populations do the same. First-draw samples therefore can justify inaction for and provide a false sense of security to an entire PWS when an underestimate of peak lead from first-draw samples lowers the 90th percentile sample below the lead action level.

H. Gaming the LCR Monitoring Program

The LCR's monitoring program has significant gaps allowing testing techniques to lower lead concentration below the actual risk of exposure. Collection procedures that will artificially reduce lead concentration include pre-flushing water lines prior to stagnation, limiting stagnation time to a minimum number of hours, instructing homeowners to remove aerators prior to sampling, and providing narrow bottles for sampling with instructions to open taps slowly.[247] The Washington, D.C., WASA employed all of these techniques at some point since 2002.[248] Philadelphia, a city where 10% of children still have BLLs greater than 5 μg/dL (50 ppb), has instructed residents to pre-flush the tap prior to the stagnation period, remove aerators prior to sampling, and use a low water flow during sampling.[249]

In Flint, pre-flushing and small-mouth bottles contributed state lead testing results (90th percentile at 11 ppb) markedly below the levels of private testing conducted at Virginia Tech (25 ppb).[250] In Durham, North Carolina, in 2006, a child was lead-poisoned from drinking water despite tests showing compliance with the LCR.[251] Durham was removing aerators prior to sampling.[252] In 2016, when New York City stopped pre-flushing, taps exceeding the EPA action level increased by nine times.[253] One school in Staten Island where pre-flush tests found six outlets over the EPA action level and a high concentration of 49 ppb, now found 53 taps over 15 ppb, 14 over 1,000 ppb, a drinking fountain over 3,680 ppb, and a classroom faucet over 32,500 ppb.[254] These are only a few examples of practices that persist across the United States undermining already unreliable lead testing programs.[255]

These collection techniques that reduce lead concentration are legal. EPA issued guidance in 2016 recommending that PWSs conduct sampling with wide-mouth bottles and that sampling instruction not include directions to remove

237. 40 C.F.R. §141.84(f).
238. *Id*. §141.84(d).
239. *See* Del Toral et al., *supra* note 157, at 9304-05.
240. 40 C.F.R. §141.84(d).
241. *See id*.
242. *Id*. §141.86(b)(1); EPA 3T Revised Technical Guidance, *supra* note 209, at 12; U.S. EPA, 3Ts for Reducing Lead in Drinking Water in Child Care Facilities: Revised Guidance 10 (2005).
243. Water Research Foundation, *supra* note 182, at 48-49; *see* Del Toral et al., *supra* note 157, at 9302-03 (collecting studies finding first-draw samples unreliable to measure peak lead concentration).
244. Water Research Foundation, *supra* note 182, at 48-49, 51.
245. *Id*.
246. *See id*.; Clark et al., *supra* note 173, at 6837.
247. Marc Edwards et al., Gaps in the EPA Lead and Copper Rule That Can Allow for Gaming Compliance: DC WASA 2003-2009, at 2-4 (2009).
248. *Id*.
249. Oliver Milman & Jessica Glenza, *Philadelphia's Water-Testing Procedures Are "Worse Than Flint"—Expert*, Guardian, Jan. 28, 2016, https://www.theguardian.com/environment/2016/jan/28/philadelphia-water-testing-crisis-flint-health-risk.
250. FWATF Final Report, *supra* note 78, at 8, 18, 29, 20-21, 44; Marc Edwards et al., *Our Sampling of 252 Homes Demonstrates a High Lead in Water Risk: Flint Should Be Failing to Meet the EPA Lead and Copper Rule*, Flint Water Study, Sept. 8, 2015, http://flintwaterstudy.org/2015/09/our-sampling-of-252-homes-demonstrates-a-high-lead-in-water-risk-flint-should-be-failing-to-meet-the-epa-lead-and-copper-rule/.
251. Renner, *supra* note 28, at 544, 547.
252. *Id*. at 547.
253. Kate Taylor, *New York Changes How It Tests for Lead in Schools' Water, and Finds More Metal*, N.Y. Times, Feb. 3, 2017, https://www.nytimes.com/2017/02/03/nyregion/new-york-dept-education-lead-water.html.
254. *Id*.
255. *See* Oliver Milman, *US Authorities Distorting Tests to Downplay Lead Content of Water*, Guardian, Jan. 22, 2016, https://www.theguardian.com/environment/2016/jan/22/water-lead-content-tests-us-authorities-distorting-flint-crisis; Oliver Milman & Jessica Glenza, *At Least 33 US Cities Used Water Testing "Cheats" Over Lead Concerns*, Guardian, June 2, 2016, https://www.theguardian.com/environment/2016/jun/02/lead-water-testing-cheats-chicago-boston-philadelphia.

aerators or pre-flush.[256] These recommendations, however, are guidance, not a regulatory requirement. In response to a 2016 *Guardian* investigation on lead testing procedures, many water departments from 81 major cities east of the Mississippi River said EPA had not issued clear guidance on testing, they never received a memo from EPA, or that the sampling techniques are not illegal.[257]

The only real accountability to prevent PWSs from employing legal collection practices designed to lower the 90th percentile sample is political. Political pressure often encounters government resistance and forces change only after tragic lead exposure to entire communities.[258] And given the history of government incompetence and misconduct in administering the LCR discussed in the next part, relying on political pressure to protect people from lead exposure will result in dangerous lead exposure across the United States.

IV. Government Incompetence and Misconduct

This part discusses the threat to the public health of entire communities because of violations of the LCR through incompetence, malfeasance, and, in some cases, alleged criminal misconduct on the part of government officials. The fact of government incompetence and misconduct strongly supports funding private filtration so individuals can protect themselves from lead in the home and requiring filtration in drinking fountains in nonresidential buildings. This part will first discuss how LCR violations throughout the nation exacerbate the threat of lead exposure, and then explore the Flint water crisis as an example of how government incompetence and alleged official misconduct resulted in widespread toxic lead exposure.

A. LCR Violations

Failing to collect samples for testing from high-risk taps is a particular problem in administration of the LCR. Washington, D.C., intentionally employed this technique in 2003 and refused to make public the sampling pool in order to avoid LSL replacement requirements.[259] PWSs that have not completed the required materials evaluation are probably not testing from high-risk locations. As a practical matter, selecting locations for testing without information about lead materials is little more than a guessing game.

Violations of the LCR extend far beyond materials evaluations and testing locations. According to a June 2016 NRDC report, in 2015, "over 18 million people were served by 5,363 community water systems that violated the [LCR]."[260] PWS violations ranged from failing to test properly for lead and water conditions, to failing to report violations to state officials, to failing to implement corrosion control.[261] This number only includes detected violations and likely is a significant underestimate, considering underreporting has been a problem since the LCR's inception and Flint's rampant violations were known and unreported at that time.[262] Making matters worse, EPA and state authorities with primary enforcement authority took no formal enforcement action for nearly 90% of violations and only 3% resulted in penalties.[263] This anemic enforcement rate likely contributed to a culture of noncompliance that tolerated incompetence, misconduct, and cover-up resulting in the Flint water crisis.

B. The Flint Water Crisis

The water crisis in Flint is a tragic example of government incompetence, malfeasance, and alleged criminal misconduct at all levels of government. The seeds of Flint's water crisis began in 2011 when Gov. Rick Snyder stripped Flint's city council of power and appointed an emergency manager to fix Flint's fiscal problems.[264] In June 2013, using his power as emergency manager, Edward Kurtz unilaterally decided to switch Flint's water source to the Flint River rather than Lake Huron-treated water from Detroit.[265] On April 25, 2014, Flint officially switched its water source to the Flint River.[266] Nine days prior, Michael Glasgow of the Flint Utilities Department e-mailed the Michigan Department of Environmental Quality (MDEQ) warning that the Flint water treatment plant was not prepared to handle the switch.[267] Flint's water treatment system had not been used in 50 years and river water is very difficult to treat with water chemistry changing sometimes by the hour.[268]

The disastrous health and safety consequences to the people of Flint began almost immediately. Within the first six months, brown water began coming out of taps, *E. coli* contamination required boil notices, and more than 70 cases of legionellosis were reported in Flint resulting in 12 deaths.[269] In October 2014, General Motors switched its water source back to Lake Huron because water was corroding engine parts.[270] Corrosion was occurring because Flint increased chloride treatment to kill bacteria but did not treat the water with corrosion control as required under the LCR.[271] Emergency Manager Darnell Earley, replacing Kurtz, rejected a proposal from Valerie Brader, the state deputy legal counsel and senior policy advisor, and Michael Gadola, the governor's legal counsel, to switch back to Lake Huron water provided through Detroit.[272]

256. U.S. EPA, Clarification of Recommended Tap Sampling Procedures for Purposes of the Lead and Copper Rule (2016).
257. Milman & Glenza, *supra* note 255.
258. *See NOVA: Poisoned Water*, *supra* note 75.
259. Edwards et al., *supra* note 250, at 2.
260. Olson & Fedinick, *supra* note 34, at 5.
261. *Id.*
262. *Id.*
263. *Id.* at 6.
264. FWATF Final Report, *supra* note 78, at 39; *NOVA: Poisoned Water*, *supra* note 75.
265. FWATF Final Report, *supra* note 78, at 17, 40.
266. *NOVA: Poisoned Water*, *supra* note 75.
267. FWATF Final Report, *supra* note 78, at 17.
268. *NOVA: Poisoned Water*, *supra* note 75.
269. *Id.*; FWATF Final Report, *supra* note 78, at 17.
270. *NOVA: Poisoned Water*, *supra* note 75.
271. *Id.*
272. FWATF Final Report, *supra* note 78, at 17-18.

Residents alarmed at the quality of the water protested at town meetings with city officials dismissing their concerns and insisting that Flint's water was safe to drink.[273]

Shortly after Flint switched its water source, LeeAnne Walters, who like many Flint residents was experiencing hair loss and whose children were suffering painful skin rashes while bathing, requested documents from Flint about water treatment and requested that Flint test her water for lead.[274] Walters' water tested at 104 and 397 ppb for lead.[275] Flint officials insisted that Walters' water was an isolated problem, not systemic.[276] Walters contacted Miguel Del Toral at EPA and shared the results of her lead test.[277] In February 2015, Del Toral contacted the MDEQ to determine whether Flint was using corrosion control and informed the MDEQ that corrosion control was required.[278] The MDEQ told Del Toral that Flint was using corrosion control.[279] Walters then found through her document requests a water monthly operational report showing that Flint was not treating water with corrosion control.[280] Walters shared the report with Del Toral who again contacted the MDEQ about the use of corrosion control in Flint's water system.[281] In April 2015, the MDEQ informed Del Toral that Flint was not using corrosion control.[282] Del Toral again informed the MDEQ that the LCR requires corrosion control for Flint.[283]

As lead continued to leach into Flint's drinking water, public protests escalated in Flint with no government response.[284] In June 2015, Del Toral, frustrated with EPA's lack of response and alarmed at Flint's failure to implement corrosion control, wrote an interim report warning of serious risks of lead exposure to Flint residents from failing to use corrosion control.[285] Del Toral provided a copy to Walters, who sent the report to the press.[286] The disclosure did not trigger government action to protect the residents of Flint.[287] Instead, the MDEQ dismissed Del Toral's report; MDEQ spokesman Brad Wurfel commented, "the residents of Flint do not need to worry about lead in the water supply . . . anyone who is concerned about lead in the drinking water in Flint can relax."[288] EPA did not take any action or even require that MDEQ force Flint to implement corrosion control.[289] Instead, EPA Region 5 Administrator Susan Hedman apologized to Flint's mayor for the release of Del Toral's report and the mayor went on television telling residents that Flint water was safe to drink.[290] The MDEQ described Del Toral as a "rogue employee" and said that Del Toral had been "handled."[291]

In summer 2015, Walters contacted Dr. Marc Edwards at Virginia Tech to perform lead tests on her water.[292] Walters took 30 samples, with some testing as high as 13,280 ppb.[293] Flint and the MDEQ refused to take action, insisting that the water was safe to drink because LCR monitoring from July-December 2014 showed the 90th percentile at 6 ppb and at 11 ppb for the next six-month monitoring period.[294] Official tests were artificially low because Flint was not sampling from high-risk sources and was using collection techniques that reduce lead levels, including pre-flushing for five minutes and using narrow collection bottles.[295] Flint specifically excluded samples from Walters' home from the sampling pool.[296]

Walters and Dr. Edwards then organized a private lead testing program collecting 300 representative samples throughout Flint.[297] On September 8, 2015, Virginia Tech completed testing on 252 samples and found the 90th percentile of lead at 25 ppb.[298] Several samples tested over 100 ppb and one sample tested over 1,000 ppb.[299] Researchers at Virginia Tech concluded that "even if the remaining samples did not detect lead, Flint had a very serious lead problem in the drinking water" and released the results to the public.[300] Dr. Edwards estimated that 40% of homes in Flint had lead contamination above 15 ppb.[301] Instead of acting to protect the residents of Flint, the MDEQ disputed Virginia Tech's findings.[302]

Shortly after Dr. Edwards released the results of the water testing, Dr. Mona Hanna-Attisha, director of the pediatric residency program at Hurley Medical Center, conducted a study of BLLs in children after Flint switched water sources.[303] Dr. Hanna-Attisha compared BLLs from 2013 with BLLs in 2015 and found that the number of children with BLLs above 5 µg/dL doubled and in some neighborhoods almost tripled.[304] Instead of recognizing Dr. Hanna-Attisha's study as consistent with and supporting Dr. Edwards water test results, the state of Michigan disputed Dr. Hannah-Attisha's study.[305] It was not until later in September when Dr. Eden Wells, chief medical officer of the Michigan Department of Health and Human Services (MDHHS), concluded that Dr. Hannah-Attisha's

273. *NOVA: Poisoned Water*, *supra* note 75.
274. *Id*.
275. *Id*.
276. *Id*.
277. *Id*.
278. *Id*.; FWATF Final Report, *supra* note 78, at 18.
279. FWATF Final Report, *supra* note 78, at 19; *NOVA: Poisoned Water*, *supra* note 75.
280. *NOVA: Poisoned Water*, *supra* note 75.
281. *Id*.
282. *Id*.
283. FWATF Final Report, *supra* note 78, at 19.
284. *NOVA: Poisoned Water*, *supra* note 75.
285. *Id*.; FWATF Final Report, *supra* note 78, at 20.
286. *NOVA: Poisoned Water*, *supra* note 75.
287. *Id*.
288. *Id*.; FWATF Final Report, *supra* note 78, at 20.
289. FWATF Final Report, *supra* note 78, at 51.
290. *NOVA: Poisoned Water*, *supra* note 75.
291. *Id*.
292. *Id*.
293. *Id*.
294. *Id*.; FWATF Final Report, *supra* note 78, at 19, 21.
295. FWATF Final Report, *supra* note 78, at 44, 51; *NOVA: Poisoned Water*, *supra note* 75.
296. FWATF Final Report, *supra* note 78, at 29; *NOVA: Poisoned Water*, *supra* note 75.
297. *NOVA: Poisoned Water*, *supra* note 75.
298. FWATF Final Report, *supra* note 78, at 21.
299. *Id*.
300. *Id*.; *NOVA: Poisoned Water*, *supra* note 75.
301. *NOVA: Poisoned Water*, *supra* note 78.
302. *Id*.
303. *Id*.
304. Hanna-Attisha et al., *supra* note 28, at 283.
305. *NOVA: Poisoned Water*, *supra* note 75.

research was sound that Flint, the state of Michigan, and EPA began to take Flint's water crisis seriously.[306] On October 1, 2015, the MDHHS publically confirmed Dr. Hanna-Attisha's findings. On October 16, Flint switched its water source back to Lake Huron.[307]

The Flint water crisis represents government malfeasance and incompetence at its worst. At every level of government from Flint to EPA, incompetence, denial, and cover-up failed the people of Flint and exposed approximately 8,000 children to lead contamination. The state appointed emergency managers who put money over community health in making a risky switch in water source to the Flint River and then ignored clear evidence of dangerous and contaminated water.[308] The Flint water crisis could have been significantly mitigated if emergency managers had switched Flint's water source back to Lake Huron in October 2014 as the people demanded and the state legal counsel recommended.[309]

The Flint Utilities Department was not prepared to handle the complicated task of treating river water for public consumption.[310] As a result, the people of Flint were in significant danger the minute that water began to flow from the Flint River to the tap. A dangerous decision at its inception was made exponentially more so because Flint illegally failed to treat the water with corrosion control. And Flint's illegal practice of not selecting high-risk homes for testing and using collection techniques that reduce lead concentration hid the obvious threat.

The MDEQ failed to execute its mission and protect the people of Flint. The MDEQ advised Flint water treatment plant staff not to use corrosion control and then lied to EPA about its application, failed to correct and even condoned improper water sampling techniques, insisted on the accuracy of incorrect data, and ignored Flint residents, elected officials, and EPA.[311] The MDEQ waited months before accepting EPA's offer to provide expert assistance to address lead contamination, actively worked to discredit the work of outside experts, and ignored the people of Flint.[312] For 18 months, the MDEQ advertised Flint's water as safe to drink and insisted on the safety of Flint's water even after compelling evidence of elevated BLLs in Flint's children.[313] MDEQ's illegal acts, incompetence, and sustained dissemination of false information directly caused the Flint water crisis.[314]

The MDHHS failed to identify that BLLs in Flint were rising. An internal analysis concluding that BLLs were rising was questioned, and the MDHHS never resolved the conflict.[315] The MDHHS' internal failures and initial questioning of Dr. Hanna-Attisha's study likely extended the water crisis by three months.

EPA failed to protect the people of Flint after the MDEQ disclosed in April 2015 that corrosion control was not being used. EPA did not require Flint to use corrosion control until July 2015, deferring corrosion control pending a legal opinion that the MDEQ requested despite the clear and unambiguous requirement that community water systems use corrosion control.[316] EPA deferred to the MDEQ despite internal protests from Del Toral and clear evidence of egregious LCR violations.[317] EPA also did not use its enforcement authority until issuing a January 2016 emergency order after increasing public pressure and clear evidence of elevated BLLs in children.[318] EPA's apathy and failure to timely enforce the SDWA exacerbated and extended the Flint water crisis. It was the extraordinary efforts of Walters, protests of the Flint community, Dr. Edwards' team of researchers at Virginia Tech, and Dr. Hanna-Attisha's research that exposed the Flint water crisis.[319]

The fallout from the Flint water crisis resulted in a congressional investigation and detailed state investigation. The people of Flint voted Dayne Walling out of office and Susan Hedman resigned as administrator of EPA Region 5.[320] To date, 15 government officials have been indicted in connection with the Flint water crisis, including former emergency managers Darnell Earley and Gerald Ambrose for misconduct in office and willful neglect of duty; former Flint Public Works Administrator Howard Croft and former Flint Utilities Administrator Daugherty Johnson for conspiracy and false pretenses; Flint Laboratory Water Quality Supervisor Mike Glasgow for tampering with evidence and willful neglect; fired head of the MDEQ Liane Shekter-Smith for misconduct in office and willful neglect of duty; MDEQ Water Quality Analyst Adam Rosenthal for misconduct in office, tampering with evidence, and willful neglect of duty; MDEQ employee Mike Prysby for tampering with evidence, and treatment and monitoring violations of Michigan's SDWA; and several other MDEQ officials.[321] Several officials at the MDHHS face more serious charges in connection with the legionellosis outbreak, including involuntary manslaughter.[322] But the lifelong health consequences for as many as 8,000 chil-

306. *See* FWATF Final Report, *supra* note 78, at 21; *NOVA: Poisoned Water*, *supra* note 75.
307. FWATF Final Report, *supra* note 78, at 21.
308. *Id.* at 40.
309. *Id.* at 17-18.
310. *Id.* at 43-44.
311. *Id.* at 27-28.
312. *Id.* at 28-29; *NOVA: Poisoned Water*, *supra* note 75.
313. FWATF Final Report, *supra* note 78, at 29; *NOVA: Poisoned Water*, *supra* note 75.
314. FWATF Final Report, *supra* note 78, at 29.
315. *Id.* at 31-32.
316. *Id.* at 18, 51.
317. *NOVA: Poisoned Water*, *supra* note 75.
318. FWATF Final Report, *supra* note 78, at 51-52.
319. John McQuaid, *Without These Whistleblowers, We May Never Have Known the Full Extent of the Flint Water Crisis*, Smithsonian Mag., Dec. 2016, https://www.smithsonianmag.com/innovation/whistleblowers-marc-edwards-and-leeanne-walters-winner-smithsonians-social-progress-ingenuity-award-180961125/; *NOVA: Poisoned Water*, *supra* note 75.
320. Josh Sanburn, *Former EPA Official Grilled Over Flint Water Crisis*, Time Mag., Mar. 15, 2016, http://time.com/4259438/susan-hedman-flint-water-crisis-congress/.
321. Paul Egan, *These Are the 15 People Criminally Charged in the Flint Water Crisis*, Detroit Free Press, June 14, 2017, https://www.freep.com/story/news/local/michigan/flint-water-crisis/2017/06/14/flint-water-crisis-charges/397425001/.
322. *Id.*

dren in Flint exposed to toxic lead, a community living in fear and loss of trust in government, and the $1.5 billion price tag is the true legacy of this government-caused public health disaster.[323]

In a perfect world, the water crisis in Flint would produce lasting lessons learned that are implemented in every community across the United States and political action for robust enforcement and revision of the LCR. Instead, EPA Region 5 Administrator Hedman refused to take responsibility before Congress in March 2016, stating: "I don't think anyone in the EPA did anything wrong."[324] And the Flint crisis has not deterred government officials from resisting attempts to protect residents from lead in water. Just this year, the mayor of Denmark, South Carolina, refused to allow Dr. Edwards to collect testing samples from town wells for bacteria after finding lead in tap water in some Denmark homes.[325] The mayor claimed that additional testing is unnecessary because "the state Department of Health and Environmental Control has found [the water] to be safe."[326]

Because of government incompetence and misconduct and the inadequacy of the LCR to protect public health from lead exposure, children across the United States are at risk of suffering the significant and permanent adverse health effects of lead exposure. This continuing risk of lead present at the tap demands a policy approach that promotes removing the lead that is present at the tap consistent with primary prevention: a refundable tax credit for individuals to purchase a filtration system and replacement filters certified for lead reduction under NSF/ANSI Standard 53, and requiring nonresidential buildings install BAT for filtration in drinking fountains.

V. Preventing Lead Exposure With a Refundable Tax Credit and Requiring BAT

This part recommends that Congress provide a refundable tax credit for individuals to acquire a filtration system and replacement filters certified for lead reduction under NSF/ANSI Standard 53, and require best available filtration technology in drinking fountains in nonresidential buildings. The medical community has adopted primary prevention to address the significant, permanent, and irreversible health effects of lead in children at very low BLLs. The LCR is inconsistent with primary prevention because the inherent difficulty of regulating lead in water, the unreliability of testing, and specific shortcomings of the LCR allow lead to be present in drinking water at the tap. Lead will persist in drinking water as long as there are lead-containing materials in drinking water infrastructure and private plumbing.

Researchers studying corrosion and the efficacy of lead testing recommend that it usually is better to assume that lead is present in drinking water at unsafe levels and focus on preventing exposure than to rely on the results of testing to determine when intervention is necessary.[327] Government incompetence and misconduct in implementing the LCR exacerbate the inherent difficulty of regulating lead and the inadequacy of the LCR. Further, compliance with the LCR can create a false sense of security in the safety of drinking water, particularly at individual taps.

Public policy to address lead in drinking water must recognize that even with best regulatory efforts to prevent lead leaching into drinking water, the risk of lead in drinking water will persist across the country and testing cannot assure safety. Consistent with the medical consensus that primary prevention is necessary to protect children from lead exposure, public policy should promote efforts to remove lead that is actually present in water at the point of use. This part first discusses why POU filtration will fill the regulatory gap, and next recommends that Congress provide a refundable tax credit for POU filtration and require nonresidential buildings to filter water at drinking fountains.

A. POU Filtration Is Effective and Fills the Regulatory Gap

Promoting and funding POU filters effective at reducing lead is consistent with a primary prevention approach to childhood lead exposure and would fill the regulatory gap that necessarily results in dealing with lead at the tap. Filtration technology implements a primary prevention approach because removing lead from water at the tap prevents exposure to lead. Filtering water at the tap will also remove many other contaminants and protect against attacks to drinking water supplies by the intentional introduction of contaminants. Recent efforts to reduce lead in drinking water do not adequately protect public health, making promotion of POU filtration all the more necessary.

Water filtration technology is highly effective at removing lead from drinking water at the tap. NSF International[328] tests filtration technology to ensure that filters meet minimum standards of filtration for many contaminants.[329] Filters that meet NSF filtration standards for health effects receive certification under the NSF/ANSI

323. *See NOVA: Poisoned Water*, *supra* note 75.

324. Steve Carmody, *Flint Mayor Leaving Office After Defeat, but Not Politics*, Mich. Radio, Nov. 4, 2015, http://michiganradio.org/post/flint-mayor-leaving-office-after-defeat-not-politics; Sanburn, *supra* note 320.

325. Sammy Fretwell, *Small Town SC Mayor Won't Let Flint Water Crisis Researcher Test Wells for Pollution*, State, Jan. 27, 2018, http://www.thestate.com/news/local/article196354779.html.

326. *Id.*

327. Masters et al., *supra* note 157, at 12-13.

328. NSF International is an independent, accredited organization that develops health standards and certification programs to protect food, water, consumer products, and the environment. NSF International tests products advertised to perform a claimed function (e.g., filtration) and provides certification if the product is effective to the NSF-established standard. NSF International, *Certified Product Listings for Lead Reduction*, http://info.nsf.org/Certified/DWTU/listings_leadreduction.asp?ProductFunction=053|Lead+Reduction&ProductFunction=058|Lead+Reduction&ProductType;=&submit2=Search (last visited Sept. 28, 2018) [hereinafter *NSF Product Listings*].

329. *Id.*

Standard 53 for Drinking Water Treatment Units.[330] NSF/ANSI Standard 53 includes certification for lead reduction in drinking water for POU filtration systems, including pour-through pitchers, faucet mounts, countertop units connected to a sink faucet, under-the-counter plumbing-connected filters, and refrigerator filters.[331] To receive certification, filters must be able to filter lead below 10 ppb from a challenge level of 150 ppb.[332] After providing certification, NSF annually audits manufacturing facilities to confirm that the product sold to the public meets the standard confirmed in the laboratory.[333] There are hundreds of water filtration systems that meet the NSF/ANSI Standard 53, including convenient faucet mount options and pour-through pitchers.[334]

In practice, NSF/ANSI Standard 53 certified water filtration technology performs significantly better than the reduction level of 10 ppb required under Standard 53. In response to the water crisis in Flint, EPA performed a filter challenge assessment on the efficacy of Brita and Pur manufactured filters that are NSF Standard 53-certified to remove lead from drinking water.[335] EPA conducted this test to determine whether these POU filters would filter effectively when filtering water with lead levels greater than 150 ppb.[336]

Based on more than 200 samples, including samples with confirmed lead levels above 150 ppb and some over 4,000 ppb, the POU filters reduced average lead concentration to 0.3 ppb, the highest lead concentration after filtration was 2.9 ppb, and 80% of the filtered samples were below the detectable level for lead.[337] EPA then collected more than 50 additional samples from locations recommended by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR).[338] The filters again removed lead to less than 1 ppb on average.[339] The ATSDR reviewed EPA's study and confirmed the results: filtered water from POU filters certified for lead removal is safe for consumption and cooking for all people, including children and pregnant women.[340] NSF/ANSI Standard 53-certified POU filtration technology thus would effectively remove lead present in drinking water at the tap.

The SDWA recognizes the utility of POU filtration and even contemplates the use of POU filtration to comply with NPDWRs. For some contaminants, filtration is a treatment technique.[341] The SDWA also requires EPA to list POU treatment units as a compliance technology for small PWSs to meet SDWA standards.[342] EPA has listed POU filtration technologies as compliance technologies under the SDWA.[343] Reverse osmosis and cation exchange are compliance technologies for lead, but other filtration technologies also filter lead effectively.[344]

States have implemented POU treatment systems for compliance with NPDWRs. For example, Arizona allows qualifying PWSs to use POU treatment systems to comply with NPDWRs.[345] Under the Arizona program, a PWS authorized to use POU treatment must use a treatment system that complies with applicable NSF/ANSI standards, including Standard 53.[346] EPA advertises POU filtration as effective for individuals to reduce exposure to lead at the tap.[347] Some states also recommend that individuals use POU filters to protect from the risk of lead exposure through drinking water.[348] State implementation of POU filtration to comply with NPDWRs as well as EPA and state recommendations that individuals use POU filters to protect themselves from lead in drinking water reflect what NSF/ANSI standards and the Flint water filtration field test confirm: POU filtration is highly effective at reducing lead in drinking water.

In addition to removing lead actually present at the tap, promoting POU filtration nationally would also remove other harmful contaminants present and support water security against the intentional introduction of contaminants into water distribution systems. Filtration systems meeting NSF/ANSI Standard 53 generally filter for many more contaminants than just lead.[349] For example, the readily accessible Brita faucet mount filtration system reduces 21 other contaminants, including harmful contaminants like asbestos, benzene, and toluene, and more than 40 volatile organic compounds.[350] Filtration systems also often reduce other compounds, including emerging contami-

330. *Id*.
331. *Id*.
332. *Id*.; NSF International/ANSI Standard 53, Drinking Water Treatment Units—Health Effects 3, 9 (2016).
333. *NSF Product Listings*, *supra* note 328.
334. *Id*.
335. U.S. EPA, Flint, MI Filter Challenge Assessment (2016).
336. *Id*. at 1.
337. *Id*. at 1, 3.
338. *Id*. at 1.
339. *Id*. at 4.
340. *See id*. at attachment.
341. *See* 40 C.F.R. §§141.70, 141.500 (establishing filtration as an NPDWR for PWSs where the source water is, or is directly influenced by, surface water for *Giardia lamblia*, viruses, heterotrophic plate count bacteria, *Legionella*, *Cryptosporidium*, and turbidity).
342. 42 U.S.C. §300g-1(b)(4)(E)(ii)-(iii).
343. *See generally* Announcement of Small System Compliance Technology Lists for Existing National Primary Drinking Water Regulations, 63 Fed. Reg. 42039 (Aug. 6, 1998); *see* U.S. EPA, Point-of-Use or Point-of-Entry Treatment Options for Small Drinking Water Systems 3-1, 3-3 (2006).
344. U.S. EPA, *supra* note 343, at 3-3; U.S. EPA, *supra* note 335, at 3-4.
345. *See* Ariz. Admin. Code §R18-4-218.
346. *Id*. §R18-4-218B(3); Arizona Department of Environmental Quality, Arizona Point of Use Compliance Program Guidance 5 (2005).
347. U.S. EPA, Concerned About Lead in Your Drinking Water? 2 (2017).
348. *See*, *e.g.*, Minnesota Department of Health, Point-of-Use Water Treatment Units for Lead Reduction (2010); *see also* Florida Department of Environmental Protection, *Monitoring Lead and Copper in Florida Drinking Water*, https://floridadep.gov/water/source-drinking-water/content/monitoring-lead-and-copper-florida-drinking-water (last modified Apr. 11, 2018).
349. *See* NSF International, *NSF Product and Service Listings: NSF/ANSI 53 Drinking Water Treatment Units—Health Effects*, http://info.nsf.org/Certified/DWTU/Listings.asp?ProductFunction=053%7CLead+Reduction&ProductFunction=058%7CLead+Reduction&ProductType=&submit2=Search (last visited Sept. 28, 2018).
350. NSF International, *NSF Product and Service Listings: NSF/ANSI 53 Drinking Water Treatment Units—Health Effects, the Brita Company Products*, http://info.nsf.org/Certified/DWTU/Listings.asp?TradeName=SAFF-100&Standard=053&ProductType=&PlantState=&PlantCountry=CHINA&PlantRegion=&submit3=Search&hdModlStd=ModlStd (last visited Sept. 28, 2018).

nants. The Brita faucet system, for example, filters bisphenol-A, estrone (a hormone), and several over-the-counter and pharmaceutical drugs.[351] POU filtration's ability to remove a range of contaminants could be effective against attacks to drinking water supplies by the intentional introduction of contaminants.[352] A single filter does not reduce every potential contaminant,[353] but use of a POU filter will provide effective protection against many contaminants.

Filtration to remove lead actually present in drinking water also is important because recent regulatory, congressional, and state actions to reduce lead in water are inadequate to protect public health. EPA is considering substantially revising the LCR. Under consideration is a full LSL replacement program; requiring all systems to use and update corrosion control; incorporating a health-based "household action level"; requiring POU filters when there is a disturbance of an LSL or lead levels exceed a health-based standard; strengthening testing procedures and real-time monitoring of water quality; requiring PWSs to post all sampling results and shortened deadlines for public notice and education; making LSL locations public; more reporting requirements to EPA; and increased public education about lead risks for new customers of a PWS and those at risk of lead exposure.[354]

Even if EPA promulgated all of the proposed rule revisions, the LCR still would not sufficiently protect individuals from lead exposure. Completely removing all LSLs is absolutely necessary in the long term to protect people from lead exposure, but is a massive undertaking requiring local expenditures up to $80 billion.[355] The utility work required to remove all LSLs would take decades to complete, exposing another generation of Americans to dangerous levels of lead in the interim.[356] And major cities like Chicago have no intention of beginning a voluntary LSL replacement program.[357] If EPA were to allow partial LSL replacement, the lead problem would be worse for those served.[358] The proposed use of filtration is reactive to LSL disturbances and threshold levels reliant on unreliable testing. Filtration that is reactive does not implement primary prevention.

The other proposals would improve the LCR on paper but would not fix the inherent regulatory problem of lead leaching at any time and unreliable testing. Ironically, an improved LCR could provide an increased false sense of security, making lead exposure worse for some individuals. And there is no reason to believe that a strengthened LCR will sufficiently protect communities from lead exposure resulting from government incompetence and misconduct. A strengthened LCR would likely add further complexity to a complicated regulation that local governments already struggle to implement.

Recent congressional and state efforts to prevent lead exposure also are inadequate to reduce lead exposure at the tap. The Water Infrastructure Improvements for the Nation Act of 2016 (WIIN Act) required EPA to establish a grant program to assist voluntary lead testing programs at schools and day-care centers.[359] The testing grant program must provide funds to assist implementation of EPA's voluntary water testing program for schools and day-care centers named "3Ts for Reducing Lead in Drinking Water in Schools" (3T testing program) or a state program equivalent at least as stringent.[360] At least seven states and the District of Columbia now require that K-12 schools test for lead in drinking water and at least another 13 provide financial assistance to school districts to test for lead in drinking water.[361]

Testing for lead in school drinking water rather than first taking proactive measures to reduce the risk of lead exposure is the type of reactive approach to lead exposure inconsistent with primary prevention and could justify inaction when there is a significant risk of lead at the tap. Even worse, some school districts do not take remedial measures unless testing shows lead present above 20 ppb.[362] And school districts can spend millions of dollars on testing that is inherently unreliable.[363]

The WIIN Act also requires EPA to establish a grant program for local projects to reduce lead in drinking water.[364] The grant program authorized for appropriation $60 million per year for fiscal years 2017-2021 for qualifying lead reduction projects.[365] The grant program, while important, is very small compared to the $80 billion of funding necessary to eliminate just the risk posed by LSLs.[366] The grant program also likely does not authorize funds to remove lead actually present in drinking water.[367]

Where possible LCR revisions, WIIN Act provisions, and school testing programs fall short, a robust POU filtration program can succeed. Removing lead actually present at the tap through POU filtration implements the primary prevention policy for childhood lead exposure in drinking water. POU filtration is a highly effective last line of

351. NSF International, *NSF Product and Service Listings: NSF/ANSI 401 Drinking Water Treatment Units—Emerging Compounds/Incidental Contaminants*, http://info.nsf.org/Certified/DWTU/Listings.asp?TradeName=&Standard=401&ProductType=&PlantState=&PlantCountry=&PlantRegion=&submit3=Search&hdModlStd=ModlStd (last visited Sept. 28, 2018).
352. Irwin Silverstein, U.S. EPA, Investigation of the Capability of Point-of-Use/Point-of-Entry Treatment Devices as a Means of Providing Water Security 31-33 (2006).
353. *See id.*
354. EPA White Paper, *supra* note 127, at 8-16.
355. *Id.* at 9.
356. *See* Lead and Copper Working Group to the National Drinking Water Advisory Council, Final Report 13-17, 45 (2015); Emily Lawler, *DEQ Rules Propose Michigan Remove All Lead Service Lines in 20 Years*, MLive, Nov. 29, 2017, http://www.mlive.com/news/index.ssf/2017/11/deq_rules_propose_michigan_rem.html.
357. Hawthorne & Reyes, *supra* note 11.
358. *See* Del Toral et al., *supra* note 157, at 9304-05.
359. 42 U.S.C. §300j-24(d).
360. *Id.* §300j-24(d)(5).
361. GAO, K-12 Education: Lead Testing of School Drinking Water Would Benefit From Improved Federal Guidance 25-30 (2018)
362. *Id.* at 27.
363. *Id.* at 15-16.
364. 42 U.S.C. §300j-19b(b).
365. *Id.* §300j-19b(a)(2), (b)(6)(d).
366. EPA White Paper, *supra* note 127, at 9.
367. 42 U.S.C. §300j-19b(a)(2) (defining a lead reduction project as "(i) replacement of publically owned LSLs, (ii) . . . addressing conditions that contribute to increased concentration of lead in water, and (iii) providing assistance to low-income homeowners to replace LSLs. . . .").

defense against lead present at the tap. Because of the difficulty of regulating lead and history of government misconduct in implementing the LCR, a filtration strategy to reduce lead in drinking water should not rely primarily on government implementation.

B. Congress Should Provide a Refundable Tax Credit for Individuals and Require Nonresidential Buildings to Use BAT for Filtration

In order to promote POU filtration, Congress should provide a refundable tax credit for individuals to purchase a water filtration system and replacement filters certified to reduce lead under NSF/ANSI Standard 53, and require nonresidential buildings use BAT for filtration in drinking fountains. Providing a refundable tax credit for individuals to purchase a qualifying water filtration system and replacement filters will allow individuals to implement primary prevention without government assistance and fill the regulatory gap where government has been unable to adequately protect public health. Requiring nonresidential buildings to use BAT for filtration in drinking fountains will provide protection for individuals from lead in water outside the home and effectively enlist the private sector to address the problem of lead in drinking water.

1. Refundable Tax Credit for Individuals

Providing individuals a refundable tax credit to purchase a filtration system and replacement filters certified to reduce lead under NSF/ANSI Standard 53 is an effective and efficient mechanism to allow individuals to implement primary prevention for themselves and their families. There are faucet-mounted and water pitcher filters that are NSF/ANSI Standard 53-certified to reduce lead that are readily available to the public.[368] Congress has broad authority to reach consumer behavior through the tax code.[369] Tax credits provide the taxpayer a dollar-for-dollar reduction of their tax liability.[370] Refundable tax credits are paid to the taxpayer even if there is no offsetting tax liability.[371] Providing a refundable tax credit to individuals for the purchase of a qualifying filtration system will fund private purchase of filtration systems. Directly funding purchase of filtration systems avoids the expense of a government or nonprofit middleman, efficiently allocating resources to distribute filtration systems.[372]

Providing individuals with a means to protect themselves and their families from lead in drinking water is necessary where government has been unable to protect public health. Funding private purchase of filtration systems and replacement filters accomplishes this goal. It is difficult to ask communities to trust local government to protect the water supply from lead contamination given the inherent difficulty of regulating lead and widespread incompetence and misconduct of state and local government in implementing the LCR. If the public knew the inherent difficulty of regulating lead in drinking water, unreliability of testing, and limited knowledge of which taps are at risk of lead contamination, it is safe to conclude that the use of POU filtration would significantly increase. Removing financial barriers to acquiring a filtration system and replacement filters will also help low-income individuals protect themselves and help reduce the disproportionate effect lead exposure has on minority and low-income communities.[373]

The cost of a refundable tax credit for water filtration systems would be modest. The NSF/ANSI Standard 53-certified Brita Faucet Filtration System SAFF-100, which filters 100 gallons of water before filter replacement, currently costs approximately \$19.[374] Replacement filters currently cost approximately \$19.[375] The NSF/ANSI Standard 53 certified ZeroWater pitcher costs approximately \$20.[376] An eight-pack of ZeroWater replacement filters with a 15-gallon capacity for each filter costs approximately \$90.[377] A \$100 refundable tax credit would purchase a filtration system and filters sufficient to filter 500 gallons of water in the case of the faucet mount and 120 gallons in the case of the ZeroWater pitcher.

If 100 million individuals took advantage of the tax credit, likely a significant overestimate with approximately 152 million filers in 2017,[378] the cost would be \$10 billion. By contrast, the lost earnings for children under six years old with BLLs 2-10 µg/dL from 2003-2006 is estimated to be \$165-\$233 billion.[379] And costs from lead exposure extend well beyond lost earnings, including significant medical, education, social, and personal costs.[380] Moreover, Congress could easily fund a refundable tax credit through increasing revenues elsewhere in the tax code. A uniform credit would provide the most protection from lead in drinking water, but Congress could limit the cost given competing priorities by lowering the credit limit, means-testing the credit in full or in part, or limiting the number of years for which the credit is available.

Funding a federal refundable tax credit for filtration would allocate federal resources to a problem many state

368. *See*, *e.g.*, Brita, *Basic Faucet Filtration System*, https://www.brita.com/faucet-systems/basic/ (last visited Sept. 28, 2018); *see also* ZeroWater, *Pitcher/Dispenser 6-Cup*, https://www.zerowater.com/products-pitchers.php (last visited Sept. 28, 2018).
369. *See* National Fed. of Indep. Bus. v. Sebelius, 567 U.S. 519, 563-74 (2012) (upholding the shared responsibility payment of the Affordable Care Act as a proper exercise of Congress' power under the Taxing Clause).
370. *See*, *e.g.*, 26 U.S.C. §24(a).
371. *See id.*; Lily L. Batchelder et al., *Efficiency and Tax Incentives: The Case for Refundable Tax Credits*, 59 Stan. L. Rev. 23, 32-34 (2006).
372. *See generally* Batchelder et al., *supra* note 371.
373. *See* discussion *supra* Section I.C.
374. Brita, *supra* note 368.
375. Brita, *Faucet Mount Filter*, https://www.brita.com/replacement-filters/faucet-system/ (last visited Sept. 28, 2018).
376. ZeroWater, *supra* note 368.
377. ZeroWater, *Replacement Filters*, https://www.zerowater.com/products-filters.php (last visited Sept. 28, 2018).
378. Internal Revenue Service, *Filing Season Statistics for Week Ending December 29, 2017*, https://www.irs.gov/newsroom/filing-season-statistics-for-week-ending-december-29-2017 (last updated Jan. 12, 2018).
379. Gould, *supra* note 52, at 1164.
380. *See* discussion *supra* Section I.C.

and local governments would struggle to fund. State and local governments need upwards of $1 trillion by 2037 just to maintain current levels of water service.[381] Although the federal government provides some assistance through revolving loan funds and limited direct financing, local governments bear most of the cost of water infrastructure projects through bond issues.[382] Local governments face a shortfall of up to $530 billion between available funds and necessary funds for water infrastructure projects.[383] Allocating federal funds for POU water filtration would provide a stopgap measure for individuals to ensure safe drinking water as local governments face funding shortfalls for critical water infrastructure maintenance.

Investing in POU filtration is more important than additional direct congressional expenditures to replace lead-containing materials. POU filtration will ensure water without dangerous lead concentrations for hundreds of millions of Americans where the same sum would fund only a small fraction of the massive LSL replacement project,[384] which does not include lead-containing materials in approximately 81 million American homes. The potential reach of a tax credit-funded filtration program can quickly provide safe water to significantly more people than equal direct expenditures on replacing LSLs. Stated simply, funding POU filtration with a tax credit will efficiently allow individuals access to safe water while policymakers struggle with the difficult public health problem of how best to identify and remove lead-containing material in drinking water infrastructure and private plumbing.

A uniform refundable tax credit for all filers is preferable because there is no accurate accounting of at-risk homes. Given the massive number of people whose drinking water passes through lead-containing material, overcorrecting with a uniform credit is necessary for primary prevention because an accurate accounting of at-risk homes could take decades or possibly will never be complete given the obvious challenges of identifying lead material in private plumbing. Implementing a primary prevention policy to protect against the significant, permanent, and irreversible health effects of lead requires immediate action.

A uniform refundable tax credit is also preferred in order to establish POU filtration as a regular cultural practice. Encouraging filtration with a refundable tax credit is the first step to establishing POU filtration as a habit. The more homes that use POU filters, the more likely POU filtration will be seen as a regular and necessary practice. Just as devices to protect public health like smoke alarms are now common,[385] uniform promotion of POU filtration will encourage cultural adoption of filtration as a public health necessity. Excluding individuals based on income or location would necessarily reduce the number of people using POU filtration and frustrate its adoption as a common practice. The consequences of childhood lead exposure and primary prevention policy support promoting POU filtration with the goal of universal adoption in the home. A uniform refundable tax credit would best accomplish this goal.

2. BAT for Filtration in Nonresidential Building Drinking Fountains

Providing a refundable tax credit for individuals will ensure safe drinking water in the home but will not reduce lead in drinking water outside the home. Nonresidential buildings can be a significant source of lead exposure, especially for children in school and day-care.[386] And while some states and local school districts are implementing EPA's 3T testing program,[387] widespread adoption of filtration in schools consistent with primary prevention policy to reduce lead at the tap has not materialized. Requiring nonresidential buildings to install drinking fountains with BAT will fill a regulatory gap for lead in drinking water in public buildings and protect against lead exposure at taps outside the home consistent with primary prevention.

Under the BAT approach, owners and operators of nonresidential buildings would be required to use BAT for filtration when considering the cost of implementation. In practice, covered buildings could satisfy this requirement by installing one of the many drinking fountain stations on the market that filter for lead certified under NSF/ANSI Standard 53.[388] Buildings would have to replace the filters at the end of the useful life, which would be no different than having to replace heating, ventilating, and air-conditioning filters or other routine maintenance on a building. Monitoring and replacing filters fits comfortably in the responsibility of building managers and can be easily implemented.

Using BAT for filtration in drinking fountains in nonresidential buildings would significantly reduce lead and other contaminants at a reasonable cost. A drinking fountain bottle-filling station that includes an NSF/ANSI Standard 53-certified filter costs approximately $1,800 with a filter capacity of 3,000 gallons.[389] Replacement filters cost as little as $57 when purchased in a 12-pack.[390] A filtered drinking fountain without a bottle-filling station costs approximately $750 and has a filter capacity of 1,500 gal-

381. American Water Works Association (AWWA), Buried No Longer: Confronting Americas Water Infrastructure Challenge 3 (2012).
382. AWWA et al., A Cost Effective Approach to Increasing Investment in Water Infrastructure 1 (2011); American Society of Civil Engineers, 2017 Infrastructure Report Card: Drinking Water 2 (2017).
383. AWWA et al., *supra* note 382, at 1.
384. EPA White Paper, *supra* note 127, at 9.
385. *See* Marty Ahrens, Smoke Alarms in U.S. Home Fires 1 (2015).
386. *See, e.g.*, Taylor, *supra* note 253.
387. *See, e.g.*, Alabama Department of Environmental Quality, Determining Lead Levels in Drinking Water Alabama's PK Thru 12 Public Schools Master Plan 1-3 (2017).
388. *See, e.g.*, Elkay, *Elkay Enhanced EZH2O Bottle Filling Station & Single ADA Cooler, Filtered 8 GPH Light Gray*, http://www.elkay.com/drinking-solutions/lzs8wslp (last visited Sept. 28, 2018).
389. *Id.*
390. Amazon, *Elkay 51300C 12-Pack WaterSentry Plus Replacement Filters*, https://www.amazon.com/Elkay-51300C-WaterSentry-Replacement-Filters/dp/B005MEWL60/ref=sr_1_1?ie=UTF8&qid=1539270859&sr=8-1&keywords=Elkay%2B51300C&th=1 (last visited Sept. 28, 2018).

lons.[391] Replacement filters cost approximately $60.[392] After the initial investment in a drinking water station, replacing the filter would be the only recurring cost.

If requiring all drinking fountains to have BAT for filtration is too costly, Congress could limit the filtration requirement to a specified number of drinking fountains per floor or require application of BAT for filtration in buildings primarily serving children like schools and day-care centers. Requiring schools to install BAT for filtration would provide political cover for school districts to spend money on effective filtration rather than unreliable testing programs. Congress could also provide a waiver for owners of buildings that can show that there are no lead-containing materials in drinking water infrastructure and building plumbing. Requiring that waiver applicants show that no lead-containing materials exist may provide the incentive for policymakers to finally do the materials evaluation for lead in drinking water infrastructure that should have been completed decades ago.

Congress likely the authority under the Commerce Clause to require BAT for drinking fountain filtration in nonresidential buildings. Congress has the power to "regulate Commerce . . . among the several States."[393] All economic activity that substantially affects commerce falls under the scope of Congress' authority to regulate commerce.[394] The distribution of drinking water is an economic activity, and the collective effect on commerce of lead exposure through drinking water and benefit from requiring filtration in all nonresidential buildings would easily qualify as substantial.[395] Exposure to lead in drinking water costs the United States billions of dollars annually.[396] The adverse health effects of lead exposure affect many markets, including health care, education, and employment markets, to name a few.[397]

Using BAT to reduce contaminants in the environment is a familiar regulatory approach. The SDWA sets MCLs based on the performance of control technology.[398] Both the Clean Water Act (CWA) and the Clean Air Act (CAA) require technology controls to reduce contaminants in the environment.[399] The CWA requires direct dischargers of regulated pollutants from point sources into the waters of the United States and indirect dischargers into publicly owned treatment works to meet maximum permissible limits based on the performance control technology.[400] The CAA requires that emitters of hazardous air pollutants and new sources of covered pollutants meet emission limits based on the performance of control technology.[401] The CAA also specifically requires major modifications of major emitting sources to apply best available control technology to reduce the emission of covered pollutants.[402] The application of control technology under the CWA and CAA has realized significant reductions of discharges of pollutants into the environment.[403]

Requiring BAT for drinking fountain filtration in nonresidential buildings will effectively and efficiently fill the regulatory gap that allows lead in drinking water at the tap outside the home. Filtration in nonresidential buildings will reach schools and day-care centers where children consume a substantial portion of drinking water. Requiring filtration comes at a modest cost to ensure safe water outside the home for all Americans through a familiar and effective regulatory approach.

VI. Conclusion

The problem of lead in drinking water will persist as long as there are lead-containing materials in drinking water infrastructure and private plumbing. Regulatory efforts to control corrosion are inadequate to prevent lead from leaching into drinking water, and testing for lead in water is inherently unreliable. The LCR suffers from multiple regulatory gaps, and government incompetence and misconduct have exposed entire cities to lead-contaminated water. The problem of lead in drinking water is not limited to high-profile crises like those seen in Washington, D.C., and Flint; it is a problem across the United States. Most significantly, without an accurate accounting of lead-containing materials in drinking water infrastructure and private plumbing, it is impossible to determine which taps are at risk of lead contamination.

The significant, permanent, and irreversible adverse health effects of lead exposure in children at very low levels require a solution to remove lead actually present at the tap consistent with the medical consensus policy of primary prevention; POU filtration is an effective and inexpensive solution. Providing a refundable tax credit to individuals for a filtration system and replacement filters certified for lead reduction under NSF/ANSI Standard 53 will allow individuals to protect themselves from lead

391. Elkay, *Elkay Cooler Wall Mount ADA Filtered, Non-Refrigerated Light Granite*, http://www.elkay.com/lzsdl (last visited Sept. 28, 2018).
392. Home Depot, *WaterSentry VII Coolers and Fountains Replacement Filter for Elkay and Halsey Drinking Fountains*, https://www.homedepot.com/p/Elkay-WaterSentry-VII-Coolers-and-Fountains-Replacement-Filter-for-Elkay-and-Halsey-Drinking-Fountains-51299C/206925498 (last visited Sept. 28, 2018).
393. U.S. Const. art. I, §8, cl. 3.
394. *See, e.g.*, Gonzales v. Raich, 545 U.S. 1, 17 (2005).
395. *See, e.g.*, Wickard v. Filburn, 317 U.S. 111, 128-29 (1942) (finding Congress could regulate consumption of homegrown wheat because cumulative effects would affect the commodity price); *see also Gonzales*, 545 U.S. at 22 (finding Congress could prohibit purely intrastate cultivation and use of marijuana as part of comprehensive legislation to regulate interstate marijuana market).
396. *See* discussion *supra* Section I.C.
397. *Id.*
398. 42 U.S.C. §300g-1(b)(4)(B), (D).
399. 33 U.S.C. §§1251-1387, ELR Stat. FWPCA §§101-607; 42 U.S.C. §§7401-7671q, ELR Stat. CAA §§101-618.
400. 33 U.S.C. §§1311(a)-(b), 1314(b), (d), 1316, 1317.
401. 42 U.S.C. §§7411(a)-(b), 7412(d).
402. *Id.* §7475(a).
403. *See* William L. Andreen, *Water Quality Today—Has the Clean Water Act Been a Success?*, 55 Ala. L. Rev. 537, 569-73 (2004); David A. Keiser & Joseph S. Shapiro, National Bureau of Economic Research, NBER Working Paper No. 23070, Consequences of the Clean Water Act and the Demand for Water Quality 21-22 (2018); U.S. EPA, *Progress Cleaning the Air and Improving People's Health*, https://www.epa.gov/clean-air-act-overview/progress-cleaning-air-and-improving-peoples-health (last updated Aug. 14, 2018).

in drinking water and promote POU filtration to protect public health and provide safe drinking water. Requiring nonresidential buildings to install BAT for filtration will provide the public protection from lead in drinking water from significant sources outside the home like schools, day-care centers, and workplaces. POU filtration will ensure safe drinking water while searching for a solution to the more difficult problem of identifying and removing lead-containing materials from drinking water infrastructure and private plumbing.

If a refundable tax credit were available to the residents of Washington, D.C., and Flint, and nonresidential buildings had filtered drinking fountains during the high-profile lead-contaminated water crises, the significant, permanent, and irreversible health consequences for thousands of children could have been avoided. Many families likely already would have owned and used POU filtration, and those who did not could have quickly purchased a POU filtration system to ensure water without dangerous lead. Parents could send their children to schools and day-care centers that have safe drinking water and adults could use drinking fountains at work without being exposed to toxic lead. A modest investment in POU filtration can prevent the devastating health effects of the next lead crisis and protect individual taps across the country that are delivering dangerous levels of lead today.