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

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Disclaimer

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Abstract

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

Lead exposure through drinking water is an acute and persistent problem in the United States. The Flint, Michigan water crisis brought national attention to the problem of lead in drinking water, but every city in the United States is at risk of a Flint scale crisis where lead containing materials are present in drinking water infrastructure and building plumbing. The adverse health effects of very low levels of lead exposure in children are significant, permanent and irreversible. The costs of lead exposure in the United States are tens of billions of dollars annually. Preventing childhood exposure to lead is the primary policy in the medical community. The Federal Lead and Copper Rule is inadequate to protect public health from lead and inconsistent with primary prevention. The unique difficulty of regulating lead, the inherent unreliability of testing water for lead, specific shortcomings of the Lead and Copper Rule, and government incompetence and misconduct allow dangerous lead to be present in drinking water at the tap across the United States. This thesis describes how and why lead is present at the tap across the United States; the health effects of lead, costs of lead exposure, and primary prevention policy; and why regulatory efforts to control lead are inadequate. This thesis argues that point-of-use filtration to remove lead from drinking water present at the tap is necessary to protect against lead exposure consistent with primary prevention. This thesis specifically recommends that Congress provide a refundable tax credit for individuals to acquire an NSF/ANSI Standard 53 certified filtration system and replacement filters, and require all non-residential buildings to use best available technology for water filtration in drinking fountains.

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INTRODUCTION

Exposure to lead through drinking water is a persistent problem in the United States that poses a serious health risk anywhere where lead is present in drinking water infrastructure or privately owned plumbing. Lead causes significant, permanent and irreversible neurological damage in children at very low levels of exposure. Preventing childhood exposure to lead rather than reacting when children have measurable blood lead levels is now the primary medical-policy for lead exposure in children. The current regulatory approach of the Federal Lead and Copper Rule is insufficient to protect children from lead exposure because of the inherent difficulty of regulating lead and specific limitations of the Lead and Copper Rule allow lead to be present at the tap. Preventing children from being exposed to lead requires promoting point-of-use filtration to remove lead present at the tap. In order to mitigate the wide-spread risk of lead exposure through drinking water across the United States, Congress should enact a refundable tax credit for individuals to acquire an NSF International (NSF)/American National Standards Institute (ANSI) Standard 53 filtration system and replacement filters certified for lead reduction, and require all non-residential buildings to include the best available technology for water filtration in drinking fountains.

For over a year, reports of lead contamination in drinking water dominated the news cycle in a city where 4,075 of 6,118 residences exceeded the Environmental Protection Agency (EPA) action level for lead in drinking water of 15 parts per billion (ppb).[1] Testing found lead levels of 50 ppb in 2,287 residences and 300 ppb in 157

[1] 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.

residences.[2] 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.[3] The Water and Sewer Authority (WASA) for the city was aware of lead contamination for over a year but did not timely inform the public, which learned about the lead contamination from newspaper reporting.[4] 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 health issues.[5] During the lead crisis, late term miscarriages and spontaneous abortions occurred at an unusually high rate.[6] 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 the EPA.[7] 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 today.[8] And another crisis could occur in any city that has lead

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[2] *Id.*
[3] *Id.*
[4] *Id.*
[5] Carol D. Leonnig, *High Lead Levels Found in D.C. Kids; Numbers Rose During Water Crisis*, WASH. POST, Jan 27, 2009, at A1.
[6] 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.
[7] David Nakaruma, *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).
[8] *See, e.g.*, Michael Hawthorne & Cecilia Hayes, *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.

containing material in its drinking water infrastructure and private property plumbing materials.

The threat that lead poses to entire communities through drinking water 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 to protect public health, and government incompetence and misconduct. Lead infrastructure, including up to 6.1 million lead service-lines in drinking water infrastructure and 81 million housing units in the United States constructed prior to 1986 pose a risk of releasing lead and contaminating drinking water at any time. Once ingested, very low levels of lead exposure in children are 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. Health experts also agree that a primary prevention program for childhood lead exposure is the only scientifically defensible policy and the only policy that will protect children from dangerous lead exposure. Significant economic, societal and personal costs result from low levels of lead exposure, costs that disproportionately fall on low-income and minority communities.

The Federal Lead and Copper Rule is inadequate to protect the public from lead in drinking water, particularly children. Lead is difficult to regulate because lead enters drinking water after leaving water treatment plants primarily through corrosion of lead containing material in the drinking water infrastructure and buildings, and cannot be

effectively removed by the public water system before consumption. The Lead and Copper Rule thus addresses lead in water by requiring public water systems to control corrosion, monitor corrosion control efficacy through testing lead levels in water at representative taps, and take remedial measures like lead service-line replacement based on an action level of 15 parts per billion. 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 and testing for lead in drinking water is inherently unreliable.

Beyond the inherent difficultly of regulating lead in drinking water, the Lead and Copper Rule 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 public water systems and states to show compliance with the Lead and Copper Rule 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, Michigan.

Any policy to limit lead in drinking water seriously implementing a primary prevention strategy must include efforts to reduce through filtration any lead present at the tap. Household filtration is 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. Federal and state regulations that react to confirmed presence of lead in drinking water are inconsistent with a primary prevention approach, conflict with current scientific research on the adverse health effects of childhood lead

exposure at very low levels, and are insufficient to protect children from lead exposure at the tap. A Federal refundable tax credit for individuals to purchase an NSF/ANSI Standard 53 certified water filtration system and replacement filters 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 best available technology for filtering water from drinking fountains in non-residential buildings will efficiently protect the public from lead outside the home.

Part One of this thesis will address how lead enters drinking water, the health effects and costs of lead exposure and current medical emphasis on preventing lead exposure in children. Part Two will provide a comprehensive discussion of relevant sections of the Safe Drinking Water Act and specific requirements of the Lead and Copper Rule to address the threat of lead exposure. Part Three will discuss how the Lead and Copper Rule is inadequate to protect public health including the inherent difficulty of regulating and testing for lead, and the specific shortcomings of the Lead and Copper Rule. Part Four will discuss government incompetence and misconduct when implementing the Lead and Copper Rule, and present the Flint water crisis as an illustration of how government incompetence and misconduct can exponentially increase and lengthen the already significant risk of lead exposure in drinking water. Part Five will recommend a robust program of point-of-use filtration to reduce the risk of lead exposure through drinking water financed through a refundable tax credit for individuals and requiring non-residential buildings install best available filtration technology.

I: LEAD IN WATER, HEALTH EFFECTS AND PRIMARY PREVENTION

This section 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 the significant, permanent and irreversible adverse health effects of lead. This section 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 also will provide support for funding a robust private filtration program and requiring filtration in non-residential 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.[9] Humans have used lead pipes in drinking water infrastructure for millennia.[10] Lead pipes were so common in ancient Rome that the word "plumbing" comes from the Latin word for lead, "plumbum."[11] 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.[12] The Reduction of Lead in Water Act banned the use of lead plumbing materials in large

[9] WORLD HEALTH ORG. [WHO], CHILDHOOD LEAD POISONING 15-16 (2010).
[10] Dartmouth Toxic Metals Superfund Research Project, *Lead: A Versatile Metal, Long Legacy*, DARTMOUTH U., https://www.dartmouth.edu/~toxmetal/toxic-metals/more-metals/lead-history.html (last visited Apr. 22, 2018) [hereinafter Dartmouth Research].
[11] Jack Lewis, *Lead Poisoning: A Historical Perspective*, EPA J. (May 1985), https://archive.epa.gov/epa/aboutepa/lead-poisoning-historical-perspective.html (last visited Apr. 22, 2018).
[12] 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).

part,[13] 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.[14] There are at least 6.1 million lead service-lines in drinking water infrastructure serving 15 – 22 million people.[15] The 81 million housing units in the United States constructed prior to 1986 are certain to have lead solder.[16] Housing units constructed after 1986 are likely to have brass plumbing materials 1.5 - 8% lead by weight.[17] 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.[18]

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.[19] Lead leaches into water as dissolved lead or detaches into water as particulate lead.[20] Lead can leach or detach into drinking water from any lead-containing material: pipes in the water

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[13] 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) (2012). 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. 42 U.S.C.§ 300g-6(d)(1).

[14] Triantafyllidou & Edwards, *supra* note 12, at 1302-03.

[15] David A. Cronwell et al., *National Survey of Lead Service Line Occurrence*, 108 J. AM. WATER WORKS ASS'N 182, 182 (2016).

[16] Triantafyllidou & Edwards, *supra* note 12, at 1302-03.

[17] *Id.*

[18] U.S. GOV'T 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 12, at 1302.

[19] Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, 56 Fed. Reg. 26,460, 26,466 (June 7, 1991).

[20] Triantafyllidou & Edwards, *supra* note 12, at 1302-03.

distribution system, building plumbing systems, solder connecting pipes, and even brass and bronze (copper alloys that contain lead) faucets and fixtures.[21] Once lead-containing materials have corroded, lead can leach into water indefinitely.[22]

Exposure to lead in drinking water contributes to elevated blood lead levels.[23] Children, especially infants fed formula, and pregnant women are at particular risk of exposure to lead from drinking water.[24] Recent studies suggest that the risk of lead exposure from water can be significant and greater than previously thought.[25]

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.[26] 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,

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[21] 56 Fed. Reg. at 26,466.
[22] *Id.*
[23] *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 12, at 1328-1335; 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).
[24] U.S. DEP'T OF HEALTH & HUMAN SERVS., TOXICOLOGICAL PROFILE FOR LEAD 220-224 (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).
[25] Simoni Triantafyllidou et al., *supra* note 24 at 67.
[26] Carol D. Leonnig, *Lead Levels in Water Misrepresented Across U.S.*, WASH. POST, Oct. 5, 2004, at A1.

South Carolina.[27] In 2006, testing in Durham and Greenville, North Carolina found lead contamination.[28] In 2015, the National Resources Defense Council reported that 1,100 community water systems serving 3.9 million people reported lead contamination.[29] A USA Today Network investigation found that from 2012-2015 approximately 2,000 water systems servicing 6 million people across all 50 states had lead contaminated water.[30]

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 the lead contamination.[31] In the five years prior to 2017, lead contamination has been found in over two-dozen South Carolina communities.[32] In 2016, lead was still contaminating the water in the Calumet neighborhood of East Chicago, Illinois, seven years after the E.P.A. identified the neighborhood as a lead Superfund site.[33] And schools across the United

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[27] 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?_r=0.
[28] *Id.*
[29] ERIK OLSON & KRISTI P. FEDINICK, WHAT'S IN YOUR WATER? FLINT AND BEYOND 4 (2016).
[30] 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/.
[31] 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.
[32] Sammy Fretwell, *Lead Tainted Water in SC Communities*, TheState.com (Mar. 17, 2016), http://www.thestate.com/news/local/article61283287.html.
[33] 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),

States have drinking fountains providing lead contaminated water.[34] The reported cases of lead contamination and high profile crises are almost certainly just the tip of the iceberg of lead contaminated water.[35] 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.

B. Health Effects of Lead

Lead is extraordinarily toxic to humans.[36] Blood lead levels (BLL)[37] greater than 100 micrograms per deciliter (μg/dL) (1000 ppb) can cause protracted vomiting, encephalopathy and even death.[38] Children are particularly vulnerable to the harmful effects of lead even at very low levels.[39] Children are exposed to lead in greater quantities from age appropriate hand to mouth behavior and they adsorb lead more

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http://www.chicagotribune.com/suburbs/post-tribune/news/ct-ptb-east-chicago-one-year-later-st-0723-20170721-story.html.

[34] *See, e.g.*, Christopher Heimerman, *Water in DeKalb, Sycamore Schools Tests Positive for Lead Contamination*, DAILY CHRONICLE (Jan. 12, 2018), http://www.daily-chronicle.com/2018/01/12/water-in-dekalb-sycamore-schools-tests-positive-for-lead-contamination/an9bdl0/; *see also* Malini Ramaiyer, *6 Berkeley Schools Shut Off Water Source Because of Lead Contamination*, DAILY CALIFORNIAN (Jan. 24, 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.

[35] *See* discussion *infra* III.B, .H.

[36] *See generally*, U.S. ENVTL. PROTECTION AGENCY [EPA], AIR QUALITY CRITERIA FOR LEAD, VOL. I, Chapter 6 (2006) [hereinafter AIR CRITERIA].

[37] 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.*

[38] HHS TOXICOLOGICAL PROFILE, *supra* note 24, at 22-23.

[39] *See* AIR CRITERIA, *supra* note 36, at 6-1, 7-8; HHS TOXICOLOGICAL PROFILE, *supra* note 24, at 220-224.

efficiently than adults.[40] Lead is significantly more toxic to a child's developing brain than an adult.[41] BLLs less than 5 μg/dL (50 ppb) are strongly associated with significant adverse neurological effects: decreased intelligence, lower academic performance, attention deficit disorders, impulse control and behavior problems.[42] Women exposed to lead as children can expose a fetus to lead from lead stored in bone.[43] Lead exposure in utero is correlated with increased instances of fetal death, lower birth weight and cognitive impairment.[44] It is now well-established that there is no known safe level of lead exposure in children.[45] Making matters work, the significant adverse neurological health effects of lead exposure in children are permanent irreversible and most significant at BLLs less than 10 μg/dL (100 ppb).[46]

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

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[40] HHS TOXICOLOGICAL PROFILE, *supra* note 24, at 220-21; WHO *supra* note 9, at 18.
[41] HHS TOXICOLOGICAL PROFILE, *supra* note 24, at 220-224.
[42] NAT'L TOXICOLOGY PROGRAM, U.S. DEP'T OF HEALTH & HUMAN SERVS., NTP MONOGRAPH: HEALTH EFFECTS OF LOW-LEVEL LEAD xviii (2012).
[43] Lidsky & Schneider, *supra* note 37, at 9.
[44] *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 37, at 9-10.
[45] *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 24, at 31.
[46] 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).

loss of $17,815 in the present discounted value of lifetime earnings."[47] 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-70s based on the significant reduction of average BLLs over time.[48] 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.[49] The estimated present value of economic losses for children who were five-years old in 1997 is estimated to be $43.4 billion.[50] With hundreds of thousands of children identified with BLLs greater than 5 μg/dL every year,[51] massive economic losses accrue annually.[52]

Medical studies identifying reduced intelligence, attention-deficit disorders, and reduced impulse control 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.[53] There is a particularly strong correlation between childhood lead exposure and

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[47] Elise Gould, *Childhood Lead Poisoning: Conservative Estimates of the Social and Economic Benefits of Lead Hazard Control*, 117 ENVTL. HEALTH PERSP. 1162, 1164 (2009).
[48] 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).
[49] Gould, *supra* note 47, at 1164.
[50] 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).
[51] *See* Ctrs. for Disease Control and Prevention [CDC], Lead National Surveillance Data (1997-2015), https://www.cdc.gov/nceh/lead/data/national.htm (last visited Apr. 22, 2018).
[52] Landrigan et al., *supra* note 50, at 726.
[53] *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,

murder rates.[54] Confirming cross-section study findings, prospective longitudinal studies have found prenatal and childhood lead exposure associated with adolescent delinquent behavior,[55] and a significant predictor of later adult criminal behavior.[56] Researchers estimate that every 1 μg/dL reduction in blood lead levels in pre-school 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."[57] 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.[58] In addition to the obvious personal and social 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 pre-school BLL.[59]

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

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Environmental Policy as Social Policy? The Impact of Childhood Lead Exposure on Crime, 7 B.E. J. ECON. ANALYSIS & POLICY 1, 33 (2007).

[54] *See* Nevin, *supra* note 53, at 330; Paul B. Stretesky & Michael J. Lynch, *The Relationship Between Lead Exposure and Homicide*, 155 PEDIATRIC ADOLESCENT MED. 579, 580-82 (2001).

[55] Kim N. Dietrich et al., *Early Exposure to Lead and Juvenile Delinquency*, 23 NEUROTOXICOLOGY & TERATOLOGY 511, 514-17 (2001).

[56] *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 MEDICINE 732, 735-737 (2008).

[57] Gould, *supra* note 47, at 1165.

[58] *See e.g.*, Reyes, *supra* note 53, at 36.

[59] Gould, *supra* note 47, at 1165.

was born in August 1989 into a home with peeling and flaking lead paint.[60] In June 1991, at only 22 months old, Freddie's BLL tested at an astonishing 37 μg/dL.[61] Freddie developed attention deficit disorder, was in special education classes his entire academic career and failed to graduate from high school.[62] Freddie's struggles with self-regulation and aggression were clear with frequent school suspensions and more than a dozen arrests.[63] 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.[64] 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.[65] Freddie Gray's death while in police custody caused severe anger and mass protests in Baltimore.[66] Freddie's tragic death received significant news coverage, but is it Freddie's troubled life after severe childhood lead poisoning that is the silent tragedy that children and families face across the United States everyday.

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[60] 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.
[61] *Id.*
[62] *Id.*
[63] *Id.*
[64] *See id.*; Mark Puente & Doug Donovan, *The Truth About Freddie Gray's Pre-existing Existing Injury from Car Accident*, BALT. SUN (Apr. 29, 2015), http://www.baltimoresun.com/news/maryland/bs-md-gray-settlement-20150429-story.html.
[65] 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.
[66] *Id.*

Lead poisoning from exposure to lead contaminated water similarly can ruin lives and terrify communities for years. In Flint, the entire city was traumatized as a result of the two-year lead 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.[67] Some parents of children exposed to lead have suffered nervous breakdowns and contemplated suicide as a result of the crisis.[68] The lead contaminated water in Flint not only was a direct public health crisis, but also a mental health emergency.[69] The personal, familial and community cost of a contaminated water system only begins with drinking the water.[70]

The tragic life of Freddie Gray and drinking water catastrophe in Flint highlight the unfortunate 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.[71] Freddie Gray was an African American who grew up in one of the poorest neighborhoods of Baltimore.[72] Flint's current population is approximately 57% African American and has

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[67] *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.
[68] *Id.*
[69] *See id.*
[70] *See NOVA: Poisoned Water*, (PBS television broadcast May 31, 2017).
[71] *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).
[72] McCoy, *supra* note 60.

struggled with poverty for decades.[73] 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.[74] In 2015, Flint had the highest poverty rate for a city of its size.[75]

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.[76] The recent NHANES documented disparity in lead poisoning is consistent with historic data.[77] Racial disparities in lead exposure are the result of racism and discriminatory policy and practice.[78] Toxic lead exposure is an almost insurmountable impediment to economic advancement perpetuating poverty.[79] 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.

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[73] FLINT WATER ADVISORY TASK FORCE, FINAL REPORT 15 (Mar. 21, 2016).
[74] U.S. Census Bureau, *Quick Facts, Flint, Michigan*, Census.gov, https://www.census.gov/quickfacts/fact/table/flintcitymichigan/PST045216 (last visited Apr. 22, 2018).
[75] Alex Rossman, *Census Data Shows Flint and Detroit Poverty Worst in Nation, People of Color Still Struggling Statewide*, MICH. LEAGUE PUB. POLICY (Sep. 15, 2016), http://www.mlpp.org/census-data-shows-flint-and-detroit-poverty-worst-in-nation-people-of-color-still-struggling-statewide.
[76] ADVISORY COMM. ON CHILDHOOD LEAD POISONING PREVENTION, CTRS. FOR DISEASE CONTROL & PREVENTION, LOW LEVEL LEAD EXPOSURE HARMS CHILDREN: A RENEWED CALL FOR PRIMARY PREVENTION 15 (2012) [hereinafter ADVISORY COMMITTEE].
[77] *See* Benfer, *supra* note 71, at 504.
[78] *See id.* at 505-513.
[79] *See id* at 504-05; Dr. Mona Hanna-Attisha, *Quotation of the Day*, N.Y. TIMES, Jan. 30, 2016, at A2 ("If you were going to put something in a population to keep them down for generations to come it would be lead.").

D. Preventing Childhood Lead Exposure as Primary National Policy

The medical and scientific community agree based on the significant, permanent and irreversible adverse health effects of low-level lead exposure, preventing childhood exposure must be the primary policy to protect children (primary prevention).[80] "Once an elevated blood lead concentration has been detected, it is too late to prevent lead's deleterious effects on the developing brain."[81] 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.[82] In 2012, The Advisory Committee on Childhood Lead Poisoning Prevention of the CDC (The Advisory Committee) recommended eliminating the use of the term blood lead "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.[83] 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."[84]

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.[85] The

[80] CEH, *supra* note 45, at 5; Lidsky & Schneider, *supra* note 37, at 15.
[81] Lidsky & Schneider, *supra* note 37, at 15.
[82] ADVISORY COMMITTEE, *supra* note 76, at 3.
[83] *Id.* at 3-5.
[84] *Id.* at 4.
[85] CTRS. FOR DISEASE CONTROL & PREVENTION [CDC], CDC RESPONSE TO ADVISORY COMM. ON CHILDHOOD LEAD POISONING PREVENTION RECOMMENDATIONS 5-6, 8 (2012) [hereinafter CDC RESPONSE]; CDC, *What Do Parents Need to Know to Protect Their*

CDC now uses a reference level of 97.5th percentile of the NHANES's blood lead distribution to determine which children have blood lead levels that are much higher than the average child.[86] 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.[87] 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.[88]

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.[89] The lead burden of humans today is 500-1000 greater than preindustrial humans.[90] Taking into account lead's wide spread use for several millennia, efforts to reduce human exposure to this toxic metal are fairly recent.[91] The primary regulatory effort in the United States to reduce lead exposure at the tap and subject of the next section is the Lead and Copper Rule promulgated pursuant to the Safe Drinking Water Act.

II: REGULATION OF LEAD IN WATER

This section will discuss how the Lead and Copper Rule (LCR), which implements the Safe Drinking Water Act (SDWA), regulates lead in drinking water. The statutory structure of the SDWA and the specific requirements of the LCR are necessary

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Children, cdc.gov, https://www.cdc.gov/nceh/lead/acclpp/blood_lead_levels.htm (last visited Apr. 22, 2018).
[86] CDC, *supra* note 85.
[87] *Id.* at 7; ADVISORY COMMITTEE, *supra* note 76, at 6.
[88] CDC, *supra* note 85; CEH, *supra* note 45, at 5 WHO, *supra* note 9, at 54.
[89] WHO, *supra* note 9, at 16.
[90] *Id.*
[91] *See* Dartmouth Research, *supra* note 10.

context for understanding how the LCR is insufficient to protect public health from lead in drinking water. This section will discuss first the SDWA generally and next the relevant provisions of the LCR.

A. The Safe Drinking Water Act

The SDWA, codified at 42 U.S.C. § 300f et seq., requires the EPA to establish maximum contaminant level goals and promulgate primary drinking water regulations for contaminants[92] if the EPA determines that "(1) the contaminant may have an adverse effect on the health of persons, (2) 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 (3) 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."[93] National primary drinking water regulations (NPDWR) promulgated under the SDWA apply only to public water systems (PWS).[94] 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."[95] [96] The EPA is required to review and revise NPDWRs every six years.[97]

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[92] Contaminant is defined under the SDWA as "any physical, chemical, biological, or radiological substance or matter in water." 42 U.S.C. § 300f (2016).
[93] 42 U.S.C. § 300g-1(b)(1)(A), (E).
[94] 42 U.S.C. §§ 300f(1)(A), 300g. The SDWA also provides in 42 U.S.C. § 300g for a narrow, limited exception for certain public water systems.
[95] 42 U.S.C. § 300f(4)(A).
[96] Regulatory requirements applicable under the SDWA vary based on the size and type of a public water system. The SDWA divides public water systems into community water systems, which serve users year-round, 42 U.S.C. § 300f(15), and non-community

A maximum contaminant levels goal (MCLG) is the maximum contaminant level "at which no known or anticipated adverse effects on the health of persons occur and which allows an adequate margin of safety."[98] MCLGs are aspirational goals to protect public health, not Federally enforceable standards.[99]

NPDWRs are implemented as a maximum contaminant level (MCL) or a treatment technique.[100] When an MCLG is established for a contaminant, the MCL must be as close to the MCLG as is "feasible" under the SDWA.[101] [102] "Feasible" means the use of the best technology, treatment technique or other means available that the EPA finds after examination for efficacy under field conditions and considering costs.[103] The EPA must conduct a comprehensive cost-benefit analysis for each proposed MCL.[104] When the EPA sets an MCL as an NPDWR, a PWS may not provide water that exceeds the MCL.[105] The EPA has promulgated numerous MCLs codified at 40 C.F.R. §§ 141.60-.66 (2017).

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water systems, which is any public water system that is not a community water system, 42 U.S.C. § 300f(15). For NPDWRs, the 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 serves at least 25 of the same persons over six months per year. 40 C.F.R. § 141.2 (2017).

[97] 42 U.S.C. § 300g-1(b)(9).

[98] 42 U.S.C. § 300g-1(b)(4)(A).

[99] 42 U.S.C. §§ 300(f)(1), 300g, 300g-1(b)(4)(A); 40 C.F.R. § 141.2.

[100] 42 U.S.C. § 300g-1(b)(3)(C)(i)-(ii), (4)(B), (7).

[101] 42 U.S.C. § 300g-1(b)(4)(B).

[102] The 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. 42 U.S.C. § 300g-1(b)(5), (6).

[103] 42 U.S.C. § 300g-1(b)(4)(D).

[104] 42 U.S.C. § 300g-1(b)(3)(C).

[105] 42 U.S.C. § 300g-3(a), (b), (g).

The EPA may use a treatment technique rather than an MCL for a NPDWS if it is not economically or technologically feasible to determine the level of the contaminant.[106] When using a treatment technique, the EPA must identify treatment techniques that "would prevent known or anticipated adverse effects on the health of persons to the extent feasible."[107] The EPA must conduct the same cost-benefit analysis required for an MCL when establishing a treatment technique as a NPDWR.

The EPA is required to identify technologies that will meet MCLs.[108] For small PWSs, the EPA must identify technologies that comply with MCLs and treatment techniques.[109] Like other major environmental legislation, however, PWSs are not required to use a specific technology to meet the contaminant levels required under an MCL.[110]

The SDWA utilizes cooperative federalism to enforce the SDWA. States have primary enforcement authority of the SDWA when a proper application is made to the EPA.[111] 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.[112] The SDWA does not prohibit states from

[106] 42 U.S.C. § 300g-1(b)(7).
[107] *Id.*
[108] 42 U.S.C. § 300g-1(b)(4)(E)(i).
[109] 42 U.S.C. § 300g-1(b)(4)(E)(ii)-(iii).
[110] 42 U.S.C. § 300g-1(b)(4)(E)(i).
[111] 42 U.S.C. § 300g-2.
[112] 42 U.S.C. § 300g-2(a).

further regulating drinking water or PWSs.[113] All states have assumed primary enforcement authority except Wyoming and the District of Columbia.[114]

B. The Lead and Copper Rule

The EPA's LCR, codified at 40 C.F.R. §§ 141.80 et seq., was first promulgated in 1991 and remains largely unchanged in its substantive requirements.[115] The LCR established a health-based MCLG of zero for lead[116] and a treatment technique relying primarily on corrosion control but also includes source water treatment, lead service-line (LSL) replacement and public education.[117] PWSs are generally required to "install and operate optimal corrosion control treatment."[118] The LCR requires source water treatment and public education about lead risks and mitigation when a PWS exceeds the "action level" for lead.[119] 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 mg/L (15 ppb), which is met when the 90th percentile[120] from sampling required under the LCR is greater 0.015 mg/L (15 ppb).[121]

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[113] 42 U.S.C. § 300g-3(e).

[114] MARY TIEMANN, CONGRESSIONAL RESEARCH SERVICE, SAFE DRINKING WATER ACT (SDWA): A SUMMARY OF THE ACT AND ITS MAJOR REQUIREMENTS 17 (2017).

[115] 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. 26,460 (June 7, 1991).

[116] 40 C.F.R. § 141.51(b). Optimal corrosion control treatment is defined at 40 C.F.R. § 141.2. Further requirements for optimal corrosion control under the LCR are contained in 40 C.F.R. §§ 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.

[117] 40 C.F.R. § 141.80(b).

[118] 40 C.F.R. § 141.80(d).

[119] 40 C.F.R. § 141.80(e)–(g).

[120] 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* 40 C.F.R. § 141.80(c)(3). For 30 samples (30×0.9 = 27), sample

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."[122] 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.[123]

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."[124] When testing exceeds the lead action level despite optimal corrosion control treatment, the PWS must replace per year at least seven percent of the LSLs under PSW control.[125] 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.[126] As part of a LSL replacement program, the PWS must offer to replace privately owned LSLs but is not required to pay replacement costs.[127] 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.[128]

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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.

[121] 40 C.F.R. § 141.80(c)(1).

[122] 56 Fed. Reg. at 26,490.

[123] *Id.*; U.S. ENVTL. PROTECTION AGENCY OFFICE OF WATER, LEAD AND COPPER RULE REVISIONS WHITE PAPER 6 (2016) [hereinafter EPA WHITE PAPER].

[124] 40 C.F.R. § 141.81(b).

[125] 40 C.F.R. § 141.84(b).

[126] 40 C.F.R. § 141.84(c), (f).

[127] 40 C.F.R. § 141.84(d).

[128] *Id.*

The LCR relies on testing to determine whether a PWS exceeds the lead action level, and for medium and small PWS, 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."[129] Community water systems are required to identify whether lead materials are present in the water distribution system and home plumbing.[130] PWSs generally are 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.[131] For community water systems, the PWS must use water samples from single-family structures when available.[132] Taking together, these testing requirements attempt to require testing from sources of drinking water most likely to leach lead.[133]

Sample collection techniques are proscriptive and specific.[134] Testing samples generally must be one-liter first-draw samples after water stands motionless in the plumbing system for six hours.[135] PWSs may allow residents to collect samples after providing proper instruction, which can be written.[136] The number of samples a PWS must collect varies based on the number of people served, ranging from 5 samples for PWS serving at most 5 people to 100 samples for PWSs serving greater than 100,000

[129] 40 C.F.R. § 141.86(a)(2).
[130] 40 C.F.R. § 141.42(d).
[131] 40 C.F.R. § 141.86(a).
[132] 40 C.F.R. § 141.86(a)(3).
[133] U.S. ENVTL. PROTECTION AGENCY, LEAD AND COPPER RULE – CLARIFICATION REQUIREMENT FOR COLLECTING SAMPLES AND CALCULATING COMPLIANCE 2 (Nov. 23, 2004) [hereinafter EPA CLARIFICATION].
[134] *See* 40 C.F.R. § 141.86(b).
[135] 40 C.F.R. § 141.86(b)(3).
[136] 40 C.F.R. § 141.86(b)(2); EPA CLARIFICATION, *supra* note 133, at 2; *see* MICH. DEP'T OF ENVTL QUALITY, DRINKING WATER LEAD AND COPPER SAMPLING INSTRUCTIONS (May 2016).

people.[137] Samples collected in addition to required samples must be included in the sample set for determining the 90th percentile sample.[138] 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.[139] States may not invalidate a sample solely because a subsequent sample tested at a different level.[140] States also are not allowed to invalidate a resident collected sample because of collection errors.[141]

PWSs must collect and test the required number of samples from the required sources every six months.[142] Any PWSs 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.[143] 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.[144] 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.[145] The LCR provides for specific months when PWS must draw samples for reduced monitoring.[146] Small PWSs may test once every nine years if the

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[137] *See* 40 C.F.R. § 141.86(c).
[138] 40 C.F.R. § 141.86(e).
[139] 40 C.F.R. § 141.86(f)(1).
[140] 40 C.F.R. § 141.86(f)(3).
[141] 40 C.F.R. § 141.86(b)(2); EPA CLARIFICATION, *supra* note 133, at 6.
[142] 40 C.F.R. § 141.86(d)(1).
[143] 40 C.F.R. § 141.86(d)(4)(ii). Small and medium PWSs must meet only the lead and copper action level to qualify initially for annual testing. 40 C.F.R. § 141.86(d)(4)(i).
[144] 40 C.F.R. § 141.86(d)(4)(iii).
[145] 40 C.F.R. § 141.86(d)(4)(v).
[146] 40 C.F.R. § 141.86(d)(4)(iv) (states can approve different draw times).

system can show that there are no plastic pipe or service lines with lead plasticizers; pipes, service lines, solder joints and fixtures are lead free within the definition of the SDWA, and the 90th percentile of lead does not exceed 0.005 mg/L (5 ppb).[147]

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, the 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.[148] The 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 to children from BLLs less than 10 μg/dL (100 ppb).[149] Moreover, the LCR's primary reliance on reducing lead content in water through controlling corrosion measured through testing is inconsistent with a primary prevention approach to lead exposure.[150] 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.[151] 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 section.

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[147] 40 C.F.R. § 141.86(g).
[148] 56 Fed. Reg. at 26,491.
[149] *See* discussion *supra* I.B.
[150] *See* discussion *supra* I.D.
[151] *See id.*

III: THE INADEQUACY OF THE LEAD AND COPPER RULE

This section will discuss 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 point-of-use filtration with a refundable tax credit for individuals and require filtration in drinking fountains in non-residential buildings. Lead poses a unique regulatory problem based on how and when lead enters drinking water and because testing for lead is inherently unreliable. In addition to the inherent difficulty of regulating lead and unreliability of testing, the LCR has specific provisions and gaps that exacerbate the inherent 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 with the LCR. 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.[152] 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 works.[153] Lead can leach into

[152] *See* 56 Fed. Reg. at 26,471.
[153] Sheldon Masters et al., *Inherent Variability in Lead and Copper Collected During Standardized Sampling*, ENVTL. MONITORING & ASSESSMENT, Feb. 20, 2016, at 1;

drinking water from any lead-containing material from treatment to the tap: pipes in the water distribution system, building plumbing systems, solder containing lead that connects pipes, and even brass and bronze faucets and fixtures that contain lead.[154] Once lead-containing materials have corroded, lead can leach into water indefinitely.[155]

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.[156] Total alkalinity, pH, dissolved inorganic carbonate, calcium, hardness, temperature, free chlorine, total dissolved solids and dissolved oxygen all contribute to the corrosivity of water.[157] 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.[158] All water is corrosive and will corrode lead-containing materials over time.[159]

The EPA recognized the difficulty inherent in regulating lead with an MCL.[160] 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

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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 26,463.

[154] 56 Fed. Reg. at 26,466.

[155] *Id.*

[156] Masters et al., *supra* note 153, at 2; 56 Fed. Reg. at 26,463, 466.

[157] 56 Fed. Reg. at 26,466.

[158] *Id.* at 26,473.

[159] *Id.* at 26,466.

[160] *Id.* at 26,471.

SDWA.[161] An MCL measured when drinking water leaves the water treatment plant would remove little to no lead in drinking water.[162] 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.[163] And the variability of lead at the tap and source water quality across PWSs make applying a single MCL applicable to all PWSs infeasible.[164] The Court of Appeals for the District of Columbia thus found in a challenge from the NRDC that the 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."[165]

The 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, often 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 public water systems, required.[166] Relying on

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[161] *Am. Water Works Ass'n v. EPA*, 40 F.3d 1266, 1269 (D.C. Cir. 1994); 56 Fed. Reg. at 26,476.
[162] 56 Fed. Reg. at 26,475.
[163] *Id.* at 26,472-473.
[164] *See* 56 Fed. Reg. at 26,472-477, 487.
[165] *Am. Water Works Ass'n*, 40 F.3d at 1271.
[166] *See* discussion *supra* II.B; Del Toral et al., *supra* note 153, at 9304.

testing for lead at the tap, however, is insufficient to measure the individual and system 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.[167] A single test for lead provides reliable information about the lead content of water at the tap only for the specific sample.[168] Subsequent tests could yield significantly different results even when water quality does not change.[169] Multiple field studies have found highly variable lead concentrations in sequential drinking water samples from the same tap and across taps in PWSs using different corrosion control techniques.[170] 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

[167] Masters et al., *supra* note 153, 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.
[168] *See* Masters et al., *supra* note 153, at 2; Del Toral et al., *supra* note 153, at 9304.
[169] *See* Masters et al, *supra* note 153, 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 153, at 9304.
[170] *See* Del Toral et al., *supra* note 153, 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).

the plumbing materials themselves."[171] Reliably measuring the risk of system-wide lead exposure in a PWS, thousands more tests would be necessary than required under the LCR and at greater frequency.[172] Even then, reliability would be far from assured.[173] What can be assured, however, is that one-time testing from multiple taps in a system is insufficient to determine whether water is safe.[174]

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.[175] 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.[176] 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.[177]

Individual sample collection generally underestimates significantly the peak lead level in water. One study of five sampling techniques designed to determine the best

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[171] Masters et al., *supra* note 153, at 12 (emphasis added).
[172] *Id.*
[173] *See id.*
[174] *See id.*; Del Toral et al., *supra* note 153, at 9304.
[175] *See generally* Del Toral et al., *supra* note 153.
[176] *Id.* at 9304-05.
[177] *Id.* at 9303.

collection procedure[178] found that none of the techniques were proficient.[179] The best method came within 70% of the peak lead concentration only 48% of the time and came within 30% of peak lead concentration 30% of the time.[180] For example, a lead test measuring .010 mg/L (10 ppb) would miss the peak lead level of .033 mg/L (33 ppb) on at least 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.[181] The unreliability of the first-draw method is consistent with prior studies.[182]

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.[183] Making matters worse, particulate lead release is particularly erratic, and it is close to impossible to identify particulate release risk through testing.[184] 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.[185] The process that causes lead to flake off into water is different than leaching and lacks sufficient research to prevent particulate lead release.[186]

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[178] 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).
[179] WATER RESEARCH FOUNDATION, EVALUATION OF LEAD SAMPLING STRATEGIES 48-49 (2015).
[180] *Id.*
[181] *Id.*
[182] Del Toral et al., *supra* note 153, at 9302-03.
[183] Triantafyllidou & Edwards, *supra* note 12, at 1316-18.
[184] *Id.* at 1317.
[185] *Id.* at 1318.
[186] *Id.*

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.[187] 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.[188] 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.[189] Flint had not completed a materials evaluation prior to its water crisis.[190] As a result, Flint did not know which homes were at risk for lead exposure or even how many homes were affected.[191] 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

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[187] *See* 40 C.F.R. § 141.86(a).
[188] *See* GAO, *supra* note 18, at 26-27.
[189] *Id.* at 27.
[190] FLINT WATER ADVISORY TASK FORCE, FINAL REPORT 44 (Mar. 21, 2016).
[191] *See id.*; Anthony Delany, *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.

still speculation."[192] Even if states do have a full materials evaluation, the LCR does not require states report this information to the EPA and 13 states have refused to provide this information even if it were available.[193] 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 primary reasons that the EPA promulgated a NPDWR as a treatment technique instead of using an MCL.[194] The 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."[195] 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."[196] The unreliability of testing is one of the many ways the LCR does not adequately protect public health. The next six subsections address specific deficiencies of the LCR.

C. The Lead and Copper Rule 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

[192] *Id.*
[193] GAO, *supra* note 18, at 26.
[194] 56 Fed. Reg. at 26,473
[195] *Id.*
[196] *Id.*

applicable, under the LCR are not required at that time.[197] 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.[198]

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.[199] Eight PWS 90th percentile test were above 15 ppb and one PWS tested at 110 ppb.[200] Another 16 PWSs 90th percentile tests were 10 ppb or greater.[201] 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.[202] The City of Philadelphia, Pennsylvania also advertises the EPA action level as a safety standard.[203] 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.[204]

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[197] 40 C.F.R. § 141.80(d)-(g).
[198] *See* discussion *infra* II.B.
[199] Ark. Dep't of Health, *Lead Test Results*, healthy.arkansas.gov, http://www.healthy.arkansas.gov/images/uploads/pdf/drinking-water-LeadMonitoringResults.pdf.
[200] *Id.*
[201] *Id.*
[202] Ark. Dep't of Health, *Public Water Systems FAQS*, health.arkansas.gov, http://www.healthy.arkansas.gov/programs-services/topics/drinking-water-public-water-system-faqs.
[203] City of Phila., *Lead in Drinking Water*, Phila.gov, http://www.phila.gov/water/wu/drinkingwater/pages/leadinfo.aspx.
[204] *Id.*

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.[205] Setting the action level at the 90th percentile allows individual taps to test above the action level with no limit. The Table below is a chart of hypothetical monitoring results at and above the 90 percentile from a community water system that would not trigger additional corrosion control, LSL replacement or public education requirements.

Table: Hypothetical Lead Monitoring Results

Sample percentile	Lead Concentration (Parts per billion)
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	1000
91	500
90	14

[205] U.S. ENVTL. PROTECTION AGENCY, 3TS FOR REDUCING LEAD IN DRINKING WATER IN SCHOOLS, REVISED TECHNICAL GUIDANCE 12 (Oct. 2006) [hereinafter EPA 3T REVISED TECHNICAL GUIDANCE].

Although LCR compliant, this hypothetical example is 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,[206] 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 allowing dangerous lead levels in drinking water for years.[207] Reduced monitoring has resulted in delayed responses to toxic lead exposure in drinking water. In 2011, two homes in Brick Township, New Jersey, which qualified for triennial testing, tested over 15 ppb.[208] 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.[209] 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.[210] Treating roads with salt increased chloride in Brick Township's source water, which in turn caused pipes to

[206] *See* 40 C.F.R. § 141.86(c).
[207] Del Toral et al., *supra* note 153, at 9305.
[208] 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?_r=0.
[209] *Id.*
[210] *Id.*

corrode.[211] Corrosion went undetected because of reduced monitoring and caused the alarming amounts of lead to leach into Brick Township's drinking water.[212]

The water crisis in Washington, D.C. also highlights the potential danger of triennial monitoring. In both cities, 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.[213] Using chloramine to disinfect had the unintended consequence of corroding the water distribution system and caused lead to leach into the drinking water. Within 8 months, the 90th percentile sample in Washington, D.C. exceed 15 ppb.[214] By December 2001, the 90th percentile sample was almost 80 ppb,[215] with some homes testing at 20 times the EPA action level.[216]

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.[217] In total, 42,000 children in Washington, D.C. from 2001-2004 are at risk of life long health consequences from lead exposure through drinking water.[218] The Washington, D.C. water crisis, which was 20-30 times worse than Flint,[219]

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[211] *Id.*
[212] *Id.*
[213] Marc Edwards et al., *supra* note 23, at 1618.
[214] *Id.* at 1619.
[215] *Id.*
[216] Wines & Schwartz, *supra* note 208.
[217] Edwards et al., *supra* note 23, at 1618, 21; Edwards, *supra* note 44, at 741-42.
[218] Leonnig, *supra* note 5.
[219] 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),

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.[220] PWSs satisfy this requirement with an instruction sheet accompanying testing materials,[221] which materially differ between PWSs.[222] 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.[223] Many PWSs face challenges getting properly collected samples from residents and lack the resources necessary to ensure proper sampling.[224] Compounding this problem, studies show that in order to capture peak lead levels, more sophisticated procedures are necessary,[225] which will increase the likelihood of collection errors from resident sampling.[226] If researchers with expertise in corrosion and water sampling have difficulty capturing peak lead concentration from water samples,[227] using residents to collect samples further undermines the reliability of testing.

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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.

[220] Del Toral et al., *supra* note 153, at 9301.

[221] *See, e.g.*, MICH. DEP'T OF ENVTL. QUALITY, DRINKING WATER LEAD AND COPPER SAMPLING INSTRUCTIONS (May 2016); ILL. ENVTL. PROTECTION AGENCY, LEAD/COPPER SAMPLE COLLECTION INSTRUCTIONS (Feb. 2016).

[222] Del Toral et al., *supra* note 153, at 9301.

[223] WATER RESEARCH FOUNDATION, *supra* note 179, at xv.

[224] *Id.*

[225] *Id.*; *see, generally*, Del Toral et al., *supra* note 153.

[226] WATER RESEARCH FOUNDATION, *supra* note 179, at xv.

[227] *See generally* WATER RESEARCH FOUNDATION, *supra* note 179.

The LCR compounds resident collection error by prohibiting PWSs from excluding a sample based on collection error.[228] This part of the rule was intended to prevent PWSs from excluding samples with a high lead concentration to lower the 90th percentile.[229] The EPA interprets this rule strictly and does not let PWSs exclude samples even it is likely that sampling error would result in underreporting lead concentration.[230] A sampling procedure designed to capture peak lead would leave little room for error and result in underreporting lead content in most cases.[231] Even under the current testing protocols, errors like collecting samples after flushing the tap would result in underreporting lead content in the water.[232] 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. Lead Service-Line 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 action level.[233] Allowing a PWS to pause a 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 and likely risk of increased lead exposure to individual homeowners. The LCR LSL replacement program

[228] 40 C.F.R. § 141.86(b)(2).
[229] EPA CLARIFICATION, *supra* note 133, at 2.
[230] *Id.* at 6.
[231] *See* WATER RESEARCH FOUNDATION, *supra* note 179, at xv.
[232] EPA CLARIFICATION, *supra* note 133, at 2.
[233] 40 C.F.R. § 141.84(f).

requires the PWS to replace the PWS's owned portion of an LSL even if a homeowner elects not to replace the privately owned portion of the LSL.[234] Disturbance of LSLs causes a sharp increase in lead leaching into drinking water and can persist for years.[235] A PWS is required to offer to replace at homeowner expense the privately owned portion of an LSL when replacing the publically owned portion.[236] Homeowners are unlikely to pay for an expensive LSL replacement project if unaware of the full extent of increased lead exposure from partial replacement. Partial LSL replacement therefore is likely not to mitigate lead exposure but rather increase lead exposure.[237]

G. First-Draw Samples

The 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.[238] First-draw samples usually are not effective in determining the risk of lead exposure at the tap.[239] First-draw samples significantly underestimate peak lead levels in drinking water about 70% of the time.[240] 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.[241] Sequential sampling and testing multiple liters of water after stagnation is the only way to measure peak lead

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[234] 40 C.F.R. § 141.84(d).
[235] *See* Del Toral et al., *supra* note 153, at 9304-05.
[236] 40 C.F.R. § 141.84(d).
[237] *See id.*
[238] 40 C.F.R. § 141.86(b)(1); EPA 3T REVISED TECHNICAL GUIDANCE, *supra* note 205, at 12; U.S. ENVTL. PROTECTION AGENCY, 3TS FOR REDUCING LEAD IN DRINKING WATER IN CHILD CARE FACILITIES: REVISED GUIDANCE 10 (Dec. 2005).
[239] WATER RESEARCH FOUNDATION, *supra* note 179, at 48-49; *see* Del Toral et al., *supra* note 153, at 9302-03 (collecting studies finding first-draw samples unreliable to measure peak lead concentration).
[240] WATER RESEARCH FOUNDATION, *supra* note 179, at 48-49.
[241] *Id.*

with any reliable accuracy.[242] The LCR essentially requires that PWSs collect samples that significantly underestimates 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 Lead and Copper Rule 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.[243] The Washington D.C. Water and Sewer Authority employed all of these techniques at some point since 2002.[244] Philadelphia, a city where 10% of children still have BLLs greater than 5 μg/dL (50 ppb), instructs residents to pre-flush the tap prior to the stagnation period, remove aerators prior to sampling, and use a low water flow during sampling.[245] In Flint, pre-flushing and small mouth bottles contributed state lead testing results (90th percentile at 11 ppb)

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[242] *See id.*; Clark et al., *supra* note 169, at 6837.
[243] MARC EDWARDS ET AL., GAPS IN THE EPA LEAD AND COPPER RULE THAT CAN ALLOW FOR GAMING COMPLIANCE: DC WASA 2003-2009 2-4 (Oct. 2009).
[244] *Id.*
[245] 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.

markedly below the levels of private testing conducted at Virginia Tech (25 ppb).[246] In Durham, North Carolina in 2006, a child was lead poisoned from drinking water despite tests showing compliance with the LCR.[247] Durham was removing aerators prior to sampling.[248] In 2016, when New York City stopped pre-flushing, taps exceeding the EPA action level increased by nine times.[249] 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, fourteen over 1,000 ppb, a drinking fountain over 3,680 ppb and a classroom faucet over 32,500 ppb.[250] These are only a few examples of practices that persist across the United States undermining already unreliable lead testing programs.[251]

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[246] FLINT WATER ADVISORY TASK FORCE, FINAL REPORT 8, 18, 29, 20-21, 44 (Mar 21, 2016); Flint Water Study, *Our Sampling of 252 Homes Demonstrates a High Lead in Water Risk: Flint Should be Failing to Meet the EPA Lead and Copper Rule*, flintwaterstudy.org (Sep. 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/.

[247] Renner, *supra* note 23, at 544, 47.

[248] *Id.* at 547.

[249] 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?rref=collection%2Ftimestopic%2FLead&action=click&contentCollection=timestopics&region=stream&module=stream_unit&version=latest&contentPlacement=9&pgtype=collection.

[250] *Id.*

[251] *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 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.

These collection techniques that reduce lead concentration are legal. The EPA issued guidance in 2016 recommending that PWSs conduct sampling with wide-mouth bottles and that sampling instruction not include directions to remove aerators or pre-flush.[252] 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 the EPA had not issued clear guidance on testing, they never received a memo from the EPA or that the sampling techniques are not illegal.[253] The only real accountability in faithfully administering lead testing programs for PWSs and even state regulatory agencies is political. Political pressure often encounters government resistance and forces change only after tragic lead exposure to entire communities.[254] And given the history of government incompetence and misconduct in administering the LCR discussed in the next section, 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 section will discuss 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. Government incompetence and misconduct strongly supports funding private filtration so individuals can protect themselves from lead in drinking water in the home and requiring filtration in drinking fountains in non-residential buildings. This section will first discuss how LCR

[252] U.S. ENVTL. PROTECTION AGENCY, CLARIFICATION OF RECOMMENDED TAP SAMPLING PROCEDURES FOR PURPOSES OF THE LEAD AND COPPER RULE (Feb. 29, 2016).
[253] Milman & Glenza, *supra* note 251.
[254] *See NOVA: Poisoned Water*, (PBS television broadcast May 31, 2017).

violations throughout the nation exacerbate the threat of lead exposure and next provide the Flint water crisis as an example of how government incompetence and alleged official misconduct has resulted in wide-spread lead poisoning.

A. Lead and Copper Rule Violations

Failing to collect samples for testing from high-risk taps is a particular problem in the administration of the LCR. Washington, D.C. intentionally employed this technique in 2003 and refused to make pubic the sampling pool in order to avoid LSL replacement requirements.[255] 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 Natural Resources Defense Council Report, in 2015 "over 18 million people were served by 5,363 community water systems that violated the [LCR]."[256] PWS violations ranged from failing to test properly for lead and water conditions, failing to report violations to state officials, and failure to implement corrosion control.[257] This number only includes detected violations, which 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.[258] Making matters worse, the EPA and states authorities with primary enforcement authority took no formal enforcement action for nearly 90% of violations and only 3% resulted in

[255] MARC EDWARDS ET AL., *supra* note 243, at 2.
[256] OLSON & FEDINICK, *supra* note 29, at 5.
[257] *Id.*
[258] *Id.*

penalties.[259] This anemic enforcement rate likely contributed to a culture of non-compliance 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 with Governor Rick Snyder stripping Flint's city council of power and appointing an emergency manager to fix Flint's fiscal problems.[260] In June 2013, using his power as emergency manager, Mr. Edward Kurtz unilaterally decided to switch Flint's water source to the Flint River from Lake Huron treated water from Detroit.[261] On April 25, 2014, Flint officially switched its water source to the Flint River.[262] Nine days prior, Michael Glasgow of the Flint Utilities Department emailed the Michigan Department of Environmental Quality warning that the Flint water treatment plant was not prepared to handle the switch.[263] 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.[264]

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 over 70 cases of Legionellosis were reported in

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[259] *Id.* at 6.
[260] FLINT WATER ADVISORY TASK FORCE, FINAL REPORT 39 (Mar. 21, 2016) [hereinafter FWATF FINAL REPORT]; *NOVA: Poisoned Water*, (PBS television broadcast May 31, 2017).
[261] FWATF FINAL REPORT, *supra* note 260, at 17, 40.
[262] *NOVA: Poisoned Water, supra* note 260.
[263] FWATF FINAL REPORT, *supra* note 260 at 17.
[264] *NOVA: Poisoned Water, supra* note 260.

Flint resulting in 12 deaths.[265] In October 2014, General Motors switched its water source back to Lake Huron because water was corroding engine parts.[266] 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.[267] Emergency Manager Darnell Earley, replacing Mr. 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.[268] 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.[269]

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.[270] Ms. Walters' water tested at 104 and 397 ppb for lead.[271] Flint officials insisted that Ms. Walters water was an isolated problem, not systemic.[272] Ms. Walters contacted Miguel Del Toral at the EPA and shared the results of her lead test.[273] In February 2015, Mr. Del Toral contacted the Michigan Department of Environmental Quality (MDEQ) to determine whether Flint was using

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[265] *Id.*; FWATF Final Report at 17.
[266] *NOVA: Poisoned Water, supra* note 260.
[267] *Id.*
[268] FWATF FINAL REPORT, *supra* note 260, at 17-18.
[269] *NOVA: Poisoned Water, supra* note 260.
[270] *Id.*
[271] *Id.*
[272] *Id.*
[273] *Id.*

corrosion control and informed MDEQ that corrosion control was required.[274] The MDEQ told Mr. Del Toral that Flint was using corrosion control.[275] Ms. Walters then found through her document requests a water monthly operational report showing that Flint was not treating water with corrosion control.[276] Ms. Walters shared the report with Mr. Del Toral who again contacted the MDEQ about the use of corrosion control in Flint's water system.[277] In April 2015, the MDEQ informed Mr. Del Toral that Flint was not using corrosion control.[278] Mr. Del Toral again informed the MDEQ that the LCR requires corrosion control for Flint.[279]

As lead continued to leach into Flint's drinking water, public protests escalated in Flint with no government response.[280] In June 2015, Mr. Del Toral, frustrated with the 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.[281] Mr. Del Toral provided a copy to Ms. Walters who sent the report to the press.[282] The disclosure did not trigger government action to protect the residents of Flint.[283] Instead, the Michigan MDEQ dismissed Mr. 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

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[274] *Id.*; FWATF FINAL REPORT, *supra* note 260, at 18.
[275] FWATF FINAL REPORT, *supra* note 260, at 19; *NOVA: Poisoned Water, supra* note 260.
[276] *NOVA: Poisoned Water, supra* note 260.
[277] *Id.*
[278] *Id.*
[279] FWATF FINAL REPORT, *supra* note 260, at 19.
[280] *NOVA: Poisoned Water, supra* note 260.
[281] *Id.*; FWATF FINAL REPORT, *supra* note 260, at 20.
[282] *NOVA: Poisoned Water, supra* note 260.
[283] *Id.*

water in Flint can relax."[284] The EPA did not take any action or even require that MDEQ force Flint to implement corrosion control.[285] Instead, EPA Region 5 administrator Susan Hedman apologized to Flint's mayor for the release of Mr. Del Toral's report and the mayor went on television telling residents that Flint water was safe to drink.[286] The MDEQ described Mr. Del Toral as a "rogue employee" and said that Mr. Del Toral had been "handled."[287]

In Summer 2015, Ms. Walters contacted Dr. Marc Edwards at Virginia Tech University to perform lead tests on her water.[288] Ms. Walters took 30 samples with some testing as high as 13,280 ppb.[289] 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 11ppb for testing from January-July 2015.[290] 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.[291] Flint specifically excluded samples from Ms. Walters' home from the sampling pool.[292]

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[284] *Id.*; FWATF FINAL REPORT, *supra* note 260, at 20.
[285] FWATF FINAL REPORT, *supra* note 260, at 51.
[286] *NOVA: Poisoned Water, supra* note 260.
[287] *Id.*
[288] *Id.*
[289] *Id.*
[290] *Id.;* FWATF FINAL REPORT, *supra* note 260, at 19-20.
[291] FWATF FINAL REPORT, *supra* note 260, at 44, 51; *NOVA: Poisoned Water, supra* note 260.
[292] FWATF FINAL REPORT, *supra* note 260, at 29; *NOVA: Poisoned Water, supra* note 260.

Ms. Walters and Dr. Edwards then organized a private lead testing program collecting 300 representative samples throughout Flint.[293] On September 8, 2015, Virginia Tech completed testing on 252 samples and found the 90th percentile of lead at 25 ppb.[294] Several samples tested over 100 ppb and one sample tested over 1,000 ppb.[295] 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.[296] Dr. Edwards estimated that 40% of homes in Flint had lead contamination above 15 ppb.[297] Instead of acting to protect the residents of Flint, the MDEQ disputed Virginia Tech's findings.[298]

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.[299] 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.[300] Instead of recognizing Dr. Hanna-Attisha'a study as consistent with and supporting Dr. Edwards water test results, the State of Michigan disputed Dr. Hannah-Attisha's study.[301] It was not until September 2015 when Dr. Eden Wells, Chief Medical Officer of the Michigan Department of Health and Human Services (MDHHS), concluded that Dr.

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[293] *NOVA: Poisoned Water, supra* note 260.
[294] FWATF FINAL REPORT, *supra* note 260, at 21.
[295] *Id.*
[296] FWATF Final Report at 21; *NOVA: Poisoned Water, supra* note 260.
[297] *NOVA: Poisoned Water, supra* note 260.
[298] *Id.*
[299] *Id.*
[300] Hanna-Attisha et al., *supra* note 23, at 283.
[301] *NOVA: Poisoned Water, supra* note 260.

Hannah-Attisha's research was sound that Flint, the State of Michigan and the EPA began to take Flint's water crisis seriously.[302] 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.[303]

The Flint water crisis represents government malfeasance and incompetence at its worst. At every level of government from Flint to the 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 the community's health in making a risky switch in water source to the Flint River and then ignored clear evidence of dangerous and contaminated water.[304] 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 State legal counsel recommended.[305]

The Flint Utilities Department was not prepared to handle the complicated task of treating river water for public consumption.[306] 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.

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[302] *See* FWATF FINAL REPORT, *supra* note 260, at 21; *NOVA: Poisoned Water, supra* note 260.
[303] FWATF FINAL REPORT, *supra* note 260, at 21.
[304] *Id.* at 40.
[305] *Id.* at 17-18.
[306] *Id.* at 43-44.

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 the EPA about it 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 the EPA.[307] The MDEQ waited months before accepting the 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.[308] 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.[309] MDEQ's illegal acts, incompetence and sustained dissemination of false information directly caused the Flint water crisis.[310]

The MDHHS failed to identify that BLLs in Flint were rising. An internal analysis concluding that BLLs were rising was questioned internally and the MDHHS never resolved the conflict.[311] The MDHHS's internal failures and initial questioning of Dr. Hanna-Attisha's study likely extended the water crisis three months.

The EPA failed to protect the people of Flint after the MDEQ disclosed in April 2015 that corrosion control was not being used. The EPA did not require Flint to use corrosion control until July 2015, deferring corrosion control pending a legal opinion MDEQ requested despite the clear and unambiguous requirement that community water

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[307] *Id.* at 27-28.
[308] *Id.* at 28-29; *NOVA: Poisoned Water, supra* note 260.
[309] FWATF FINAL REPORT, *supra* note 260, at 29; *NOVA: Poisoned Water, supra* note 260.
[310] FWATF FINAL REPORT, *supra* note 260, at 29.
[311] *Id.* at 31-32.

systems use corrosion control.[312] The EPA deferred to the MDEQ despite internal protests from Mr. Del Toral and clear evidence of egregious LCR violations.[313] The 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.[314] The EPA's apathy and failure to timely enforce the SDWA exacerbated and extended the Flint water crisis. It was the extraordinary efforts of LeeAnne Walters, protests of the Flint community, Dr. Edwards' team of researchers at Virginia Tech University and Dr. Hanna-Attisha's research that exposed the Flint water crisis.[315]

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.[316] 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 supervisory 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

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[312] *Id.* at 18, 51.
[313] *NOVA: Poisoned Water, supra* note 260.
[314] FWATF FINAL REPORT, *supra* note 260, at 51-52.
[315] 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 260.
[316] Josh Sanburn, *Former EPA Official Grilled Over Flint Water Crisis*, TIME MAG. (Mar. 15, 2016), http://stime.com/4259438/susan-hedman-flint-water-crisis-congress/.

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.[317] Several officials at the MDHHS face more serious charges in connection with the Legionellosis outbreak, including involuntary manslaughter.[318] But the lifelong health consequences for as many as 8,000 children 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.[319]

In a perfect world, the water crisis in Flint would produce lasting lessons learned and implemented in every community across the United States and political action for robust enforcement and revision of the LCR. Susan Hedman refused to take responsibility before before Congress in March 2016 stating "I don't think anyone in the EPA did anything wrong."[320] 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 Marc Edwards to collect testing samples from town wells for bacteria after finding lead in tap water in some Denmark homes.[321]

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[317] Paul Egan, *These Are the 15 People Criminally Charged in the Flint Water Crisis*, DETROIT FREE PRESS (June 14, 2017), shttps://www.freep.com/story/news/local/michigan/flint-water-crisis/2017/06/14/flint-water-crisis-charges/397425001/.
[318] *Id.*
[319] *See NOVA: Poisoned Water, supra* note 260.
[320] Steve Carmody, *Flint Mayor Leaving Office After Defeat, But Not Politics*, Michiganradio.org (Nov. 4, 2015), http://michiganradio.org/post/flint-mayor-leaving-office-after-defeat-not-politics; Sanburn, *supra* note 316.
[321] Sammy Fretwell, *Small Town SC Mayor Won't Let Flint Water Crisis Researcher Test Wells For Pollution*, STATE (Jan. 24, 2018), http://www.thestate.com/news/local/article196354779.html.

The mayor claims that additional testing is unnecessary because "the state Department of Health and Environmental Control has found [the water] to be safe."[322]

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 an NSF/ANSI Standard 53 certified filtration system and replacement filters, and requiring non-residential buildings install best available filtration in drinking fountains.

V: PREVENTING LEAD EXPOSURE IN DRINKING WATER THROUGH POINT-OF-USE FILTRATION WITH A REFUNDABLE TAX CREDIT FOR INDIVIDUALS AND BEST AVAILABLE TECHNOLOGY IN NON-RESIDENTIAL BUILDINGS

This section recommends that Congress provide a refundable tax credit for individuals to acquire an NSF/ANSI Standard 53 certified filtration system and replacement filters, and require best available filtration technology in drinking fountains in non-residential 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 allows 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

[322] *Id.*

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.[323] Government incompetence and misconduct in implementing the LCR exacerbate the inherent difficulty of regulating lead and problems of the LCR. And 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 section will first discuss why point-of-use filtration will fill the regulatory gap and next recommend that Congress provide a refundable tax credit for point-of-use filtration and require non-residential buildings to filter water at drinking fountains.

A. Point-of-Use Filtration Is Effective and Fills the Regulatory Gap that Allows Lead at the Tap

Promoting and funding point-of-use (POU) filters effective at reducing lead is consistent with a primary prevention approach to childhood lead exposure and would fill the regulatory gap which 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 also will remove many other contaminants and protect against attacks to drinking water supplies by the

[323] Masters et al., *supra* note 153, at 12-13.

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[324] (NSF) tests filtration technology to ensure that filters meet minimum standards of filtration for many contaminants.[325] Filters that meet NSF filtration standards for health effects receive certification under the NSF/ANSI Standard 53 for Drinking Water Treatment Units.[326] NSF/ANSI Standard 53 includes certification for lead reduction in drinking water for POU filtration systems, including pour-through pitchers, faucet mounts, counter-top units connected to a sink faucet, under the counter plumbing connected filters and refrigerator filters.[327] To receive certification, filters must be able to filter lead below 10 ppb from a challenge level of 150 ppb.[328] After providing certification, NSF annually audits manufacturing facilities to confirm that the product sold to the public meets the standard confirmed in the laboratory.[329] There

[324] 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* (Jan. 2016), http://info.nsf.org/Certified/DWTU/listings_leadreduction.asp?ProductFunction=053|Lead+Reduction&ProductFunction=058|Lead+Reduction&ProductType;=&submit2=Search [hereinafter NSF Product Listings].
[325] *Id.*
[326] *Id.*
[327] *Id.*
[328] *Id.*; NSF INTERNATIONAL/ANSI STANDARD 53, DRINKING WATER TREATMENT UNITS – HEALTH EFFECTS 3, 9 (2016).
[329] NSF Product Listings, *supra* note 324.

are hundreds of water filtration systems that meet the NSF/ANSI Standard 53, including convenient faucet mount options and pour-through pitchers.[330]

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, the 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.[331] The EPA conducted this test to determine whether these POU filters would filter effectively when filtering water with lead levels greater than 150 ppb.[332] Based on over 200 samples, including samples with confirmed lead levels above 150 ppb and some over 4000 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.[333] The EPA then collected over 50 additional samples from locations recommended by the United States Agency for Toxic Substances and Disease Registry (ATSDR).[334] The filters again removed lead to less than 1 ppb on average.[335] The ATSDR reviewed the 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

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[330] *Id.*
[331] U.S. ENVTL. PROTECTION AGENCY [EPA], FLINT, MI FILTER CHALLENGE ASSESSMENT (2016).
[332] *Id.* at 1.
[333] *Id.* at 1, 3.
[334] *Id.* at 1.
[335] *Id.* at 4.

women.[336] NSF/ANSI Standard 53 certified POU filtration technology thus would effectively remove lead present in drinking water at the tap.

The SDWA Act recognizes the utility of POU filtration and even contemplates the use of POU filtration to comply with NPDWSs. For some contaminants, filtration is a treatment technique.[337] The SWDA also requires the EPA to list POU treatment units as a compliance technology for small public water systems to meet SDWA standards.[338] The EPA has listed POU filtration technologies as compliance technologies under the SDWA.[339] Reverse-osmosis and cation-exchange are compliance technologies for lead but other filtration technology also filters lead effectively.[340]

States have implemented POU treatment systems for compliance with NPDWSs. For example, Arizona allows qualifying PWSs to use POU treatment systems to comply with NPDWS.[341] 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.[342] The EPA advertises POU filtration as effective for individuals to reduce exposure to lead at the tap.[343] Some states also recommend that individuals use

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[336] *See id.* at attachment.
[337] *See* 40 C.F.R. §§ 141.70, 141.500 (establishing filtration as a NPDWS for PWS where the source water is, or is directly influenced by, surface water for Giardia lamblia, viruses, heterotrophic plate count bacteria, Legionella, Cryptosporidium and turbidity).
[338] 42 U.S.C. § 300g-1(b)(4)(E)(ii)-(iii).
[339] *See generally* Announcement of Small System Compliance Technology Lists for Existing National Primary Drinking Water Regulations, 63 Fed. Reg. 42,039 (Aug. 6, 1998); *see* U.S. ENVTL. PROTECTION AGENCY [EPA], POINT-OF-USE OR POINT-OF-ENTRY TREATMENT OPTIONS FOR SMALL DRINKING WATER SYSTEMS 3-1 at 3-3 (April 2006).
[340] EPA, *supra* note 339, at 3-3; EPA, *supra* note 331, at 3-4.
[341] *See* ARIZ. ADMIN. CODE § R18-4-218.
[342] ARIZ. ADMIN. CODE § R18-4-218B(3); ARIZ. DEP'T OF ENVTL QUALITY, ARIZONA POINT OF USE COMPLIANCE PROGRAM GUIDANCE 5 (July 2005).
[343] U.S. ENVTL. PROTECTION AGENCY, CONCERNED ABOUT LEAD IN YOUR DRINKING WATER? 2 (Aug, 2017).

POU filters to protect from the risk of lead exposure through drinking water.[344] State implementation of POU filtration to comply with NPDWSs 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 also would remove other harmful contaminants present and support water security against the intentional introduction of contaminants into the water distribution systems. Filtration systems meeting NSF/ANSI Standard 53 generally filter for many more contaminants than just lead.[345] For example, the readily accessible Brita faucet mount filtration system reduces 21 other contaminants, including harmful contaminants like asbestos, benzene and toluene, and over 40 volatile organic compounds.[346] Filtration systems also often reduce other compounds, including emerging contaminants. The Brita Faucet System, for example, filters bisphenol-A, estrone (a hormone) and several over

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[344] *See e.g.*, MINN. DEP'T OF HEALTH, POINT-OF-USE WATER TREATMENT UNITS FOR LEAD REDUCTION (Aug. 2010); *see also* Fla. Dep't of Envtl Protection, *Information about Lead-Free Plumbing and Reducing Exposure to Lead in Drinking Water*, Floridadep.gov, https://floridadep.gov/water/source-drinking-water/content/monitoring-lead-and-copper-florida-drinking-water (last visited Apr. 22, 2018).

[345] *See* NSF International, NSF/ANSI 53 Drinking Water Treatment Units – Health Effects, nsf.org, http://info.nsf.org/Certified/DWTU/Listings.asp?ProductFunction=053%7CLead+Reduction&ProductFunction=058%7CLead+Reduction&ProductType=&submit2=Search (last visited Apr. 21, 2018).

[346] NSF International, NSF/ANSI 53 Drinking Water Treatment Units – Health Effects, The Brita Company Products, nsf.org, http://info.nsf.org/Certified/DWTU/Listings.asp?TradeName=SAFF-100&Standard=053&ProductType=&PlantState=&PlantCountry=CHINA&PlantRegion=&submit3=Search&hdModlStd=ModlStd (last visited Apr. 21, 2018).

the counter and pharmaceutical drugs.[347] 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.[348] A single filter does not reduce every potential contaminant,[349] 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 and Congressional action to reduce lead in water are inadequate to protect public health. The EPA is considering revising substantially 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 the EPA; and increased public education about lead risks for new customers of a PWS and those at risk of lead exposure.[350]

Even if the EPA promulgated all of the proposed rule revisions, the LCR still would not sufficiently protect individuals from lead exposure. Completely removing all

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[347] NSF International, NSF/ANSI Drinking Water Treatment Units – Emerging Compounds/Incidental Contaminants, nsf.org, http://info.nsf.org/Certified/DWTU/Listings.asp?TradeName=&Standard=401&ProductType=&PlantState=&PlantCountry=&PlantRegion=&submit3=Search&hdModlStd=ModlStd (last visited Apr. 22, 2018).

[348] IRWIN SILVERSTEIN, INVESTIGATION OF THE CAPABILITY OF POINT-OF- USE/POINT-OF-ENTRY TREATMENT DEVICES AS A MEANS OF PROVIDING WATER SECURITY 31-33 (U.S. EPA Feb. 2006).

[349] *See id.*

[350] EPA WHITE PAPER, *supra* note 123, at 8-16.

LSLs is absolutely necessary in the long term to protect people from lead exposure but is a massive undertaking requiring local expenditures of upwards of $80 billion.[351] 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.[352] And major cities like Chicago have no intention of beginning a voluntary LSL replacement program.[353] If the EPA were to allow partial LSL replacement, the lead problem would be worse for those served.[354] 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 likely would add further complexity to a complicated regulation that local governments already struggle to implement.

Recent Congressional 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 the EPA to establish a grant program to assist

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[351] *Id.* at 9.
[352] *See* LEAD AND COPPER WORKING GROUP TO THE NATIONAL DRINKING ADVISORY COUNCIL, FINAL REPORT 13-17, 45 (Aug. 24 2015); Emily Lawler, *DEQ Rules Propose Michigan Remove All Lead Service Lines in 20 Years*, mLive.com (Nov. 29, 2017), http://www.mlive.com/news/index.ssf/2017/11/deq_rules_propose_michigan_rem.html.
[353] Hawthorne & Hayes, *supra* note 8.
[354] *See* Del Toral et al., *supra* note 153, at 9304-05.

voluntary lead testing programs at schools and day-care centers.[355] The testing grant program must provide funds to assist implementation of the EPA's voluntary water testing program for schools and day care centers named "3Ts for Reducing Lead in Drinking Water and School and Child Care Facilities" (3T program).[356] The 3T program is the type of reactive approach to lead exposure inconsistent with primary prevention and could justify inaction in critical locations serving children based on inaccurate testing results. The WIIN Act also requires the EPA to establish a grant program for local projects to reduce lead in drinking water.[357] The grant program authorized for appropriation $60 million per year for fiscal years 2017 – 2021 for qualifying lead reduction projects.[358] The grant program, while important, is very small compared to the $80 billion of funding necessary to eliminate just the risk posed by LSLs.[359] The grant program also likely does not authorize funds to remove lead actually present in drinking water.[360]

Where possible LCR revisions and WIIN Act provisions 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 defense against lead present at the tap. Because of the difficulty of regulating lead and history of government

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[355] 42 U.S.C. § 300j-24(d).
[356] 42 U.S.C. § 300j-24(d)(5).
[357] 42 U.S.C. § 300j-19b(b).
[358] 42 U.S.C. § 300j-19b(a)(2), (b)(6)(d).
[359] EPA WHITE PAPER, *supra* note 123, at 9.
[360] 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 . . . .").

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 to Purchase Filtration Systems and Replacement Filters, and Require Non-Residential Buildings Use Best Available Technology for Filtration in Drinking Fountains

In order to promote POU filtration Congress should provide a refundable tax credit for individuals to purchase an NSF/ANSI Standard 53 certified filtration system and replacement filters, and require non-residential buildings use best available technology (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 non-residential 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 an NSF/ANSI Standard 53 filtration system and replacement filters 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.[361] Congress has broad

[361] *See e.g.*, The Brita Company, *Basic Faucet Filtration System*, Brita.com, https://www.brita.com/faucet-systems/basic/ (last visited Apr. 22, 2018); *see also* ZeroWater, *Pitcher/Dispenser 6-Cup*, Zerowater.com, https://www.zerowater.com/products-pitchers.php (last visited Apr. 22, 2018).

authority to reach consumer behavior through the tax code.[362] Tax credits provide the taxpayer a dollar for dollar reduction of their tax liability.[363] Refundable tax credits are paid to the taxpayer even if there is no offsetting tax liability.[364] 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 cuts out the expense of a government or non-profit middleman efficiently allocating resources to distribute filtration systems.[365]

Providing individuals 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 also will help low-income individuals protect themselves and help

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[362] *See Nat'l Fed. of Indep. Bus. v. Sebelius*, 567 U.S. 519, 563-574 (2012) (upholding the shared responsibility payment of the Affordable Care Act as a proper exercise of Congress' power under the Taxing Clause).
[363] *See, e.g.*, 26 U.S.C. § 24(a).
[364] *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).
[365] *See generally* Lily L. Batchelder et al., *Efficiency and Tax Incentives: The Case for Refundable Tax Credits*, 59 STAN. L. REV. 23 (2006).

reduce the disproportionate effect lead exposure has on minority and low-income communities.[366]

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.[367] Replacement filters currently cost approximately $19.[368] The NSF/ANSI Standard 53 certified ZeroWater pitcher costs approximately $20.[369] An eight pack of zero water replacement filters with a 15-gallon capacity for each filter costs approximately $90.[370] 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 zero water pitcher. If 100 million individuals took advantage of the tax credit, likely a significant overestimate with approximately 152 million filers in 2017,[371] the cost would be $10 billion. By contrast, the lost earnings for children under six-years old with BLL 2-10 μg/dL from 2003-2006 is estimated to be $165-$233 billion.[372] And costs from lead exposure extend well beyond lost earnings, including significant medical, education, social and personal costs.[373] Moreover, Congress easily could fund a refundable tax credit through increasing revenues elsewhere in the tax code.

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[366] *See* discussion *supra* I.C.
[367] The Brita Company, *supra* note 361.
[368] The Brita Company, *Faucet Filter Replacement Cartridge*, Brita.com, https://www.brita.com/replacement-filters/faucet-system/ (last visited Apr. 22, 2018).
[369] ZeroWater, *supra* note 361.
[370] ZeroWater, *Replacement Filters*, Zerowater.com, https://www.zerowater.com/products-filters.php (last visited Apr. 22, 2018).
[371] Internal Revenue Serv., *Filing Season Statistics for Week Ending December 29, 2017*, irs.gov, https://www.irs.gov/newsroom/filing-season-statistics-for-week-ending-december-29-2017 (last visited Apr. 22, 2018).
[372] Gould, *supra* note 47, at 1164.
[373] *See* discussion *supra* I.C.

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 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.[374] 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.[375] Local governments face a shortfall of up to $530 billion between available funds and necessary funds for water infrastructure projects.[376] Allocating Federal funds for POU water filtration would provide a stop-gap 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,[377] which does not include lead-containing materials in approximately 81 million American

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[374] AMERICAN WATER WORKS ASSOCIATION, BURIED NO LONGER: CONFRONTING AMERICAS WATER INFRASTRUCTURE CHALLENGE 3 (2012).
[375] AMERICAN WATER WORKS ASSOCIATION [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).
[376] AWWA ET AL., *supra* note 375, at 1.
[377] EPA WHITE PAPER, *supra* note 123, at 9.

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 replacement LSL. Stated simply, funding POU filtration with a tax credit will efficiently allow individuals access to safe water while policy makers 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 also is 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,[378] uniform promotion of POU filtration will encourage cultural adoption of filtration as a public health necessity. Excluding individuals based on income or location necessarily would reduce the number of people using POU filtration and frustrate its adoption as a common

[378] *See* MARTY AHRENS, SMOKE ALARMS IN U.S. HOME FIRES 1 (2015).

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. *Best Available Technology for Filtration in Non-Residential 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. Non-residential buildings can be a significant source of lead exposure, especially for children in school and day-care.[379] And while some states and local school districts are implementing the EPA's 3T testing program,[380] widespread adoption of filtration in schools consistent with primary prevention policy to reduce lead at the tap has not materialized. Requiring non-residential 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 for taps outside the home consistent with primary prevention.

Under the BAT approach, owners and operators of non-residential 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.[381] Buildings would have to replace the filters at the end of the useful life, which would be no different than having to replace HVAC filters or other routine

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[379] *See, e.g.*, Taylor, *supra* note 249.
[380] *See, e.g.*, ALA. DEP'T ENVTL. QUALITY, DETERMINING LEAD LEVELS IN DRINKING WATER ALABAMA'S PK THRU 12 PUBLIC SCHOOLS MASTER PLAN 1-3 (2017).
[381] *See, e.g.*, Elkay, *Elkay Enhanced EZH2O Bottle Filling Station & Single ADA Cooler, Filtered 8 GPH Light Gray*, Elkay.com, http://www.elkay.com/drinking-solutions/lzs8wslp (last visited Apr. 22, 2018).

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 non-residential 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.[382] Replacement filters cost as little as $57 when purchased in a 12-pack.[383] A filtered drinking fountain without a bottle filling station costs approximately $750 and has a filter capacity of 1,500 gallons.[384] Replacement filters cost approximately $60.[385] 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. Congress also could provide a waiver for owners of buildings that can show that there are no lead containing materials in drinking water infrastructure and building plumbing.

Congress likely has the authority under the Commerce Clause to require BAT for drinking fountain filtration in non-residential buildings. Congress has the power to

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[382] *Id.*
[383] Amazon, *Elkay 51300C WaterSentry Plus Replacement Filters*, Amazon.com, visit Amazon.com and search for Elkay 51300C, then select 12PK Watersentry Plus Option.
[384] Elkay, Elkay Cooler Wall Mount ADA Filtered, Non-Refrigerated Light Granite, Elkay.com, http://www.elkay.com/lzsdl (last visited Apr. 22, 2018).
[385] Home Depot, *WaterSentry VII Coolers and Fountains Replacement Filter*, Homedepot.com, https://www.homedepot.com/p/Elkay-WaterSentry-VII-Coolers-and-Fountains-Replacement-Filter-for-Elkay-and-Halsey-Drinking-Fountains-51299C/206925498 (last visited Apr. 22, 2018).

"regulate Commerce . . . among the several States."[386] All economic activity that substantially affects commerce falls under the scope of Congress' authority to regulate commerce.[387] The distribution of drinking water is an economic activity and the collective effect on commerce from requiring filtration in all non-residential buildings easily would qualify as substantial.[388] Congress would have little trouble finding that exposure to lead in drinking water costs the United States billions of dollars annually.[389] The adverse health effects of lead exposure affect many different markets, including health care, education and employment markets, to name a few.[390]

Using BAT to reduce contaminants in the environment is a familiar regulatory approach. The Safe Drinking Water Act sets MCLs based on the performance of control technology.[391] Both the Clean Water Act (CWA) and the Clean Air Act (CAA) require technology controls to reduce contaminants in the environment. The CWA requires direct dischargers of regulated pollutants from point sources into the Waters of the United States and indirect dischargers into publically owned treatment works to meet maximum permissible limits based on the performance control technology.[392] The CAA requires that emitters of hazardous air pollutants and new sources of covered pollutants meet

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[386] U.S. CONST. art.I, § 8, cl. 3.
[387] *See, e.g.*, *Gonzales v. Raich*, 545 U.S. 1, 17 (2005).
[388] *See, e.g.*, *Wickard v. Filburn*, 317 U.S. 111, 128-29 (1942) (finding Congress could regulate consumption of home grown 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).
[389] *See* discussion *supra* I.C.
[390] *Id.*
[391] 42 U.S.C. § 300g-1(b)(4)(B), (D).
[392] 33 U.S.C. §§ 1311(a)-(b), 1314(b),(d), 1316, 1317.

emission limits based on the performance of control technology.[393] The CAA also specifically requires major modifications of major emitting sources to apply best available control technology to reduce the emission of covered pollutants.[394] The application of control technology under the CWA and CAA has realized significant reductions of discharges of pollutants into the environment.[395]

Requiring BAT for drinking fountain filtration in non-residential buildings will effectively and efficiently fill the regulatory gap that allows lead in drinking water at the tap outside the home. Filtration in non-residential 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.

CONCLUSION

The problem of lead in drinking water will persist as long as there are lead 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

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[393] 42 U.S.C. §§ 7411(a)-(b), 7412(d).
[394] 42 U.S.C. §§ 7475(a).
[395] *See* William L. Andreen, *Water Quality Today – Has the Clean Water Act Been a Success?*, 55 ALA. L. REV. 537, 569-573 (2004); DAVID A. KEISER & JOSEPH S SHAPIRO, CONSEQUENCES OF THE CLEAN WATER ACT AND THE DEMAND FOR WATER QUALITY, CONSEQUENCES, NATIONAL BUREAU OF ECONOMIC RESEARCH 21-22 (2017); U.S. Envtl. Protection Agency, *Progress Cleaning the Air and Improving People's Health*, epa.gov, https://www.epa.gov/clean-air-act-overview/progress-cleaning-air-and-improving-peoples-health#pollution (last visited Apr. 22, 2017).

high profile crises like those seen in Washington, D.C. and Flint; lead in drinking water 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 lows 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 an NSF/ANSI Standard 53 certified filtration system and replacement filters will allow individuals to protect themselves from lead in drinking water and promote POU filtration to protect public health and provide safe drinking water. Requiring non-residential 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 non-residential 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 school and day-care centers with safe drinking water

and 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 in drinking water and protect individual taps across the country delivering dangerous levels of lead today.