# UA Water Quality Program

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## *Research Report*

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***An Industry & Public***

***Education Initiative***


*United Association of Journeymen and Apprentices*

*Of the Plumbing and Pipe Fitting Industry*

*Of the United States and Canada*

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## I. Introduction

The United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada (UA or United Association) represents 360,000 members and is the leading labor organization for the piping trades in North America. Supported by a network of 300 state-of-the-art education centers and an annual $250 million training investment, UA members maintain the highest skill levels in the industry.

UA professionals are employed throughout the construction and maintenance industries and work on all facets of water and wastewater treatment systems. In light of recent reports revealing increased threats to water quality, the United Association conducted extensive research and field investigations on the root causes of these problems, as well as potential solutions, the findings of which are presented below.

## II. Executive Summary

Many public water systems in the U.S. today face daunting challenges from *at least three key sources* of contaminants that are posing serious risks to public health. *Lead*, highlighted by the recent crisis in Flint, Michigan, is a big part of the problem. Another significant threat is presented by recent outbreaks involving bacterial contaminants, including *Legionella*, which causes the sometimes deadly Legionnaires' disease. A third significant risk area includes unsafe chemicals being detected with increased frequency in our public water systems, for example, Per- and Polyfluoroalkyl Substances, referred to as PFASs.

While these are the most common or prevailing threats to water quality, many other contaminants can also be found in tap water, including arsenic, nitrates, copper, mercury and various types of disinfectant byproducts. With some issues, such as arsenic and nitrates, the type and degree of risk will vary with geography, soil type, and other factors. With other contaminants, *e.g.,* lead or *Legionella*, the danger is more universal.

Most Americans get their water from some 52,000 *"Community Water Systems"* (CWSs), including municipal water utilities and other water suppliers, which are regulated by federal law.[1] While we rely on CWSs to deliver water that is safe for human consumption, new challenges in sourcing and distributing clean water are making this task increasingly difficult. While many CWSs have acted responsibly to address these issues, there are compelling reasons for concern for an increasing number of jurisdictions.

One of the most extensive studies to date, issued under the auspices of the National Academy of Sciences, highlighted two key facts underscoring this problem: (a) *up to 45 million Americans* have been exposed to potentially unsafe water in recent years; and (b) *up to 10% of CWSs* are *found in violation of important public health standards* in any given year.[2] These findings are based on national data of EPA water quality violations, which impact all three major contaminant areas: lead, bacteria and chemicals.

Additional reports reviewing similar data indicate this number could be considerably higher, affecting over 75 million people.[3] Looking at these issues from a somewhat different perspective, another important study found that over 1,000 water systems across the U.S. are providing water that exceeds the federal action level for lead contamination – a situation comparable to the one in Flint, MI.[4]

It should be stressed that these violations are based on *legal standards that have been in place for decades*, which a number of experts think are no longer adequate for ensuring public health. Moreover, these findings are based on *only* those water quality violations that have been detected, verified and documented. Thus, the actual level of risk may be significantly higher.[5]

What's more, the fact that water coming from the tap smells, tastes, and looks normal does not guarantee it is free from contamination.[6] An inherent problem in detecting dangerous substances in water is they are often invisible. Of course, an unusual smell, taste, or look may be a sign of contamination, *e.g.,* a metallic taste means the water could be tainted with arsenic or lead, and a sulfur-like smell (*i.e.,* like rotten eggs) may indicate bacterial contamination.[7] It is far more common, however, that contaminants are completely invisible and undetectable to the senses. This compounds the problem since communities often do not discover the threat until after their water supply has been put at risk.

In response to these issues, some public water suppliers are investing major resources to replace lead pipes, address new bacteria or chemical threats, and adopt other measures to ensure water quality. In other jurisdictions, however, dangerous contaminants are being overlooked, ignored, or simply not dealt with in time to prevent serious risks to human health. CWSs that fall in the latter category, including certain urban municipal systems and many systems in small rural communities, often lack financial and/or technical resources to address such problems.

These findings and other emerging data reveal legitimate growing concerns over U.S. water quality. The public, in turn, is taking notice. For example, a recent survey shows that a majority of Americans who drink tap water are concerned about the safety of the water they drink.[8] What's more, reports regarding declining water quality have generally focused on water supply sources and water and wastewater infrastructure. However, recent evidence reveals that new public health threats are also being found *inside* homes and buildings, i.e., within *premise piping* systems.

Multiple factors are driving these problems. While crumbling water infrastructure tops the list, there also have been a plethora of new chemicals introduced into the environment over the past several decades, as well as new threats from various types of bacteria. In many cases, the main statutes, regulations and industry codes designed to ensure water quality are in critical need of reform. Indeed, in some cases the very strategies or products used for treating contaminants result in unintended contamination.

In addition to these factors, federal funding for water infrastructure is woefully inadequate, and even that which is available often cannot be accessed because states and localities lack required matching funds. Moreover, regulatory responses, which are usually vital for addressing emerging threats, are frequently developed in a narrow, ineffective manner and still take an inordinate amount of time to complete. Lax enforcement and oversight present additional serious challenges.

Given the scope and severity of the problems, policy makers, industry leaders and other stakeholders should commence a national debate on these issues as the first step toward finding solutions. Moving forward, both short-term and long-term solutions are needed. To prevent immediate risks, better water quality sampling and testing procedures are needed. Improved procedures must also be devised for monitoring, treating, remediation and prevention. For the long-term, major structural reforms must occur to secure adequate funding needed to protect water supply sources and rebuild water infrastructure, while more rigorous and effective health standards should be developed for critical industry codes and applicable state and federal legislation.

## III. From Source to Tap: Overview of Water Systems

Drinking water, or more accurately, "tap water" – the water we drink and use for other household purposes, including bathing and cleaning – is supplied through a network of three components: a) supply sources; b) water infrastructure maintained by water suppliers; and c) internal premise piping systems. These three sectors are represented in the following illustration:


It is important to understand these basic components for several reasons. For example, contaminants can originate in any one of these components and must be tracked to their source, so they can be dealt with at that point.

Moreover, when addressing challenges to water quality, solutions—in terms of new policy reforms and/or field responses—will likely need to be developed in each sector and customized to eliminate the distinctive threats emerging in that sector. Key facts regarding these components are as follows:

***Supply Sources***: Water supply originates in the form of surface water or groundwater. Surface water includes lakes, rivers, streams, ponds, and wetlands, while groundwater refers to water that exists underground.[9] Private water wells, a part of the water supply chain *not* subject to federal regulation, rely on groundwater sources.[10]

***Water Infrastructure***: This sector is created and maintained by local CWSs, also referred to as water suppliers or water utilities, and consists of the following facilities and piping systems: (1) supply piping from sources to water treatment plants; (2) distribution piping (mains and branch lines) from treatment plants to homes and buildings; and (3) return piping to wastewater treatment plants.[11] CWSs are responsible for bringing the water *to the property line of homes and buildings*; after this point, water systems are the responsibility of the facility owner. Currently, about one million miles of piping is used in the U.S. for these distribution systems.[12]

**Premise piping systems**: These systems consist of equipment and pipes located *within* homes and buildings that take water from the property line to various internal use points inside of structures, *e.g.,* sinks, showers, water appliances. Premise piping is generally not monitored by local or federal authorities and is the responsibility of the property owner to maintain.[13]

As discussed below, each sector of this network is governed by a different set of statutes, regulations and policies. Supply sources and water infrastructure operate under a combined federal/state legal framework, while premise piping is largely regulated by state and local laws.

## IV. U.S. Water Systems: Legal Framework

### A. Water Quality Legislation

Two federal statutes are primarily responsible for establishing the legal framework used to ensure water quality in the United States. These statutes generally divide responsibility between federal and state governments. The federal government develops key national standards to protect water quality, while the state governments implement these requirements and monitor compliance. These functions are typically administered by state health or environmental agencies.

The *Safe Drinking Water Act* (SDWA), 42 U.S.C. § 300f *et seq*., sets the vast majority of quality standards for drinking water, as well as groundwater. Thus, as discussed below, most of the regulatory structures developed to protect drinking water are established under the SDWA. The *Clean Water Act* (CWA), 33 U.S.C. § 1251 *et seq*., on the other hand, protects water *supply sources*, *e.g*., rivers, lakes and reservoirs, known as *surface* waters. This helps ensure water quality more indirectly by imposing safeguards at the main supply sources.

Specifically, the CWA protects surface water by requiring "*point sources*" of pollution to obtain a permit before discharging pollutants. Point sources are typically discrete sites where pollution is discharged into surface water, such as industrial plants. Conversely, "nonpoint" sources of pollution, *e.g.,* agricultural runoff and discharges of sewage from vessels, are not covered by the CWA. *See* 33 U.S.C. §§ 1312, 1342. However, because nonpoint sources are "one of the primary factors threatening water quality standards in rivers, lakes, and estuaries," the failure to effectively control these sources is often seen as a major shortcoming of the law.[14]

What existing federal statutes do *not* cover is well water. *See* 42 U.S.C. § 300f. While both the CWA and SDWA are designed to safeguard water quality, neither provides standards or oversight for water obtained from private wells. This is also a concern insofar as private well systems are currently used by approximately 40 million Americans.[15]

### B. Water Quality Regulations and Policy Guidance

#### ***(1) Overview of Regulatory Process*:**

While the SDWA and, to a lesser extent, the CWA, establish the overarching authority of government to set policy in the water industry, the bulk of the work involved in safeguarding water quality is carried out through administrative regulations and administrative policies developed by the EPA and implemented by state governments. 42 U.S.C. § 300g-1.

- The single most important tool the EPA uses to effectuate this goal consists of regulations that establish water quality standards known as *maximum contaminant levels* ("MCLs"). These MCLs apply to major contaminants most likely found in water systems, for example, lead and copper, certain types of bacteria, and various chemicals. 42 U.S.C. § 300g-1.

- EPA sets these standards at levels determined to ensure water is safe or relatively safe. For example, the MCL for arsenic is 10 ppb. 40 C.F.R. § 141.51. Thus, while the safest level for arsenic in water is 0 parts per billion ("ppb"), EPA sets the MCL higher due to cost factors or other obstacles to reaching this lower optimal level. 42 U.S.C. § 300g-1(b)(4).

- Achieving relatively safe levels is necessary due to the fact policy decisions must be made on the basis of what is practically and economically feasible on one hand, and what is relatively safe for human consumption on the other hand. 42 U.S.C. § 300g-1(b)(4).

- Such standards are often subject to ongoing debate. For example, while the regulatory "action level" for lead in drinking water in the U.S. is currently 15 ppb, 40 C.F.R. § 141.80, the U.S. Food & Drug Administration has established a level of 5 ppb for bottled water. Canada also uses a standard or 5 ppb for drinking water.[16]

The EPA also maintains a secondary level of regulations for well-known water contaminants that it labels *maximum contaminant level goals* ("MCLGs"). 42 U.S.C. § 300g-1(b)(4). These are set for virtually all the contaminants regulated by MCLs, except they are set at lower or more demanding levels than MCLs and serve as recommended goals or guidelines for promoting effective water quality management.

In an effort to ensure on-going compliance, the EPA requires CWAs to provide annual *Consumer Confidence Reports* to their customers. These reports must include certain required MCL/MCLG data, including, for example, disclosure of contaminant levels in excess of MCLs, the exact levels found, and the corresponding MCLG for that contaminant. 42 U.S.C. § 300g-3(c)(4).

#### *(2) MCL—EPA Regulatory Requirements*

When setting MCLs, the EPA takes into account both public health considerations <u>*and*</u> practical feasibility factors, including costs, of eliminating or reducing the contaminant from drinking water. 42 U.S.C. § 300g-1(b)(4).

- MCLs are firmly fixed, *mandatory, enforceable* requirements. If concentrations fall above these maximum permitted levels, the water supplier must take remedial action to reduce contamination and inform its customers. 42 U.S.C. § 300g-3(c)(4).

- To ensure compliance with these levels, CWSs regularly monitor and test the water they supply to the public; state agencies monitor compliance with MCLs. 42 U.S.C. § 300g-2.

- There are currently about 100 contaminants for which there are enforceable MCLs in place, including arsenic, coliform, nitrate, mercury, lead and *E. coli*.[17] CWSs regularly test and monitor systems for these contaminants for MCL compliance.

#### *(3) MCLGs—EPA Policy Guidance*

Conversely, MCLGs essentially serve as EPA policy guidelines and are established as non-enforceable public health goals. MCLGs are developed *solely on the basis of public health considerations*, *i.e.,* they are set at the level at which a contaminant causes no adverse health effects but do *not* consider cost factors or other practical considerations.[18]

| **Bacterial Contaminant** | **MCL** | **MCLG** (40 C.F.R. § 141.52) |
|---|---|---|
| *Legionella* | Specific treatment technique required (40 C.F.R. § 141.70) | 0 |

| | | |
|---|---|---|
| *Cryptosporidium* | Specific treatment technique required (40 C.F.R. § 141.700) | 0 |
| *Escherichia coli (E. coli)* | No more than 5% of samples tested each month may contain coliforms (including *E. coli*) (40 C.F.R. § 141.851 *et seq.*) | 0 |

***(4) Examples of MCL/MCL Standards***

As noted above, MCLGs are established for generally the same contaminants subject to MCLs. A comprehensive list of MCLs/MCLGs for all contaminants regulated under the SDWA is maintained on the EPA's website.[19] Examples of MCLs/MCLGs for some of the more common bacteria contaminants are as follows:

| Contaminant | MCL | MCLG |
|---|---|---|
| Chlorite | 1 ppm | 0.8 ppm |
| Chlorine | 4 ppm | 4 ppm |
| Arsenic | 10 ppb | 0 |
| Asbestos | 7 million fibres per liter (MFL) | 7 MFL |
| Fluoride | 4 ppm | 4 ppm |
| Nitrate | 10 ppm | 10 ppm |
| Benzene | 5 ppb | 0 |
| Uranium | 30 ppb | 0 |
| Atrazine | 3 ppb | 3 ppb |

Thus, in some cases these levels are the same; in others, the MCL is more demanding than the MCLG, as shown by this chart.[20]

In regulating lead, the EPA uses the term "*action level*" instead of MCL to establish the maximum contamination level; thus, this terms serves the same function as an MCL. The current lead *action level* is set at 15 ppb. 40 C.F.R. § 141.80(c). Specifically, this regulations states as follows:

- *Lead and copper action levels.* (1) The lead action level is exceeded if the concentration of lead in more than 10 percent of tap water samples collected during any monitoring period conducted . . . [per 40 C.F.R. § 141.86] is greater than 0.015 mg/L (*i.e.*, if the "90th percentile" lead level is greater than 0.015 mg/L).

- If lead concentration exceeds this level, the CWS must begin various remedial efforts to correct the problem and re-test water samples until it can prove compliance.

- There is an established *MCLG* for lead, which is zero. 40 C.F.R. § 141.51.[21]

#### *(5) Scope of EPA Mandated Testing*

Most water quality testing required by the EPA is done *at water treatment plants* and at other points *within* the *water supply system*. Current EPA rules require only very limited testing "*at the tap*" or at any other point within premise piping systems. *See* 40 C.F.R. § 141.86 (describing "at the tap" testing requirements under the Lead and Copper Rule).

- Generally, the SDWA is *not* intended to ensure water quality *inside homes or buildings*. In fact, the very limited testing required by the EPA within buildings, *i.e.*, premise piping systems, is devised to ensure *water coming in* to the premises meets federal standards.[22]

- For example, despite the serious health effects caused by lead poisoning, CWSs fulfill their obligation to test for lead "*at the tap*" by infrequently testing only 100 homes or less within their jurisdiction.[23] 40 C.F.R. § 141.84.

- Thus, the entire regulatory framework established under the SDWA is essentially focused on making sure that safe water is delivered *to the tap*, or more accurately *to the property line*.[24] Internal water quality is subject to only very minimal state and local regulation.

#### *(6) EPA Contaminant "Watch" Lists*

In addition to MCLs and MCLGs for regulated contaminants, the EPA uses two other policy tools to promote water quality. First, it maintains a *Contaminant Candidate List* ("CCL"). Contaminants on this list are not currently subject to an enforceable MCLs but are reviewed for possible future regulation.[25]

The EPA also maintains a list of *Contaminants of Emerging Concern*, which tends to involve more recently discovered contaminants, especially chemicals that may pose health risks. Chemicals on this list are "increasingly being detected" and warrant further research.[26] Some contaminants are included on both of these lists.[27]

### C. Future of Water Quality Law

For the past several decades, the legal framework described above has worked reasonably well to ensure U.S. water safety. However, growing problems in water quality are presenting serious risks to public health. Since some of the driving forces for these problems involve outdated laws and policies, as well as a piecemeal regulatory approach to contaminants, new reforms, both legislative and regulatory, as further discussed below, will be needed to address these challenges.

## V. Growing Safety Risks to Water Quality

### A. U.S. Water Quality: Impact of Collective Threats

Over the last several decades, water quality in most areas of the U.S. has been relatively good. Due to generally effective safety standards that for the most part have been properly maintained by water utilities and government regulators; most Americans could assume their water supply was free of health risks. In more recent years, however, emerging evidence reveals serious flaws in many aspects of our water supply systems. For example, one report estimates that nearly 25% of drinking water in the U.S. is improperly monitored or unsafe for consumption.[28]

The problems now surfacing pose health risks to an increasingly larger segment of the population. According to an extensive review of national data on water safety violations, *every year, millions of Americans are continuously exposed to water systems that fail public health standards*. This fact and other highly disturbing trends regarding U.S. water quality were disclosed in a study conducted by Columbia University and the University of California at Irvine.[29]

Published in January 2018 by the National Academy of Sciences, *National Trends in Drinking Water Quality Violations* included this central finding: "*health-based drinking water violations are widespread, with 9-45 million people possibly affected during each year of the past 34 years*."[30] Significantly, the highest degree of violations was concentrated in the latter years of the study. These findings were based on a careful examination of EPA data on documented violations of water quality standards.[31]

Another study, *Threats on Tap: Widespread Violations Highlight Need for Investment in Water Infrastructure and Protections*, conducted by the Natural Resources Defense Council, examined similar data and concluded even more widespread water quality problems exist. Specifically, it found that, in 2015 alone, "there were *more than 80,000 reported violations"* of the Safe Drinking Water Act by CWSs and that "*nearly 77 million people were served*" by the systems with these violations.[32] Numerous other reports bolster these findings and confirm that there are serious grounds for concern. *See* Appendix A hereto.

EPA enforcement data provides an additional macro perspective on the issue, revealing systemic failures in U.S. water supply. Over the past few decades, the EPA has brought *at least seven massive law enforcement actions* in various jurisdictions across the country. Violations of water safety standards in these cases have been so extensive that the EPA required several municipalities to incur hundreds of millions of dollars in costs in each of these cases to correct critical, widespread problems with water and wastewater systems.[33]

An additional macro perspective on water quality can be seen in other EPA enforcement data, which provides similar evidence of systemic failures in U.S. water supply. Over the past several years, the EPA has brought *at least seven massive law enforcement actions* in various jurisdictions across the country. Violations of water safety standards in these cases have been so extensive that municipalities have been required to incur *hundreds of millions of dollars* in costs in each of these cases to correct critical, widespread problems with water and wastewater systems.[34]

Examination of the above-referenced data shows that systems are threatened by three principal sources of contaminants: (1) *lead and other metals*; (2) various types of *harmful bacteria*, including *Legionella*; and (3) *dangerous or potentially dangerous chemicals*.[35] As further discussed below, industry studies, bolstered by recurring media reports, indicate that these three contaminant sources, individually and collectively, pose growing threats to U.S. water quality. Moreover, the potential harm to public health from unsafe water cannot be understated. Whether contamination is from lead, bacteria, or dangerous chemicals—water failing critical safety standards can cause death or serious illnesses, including various types of cancer.

Another critical finding from these reports is that those who can least afford to deal with these challenges are also the hardest hit: financially-strapped municipalities; economically disadvantaged communities; and small towns and rural areas lacking resources for necessary corrective actions. However, given evidence of such widespread failures, there are grounds for reassessing U.S. water quality generally and the current policies and standards currently relied upon for ensuring public safety. Clean water is a necessity of life. No one wants to wake up and find out that their city or town is facing major health risks from its water system.

### B. Internal Versus External Piping Systems

As alarming as they are, the key findings discussed above do not reveal the whole story. Virtually *ALL* of the problems discussed above stem from *external water supply systems*, for example, pollution in original water sources (e.g., rivers, lakes, reservoirs) or contamination issues that develop within water infrastructure (i.e., water and wastewater treatment plants and distribution systems).

Another significant and potentially far-reaching concern is that similar contamination issues can be found within "*premise piping" systems* on the inside of buildings. Thus, while the aging piping that makes up our water infrastructure is one of the biggest drivers of water quality problems, the fact is that many piping systems on *the inside of homes and buildings* are likewise antiquated and in some cases even older than piping systems maintained by water utilities.

Consequently, even when water coming into a building is safe, public health risks can be created by contamination from metals, bacteria, and chemicals found within premise piping systems. For example, incoming water may be relatively free of bacteria at the point it enters a building but become unsafe due to certain internal conditions. This occurs when water becomes stagnant and is combined with heat and nutrients that foster bacteria growth. [36] Such problems have been driving the recent spike in cases of Legionnaires' disease (caused by *Legionella* bacteria). [37] Another study reviewing internal piping challenges reported that "thousands of preventable injuries and deaths are annually caused by microbial, chemical and physical hazards from building water systems."[38]

The presence of lead in premise piping is also a potential health risk. About 80% of all houses in the U.S. are estimated to have lead in their service lines, solder joints, or brass fixtures.[39] Similarly, the U.S. General Accounting Office found in a 2016-2017 survey of water testing for school districts, which covered some 35 million students, that 37% of the districts that conducted tests found elevated lead levels in the water systems. Many other school districts had either not tested or did not have any records of testing.[40]

Public health risks relating to premise piping is clearly more of an issue with older buildings with older premise piping systems, which are relatively more prone to leaks and corrosion that can cause water temperature fluctuations, water stagnation, and the formation of "biofilm" bacteria clusters conducive to the spread of waterborne illnesses.[41] However, newer buildings using modern construction materials may also present unknown risks, especially since internal water quality is subject to only very limited testing.

It should also be stressed that a unique aspect of premise piping that should also be considered is the fact that safety issues are *not just about drinking water*. With respect to internal piping, it must be recognized that health hazards can come from mere exposure to water, such as when toxins are inhaled or permeate the skin while bathing or showering. [42] The latter is caused by exposure to water particles in the air, which is precisely how Legionnaires' disease is transmitted.

Part of the problem with premise piping is there is almost a complete absence of government regulation. Federal law does *not* generally regulate internal piping systems. The monitoring of contaminants required by the SDWA is designed to "give a system-wide picture" of drinking water quality but "do[es] not reflect conditions at a specific household faucet."[43] Even where premise testing *is* specifically required, such as under the Lead and Copper Rule, CWSs can generally fulfill these obligations by testing at only a minimal number of homes that are too few to be statistically representative of the community.[44]

The reality is that the primary means for ensuring water quality on the inside of buildings historically has been state and local plumbing codes, which simply require premise piping systems to deliver "*potable*" water, i.e., water safe for human use and consumption. [45] However, most of these laws require very limited testing of water quality, and this normally occurs only for new facilities at the end or close-out of the construction process. If bacteria, lead or other contaminants enter these systems at any subsequent point, which could be years or even decades later, they will usually not be detected until harm is caused.

The absence of government regulation in this area is not altogether surprising. For the past several decades, the quality of incoming water from most public water systems has been relatively safe. As a result, there was no real need to worry. EPA standards have only very limited, narrow application to premise piping and in most situations have no impact whatsoever. State and local laws, including plumbing codes, were never designed to deal with the multiple challenges now being presented to internal systems by aging pipes, modern chemical threats, or unforeseen conditions fostering bacteria growth.

In light of these facts and growing evidence of new risks presented by premise piping, policy reforms should be developed to address challenges in this area. With respect to short-term risks, new standards and protocols are needed for internal piping systems, especially for older buildings or other facilities that require more intensive monitoring, including schools and healthcare facilities. For example, during routine testing, *Legionella* was discovered in the water at a barracks at Joint Base San Antonio after stagnant water sat in the pipes for an extended period.[46]

Recently, Congress passed the CHIPS and Science Act of 2022,[47] which included the creation of a National Institute of Standards and Technology (NIST) Program to carry out various programs in the Act, including research on internal piping systems:

> . . . [NIST] shall create a program for premise plumbing research. The bill defines premise plumbing as the water distribution system located within the property lines of a property, including all buildings and permanent structures on such property. Such term includes building supply and distribution pipes, fixtures, fittings, water heaters, water-treating and water-using equipment, and all respective joints, connections, devices, and appurtenances.[48]

The program is in consultation with the EPA. The International Association of Plumbing & Mechanical Officers (IAPMO), a community of plumbing experts that develops codes and standards for the industry along with the American Society of Sanitary Engineers ("ASSE"),[49] applauded the legislation as critical to studying efficiency, resiliency, and the emergence of waterborne threats such as *Legionella* brought about by changes in 21st century plumbing.[50] IAMPO Executive Vice President Dain Hansen stated that "[w]ith many states facing historic droughts and a growing number of contamination crises, this new program will help answer critical water efficiency and quality questions and will impact how buildings and homes use water for decades to come."[51]

## VI. Three Key Threats: Metals, Chemicals & Bacteria

### A. Lead & Other Metals

Various types of metals, including lead, can cause serious health hazards for water systems. The travesty of Flint, Michigan—where thousands of residents, including children, were diagnosed with lead poisoning—put a needed spotlight on lead issues especially and water quality generally. Key findings regarding Flint include the following:

- Water in Flint became contaminated when the city switched its water supply from Lake Huron to corrosive Flint River water, which caused lead to leach from the system's old pipes.[52]

- As many as 8,000 children under the age of 6 were exposed to unsafe levels of lead in the drinking water; tens of thousands of older children and adults were likewise exposed.[53]

- Investigative reports are predicting that Flint residents will likely have long term health problems from consuming lead-contaminated water.[54]

As troubling as this incident is, subsequent research shows many other jurisdictions face similar or worse water quality issues.[55] In fact, a Reuters' investigation of lead testing results across the country in 2016 "found *nearly 3,000 areas with recently recorded lead poisoning rates at least double those in Flint* during the peak of . . . [its] contamination crisis. And *more than 1,100 of these communities had a rate of elevated blood tests at least four times higher*."[56] Viewing similar data, another report showed that "*over 18 million people were served by 5,363 [CWSs]* that violated the [EPA's] Lead and Copper Rule."[57]

It is generally well known that lead contamination poses serious health risks to infants and children. Lead poisoning can harm the central nervous system, create learning disabilities, and cause other serious medical problems.[58] There is no known safe level of lead, and children and infants are particularly at risk because their bodies absorb lead faster than adults. It should also be recognized that ***lead can originate from sources both inside and outside of buildings***. For example, lead can be found in faucets within the buildings or originate in external "service lines," in which case water is contaminated before it reaches a home or building's indoor water system.

Lead, which is highly dangerous to children, puts some 10 million American households at risk due to water supplied through lead pipes and service lines.[59] Unfortunately, reports also show lead contamination is prevalent in schools. A 2023 report published by Environment America Research & Policy Center entitled "*Get the Lead Out*" graded each state on protecting kids' drinking water at school.[60] The report assigned specific measures to prevent lead contamination with a numeric value; any state with less than 39 out of 100 points received an "F" grade. A majority of states received this failing grade.[61]

The report further warned that due to the serious risk lead presents to children, "the health threat of lead in schools' water deserves immediate attention from policymakers."[62] Extensive data demonstrates that lead is leaching into the water kids drink every day at school and preschool, and "while shocking, this widespread threat to children's health should come as no surprise. Most schools have at least some lead in their pipes, plumbing, or fixtures."[63]

***Florida Schools:*** Among the most populated states, Florida received one of the lowest grades, earning an "F" for having no state law or regulatory requirement to address lead in schools' drinking water.[64] Less than 10% of schools have participated in a federally funded voluntary testing program.

***California Municipalities and Schools***: According to another report, data from the CA Department of Health revealed that high lead levels were "found in parts of downtown Los Angeles and the Bay Area. In Alameda County, eight communities reported levels equal to or greater than Flint's rates. In Los Angeles, four communities reached or surpassed Flint's levels."[65] Virtually all testing in these cases was triggered by the crisis in Flint. In the 2023 Get the Lead Out report, California scored an overall "C" grade. While 53% of school districts reported having found lead in their water in one or more taps,[66] a 2022 law requiring new fixtures to release no more than 1 ppb of lead and the State's requirement that most lead service lines be replaced gave the State an overall passing grade, with suggestions for improvement.[67]

***New York & Chicago Schools*:** Testing of New York City schools revealed that 53 faucets in one school alone had excess lead levels, with one classroom faucet having a lead concentration of 3,680 ppb—a level alarmingly higher than EPA's 15 ppb action level.[68] Similarly, testing of Chicago's public school system revealed that 37% of the system's buildings had lead levels above the EPA action level.[69] New York scored a "C+" on the Get the Lead Out report for having a "test and fix" policy with a 5 ppb lead limit and some form of remediation.[70] Illinois, on the other hand, scored a "D" for requiring testing of schools, but having no remediation requirements if lead is detected over 5 ppb.[71]

***Texas Schools***: Texas failed nearly every metric used by the Environment Texas Research & Policy Center in its 2023 Get the Lead Out report.[72] Texas scored among the lowest of all the evaluated states because it has no law or regulatory requirements for preventing lead in drinking water, only a voluntary system.[73] Not surprisingly, this group's 2017 analysis found 71 percent of Texas schools tested had lead in their water at one or more taps.[74]

In addition to lead, other metals used in pipes present contamination issues. For example, galvanized pipe can pose health risks when its protective coating becomes corroded over time allowing base metal materials, e.g., lead or iron, to leach into the water. While lead risks are generally well known; iron can be a source of nutrients for bacteria—which, in turn, can foster the spread of *Legionella*.[75] As discussed below, *Legionella* causes the sometimes-deadly Legionnaire's disease, a major health threat that has been on the rise in recent years.

Contamination from lead and other metals can be found in both external public water systems and within internal piping systems. As noted above, since only extremely limited testing is required for the latter, the actual scope of public health risks from lead could be substantially higher than already alarming rates revealed by recent industry research. Moreover, while some new water testing requirements for lead are being imposed in the wake of Flint, these are occurring only in a handful of states and have limited application, e.g., testing in school systems only.[76]

### B. *Legionella* & Other Bacteria

While CWSs have a long history of keeping water fairly safe from bacteria, studies now show a ten-year trend and rapid escalation of bacteria-related contamination cases.[77] The most serious threat in this area is *Legionella,* a waterborne-bacterium that results in a severe and sometimes fatal type of pneumonia known as Legionnaires' disease (LD). *Legionella* bacteria exists naturally in the environment so when it is found in supply sources and water infrastructure it is not usually a threat to human safety. Thus, while it may originate from outdoor sources, this form of bacteria often does not reach levels dangerous to human health until it encounters certain indoor conditions, such as high temperatures and "dead legs" in piping that causes water to be stagnant. In these cases, both outdoor and indoor factors come into play.

When *Legionella* is formed within premise piping systems, it becomes vaporized into water droplets that are inhaled causing the disease. It can be created in various fixtures and equipment, including showers, hot tubs, ice machines, dishwashers and cooling towers.[78]

While dangerous bacteria levels can be found in water infrastructure and supply systems, these contaminants, especially *Legionella*, are of particular concern in premise piping.[79] This is because certain conditions that exist within internal piping systems, including heat and stagnant water, can cause *Legionella* and other types of bacteria to flourish. In fact, incoming water from local water supply systems may be relatively safe but then become dangerous when it encounters certain conditions susceptible to LD growth.

Over the past few years, major outbreaks of LD have alarmed CWSs and federal regulators. For example, in New York City alone, there was a *78 percent increase* in LD cases in 2017, which triggered a number of recent emergency measures, including 90-day testing requirements for hospitals.[80] Additionally, while the main focus in Flint was lead contamination, the city's water supply was also found to be tainted with *Legionella*; in 2016, researchers identified 72 LD cases in Flint, including 12 deaths.[81]

Federal data is likewise alarming. The Centers for Medicare and Medicaid Services (CMS) estimate cases involving LD and Pontiac fever (an influenza-type illness caused by the same bacteria) *have* increased *286%* in the U.S. from 2000 to 2014; 5,000 of these cases were reported to the Centers for Disease Control (CDC).[82] The CDC, in turn, reports that rates of LD *cases have increased by a factor of five over the past two decades*.[83]

Certain segments of the population, including the elderly and those with respiratory problems, are particularly susceptible to LD and other bacteria-related disease making hospitals and nursing homes especially vulnerable. Estimates indicate that 25% of LD cases arising out of hospital or healthcare settings are fatal.[84] In response to this threat, CMS recently issued a directive requiring healthcare facilities to institute new water management programs to address new health risks from bacteria-based contamination threats.[85] As a result, hospitals, nursing homes, and other health care facilities across the country are now struggling to implement new procedures and safeguards to counter these risks.

*Legionella* and other bacteria-related contaminants are described as "opportunistic premise piping pathogens" (OPPPs).[86] Two other OPPs contaminants are *mycobacterium avium* and *pseudomonas aeruginosa*; the former causes pulmonary issues while the latter causes infections in the blood or pneumonia.[87] The CDC noted a significant increase in *pseudomonas,* and the most recent estimate points to 51,000 cases per year.[88] Risks from OPPPs are expected to increase due to the country's aging population and growing number of persons with compromised immune systems; thus, like *Legionella*, these threats present particular acute risks to the healthcare industry.[89]

The threat of LD and other bacteria-based contamination is not, however, limited to healthcare settings. In fact, numerous outbreaks in various additional settings have been reported:

- ✓In 2019 , two states reported the largest LD outbreak in their history. The first occurred at an Atlanta hotel and resulted in 63 probable cases of infection and 1 death, while the second was at a state fair in North Carolina and was linked to 108 cases and one death. [90]

- ✓The largest outbreaks in 2022 occurred in a Baldwin County, Alabama apartment condominium, where more than a dozen cases were reported over the course of several. months, while 13 cases were identified in Darlington County, South Carolina;

- ✓Eight cases, including five deaths, were found in a Nursing Home in New York City between June and September 2022;

- ✓13 cases and one death were reported in Napa County, California in July 2022 in which local officials believe cooling towers were responsible.[91]

- ✓20 cases, including two deaths, were discovered in Palm Springs and Palm Desert, California in March 2022, while 30 cases, with two deaths, were found in Highbridge, New York in June 2022.[92]

Additional outbreaks were reported at a race track in West Virginia[93] and the Disneyland theme park in Anaheim, California and New York Health Department officials found *Legionella* bacteria in cooling towers in the Bronx neighborhood. [94]

In the wake of these outbreaks, several states have been developing legislation to address this crisis. For example:

- ✓The Illinois Public Act 102-0004[95] (adopted Apr. 27, 2021) requires hospitals and nursing care facilities to develop policy for *Legionella* testing and make the test results available to the state health department.

- ✓The Mich. Admin. Code R 325.45303[96] (effective Feb. 21, 2020) requires health facilities to implement a water management program that follows the American Society of Heating, Refrigerating, and Air Conditioning Engineers Standard 188-2018 ("Legionellosis: Risk Management for Building Water Systems").

- ✓Virginia Senate Bill 41097 (effective July 2, 2021) requires schools to implement a water management program that includes testing for *Legionella*.

Other states are still in the process of formulating legislative responses, which vary is scope and approach. Consider the following:

- ✓New Jersey legislators proposed Senate Bill 1006[98] (referred to assembly on January 10, 2023) requiring owners and operators of certain public water systems and buildings to take actions to prevent and control cases of Legionnaires' disease. Assembly Bill 1217 was introduced on January 11, 2022, requiring registration, inspection, testing, cleaning, and disinfection of cooling towers to control outbreaks of Legionnaires' disease.[99]

- ✓Senate Bill 1776 was introduced to the New York Legislature on January 13, 2023, and requires annual inspections by the Department of Public Health for Legionnaire's disease in locations such as apartment complexes, senior centers, multi-unit living communities that are susceptible to outbreaks.[100] And on January 11, 2023, Assembly

Bill 804 was introduced to provide funding for combatting Legionnaire's disease in cities with over one million in population.[101]

✓Senate Bill 1523 was introduced to the Illinois General Assembly on February 8, 2023, and "[p]rovides that new and existing health care facilities and buildings containing health care facilities shall develop and implement water management programs with specified elements to control the growth and spread of opportunistic waterborne pathogens."[102] In addition, Senate Bill 1454 was introduced on February 7, 2023, which would amend the Department of Veterans' Affairs Act to require oversight from the Department of Health over any outbreak of Legionnaires' disease or other pathogen involving two or more individuals living in a Veterans Home.[103]

✓Assembly Bill 263 was introduced to the Nevada Legislature on March 7, 2023, and authorizes the State Board of Health to adopt regulations governing the control of Legionnaires' disease in building water systems in certain health care facilities.[104]

### C. Chemical Contaminants

Chemical contamination is a growing concern for U.S. water systems due to the extensive use of chemicals in modern society, potential adverse effects on human health, and inadequate tracking and research on the full extent of their impact. This area is a highly complex issue for several reasons.

Chemical threats, which can be caused by both naturally occurring and man-made contaminants, take many forms, and there are literally *thousands of chemicals* that are used in society for a variety of everyday applications. The EPA, for example, currently tracks over 83,000 different chemicals through its Toxic Substances Control Act (TSCA) Inventory, which catalogs chemicals that are currently manufactured or processed in the United States.[105] Key facts:

- While existing law requires testing for nearly a hundred different types of chemicals, there are *many other chemicals for which no monitoring or testing is required*.[106]

- There are also many *compounds*, which consist of *mixtures of different chemicals* and other ingredients, and *chemical byproducts*, which may be of concern that are also unregulated.[107]

- Most existing *chemical testing that is done is conducted at water treatment plants* or other parts of the supply system, not at the tap or within premise piping systems and, therefore, *may not detect the full extent of chemical contamination*.[108]

- Serious questions exist as to whether *current standards for regulated chemicals* are even sufficient to protect public health; likewise, questions are emerging about whether many chemicals, compounds and byproducts not subject to regulation should be included.[109]

In sum, growing evidence on both the widespread level of chemical contamination in U.S. water systems, and emerging health concerns about their impact, indicate that this entire area warrants close examination and likely greater caution.[110] Given the pervasive use of chemicals, including many used for essential purposes, and their inherent complexities, chemical contaminants present one of the most difficult challenges to water quality.

### *(1)* Example of a Regulated Contaminant—Volatile *Organic* Chemicals

Volatile Organic Chemicals ("VOCs") provide an example of one of the chemicals that is currently regulated by the EPA. This class of contaminants is drawing increased scrutiny because they are widely used and present a potential public health threat.

[VOCs] are a class of chemicals that are carbon-containing and evaporate, or vaporize, easily into air at normal air temperatures. VOCs are found in a variety of commercial, industrial, and residential products, including gasoline, solvents, cleaners and degreasers, paints, inks and dyes, and pesticides.

VOCs evaporate, or vaporize, easily into air at normal air temperatures and when in contact with water may dissolve in and be transported by water. In addition, dissolved organic chemicals in water may vaporize out of water into the air. Further, when VOCs are found in the environment it is typically the result of human activity, *e.g*. a spill or inappropriate disposal where the chemical has been allowed to soak into the ground.[111]

While EPA required tests may detect VOCs once water travels from its original supply source to the water treatment plant, such chemicals may evade detection if they enter the system at a later point. It's significant that a *single spill or leak of such chemicals can contaminate the water supply for an entire locality* placing millions of residents at risk.[112] Health effects from VOCs may include:

- Eye, nose and throat irritation;
- Headaches, loss of coordination and nausea;
- Damage to liver, kidney and central nervous system;
- Some VOCs are suspected or known to cause cancer in humans.[113]

Because VOCs are one of the chemicals regulated by the EPA, unsafe levels of these chemicals can be revealed by the applicable testing, monitoring and reporting requirements. Further, there is emerging evidence showing that this is one type of regulated contaminant that is creating public health risks for which greater remedial action may be necessary. For example, a report reviewing 2015 EPA data shows that some *3.4 million people* were served with water by a CWS that was in violation of the EPA's VOC rule.[114]

### *(2)* Example of Semi-Regulated Chemicals—PFASs

One type of chemical contaminant that is presenting perhaps the most serious and extensive threat to public safety is known as PFASs, *i.e.*, Per- and Polyfluoroalkyl Substances ("PFASs"). These are common chemicals used in many types of everyday applications, including cleaning products. While PFASs are still being subject to on-going research, they have been linked to serious health complications, such as kidney and testicular cancer, thyroid disease and high cholesterol.[115]

PFASs have been traced to current and former military and industrial sites and have leached into groundwater. It should also be noted that PFASs are often referred to as "forever chemicals" because they do not break down once released in the environment and build up indefinitely in the human body once consumed.[116] Given their widespread use and potential risk to public health, these chemicals are coming under increasing scrutiny. In response to mounting pressure, the EPA has established a benchmark—albeit non-binding — of 70 parts per trillion ("ppt") for PFASs.[117]

On March 14, 2023, the EPA finally announced its proposed National Primary Drinking Water Regulation for six PFAS: perfluorooctanoic acid (PFOA), perfluorooctane sulfonic acid (PFOS), perfluorononanoic acid (PFNA), hexafluoropropylene oxide dimer acid (HFPO-DA, commonly known as GenX Chemicals), perfluorohexane sulfonic acid (PFHxS), and perfluorobutane sulfonic acid (PFBS).[118] The EPA anticipates finalizing the regulation by the end of 2023.[119] The rule proposes an MCL for PFOA and PFOS at 4.0 ppt and 1.0 (unitless) for PFNA, PFHxS, PFBS, and HPO-DA.

A 2016 Harvard study discovered higher than safe levels of PFASs in the drinking water of 33 states,[120] while another study detected unsafe levels of PFASs in 41 of 44 samples taken from public water supplies in 31 states.[121] Other reports show that these chemicals have been detected at over 400 military bases and countless industrial sites across the country.[122] Samples taken from public water systems in towns where industrial use of the chemicals was prevalent can reveal PFAS levels of up to 1,500 ppt—over 20 times the EPA's guidance level.[123] In 2023, the U.S. Geological Survey reported that at least 45% of tap water could contain one or more PFAS.[124]

Some recent cases involving PFASs have been particularly alarming. For example, the water supply for one Michigan town was recently found to have been contaminated with the highest PFAS levels found in drinking water "anywhere in the country -- possibly the world."[125] Similarly, blood tests of 235 community members living near two Navy bases in Pennsylvania revealed PFAS levels above the national average, with long-time residents reporting the highest levels. The Navy has spent $63 million so far to remedy the effects of PFAS groundwater contamination caused by these two bases alone, which the CDC estimates have been exposing residents to elevated PFAS levels for up to 50 years.[126] Nationwide, the Department of Defense has identified over 400 military bases that have serious PFAS contamination problems.[127]

Some states have moved forward on their own to address the threat posed by PFAS contamination in water. Since 2020, a significant number of states have taken action on PFAS, most significantly in banning PFAS in consumer products and firefighting foams.[128] Currently, ten states have enacted action levels or MCL standards for one or more PFAS: Ohio, New Hampshire, New Jersey, New Mexico, New York, Massachusetts, Michigan, Pennsylvania, Vermont, and Wisconsin (see Appendix C). Delaware, Maine, Rhode Island, and Virginia are moving forward in establishing MCLs, and Kentucky legislators have proposed legislation to do the same.[129]

Fourteen other states have enacted notification standards or guidance (see Appendix C). The levels vary among the states, and likely will continue to do so until the EPA issues its drinking water standards (see Appendix C). A number of other states have regulated PFAS in other ways, such as mandating the state environmental agency to study and test for PFAS in the water supply, and requiring notification if PFAS is released into groundwater.[130] The EPA is expected to finalize a National Drinking Water Regulation for PFOA and PFOS by the end of 2023.[131] The rule will include both a non-enforceable and enforceable Maximum Contaminant Level Goal (MCLG) and MCL.

### *(3)* Consequences of Chemical Use: Disinfection Byproducts

While chemicals themselves pose certain dangers to water quality, a related concern involves contaminants known as *disinfection byproducts* ("DBPs"). These are substances created as unintended or unavoidable consequences resulting from chemicals used in various everyday applications, including those serving critical purposes, *e.g.,* disinfecting water. While these contaminants are used widely in many CWSs, it has been found that concentrations of certain types of DBPs *in excess of 10 parts per billion* likely pose human health risks.[132] Exposure to DBPs is associated with an increased risk of cancer and liver, kidney, and central nervous system problems.[133]

At present, there are over 600 unregulated DBPs that have been identified in drinking water. However, only a handful of DBPs, those that are known carcinogens, are regulated by the EPA.[134] DBPs are also a concern because they not only pose risks when they are ingested but may also pose a threat when a person is exposed to them from bathing or showering.[135] These chemicals pose an increasingly difficult challenge. A report on 2015 data showed that *over 25 million Americans* were served with water that violated DBP standards established by EPA, i.e., those for "combined disinfectants and disinfection byproducts rules."[136]

Since such findings can only relate to the relatively few types of DBPs that are currently regulated, the full impact of the several hundred unregulated DBPs is unknown at this point. Likewise, it should also be stressed that since most DBPs are not regulated, they don't appear on the radar screens of many water utilities or state environmental agencies.[137]

#### *(4) Contaminants of Emerging Concern*

Due to concerns over chemical contaminants, the EPA has established a classification known as "*contaminants of emerging concern*" (CEC) to assist identifying and tracking new potential chemical risks:

> The term "*contaminant of emerging concern*" is being used within the [EPA's] Office of Water to . . . identify *chemicals and other substances that have no regulatory standard, have been recently "discovered" in natural streams* (often because of improved analytical chemistry detection levels), and *potentially cause deleterious effects* in aquatic life at environmentally relevant concentrations. They are pollutants *not* currently included in routine monitoring programs and *may be candidates for future regulation* depending on their (eco)toxicity, potential health effects, public perception, and frequency of occurrence in environmental media. CECs are not necessarily new chemicals. They include pollutants that have often been present in the environment, but whose . . . significance are only now being evaluated.[138]

These types of contaminants will warrant careful scrutiny in future efforts to ensure water quality, given their widespread use and potential health risks. In sum, DBPs and countless other potentially dangerous chemicals are being found with increasing frequency in water supply systems. These substances are not covered by current EPA rules, thereby posing another challenge for water quality management.

## VII. Root Causes of Crisis: Multiple Driving Forces

As demonstrated above, recent problems surfacing from metals, chemicals and bacteria-based contaminants collectively present increased and potentially widespread threats to U.S. water quality. A review of extensive evidence concerning these problems reveals they are the result of a myriad of factors, which include the following:

### A. Antiquated Infrastructure

The American Water Works Association, a leading trade association in the water industry, estimates the U.S. will need approximately *one trillion dollars over the next twenty-five years* to rebuild aging water infrastructure.[139] There's little question that antiquated infrastructure is one of the leading causes of system failures, a fact that becomes more obvious with each passing year.

Older pipes, especially those made of lead and galvanized iron or steel, have exceeded or are quickly reaching the end of their lifespan. The majority of the systems we rely on for drinking water were built in the first half of the 1900s and have an expected utility of 75-100 years, making much of this infrastructure antiquated and prone to failure.[140]

The most recent research shows that rural areas are particularly at risk, which is usually because smaller public water systems lack resources to address current challenges.[141] But this is not just a rural problem as recent urban failures demonstrate. For example, over the past several years, major cities across the country have been subject to strict mandates from the courts to repair or replace massive water infrastructure systems due to persistent, widespread law violations. Each of these cases tend to involve hundreds of millions of dollars in fines and infrastructure costs.[142]

It is, therefore, not surprising that the 2017 *Infrastructure Report Card*, issued by the American Society of Civil Engineers, gave U.S. water and waste water systems grades of *D and D+*, respectively.[143] Such rankings for systems vital to human life for one of the richest nations on earth should sound an alarm for policy makers and industry stakeholders that broad-scale reforms are needed. The problem is that a number of similar reports have been issued in the past, and government action and support seems to be declining rather than increasing.

Aging pipes face greater risks of contamination and are susceptible to mechanical piping failures. One major consequence of this can also be seen with the prevalence of water main breaks across the United States. In 2017, Philadelphia experienced nearly 1,000 water-main breaks[144] causing major disruptions to business and transportation throughout the city. These pipes were originally installed in 1927. This was not an isolated incident. A recent study conducted by Utah State University found that, since 2012, water main breaks in the United States and Canada have risen by 27% overall and up to 40% for certain types of pipe.[145] A 2021 report by the American Society of Civil Engineers found that there is a water main break every two minutes in the United States, resulting in an estimated loss of 6 billion gallons of treated water per day.[146] Without new major investments needed to replace these systems, such failures will escalate.

The effects of water main breaks are not limited to disruption to transportation and repair costs but also include loss of business and property damage.[147] In addition, these breaks lead to increased health risks, for example, where abrupt loss of pressure permits contaminants to enter the water supply system.[148] These factors illustrate just some of the types of high costs caused by continuous neglect of infrastructure. Mechanical failures are only one consequence of aging infrastructure. Public health risks and costs associated therewith are likely even more impactful. The astronomical health costs incurred by a city like Flint, MI, which were driven in part by older piping systems, underscore this point and should serve as a warning for the future.

### B. Insufficient Resources

While major reforms are needed to promote greater compliance with federal and state water quality standards generally, the fact is that many jurisdictions lack the resources and technical knowledge to adequately monitor water systems or institute remediation measures. This challenge is serious since thousands of public water systems across the country are facing these problems.

Research from the 2018 National Academy of Sciences report referenced above demonstrated that many of the jurisdictions failing current standards include rural areas and other localities that simply lack the financial and/or technical capabilities to meet increasingly sophisticated water quality challenges.[149] Significantly, this same report indicated that *privately-owned* water utilities, which tend to have greater resources, were less likely to have widespread violations than many publicly-owned water systems.[150]

Regardless of how CWSs are structured—public, private or mixed—all water supply systems must be assured adequate funding to be capable of monitoring and maintaining compliance with critical safety standards. Yet, current federal funding for water infrastructure continues to fall far below the amount needed to rebuild rapidly deteriorating systems. For example, while states requested $82 billion for water infrastructure projects in 2018, ultimately only $14.4 billion was committed to federal grant and loan programs.[151] Congress and President Biden made crucial investments in 2021 with the bipartisan Infrastructure Investment and Jobs Act.[152] The Act includes $50 billion in funding to EPA to strengthen the country's drinking water and wastewater systems, which is the largest single investment in water quality ever made by the federal government.[153] Current challenges demand substantially greater funding from the federal government. Major funding increases from state and local government will likewise be critical.

Federal agencies also need sufficient funding to ensure enforcement and compliance with existing federal laws. A 2020 Report by EPA's Office of Inspector General found a decline in EPA's inspections and enforcement actions from 2006 to 2018.[154] During this period, funding for EPA's enforcement program decreased by 18%, and the number of staff was reduced by 21%.[155] The number of enforcement actions initiated and concluded by EPA were *cut in half* when comparing fiscal year 2007 and fiscal year 2018.[156] As a result of budget cuts and diminished enforcement capacity, EPA's State Drinking Water Dashboard shows that over a quarter (27%) of public water systems had a documented violation of the Safe Drinking Water Act in 2022.[157]

### C. Modern Pollution Sources

Another major threat to water quality in modern society can be found in both naturally occurring and man-made chemicals, which are being identified as new health risks with increasing frequency. These substances include numerous types of unsafe chemicals that have been improperly discharged into the environment from various sources, including military and industrial sites. In addition, certain modern farming procedures have also been shown to result in increased contamination of water systems.[158]

Chemical contaminants can present health risks when they enter public water supply sources, groundwater or other supply sources, such as lakes and rivers. Moreover, the fact that water subsequently goes into a water treatment plant and is processed does not ensure its safety. While current treatment procedures may be capable of removing or neutralizing some of these threats, such procedures are generally only designed for treating contaminants *known to be in the water*. Many modern contaminants that are being detected in water supply systems are *not* generally known to CWSs or even covered by existing water quality regulations. Often, wastewater treatment facilities are not designed to remove CECs prior to discharge into waterways.[159]

### D. U.S. Water Policy Is Slow to Evolve

Current water policy is antiquated in many ways insofar as it has failed to keep pace with new and evolving challenges. Effective water quality testing has proven especially elusive in recent years. EPA rules, which establish minimum legal standards for drinking water quality, are outdated in many respects and do not require testing that is sufficiently rigorous to address a multitude of emerging contaminants. As a result, many chemicals, as well as bacterial-based substances that pose credible threats, are not subject to any regulation whatsoever.

However, the EPA has recently begun to take some steps in the right direction. For example, it recently proposed a rule for PFAS that will go into effect at an unknown future date.[160] The EPA also developed a number of revisions to its Lead and Copper Rule in 2021,[161] and then revisited this rule again in 2023 to proposed additional reforms.[162] One of the most significant aspects of the 2023 proposal is that it seeks to reduce the action level for lead in water from 15 parts per billion (ppb) to 10 ppb. In addition, the CDC has prepared a *Legionella* Control Toolkit, which provides guidance on controlling the bacteria, but neither the CDC nor EPA have promulgated legally binding regulations for managing *Legionella* in CWSs. [163]

**E. Ineffective/Piecemeal Regulations**

The driving forces of the current water crisis are more complex than aging pipes or lax enforcement of existing laws. Even when corrective measures are attempted, they are often too narrow in scope leading to piecemeal solutions that may address one problem but overlook others. For example, new state laws are being proposed to require lead testing for schools, while completely ignoring potential bacteria threats or potentially dangerous chemicals.

It would obviously be tragic to institute new testing procedures that verify a school or other facility is lead-free only to later discover the water is tainted by other contaminants. In fact, while the lead catastrophe in Flint was unfolding, citizens in this very same region were simultaneously afflicted with a large-scale outbreak of Legionnaire's disease. [164] During most of this time, virtually all the government agencies involved focused all testing activities solely on lead.

Similar problems can be seen at the federal level. For example, acting in part in response to Flint, the EPA promulgated revised water regulations for lead and copper in 2021.[165] Although beneficial, this rulemaking does *not* address other contaminants, including *Legionella* and numerous unsafe chemicals. The regulations also require all water systems to develop a lead service line inventory and lead service line replacement plan by October 16, 2024.[166]

However, the update does not require public water systems to commit to a steady schedule of lead service line removal and replacement except for water systems serving more than 10,000 persons that exceed the lead action level in tap samples.[167] In addition, the updated lead and copper rule does not cover non-community water systems that serve fewer than the same twenty-five persons over six months per year.[168] This means that health risks from internal piping in single-family homes and other small residential and commercial buildings will continue unabated.

The inverse problem can be seen in a 2018 directive issued by CMS, which requires healthcare facilities to devise water management plans to prevent the spread of bacteria, especially *Legionella*, by mandating the use of internal water management systems.[169] The Department of Veterans Affairs, Veterans Health Administration (VHA) has a similar directive for water systems in VHA buildings in which patients, residents, or visitors stay overnight.[170] Although critically needed due to the recent spike in LD cases, this directive does *not* seek to mitigate risks posed by other substances that might exist in these same systems, whether metals or chemicals.

Given the absence of federal action, a number of states have begun instituting reforms to combat PFAS contamination. According to a 2023 report by the National Conference of State Legislatures: (a) eighteen states have restricted or entirely banned use of PFAS-containing firefighting foam: (b) sixteen states have allocated funds for the cleanup and remediation of PFAS in soil and groundwater; and (c) thirteen states have enacted legislation to address PFAS in packaging and consumer products.[171]

In addition, ten states now have enforceable maximum contaminant levels for PFAS.[172] Similarly, as discussed further below, a handful of states have implemented regulations to address growing *Legionella* threats.[173] The vast majority of states and the federal government do not have comprehensive solutions to address *Legionella* contamination in drinking water.

## VIII. Solutions: Reforming Water Quality Policy

### A. Generate Capital Funding Sources

#### 1. U.S Water Infrastructure: Funding Challenges

Water systems in some parts of America have been in operation for a hundred years or longer and even newer systems must be capable of handling modern sources of contaminants. Given the current state of U.S. water quality, there's no question that major capital funding is needed to repair, replace, and update existing infrastructure.[174] Resources for these efforts will be required from all levels of government: federal, state, and local. Assistance may also be needed from the private sector, for example, through privatization of municipal water systems or other forms of public-private partnerships. Specifically, in seeking to develop new funding sources, all realistic options must be considered, including the following:

- Increase funding available through existing federal programs, including the Clean Water State Revolving Fund under the Clean Water Act, and the Drinking Water State Revolving Fund under the Safe Drinking Water Act;

- Revise the current federal standards and formulas for federal water funding for state and local government participation, i.e., reduce the current matching funds requirement;

- Create a new national trust fund similar to the federal highway fund and raise new sources and types of bond funding; and

- Promote the use of other innovative public-private partnerships as a means for developing and executing major water projects requiring significant capital construction.[175]

State governments will also need to develop new funding sources. EPA suggests that state and local governments could fund drinking water and wastewater projects through water surcharges, municipal bonds, private capital, or grants from nonprofit foundations.[176] States and municipalities can also consider implementing a local option sales tax, fuel tax, or motor vehicle registration fee and earmarking the revenue for water infrastructure.[177]

It appears that some states are stepping up to the plate in this regard. For example, In November 2023, Texas citizens voted to approve Proposition 6 to use the state's historic $1 billion in surplus to create and fund a Texas Water Fund dedicated to finance water projects, such as repairing and replacing pipes.[178] In addition, Michigan and Illinois recently announced that it will be the first state to require water utilities to replace *all* water drinking lines containing lead.[179]

While the scope of these challenges is daunting, there's simply no choice. The reality is that the *cost of inaction* will be *exponentially greater*. These include direct costs of major infrastructure failures, as well as liability exposure for governmental entities and water utilities alike, which could be astronomical, as indicated by the recent flood of legal claims in towns and cities affected by this crisis.[180] For these reasons, developing solutions to America's water quality problems is needed as a matter of public health as well as economic necessity.[181]

### 2. Recent Water Infrastructure Investments

The funding needed to rebuild America's water infrastructure is immense, as this problem has been brewing for decades and elected officials have failed to develop sufficient sources for the massive capital investments needed. As a result, estimates for such work are skyrocketing:

> Water utilities throughout the United States will need to spend *$625 billion over the next 20 years* to fix, maintain, and improve the country's drinking water infrastructure, according to the results of a periodic assessment done by the Environmental Protection Agency (EPA).[182]

Thus, this funding deficit has reached a crisis level. It is also compounded by the fact that, unlike roads and bridges that are funded by the highway tax, U.S. water systems do not have a constant, dedicated streams of funding. However, in 2021, the federal government passed legislation that provided the most substantial funding to date for addressing this crisis.

> The nation has underinvested in water infrastructure for too long. Insufficient water infrastructure threatens America's security, and it risks people's health, jobs, peace of mind, and future prosperity. The Bipartisan Infrastructure Law [BIL] delivers more than $*50 billion to EPA to improve our nation's drinking water, wastewater, and stormwater infrastructure* . . . .[183]

One key challenge being addressed by this funding involves the replacement of lead service lines, which is significant since lead contamination threatens many municipalities. Specifically, the EPA estimates that there are over 9 million lead service lines across the U.S. To address this threat, BIL funding allocates $15 billion in grants and loans to replace these lines.[184] This is also important because service lines are generally the legal responsibility of the property owner, so this program assists homeowners unable to afford replacement projects.

## B. Targeted Remediation Strategies

While many water infrastructure problems can be largely addressed by developing new funding sources, indoor water quality problems present additional, often more vexing problems. As discussed in the next section, there is a marked industry trend favoring the use of more comprehensive or holistic *Water Management Programs* for addressing water quality issues in premise piping. But some issues cannot wait for the development of such programs. Immediate threats require immediate solutions, especially when the risk poses imminent safety threats.

In these circumstances, jurisdictions are utilizing more narrowly focused strategies, which can have varying degrees of success. In some cases, solutions can be fairly simple, *e.g.*, using filters or to prevent lead in fixtures from contaminating indoor water. Likewise, sometimes *Legionella* threats can be addressed by simply increasing circulation or raising temperatures in premise piping.

In other cases, quick fixes are not feasible. For example, even before the BIL funding discussed above was approved, some municipalities, which faced dangerous lead contamination threats, such as Flint, MI and Newark, NJ, raised funding from various sources to replace most or all lead service lines within their jurisdiction. Accelerating *Legionella* risks in cooling towers in some areas likewise requires more intensive and immediate responses.

As a result, some municipalities have implemented regulations to require the registration of all cooling towers within their purview. The purpose of these laws is to require regular monitoring and testing of this equipment to prevent contaminant levels from reaching dangerous levels and to provide remedial measures when serious risks are detected. Such laws also require detailed reporting to public health agencies and mandatory government inspections.[185]

### C. Major Industry Trend: "Water Management Programs"

#### 1. WMPs Basics

One of the most significant trends in water quality has been the development and use of *Water Management Plans or Programs* (WMPs), which offer a comprehensive, systematic approach for evaluating, monitoring, treating and maintaining internal water systems to eliminate and prevent threats from both internal and external sources.

This holistic approach of course makes sense insofar as internal water systems can be exposed to multiple contaminants from diverse sources. After all, successfully treating a system for lead only to later find *Legionella* problems fails to serve both safety and cost-efficiency goals.

For these reasons, WMPs are gaining significant traction among professionals in the mechanical and plumbing trades, environmental engineers and facility managers and, indeed, are being broadly adopted for buildings with more sophisticated water systems, especially hospitals and other healthcare facilities.

#### 2. ASHRAE 514-2023 WMPs

The emerging industry standards for WMPs is ANSI/ASHRAE Standard 514-2023, *Risk Management for Building Water Systems: Physical, Chemical, and Microbial Hazards.*[186] *While WMPs were initially developed to combat Legionella threats, with the leading standards being ASHRAE 188, it was soon recognized there are major advantages for expanding such programs to address other contaminants.*

Thus, ASHRAE developed Standard 514 to provide expanded coverage for "illness and injury from physical, chemical, and microbial hazards from water systems in buildings."[187] Specifically, this standard:

> [a]pplies to the *design, construction, commissioning, operation, maintenance, repair, replacement, and expansion of new and existing building water systems (potable and nonpotable) and components*. Applies to human-occupied commercial, institutional, multiunit residential, assembly, educational, and industrial buildings . . . . Intended for *owners, authorities having jurisdiction, and those involved in the design, construction, management, installation, commissioning, operation, maintenance, and service of centralized building water systems and components*.[188]

This broader strategy of Standard 514 comports with the notion that a more comprehensive water management strategy is more sensible and effective. Issued in 2023, this standard is new to the market but will likely be widely embraced by the industry. Its predecessor, ASHRAE 188, has been incorporated into to federal policy in several respects, *e.g.*, as mandatory policy for healthcare facilities receiving federal financial assistance from the Centers for Medicare and Medicaid.[189]

### 3. Federal Policy on WMPs

Federal agency guidance for WMPs, while designed in accordance with ASHRAE Standard 188 is helpful for understanding how these programs work, including in a broader context focused on multiple contaminants. Thus, the following overview of WMPs from the Center for Disease Control and Prevention[190] is instructive:

> *Water management programs identify hazardous conditions and take steps to minimize the growth and transmission of Legionella and other waterborne pathogens in building water systems. Developing and maintaining a water management program is a multi-step process that requires continuous review. . . . .*
>
> ***Key Elements:*** *Seven key elements of a . . . water management program are to:*
>
> - *Establish a water management program team.*
> - *Describe the building water systems using text and flow diagrams.*
> - *Identify areas where Legionella could grow and spread.*
> - *Decide where control measures should be applied and how to monitor them.*
> - *Establish ways to intervene when control limits are not met.*
> - *Make sure the program is running as designed (verification) and is effective (validation).*
> - *Document and communicate all the activities.*
>
> ***Principles:*** *In general, the principles of effective water management include:*
>
> - *Maintaining water temperatures outside the ideal range for Legionella growth preventing water stagnation by ensuring adequate disinfection*
> - *Maintaining devices to prevent sediment, scale, corrosion, and biofilm, all of which provide a habitat and nutrients for Legionella.*
> - *Once established, water management programs require regular monitoring of key areas for potentially hazardous conditions and the use of predetermined responses to respond when control measures are not met.*
>
> ***Building Factors*** *Each program has to be tailored for each particular building at a particular point in time. Building factors to take into consideration include:*
>
> - *Structure and size; age; location and surrounding conditions.*
> - *Unique areas of risk for Legionella growth and spread.*
> - *Whether the buildings are intended for use by people at increased risk for Legionnaires' disease.*
>
> *Options may vary depending upon state and local building codes, water treatment regulations, healthcare accreditation and survey requirements, and public health reporting requirements. For example, anti-scald regulations may limit maximum allowable water temperatures.*

In some settings, such as hospitals and other large buildings with complex water systems, you need a water management program for the entire building. In other settings, such as small buildings with simple water systems, you may only need a [WMP] to cover the devices that aerosolize water. Examples of these devices include fountains, hot tubs, cooling towers, and respiratory equipment intended for nebulization.[191]

For the reasons discussed above, where possible, it is often beneficial for WMPs to be comprehensive in scope and include various investigation protocols capable of detecting at least the main leading contaminant threats expected from multiple sources. Other key factors relating to the design and implementation of WMPs include the following.

1. Some facilities, such as hospitals and other healthcare facilities, require more comprehensive, sophisticated WMPs, usually designed by a cross-disciplinary team of experts of facilities management, healthcare experts, and experienced contractors.

2. While such facilities must be particularly vigilant for bacteria threats, risks from metal and chemicals cannot be ignored and may need to be evaluated for these risks.

3. Monitoring of water quality issues at other facilities will usually not need be as rigorous as healthcare or other complex facilities but should likewise be tailored according to the needs of each situation. However, older facilities may be more at risk of lead contamination and still need to be evaluated for bacteria and chemicals.

4. Generally, WMPs for any given facility must be designed in accordance with the needs and characteristics of the facility as determined by a technical assessment of all relevant factors, including the type and age of the facility, the type of population served by the facility (e.g., elderly people, young children), and the type of piping used for both service lines and internal systems. Other factors noted above may also need to be considered.

### D. Develop Effective Water Quality Standards

Existing federal and state laws that govern water quality are fragmented, ineffective and obsolete in many ways. To ensure public health and safety, major reforms will be required in applicable laws, as well as related industry codes incorporated by reference into these laws.

1. **Federal Law:** At the federal level, reforms will likely require amendments to the two leading federal statutes: The Safe Drinking Water Act, 42 U.S.C. § 300f (1974) and the Federal Water Pollution Control Amendments of 1972 (known as the Clean Water Act), 33 U.S.C. § 1251 (1972).

   - As noted, the EPA is in the process of re-writing *its Lead and Copper* regulation.[192] The rule includes new measurement requirements for lead, including the number of locations required for testing and methods used.[193] **T**he Infrastructure Investment and Jobs Act provided a much needed $15 billion investment specifically for lead service line replacement projects.[194] In a Congressional hearing, Senator Tammy Duckworth stated that this investment is merely a “down payment” because replacing all the lead pipes in the country will cost an estimated $45 billion dollars.[195]

   - What’s more, the new rule *focuses only on lead and copper*. However, numerous reports have shown that U.S. water quality is increasingly at risk from dangerous chemicals and bacterial contaminants showing that the EPA’s current rulemaking would benefit from a more comprehensive policy.

2. **State Law:** States enact laws implement federal standards established under the Clean Water and Safe Drinking Water acts. In some cases, states only seek to ensure that public water systems comply with minimum federal standards; in others, they enact measures that go beyond minimum federal requirements.

- With respect to the former, states need better guidance to ensure full compliance with the essential federal minimum requirements. Greater technical and regulatory guidance in monitoring and maintaining water quality can especially benefit smaller communities struggling to meet current standards.

- Regarding the latter, state statutes need to be developed from a more informed perspective to avoid repeating past mistakes, *e.g.*, by enacting more comprehensive laws and policies rather than the piecemeal responses used in the past.

- Greater sharing of best practices by state governments could also help especially on key policy issues, such as higher minimum water quality standards, better and more frequent testing requirements and improved monitoring and enforcement rules.

3. **Industry Codes:** Due to the highly technical nature of water quality issues, public law often relies on certain professional industry codes, which are incorporated into law by reference.

    - These source documents are developed by experienced engineers and other professionals with technical expertise in the industry and have a critical, substantial impact on the overall effectiveness of water policy.

    - Industry codes and standards in the water industry include those from the American Society of Sanitary Engineers and the American Society of Heating, Refrigerating and Air-Conditioning Engineers. Examples of codes that should be re-examined and likely updated include the following:

        - Uniform Plumbing Code
        - Uniform Mechanical Code
        - International Plumbing Code
        - International Mechanical Code
        - International Fire Code
        - ASHRAE Standard 188-2015
        - ASHRAE Standard 12
        - ASSE Standard 12000
        - NFPA 99 Healthcare Facility Code

4. **Qualified Contractors & Technicians:** Given the growing complexity of ensuring safe water supply and distribution systems, it is critical that the maintenance, testing, monitoring and remediation work relating to such systems be performed by properly qualified personnel, including contractors and technicians used for facility construction and maintenance.

    - Indeed, the emergence of the widespread challenges outlined in this paper and the obvious public safety threats underscore the fact that this is essential for issues affecting both CWSs and internal premise piping—only organizations and individuals with the requisite knowledge, skills and training should be entrusted with the responsibility of working on these systems.

    - Facility managers in all sectors should be properly educated on these issues and must be connected to the proper professionals in terms of government regulatory authorities, environmental engineering firms and appropriate scientific experts.

- At the ground-level, in terms of facility construction and maintenance, facility managers now have the benefit of a recent industry certification process that can be used to verify credentials for both contractors and technicians essential for this work. Specifically, the ASSE has responded to recent water quality challenges by establishing its new Series 12000.

- The Series 12000 includes ASSE 12060 for contractors, which verifies their qualifications, knowledge and training for contracting firms working in the field of Water Quality. In addition, ASSE 12061, 12062 and 12063 provide certifications for Plumbers, Pipefitters/HVAC Technicians, and Sprinkler Fitters, respectively, to ensure proper training and qualifications for technicians working in the water quality arena.

- ASSE International is a membership organization that represents all disciplines of the plumbing and mechanical industries and has advocated for plumbing practice standards for 113 years.[196] ASSE certifications qualify as industry standards, accredited by the American National Standards Institute ("ANSI").[197]

- ANSI is a private, non-profit organization which develops standards through a consensus process utilizing industry experts, in this case professionals from all segments of the plumbing and mechanical industries. ANSI "provides a framework for fair standards development and quality conformity assessment systems and continually works to safeguard [the] integrity" of its standards, which must meet "essential requirements for openness, balance, consensus, and due process."[198]

- The ASSE Series 12000 of certifications was purposely designed to "address the need for construction and maintenance personnel . . . to protect building occupants and operations from pathogens and hazards."[199] Certified contractors and tradespersons are trained to recognize and remediate water quality issues, whether they arise in more complex water systems, such as those found in healthcare facilities, or in more routine piping systems.[200]

- Significantly, certification is only awarded to those who can "[a]ssess mechanical and plumbing systems to prevent the spread of contaminants."[201] For example, contractors and technicians cannot obtain an ASSE 12000 certification unless they are knowledgeable on the topics of waterborne pathogens, biohazards, viruses, microorganisms, bacteria, protozoa, mold, algae and other potentially infectious material and are able to productively contribute to the development of a water quality risk management plan.[202]

- The ASSE Series 12000 is particularly important in combatting *Legionella*, which poses one of the most serious threats in premise piping systems, especially for healthcare facilities. This Series is designed to specifically address *Legionella*, including factors relating to the interaction between water temperature and growth of the bacteria that combine to create dangerous conditions that foster *Legionella* growth.[203]

- Among other things, the ASSE Series 12000 ensures both contractors and technicians have the proper training and qualifications to implement "contamination/infection prevention procedures for protecting facility occupants and operations."[204]

5. **New Testing Rules**: There's no question that deficiencies in data collection, water sampling and testing and system monitoring are causing major challenges for ensuring water quality. [205] Therefore, proper sampling/testing rules are a critical first step in improving standards and protocols. These should require:

   - Use of best practices protocols and procedures for water quality sampling and testing that can more effectively detect and assess public health risks;

   - Rigorous, comprehensive sampling/testing for contaminants known to pose risks to water quality, including lead, dangerous bacteria and chemicals of emerging concern, which may vary per geographic location; and

   - Increased and improved sampling/testing of water supply sources, both original water sources and infrastructure components of water utilities, and other CWSs.

### E. Launch Industry & Public Education Initiatives

Given the scope of the problems at hand, and a general lack of knowledge about these issues among many stakeholders, a full-scale education campaign on water quality is needed. The general public, including homeowners and business owners, must also be educated on the nature and severity of the problems and potential solutions, including the need for immediate and widespread water system testing.

A national communications campaign should be launched to educate the public, industry stakeholders, and policy makers on all three key risk areas and needed policy reforms. Such measures should include creating new water sampling and testing standards and procedures, reforming and updating applicable statutes and regulations, and developing adequate funding. It's also critical that major funding streams for rebuilding water infrastructure be developed. Most taxpayers today have become long accustomed to paying significant monthly bills for both cable TV and cell phones; they need to understand there will be an ongoing cost for ensuring clean water in the future just as there is for roads and bridges and schools.

### F. Establish a National Leadership Task Force

To address growing water quality challenges, a national industry task force should be convened with representatives from key stakeholder groups, including water utilities, federal and state regulators, community groups, and other organizations with technical knowledge in the industry. The collective expertise of such a task force could help develop new policy goals and recommendations for needed reforms, including those relating to future funding, legislative and industry code standards, and improved procedures and protocols for water quality testing.

## IX. Conclusion

To address growing threats to U.S. water quality, immediate action is imperative. Growing awareness of the adverse effects of failing water systems should make it clear that such reforms are urgent. As noted above, the 2018 National Academy of Sciences report warned that every year up to 44 million Americans are relying on water systems that fail basic safety standards, while a 2017 New York Times' investigation found 25% of our drinking water is unsafe for consumption or so poorly monitored that there is no way of assuring public safety.

Initially, broad-scale education efforts should be launched to inform policy makers, industry stakeholders, and the public of the scope and gravity of the problem and the need for major policy reforms. In addition, new sampling and testing procedures should be implemented as quickly as possible to correct flaws in existing approaches and identify all piping systems in need of immediate remediation. Finally, new quality standards must be established while adequate funding mechanisms are developed to address massive infrastructure needs.

## *Endnotes*

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[31] Allaire, *supra* note 2, at 2078.

[32] *See* Fedinick, *supra* note 3.

[33] *See supra* Appendix B.

[34] *See* Appendix B hereto.

[35] *See* Allaire, *supra* note 2, at 2080, Table 1; *see also Appendix B.*

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# APPENDIX A:

## *UA WATER QUALITY PROGRAM*
## *POLICY BRIEF—SOURCE MATERIALS*

### COMPREHENSIVE REPORTS & STUDIES

| Source | Key Findings |
|---|---|
| Maura Allaire et al., *National Trends in Drinking Water Quality Violations,* 115 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES 2078 (Feb. 2018).<br><br>http://www.pnas.org/content/early/2018/02/06/1719805115 | • "In 2015, nearly 21 million people relied on community water systems that violated health-based quality standards."<br>• Repeat violations occur at a substantially higher rate in rural communities than urbanized areas.<br>• Comprehensive data analysis of 17,900 community water systems from 1982-2015. |
| Kristi Pullen Fedinick, Ph.D. et al., *Threats on Tap: Widespread Violations Highlight Need for Investment in Water Infrastructure and Protections*, NAT'L RESOURCES DEF. COUNCIL (May 2017).<br><br>https://www.nrdc.org/sites/default/files/threats-on-tap-water-infrastructure-protections-report.pdf | • The Centers for Disease Control and Prevention estimate that approximately 19.5 million Americans fall ill each year from microbial, waterborne pathogens, such as cryptosporidiosis and Legionnaires' disease.<br>• "No comprehensive estimates have been published of the number of cancers, reproductive and neurological diseases, or other serious chronic health problems caused by contaminated tap water."<br>• "Systems serving less than 500 people accounted for nearly 70% of all violations and a little over half of all health-based violations."<br>• "It is recommended that Congress increase funding for drinking water infrastructure to at least $8 billion per year, roughly triple the current amount of $2.3 billion." |

| Source | Key Findings |
|---|---|
| Agnel Philip, et al, *63 Million Americans Exposed to Unsafe Drinking Water*, USA TODAY (Aug. 15, 2017).<br><br>https://www.usatoday.com/story/news/2017/08/14/63-million-americans-exposed-unsafe-drinking-water/564278001/ | • "In several Southwestern states, 2 million people received groundwater tainted with arsenic, radium or fluoride from their local water systems."<br><br>• "Millions of Americans are also exposed to suspect chemicals the EPA and state agencies don't regulate. Two of these chemicals, perfluorinated compounds PFOA and PFOS, remain unregulated after decades of use as an ingredient in firefighting foam, Teflon and other consumer products. These perfluorinated compounds have been linked to low birth weights in children, cancer and liver tissue damage, according to the EPA." |
| President's Council of Advisors on Science and Technology, *Report to the President: Science and Technology to Ensure the Safety of the Nation's Drinking Water*, EXECUTIVE OFFICE OF THE PRESIDENT (Dec. 2016).<br><br>https://obamawhitehouse.archives.gov/sites/default/files/pcast_drinking_water_final_executive_summary_final.pdf | • Internal corrosion of lead and copper pipping yields contamination by these metals in the drinking water as well as the release of arsenic and other metals.<br><br>• "From 2014-2016 outbreaks of Legionnaires occurred in several U.S. cities, including Flint, Michigan; Milwaukee, Wisconsin; Hopkins, Minnesota; and New York City."<br><br>• The EPA has determined that there is no safe exposure level to lead and set the action protocol at 10% of taps. However, millions still experience lead exposure because a small subset of homes have lead levels over the EPA threshold.<br><br>• Bacteria and other microbes account for the highest number of violations, followed by disinfection byproducts and finally, arsenic, lead, and copper. |

## REPORTS ON LEAD & OTHER METALS

| Citation | Key Topics & Points |
|---|---|
| *Lead in Drinking Water in Schools and Childcare Facilities*, U.S. ENVIRONMENTAL PROTECTION AGENCY (last visited Feb. 9, 2018).<br>https://www.epa.gov/dwreginfo/lead-drinking-water-schools-and-childcare-facilities | • "98,000 schools and 500,000 childcare facilities are not regulated by EPA."<br>• Many schools that are served by public water systems may have never been tested for lead. |
| Michael Rios, *Some California Children Exposed to Higher Lead Levels Than Those in Flint*, PBS NEWS (Mar. 24, 2017).<br>https://www.pbs.org/newshour/nation/california-children-exposed-higher-lead-levels-flint | • "In a California community, approximately 14 percent of children tested had higher lead levels than the Centers for Disease Control and Prevention's 5 micrograms per deciliter of blood threshold."<br>• "By comparison, 5 percent of children in Flint, Michigan tested above the threshold." |
| Annie Snider, *What Broke the Safe Drinking Act?*, POLITICO (May 10, 2017).<br>https://www.politico.com/agenda/story/2017/05/10/safe-drinking-water-perchlorate-000434 | • Perchlorate, a chemical that can affect brain development, has been found in the water supplies of 16 million Americans.<br>• Only 2 states require that water companies test for perchlorate and let residents know when it's in their water. |
| *Lead Contamination in Wisconsin*, SIERRA CLUB-JOHN MUIR CHAPTER (May 2017).<br>https://www.sierraclub.org/sites/www.sierraclub.org/files/sce-authors/u2196/Lead%20white%20paper%20final%20%282%29.pdf | • "Thousands of children in Wisconsin have lead poisoning—about 4.5 percent of children, compared with 4.9 percent in Flint, Michigan." |
| Agnel Philip, et al, *63 million Americans Expose to Unsafe Drinking Water*, USA TODAY (Aug. 15, 2017).<br>https://www.usatoday.com/story/news/2017/08/14/63-million-americans-exposed-unsafe-drinking-water/564278001/ | • Drinking water is unsafe for approximately 63 million people in America.<br>• "In Fayette County, West Virginia where the water was not being maintained or tested, one resident showers with a cap after doctors told him that the town's water gave him two infections near his brain." |
| *Lead in Newark's Drinking Water*, NAT'L RESOURCES DEF. COUNCIL, (Sept. 20, 2017), https://www.nrdc.org/resources/lead-newarks-drinking-water. | • An estimated 273,000 residential customers in Newark are affected by the city's excessive lead levels in its water supply.<br>• "Newark's lead levels have reached 27 parts per billion in some areas, nearly twice the federal action level of 15 parts per billion." |

| Citation | Key Topics & Points |
|---|---|
| Michael Wines & John Schwartz, *Unsafe Lead Levels in Tap Water Not Limited to Flint*, NEW YORK TIMES (Feb. 8, 2016).<br>https://www.nytimes.com/2016/02/09/us/regulatory-gaps-leave-unsafe-lead-levels-in-water-nationwide.html | • After officials in Sebring, Ohio found unsafe levels of lead in the city's water, they waited five months before telling residents to not drink the water. |
| Erik Olson & Kristi Fedinick, *What's in Your Water? Flint and Beyond*, NAT'L RESOURCES DEF. COUNCIL (June 2016).<br>https://assets.nrdc.org/sites/default/files/whats-in-your-water-flint-beyond-report.pdf?_ga=2.8434485.1453355261.1520861715-485876678.1520435356 | • Lead causes serious developmental and behavioral defects in children.<br>• "Weak regulatory language and poor enforcement limit the effectiveness of the Safe Water Drinking Act and Lead and Copper Rule." |
| M.B. Bell & Joshua Schneyer, *Off the Charts: The Thousands of U.S. Locales Where Lead Poisoning is Worse than in Flint*, REUTERS (Dec. 19, 2016).<br>https://www.reuters.com/investigates/special-report/usa-lead-testing/ | • "CDC estimates that 2.5% of small children have elevated lead levels nationwide."<br>• Report described instances of lead poisoning in California, Maryland, Missouri, Ohio, Pennsylvania, and Wisconsin. |
| Brandi N. Clark, et al, *Lead Release to Drinking Water from Galvanized Steel Pipe Coatings*, ENVTL. ENGINEERING SCI. 32, 8 (Aug. 2015). | • Direct lead release occurs when lead is present in the zinc coating and gets released directly into the water flowing through the pipes. |
| Sheldon Masters & Marc Edwards, *Increased Lead in Water Associated with Iron Corrosion*, ENVTL. ENGINEERING SCI. 32, 5 (May 2015). | • "Several studies have identified links between high levels of particulate lead and particulate iron, suggesting that mitigation of lead problems might be associated with reducing other particulates present." |
| Sravya Maru, *Lead Exposure in Children through Water and Soil*, PUB. HEALTH 560: ENVTL. MGMT. & RISK ASSESSMENT (Dec. 2015). | • Air, soil, and water all transfer lead.<br>• Factories, such as producers of aviation fuel, waste incinerators, and lead-acid battery manufacturers release lead into the air.<br>• Over-time, lead-based paint comes off exterior buildings, such as houses, and falls into the soil. |

| Citation | Key Topics & Points |
|---|---|
| Rebecca Renner, *Out of Plumb: When Water Treatment Causes Lead Contamination*, ENVTL. HEALTH PERSPECTIVES, 117, 12 (Dec. 2009).<br>https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2799485 | • "Lead in drinking water accounts for 10-20% of children's exposure to lead."<br>• Drinking water naturally contains a minimal amount of lead; however, lead enters into the tap water through lead pipes, joints, and other fixtures.<br>• Changes in water treatment have increased lead levels in tap water because treatment chemicals may cause lead pipes to deteriorate. |
| Mark Payne, *Lead in Drinking Water*, CANADIAN MED. ASS'N J. (July 2008).<br>https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2474873 | • "Homes built before 1950 often contained lead plumbing and homes as recently as 1990 may contain lead solder." |

## REPORTS ON TOXIC CHEMICALS

| Source | Key Findings |
|---|---|
| Xiaohua Li, *EPA Method 524 for Determination of VOCs in Drinking Water Using Agilent 5975T LTM GC/MSD with Static Headspace*, AGILENT TECHNOLOGIES (Oct. 2010).<br>http://hpst.cz/sites/default/files/attachments/5990-6442en-epa-method-524-determination-vocs-drinking-water-using-agilent-5975t-ltm-gc-msd-static.pdf | • VOCs in drinking water are a serious threat to human health; EPA whitepaper addresses its method for detection.<br>• A fast and accurate method of onsite water testing has been developed to separate and test 54 volatile organic compounds in 9 minutes. |
| Garret Ellison, *Rockford Well May Have Highest PFAS Level in U.S. Drinking Water*, MICHIGAN LIVE (Jan. 31, 2018).<br>http://www.mlive.com/news/grand-rapids/index.ssf/2018/01/58930-ppt_pfas_drinking_water.html | • "A Michigan town has tainted groundwater with 58,930 parts per trillion of perfluoroalkyl and polyfluoroalkyl, potentially the highest levels of the two chemicals anywhere in the world."<br>• Residents are advised to avoid the water and wells in the area tested for record-high levels of the chemicals. The tests are concerning because "contamination levels in human blood are often 100 times higher than those in the drinking water." |
| Abigale Elise, *Potent Carcinogen Contaminated Drinking Water Used by Millions, Says Report*, WCVB (Apr. 20, 2017).<br>http://www.wcvb.com/article/potent-carcinogen-contaminated-drinking-water-used-by-millions-says-report/9533939 | • According to several lawsuits, Dow and Shell facilities have contaminated water in 13 states, exposing millions of people to chemical carcinogens.<br>• "The water in Aptos, California was contaminated with TCP from a farm that operated in 1950—over a half a century ago." |

## REPORTS ON LEGIONNELLA & OTHER BACTERIA

| Source | Key Findings |
|---|---|
| Leonard N. Fleming, *State's Top Doc Threatened Flint Researchers*, THE DETROIT NEWS (Feb. 20, 2018). http://www.detroitnews.com/story/news/michigan/flint-water-crisis/2018/02/20/eden-wells-threaten-flint-research/110636072/ | • "A professor at Wayne State University testified that Eden Wells, Michigan's Medical Executive, tried to conceal information related to the connection between Flint's lead contaminated water and the Legionnaires outbreak." |
| Karla Lant, *Fragile Water Infrastructure, Often On the Verge of Collapse*, ENVIRONMENTAL MONITOR (Jan. 12, 2018). http://www.fondriest.com/news/fragile-water-infrastructure-often-verge-collapse.htm | • "In order to maintain and expand service in line with projected demands for drinking water over the next 25 years it will cost an estimated $1 trillion." |
| *Chief Medical Executive Faces Manslaughter Charge in Flint Water Crisis*, CBS NEWS (Oct. 9, 2017). https://www.cbsnews.com/news/eden-wells-chief-medical-executive-faces-manslaughter-charge-flint-water-crisis/ | • Medical Chief allegedly withheld water-quality test data that showed concentrations of *Legionella* in Flint's water that caused LD cases and deaths.<br>• One county reported nearly 100 cases of LD. |
| Katharine M. Benedict et al., *Surveillance for Waterborne Disease Outbreaks Associated with Drinking Water- United States, 2013-2014*, MORBIDITY & MORTALITY WKLY. REP., 66, 44,(CTR. FOR DISEASE CONTROL), Nov. 2017. https://www.cdc.gov/mmwr/volumes/66/wr/pdfs/mm6644a3-H.pdf | • All of the deaths (13) associated with drinking water outbreaks between 2013 and 2014 were caused by *Legionella*. |
| Sam Boyer, *A "Real Uptick" in Claims for Legionnaires' Disease*, INSURANCE BUSINESS MAGAZINE (Nov. 22, 2017). https://www.insurancebusinessmag.com/us/news/environmental/a-real-uptick-in-claims-for-legionnaires-disease-85645.aspx | • Insurance companies are underwriting more liability policies for building owners for protection against LD related lawsuits.<br>• "At Disneyland in California, nine people who visited in September 2017 developed Legionnaires' disease. Three others, who had been nearby the park also got sick, including one with additional health issues who died." |
| Dave McKinney & Tony Arnold, *Surviving War, but Not the Veterans' Home*, WBEZ CHICAGO (Dec. 12, 2017). http://interactive.wbez.org/legionnaires/ | • "In three years, legionellosis killed 13 people and sickened approximately 61 residents and staff at a veterans' home."<br>• "*Legionella* bacteria are commonly found in approximately 50 percent of all large buildings." |

| Source | Key Findings |
| --- | --- |
| Lauren Weber, *Legionnaires' Disease Is Rising At An Alarming Rate In the U.S.*, HUFFINGTON POST (Dec. 14, 2017).<br>https://www.huffingtonpost.com/entry/legionnaires-disease-cases-continue-to-rise-nationally_us_5a303039e4b01bdd7657ddff | • CDC data shows that for more than a decade, LD cases across the country have been increasing.<br>• "There have been 6,238 reported cases of LD nationwide, a 13.6 percent increase from 2016."<br>• The CDC reported a 78 percent increase in the number of LD cases reported in New York City. |
| Laurel E.Garrison et al., *Vital Signs: Deficiencies in Environmental Control Identified Outbreaks of Legionnaires' Disease- North America, 2000-2014*, MORBIDITY & MORTALITY WEEKLY REPORT, (CTR. FOR DISEASE CONTROL), June 7, 2016.<br>https://www.cdc.gov/mmwr/volumes/65/wr/mm6522e1.htm?s_cid=mm6522e1_w | • "The most common settings of *Legionella* outbreaks were hotels and resorts, longer-term care facilities, and hospitals."<br>• Most outbreaks were caused by inadequate water disinfectant levels or water temperatures within the range of bacterial growth.<br>• External changes to a water distribution system, such as a nearby construction site or a water main break, caused outbreaks in about 7% of cases. |
| Sanly, Liu et al, *Understanding, Monitoring, and Controlling Biofilm in Drinking Water Distribution Systems*, ENVTL. SCI. & TECH. 50, 17 (2016).<br>http://pubs.acs.org/doi/full/10.1021/acs.est.6b00835 | • "Biofilm formation poses a significant problem to the drinking water industry as a potential source of bacterial contamination, including pathogens, and, in many cases, affecting the taste and odor of drinking water." |
| William F. McCoy & Aaron A. Rosenblatt, *HACCP-Based Programs for Preventing Disease and Injury from Premise piping: A Building Consensus*, 4 Pathogens 513, 514 (2015).<br>https://www.ncbi.nlm.nih.gov/pubmed/26184325 | • "Thousands of preventable injuries and deaths are caused annually by microbial, chemical, and physical hazards from building water systems." |
| Pramod K. Pandey et al, *Contamination of Water Resources by Pathogenic Bacteria*, AMB EXPRESS 4, 51 (June 2014).<br>https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4077002/ | • Waterborne pathogen contamination of water resources caused a reported 5,905 cases of illness or death. |
| Hyun-Jung Jang, *Effects of Phosphate Addition on Biofilm Bacterial Communities and Water Quality in Annular Reactors Equipped with Stainless Steel and Ductile Cast Iron Pipes*, THE JOURNAL OF MICROBIOLOGY 50, 1 (Feb. 2012). | • "The addition of phosphate to the plumbing systems, under low residual chlorine conditions, promotes a more significant growth of biofilm and leads to a greater rate reduction of disinfection byproducts in DCI pipe than in STS pipe." |

| Source | Key Findings |
| --- | --- |
| Joe Gelt, *Microbes Increasingly Viewed as Water Quality Threat*, ARROYO 10, 2 (1998).<br><br>https://wrrc.arizona.edu/publications/arroyo-newsletter/microbes-increasingly-viewed-water-quality-threat | • "Microbial pathogens and contaminants in drinking water have caused various gastrointestinal illnesses in people across the country." |
| Michael Klompas, et al., Mycobacterium abscessus *Cluster in Cardiac Surgery Patients Potentially Attributable to a Commercial Water Purification System*, ANNALS OF INTERNAL MEDICINE (2023).<br><br>https://www.acpjournals.org/doi/10.7326/M22-3306. | • A mycobacterium abscesses outbreak occurred at Boston's Brigham and Women's Hospital from March to October 2017 involving four cardiac surgery patients. Three of the four patients died.<br>• "Whole-genome sequencing confirmed the presence of a genetically identical element in ice and water machine and patient specimens."<br>• "Investigation of the plumbing system revealed a commercial water purifier with charcoal filters and an ultraviolet irradiation unit leading to the ice and water machines in the cluster tower but not the hospital's other inpatient towers. Chlorine was present at normal levels in municipal source water but was undetectable downstream from the purification unit." |

# APPENDIX B

### *EPA Law Enforcement Actions*

* Note: all cases involve violations of the Clean Water Act for failure to properly obtain a permit prior to discharging pollutants into the watershed OR discharging pollutants in excess of the permitted amount.

** All cases involve sewage overflows into nearby water sources, which are regulated as discharges under the Clean Water Act. Raw sewage contains a variety of pollutants including microorganisms, viruses, chemicals and floatable materials. Health risks from human exposure include mild gastroenteritis, hepatitis and dysentery. A sewage overflow occurs because the wastewater system becomes overwhelmed, usually from excessive rainfall, and the system backs up or overflows due to lack of maintenance and general system capacity. Aging infrastructure and antiquated pipes simply do not have the capacity to transfer all wastewater during periods of rainfall.

| City | Estimated Cost of Corrective Actions | Pollutants | Impact on Water Supply |
|---|---|---|---|
| Elyria, Ohio[1] | $248 million | Sewage; polluted discharge (nitrogen and phosphorus) | • The city violated terms and conditions of its permit through unauthorized discharges of pollutants from sanity sewer overflows and untreated sewage into the Black River in violation of its permit. |
| Burns Harbor, Indiana[2] | $3 million | Discharges of untreated cyanide and ammonia nitrogen | • Several days of unpermitted releases of cyanide and ammonia nitrogen from a pump failure exceeded permit effluent limitations. The cyanide released killed hundreds of fish in the East Branch of the Calumet River and two public beaches were closed for seven days. |
| Berkeley County, West Virginia[3] | $50 million | Discharges of raw sewage | • Defective sewer pipes and pump stations in poor condition led to unintentional discharges of raw sewage from municipal sanitary sewers. |
| Palmerton, Pennsylvania[4] | $3.3 million | Discharges of cadmium pH and zinc | • Violations of permit discharge limits for cadmium pH and zinc, discharge of contact cooling water and process wastewater. |
| Colorado Springs, Colorado[5] | $1 million | E. coli | • Widespread violations of the city's discharge permit resulted in discharges of pollutants into Foundation Creek and its tributaries in Colorado Springs causing *E. coli* contamination. |

| City | Estimated Cost of Corrective Actions | Pollutants | Impact on Water Supply |
|---|---|---|---|
| New Orleans, Louisiana[6] | $8.39 million | Suspended solids, biochemical oxygen, nitrogen, phosphorus, pathogens, low dissolved oxygen | • Churchill Downs Louisiana Horseracing company regularly discharged untreated process wastewater into the New Orleans municipal separate storm sewer system containing animal excrement, leading into Lake Pontchartrain and the Mississippi River. |
| Corpus Christi, Texas[7] | $600 million | Suspended solids, biochemical oxygen, nitrogen, phosphorus | • Effluent limit exceedances, frequent discharges of raw sewage, and failure to prevent sanitary sewer overflows. |
| City of Manchester, New Hampshire[8] | $231 million | Raw sewage, industrial waste, nitrogen, phosphorus, and polluted stormwater | • When overwhelmed by rain and stormwater, the Manchester combined sewer system frequently discharges raw sewage, industrial waste, nitrogen, phosphorus, and polluted stormwater into the Merrimack River and its tributaries, which is a drinking water source for more than 500,000 people. |
| Wyandotte County & Kansas City, Kansas[9] | $600 million | Suspended solids, biochemical oxygen, nitrogen, phosphorus | • Unauthorized discharge of sewage from the sanitary sewage system leading to microbial pathogen, suspended solids, and nutrient releases to the Kansas and Missouri rivers. |
| Evansville, Indiana[10] | $500 million | Sewage; polluted runoff (nitrogen and phosphate) | • Sewage and storm water overflows into the Ohio River, which is a drinking water source for more than 3 million people. |
| Revere, Massachusetts[11] | $50 million | Sewage | • Discharges of untreated wastewater into nearby system of rivers, creeks and brooks, which serve as the primary drinking water sources for some New England communities.<br>• Reduction in the water quality for swimming, fishing and other recreational activities that take place in the area – the Mass. Dep't of Health has issued advisories related to consuming fish caught from waters of the Mystic River. |

| City | Estimated Cost of Corrective Actions | Pollutants | Impact on Water Supply |
| --- | --- | --- | --- |
| Toledo, Ohio[12] | $315 million | Sewage | • Sewage overflows into Swan Creek, the Maumee River, and the Ottawa River, which are the city's main waterways. |
| Akron, Ohio[13] | At least $900,000 | Sewage | • Sewage overflow causes back up into basements and residential property.<br>• The overflow is also released into the Cuyahoga River, which can be used for drinking water, recreation, and other public uses. |
| Jeffersonville, Indiana[14] | $100 to 150 million | Sewage | • Discharges and overflows of millions of gallons of sewage into the Ohio River annually – the Ohio River serves as the drinking water source of millions of people. |
| Nashville, TN[15] | $300-400 million | Sewage | • Discharge of over 200 million gallons of untreated sewage and overflows of billions of gallons of combined sewage into the Cumberland River and its tributaries – the water supply for Nashville. |
| Baton Rouge[16] | $330-460 million | Sewage | • Discharge occurs in streets, private property, nearby water sources, which also serve as drinking water supply. |

## *Endnotes*

1 U.S. Env't Prot. Agency, Information Sheet: The Elyria, Ohio Clean Water Act Settlement (Nov. 9, 2022), https://www.epa.gov/enforcement/elyria-ohio-clean-water-act-settlement-information-sheet.

2 U.S. Env't Prot. Agency, Information Sheet: Cleveland-Cliffs Steel LLC and Cleveland-Cliffs Burns Harbor LLC Settlement (Feb. 14, 2022), https://www.epa.gov/enforcement/cleveland-cliffs-steel-llc-and-cleveland-cliffs-burns-harbor-llc-settlement.

3 U.S. Env't Prot. Agency, Information Sheet: The Berkeley County Public Service Sewer District, West Virginia Clean Water Settlement (Nov. 17, 2021), https://www.epa.gov/enforcement/berkeley-county-public-service-sewer-district-west-virginia-clean-water-settlement.

[4] U.S. Env't Prot. Agency, Information Sheet: American Zinc Recycling Corp. Settlement (Feb. 9, 2021), https://www.epa.gov/enforcement/american-zinc-recycling-corp-settlement.

[5] U.S. Env't Prot. Agency, Information Sheet: Colorado Springs Settlement Information Sheet (Oct. 29, 2020), https://www.epa.gov/enforcement/colorado-springs-settlement-information-sheet.

[6] U.S. Env't Prot. Agency, Information Sheet: Churchill Downs Louisiana Horseracing Company, LLC, Clean Water Act Settlement (Sept. 29, 2020), https://www.epa.gov/enforcement/churchill-downs-louisiana-horseracing-company-llc-clean-water-act-settlement.

[7] U.S. Env't Prot. Agency, Information Sheet: City of Corpus Christi, Texas Clean Water Act Settlement (Sept. 25, 2020), https://www.epa.gov/enforcement/city-corpus-christi-texas-clean-water-act-settlement.

[8] U.S. Env't Prot. Agency, Information Sheet: City of Manchester, N.H. Clean Water Act Settlement (July 13, 2020), https://www.epa.gov/enforcement/city-manchester-nh-clean-water-act-settlement-information-sheet.

[9] U.S. Env't Prot. Agency, Information Sheet: Unified Government of Wyandotte County and Kansas City, Kansas (Mar. 20, 2020), https://www.epa.gov/enforcement/unified-government-wyandotte-county-and-kansas-city-kansas.

[10] Karen Thompson, "*City of Evansville, Indiana Agrees to Upgrade Sewer Systems to Comply with Clean Water Act*," EPA Press Release, Jan. 10, 2011, https://www.epa.gov/enforcement/reference-news-release-city-evansville-indiana-agrees-upgrade-sewer-systems-comply-clean; *Ohio River Facts*, Ohio River Foundation, http://www.ohioriverfdn.org /education/ohio_river_facts/ (last visited Feb. 27, 2018).

[11] David Deegan, "*Settlement With Revere Mass. Addresses Wastewater, Stormwater Discharges*," EPA Press Release, Aug. 25, 2010, https://archive.epa.gov/epapages/newsroom_archive/newsreleases/ab4e14bf117967e28525778a006588ee .html; *Combined Sewer Overflows (CSOs) in New England*, EPA,

https://www.epa.gov/sites/production/files/documents/combinedseweroverflows.pdf (last visited Feb. 27, 2018); *Combined Sewer Overflows*, Mystic River Watershed Assoc., https://mysticriver.org/csos/ (last visited Feb. 27, 2018).

[12] *Toledo, Ohio Agrees to Make Major Improvements to City's Sewer System at an Estimate Cost of $315 Million*, Press Release, 10-1180, Dep't of Justice, Oct. 21, 2010, https://www.justice.gov/opa/pr/toledo-ohio-agrees-make-major-improvements-city-s-sewer-system-estimated-cost-315-million.

[13] *City of Akron Ohio Agrees to Improve Sewer System to Resolve Clean Water Act Violations*, Press Release No. 09-1227, Dep't. of Justice, Nov. 13, 2009, https://www.justice.gov/opa/pr/city-akron-ohio-agrees-improve-sewer-system-resolve-clean-water-act-violations; *Drinking Water Source Assessment for the City of Akron*, Ohio EPA (April 2003), http://wwwapp.epa.ohio.gov/gis/swpa/OH7700011.pdf.

[14] City of Jeffersonville, Indiana Agrees to Upgrade Sewer System to Comply with Clean Water Act, EPA Press Release, Sept. 17, 2007; Ohio River Facts, *supra* note 1.

[15] *Metropolitan Government of Nashville Agrees to Extensive Sewer Systems Upgrade,* EPA Press Release Oct. 24, 2007, https://www.epa.gov/enforcement/reference-news-release-metropolitan-government-nashville-and-davidson-county-tenn-agree; *Nashville Struggles with Water, Sewer Systems*, NPR (June 1, 2008), https://www.npr.org/ templates/story/story.php?storyId=91041009.

[16] *Baton Rouge to Make Major Improvements to the Sewer System Under Clean Water Agreement with U.S. and Louisiana*, EPA Press Release, Nov. 13, 2001, https://www.epa.gov/enforcement/reference-news-release-baton-rouge-east-baton-rouge-parish-make-major-improvements-sewer.

# APPENDIX C

### *State PFAS MCL Standards/Notification/Guidance*

Notification requires informing a state official or the public that some samples from a water source owned or operated by a corporation are above the limit. Guidance establishes a recommended concentration limit for a PFAS substance, but no notification or other action is required if concentrations exceed limits. An MCL standard or Action Level requires treatment facilities to supply drinking water that adheres to the maximum contamination level set.

| State | Level | Type of Regulation |
|---|---|---|
| Alaska[1] | PFOS/PFOA (70 ppt) | Guidance |
| California[2] | PFHxS (3 ppt); PFOA (5.1 ppt); PFOS (6 ppt); PFBS (500 ppt) | Notification |
| Colorado[3] | PFOS/PFOA/PFNA (70 ppt); PFHxS (700 ppt) | Guidance |
| Connecticut[4] | PFOS (10 ppt); PFNA (12 ppt); PFOA (16 ppt); PFHxS (49 ppt) | Notification |
| Delaware[5] | PFOS/PFOA (70 ppt) | Guidance |
| Hawaii[6] | PFOA/PFOS (40 ppt) (& 16 other substances) | Guidance |
| Ohio[7] | PFOS/PFOA (70 ppt) | Action Level |
| | PFNA (21 ppt); PFHxS (140 ppt); Gen X or HFPO-DA (700 ppt); PFBS (140,000 ppt) | Guidance |
| Oregon[8] | PFOS/PFOA/PFHxS/PFNA (30 ppt) | Guidance |
| Nevada[9] | PFOA/PFOS (67 ppt); PFBS (667,000) | Guidance |
| New Hampshire[10] | PFNA (11 ppt); PFOA (12 ppt); PFOS (15 ppt); PFHxS (18 ppt) | MCL Standard |
| New Jersey[11] | PFNA/PFOS (13 ppt); PFOA (14 ppt) | MCL Standard |
| New Mexico[12] | PFOS/PFOA/PHHxS (70 ppt) | Standard |
| New York[13] | PFOA/PFAS (10 ppt) | MCL Standard |
| North Carolina[14] | GenX/HFPO-DA (140 ppt) | Guidance |
| Maine[15] | PFOA/PFOS/PFHxS/PFNA/PFHpA/PFDA (20 ppt) | Notification |
| Maryland[16] | PFHxS (140 ppt) | Guidance |
| Massachusetts[17] | PFOA/PFOS/PFHxS/PFNA/PFHpA/PFDA (20 ppt) | MCL Standard |
| Michigan[18] | PFOA (8 ppt); PFOS (16 ppt); PFHxS (51 ppt); Gen X or HFPO-DA (370 ppt);<br>PFBS (420 ppt); PFHxA (400,000 ppt) | MCL Standard |

| | | |
|---|---|---|
| Minnesota[19] | PFOS (15 ppt); PFOA (35 ppt); PFHxS (47 ppt); PFHxA (200 ppt); PFBA (7,000 ppt); PFBS (100 ppt) | Guidance |
| Pennsylvania[20] | PFOA (14 ppt); PFOS (18 ppt) | MCL Standard |
| Rhode Island[21] | PFOA/PFOS/PFHxS/PFNA/PFHpA/PFDA (20 ppt) | Notification |
| Vermont[22] | PFOA/PFOS/PFHpA/PFHxS/PFNA (20 ppt) | MCL Standard |
| Washington[23] | PFNA (9 ppt); PFOA (10 ppt); PFOS (15 ppt); PFHxS (65 ppt); PFBS (345 ppt) | Notification |
| Wisconsin[24] | PFOS/PFOA (70 ppt) | MCL Standard |

## *Endnotes*

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[12] N.M. CODE 20.6.2.7; 20.6.2.3103.

[13] N.Y. COMP. CODES R. & REGS. tit. 10, § 5-1.52.

[14] N.C. Dep't of Health & Human Servs., GenX Health Information (2017), https://files.nc.gov/ncdhhs/documents/files/Appendix%20B%20GenX%20fact%20sheet.pdf.

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[16] Md. Dep't of Health, Health Advisory on Perfluorohexane Sulfonic Acid (PFHxS) in Drinking Water (Nov. 9, 2021), https://mde.maryland.gov/PublicHealth/Documents/MDH_PFHxS%20Advisory%20Fact%20Sheet.pdf.

[17] 310 MASS. CODE REG. 22.07G.

[18] MICH. ADMIN. CODE r. 325.10604g. These standards were challenged in Michigan court, and a Court of Claims judge found them to be invalid. They will remain in effect, however, until the appellate court issues a final judgement. *3M Co. v. Mich. Dep't of Env't*, No. 21-000078-MZ (Mich. Ct. Cl. 2022).

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[20] 25 PA. CODE § 109.202.

[21] 46 R.I. GEN. LAWS § 46-32-2.

[22] VT. ADMIN. CODE § 16-3-500:6.12.

[23] WASH. ADMIN CODE § 246-290-315.

[24] WIS. ADMIN CODE NR § 809.20.