

GAO

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on Environment and Hazardous
Materials, Committee on Energy and
Commerce, House of Representatives

March 2005

DISTRICT OF COLUMBIA'S DRINKING WATER

Agencies Have
Improved
Coordination, but Key
Challenges Remain in
Protecting the Public
from Elevated Lead
Levels



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Highlights of [GAO-05-344](#), a report to the Chairman, Subcommittee on Environment and Hazardous Materials, Committee on Energy and Commerce, House of Representatives

Why GAO Did This Study

Media reports on elevated lead in the District of Columbia's drinking water raised concern about how local and federal agencies are carrying out their responsibilities. The Lead and Copper Rule requires water systems to protect drinking water from lead. The U.S. Army Corps of Engineers' Washington Aqueduct treats and sells water to the District Water and Sewer Authority (WASA), which delivers it to District residents. The Environmental Protection Agency's (EPA) Region III Office oversees these agencies.

GAO examined (1) what agencies implementing the rule in the District are doing to improve their coordination and reduce lead levels, (2) the extent to which WASA and other agencies are identifying populations at greatest risk of exposure to lead in drinking water and reducing their exposure, (3) how other drinking water systems that exceed EPA's action level for lead conduct public education, and (4) the state of research on lead exposure and how it applies to drinking water.

What GAO Recommends

GAO recommends that EPA (1) identify and publish best practices that water systems use to educate their customers about lead in drinking water and (2) develop a strategy for closing information gaps in the health effects of lead in drinking water. EPA generally agreed with the report.

www.gao.gov/cgi-bin/getrpt?GAO-05-344.

To view the full product, including the scope and methodology, click on the link above. For more information, contact John Stephenson at (202) 512-3841 or stephensonj@gao.gov.

DISTRICT OF COLUMBIA'S DRINKING WATER

Agencies Have Improved Coordination, but Key Challenges Remain in Protecting the Public from Elevated Lead Levels

What GAO Found

WASA and other government agencies have improved their coordination, but significant challenges remain. According to EPA officials, WASA has thus far met the terms of a June 2004 consent order by enhancing its coordination with EPA and the D.C. Department of Health. For example, WASA developed a plan to improve its public education efforts and collaborated with the department to set priorities for replacing lead service lines. EPA expects the August 2004 addition of a corrosion inhibitor to eventually reduce lead in drinking water, though it may take more than one year for full improvements to be observed. Tap water test results reported in January 2005 show that D.C. drinking water still exceeds the standard for lead.

WASA is identifying those customers most at risk from exposure to lead in drinking water and reducing their exposure. WASA is focusing on lead service lines as the primary source of lead in drinking water. It is updating its inventory of lead service lines, accelerating its rate of service line replacement, and providing priority replacement for customers most vulnerable to lead's health effects. However, questions remain about the success of the replacement program because, by law, WASA can only pay to replace the portion of the service line that it owns. Homeowners may pay to replace their portion of the service line, but few homeowners chose to do so in 2003 and 2004.

Other water systems use innovative methods to educate their customers and to judge the effectiveness of their efforts. These practices include using a variety of media to inform the public, forming partnerships with government and nonprofit agencies, and targeting and adapting information to the audiences most susceptible to lead exposure through drinking water. Many of these practices go well beyond the requirements of the Lead and Copper Rule. In this connection, water industry representatives and others noted several shortcomings with the rule's public education provisions, including confusing language and the lack of a requirement to notify homeowners of the specific lead levels in their drinking water. Additionally, EPA has not evaluated water systems' public education efforts on lead in drinking water since the rule was established more than a decade ago.

Much is known about the health effects of lead exposure, particularly its impact on brain development and functioning in young children. However, limited studies have been conducted on the health effects of exposure to low levels of lead in drinking water. EPA plans to prepare a health advisory document to help utilities explain the risks of lead exposure to the public, and a paper summarizing lead research conducted since the Lead and Copper Rule was published in 1991. However, the timetable for these projects is not clear, and it is also not clear how this work will fit into a broader research agenda, or if this effort needs to involve other key organizations, such as the Centers for Disease Control and Prevention.

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Abbreviations

CDC	Centers for Disease Control and Prevention
EPA	Environmental Protection Agency
IEUBK	Integrated Exposure Uptake Biokinetic Model for Lead
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MOU	memorandum of understanding
MWRA	Massachusetts Water Resources Authority
ppb	parts per billion
WASA	District of Columbia Water and Sewer Authority
WIC	Women, Infants, and Children

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United States Government Accountability Office
Washington, D.C. 20548

March 31, 2005

The Honorable Paul Gillmor
Chairman
Subcommittee on Environment and Hazardous Materials
Committee on Energy and Commerce
House of Representatives

Dear Mr. Chairman:

In January 2004, local media reported that the District of Columbia Water and Sewer Authority (WASA) had found elevated lead levels in the drinking water of more than 4,000 homes in the city—the results of tests conducted during the summer of 2003. The lack of timely disclosure of this problem and the subsequent confused effort by government agencies to inform the public on steps to protect itself resulted in numerous congressional hearings and ongoing Environmental Protection Agency (EPA) efforts to review the adequacy of federal regulations on lead in drinking water. In July 2004 testimony before your subcommittee,¹ we made preliminary observations on issues surrounding the elevated levels of lead found in Washington, D.C.'s drinking water and highlighted areas for further examination. This letter discusses our findings and recommendations from that further review.

Although rarely the sole cause of lead poisoning, lead in drinking water can significantly increase a person's total lead exposure. EPA estimates that drinking water is the source of up to 20 percent of Americans' lead exposure, and recent research suggests that drinking water may provide as much as 60 percent of total lead exposure for infants who drink baby formula and concentrated juices that are mixed with water. Adults exposed to high levels of lead could develop kidney problems or high blood pressure. Developing fetuses, infants, and young children are more vulnerable to lead from all sources, including drinking water. Their exposure to lead may harm their physical or mental development.

Lead is unusual among drinking water contaminants because it generally does not come from source water supplies like rivers and lakes. Rather, lead enters drinking water primarily from the corrosion of materials

¹GAO, *Drinking Water: Safeguarding the District of Columbia's Supplies and Applying Lessons Learned to Other Systems*, [GAO-04-974T](#) (Washington, D.C.: July 22, 2004).

containing lead in the water distribution system and in household plumbing. These materials include lead service lines that connect a house to the water main, lead-based solder used in a house to join copper pipe, and brass plumbing fixtures such as faucets. The 1986 Amendments to the Safe Drinking Water Act limited the amount of lead used in solder, faucets, pipes, and other plumbing components. However, older leaded components are still present in many homes, and many new components still contain some lead.

The Safe Drinking Water Act is the key federal law protecting public water supplies from harmful contaminants.² Its 1991 Lead and Copper Rule requires water systems to protect consumers against exposure to elevated levels of lead in drinking water by chemically treating water to reduce its corrosiveness and by collecting water samples from consumer taps and testing them for evidence of lead corrosion.³ Because lead contamination generally occurs after water leaves the treatment plant, the Lead and Copper Rule requires testing for lead at consumer taps. Large water systems, like WASA's, generally must take 100 samples in a 6-month period. EPA considers lead to be over the "action level" when lead levels are higher than 15 parts per billion in over 10 percent of tap water samples taken. If a water system exceeds the action level, it must notify and educate the public about ways to reduce exposure. If lead levels exceed the action level after treatment to minimize water's corrosiveness, the water system must annually replace 7 percent of the lead service lines that it owns.

Implementation and enforcement of the Lead and Copper Rule in the District of Columbia is complicated because of the number and nature of the entities involved. The Washington Aqueduct, owned and operated by the U.S. Army Corps of Engineers, treats the water (including controlling for corrosion). WASA purchases water from the Washington Aqueduct and delivers it to District residents, and is responsible for monitoring tap water samples for lead. EPA Region III in Philadelphia has oversight and enforcement authority for the District's public water systems.

You asked us to determine (1) what the key government entities that implement the Safe Drinking Water Act's regulations for lead in the District of Columbia are doing to increase their level of coordination and reduce

²42 U.S.C. 300f-300j.

³40 C.F.R. pt. 141, subpart I.

lead levels, (2) to what extent WASA and other agencies are determining which adult and child populations in the District of Columbia are at greatest risk of exposure to elevated lead levels in drinking water and how the agencies are reducing the public's lead exposure, (3) how other drinking water systems that exceeded EPA's action level for lead conducted public notification and education, and (4) the state of research on lead exposure and how this information could help inform other drinking water utilities of potential problems in their systems.

To answer the first two questions, we interviewed officials responsible for the delivery and regulation of drinking water in the District of Columbia, including WASA, EPA, the Washington Aqueduct, and officials from community advocacy groups. We also reviewed key documents, such as the consent orders between WASA and EPA and testimony by the involved entities. Additionally, we spoke to officials with the D.C. Department of Health and the Centers for Disease Control and Prevention (CDC), and reviewed a March 2004 CDC study on lead exposure from drinking water in the District of Columbia. To answer the third question, we interviewed officials responsible for the delivery and regulation of drinking water in several cities around the country, reviewed documents these officials produced, and observed aspects of their public education programs. We also spoke with EPA, water industry groups, and public advocacy groups and reviewed reports these entities produced. Finally, to answer the fourth question, we interviewed experts on the health effects of lead exposure, including officials at EPA and CDC, and reviewed public health studies and medical literature describing the health effects of lead exposure. We also interviewed EPA officials and reviewed program documentation to understand EPA's involvement in lead research.

We conducted our review from April 2004 through February 2005 in accordance with generally accepted government auditing standards. For a more detailed discussion of our scope and methodology, see appendix I.

Results in Brief

WASA and other government agencies implementing the Safe Drinking Water Act's regulations for lead have taken steps to improve their coordination, but challenges remain to reduce lead levels. According to EPA officials, WASA appears to be on track to meet the terms of a June 17, 2004, consent order the two agencies signed. The consent order required WASA to take a number of corrective actions that, by necessity, enhanced its coordination with EPA and the D.C. Department of Health. Among these actions were developing a plan to identify additional lead service lines,

improving the selection of sampling locations and reporting of water testing results to EPA, developing a strategy to improve WASA's public education efforts, and collaborating with the D.C. Department of Health to set priorities for replacing lead service lines. WASA has also agreed to implement several recommendations the D.C. Inspector General made in a January 2005 report to improve coordination between EPA, WASA and the D.C. Department of Health. However, improved coordination has not, and may not, resolve all problems. EPA and WASA officials remain concerned about lead levels in drinking water. Tap water test results that WASA submitted in January 2005 indicate the drinking water WASA provided still exceeds the action level for lead of 15 parts per billion. According to EPA, experts have said that it can take 6 months or more to begin seeing a drop in lead levels and a year or more for the orthophosphate treatment to reduce lead levels below the EPA action level.

WASA is taking steps to identify those customers most at risk from exposure to lead in drinking water and to reduce their exposure. WASA and EPA are focusing on lead service lines as the primary source of lead in drinking water in the District of Columbia. Under the consent order, WASA is identifying those most at risk by updating its inventory of lead service lines, primarily by determining the composition of service lines made of unknown materials. In addition, to reduce the exposure of District residents to lead in drinking water, WASA is accelerating its rate of lead service line replacement and, consistent with the consent order, providing priority replacement for populations particularly vulnerable to the health effects of lead. Locations eligible for priority replacement of lead service lines include day care centers and homes housing children up to 6 years old with elevated blood lead levels. However, questions remain about the success of this replacement program because WASA often replaces only part of the lead service line. Generally, ownership of service lines is shared—WASA owns the portion from the water main to the property line, and homeowners own the portion from the property line to the home. Homeowners may pay to replace their portion of the lead service line at the same time as WASA replaces its portion, but are not required to do so. Only 2 percent of homeowners replaced their portion of the service line in fiscal years 2003 and 2004. WASA officials attribute low homeowner participation to cost concerns, but believe its incentive program—which includes low-interest loans, grants, and a fixed-fee structure—is increasing the number of full pipe replacements. Available data from fiscal year 2005 show that 14 percent of customers have replaced the private portion of their home's lead service line.

Other water systems use innovative methods to educate their customers about lead in drinking water and to judge the effectiveness of their efforts. These practices include using a variety of media to inform the public, forming partnerships with government and community groups, and targeting and adapting information to audiences most susceptible to lead exposure through drinking water. Many of these practices go well beyond the requirements of the Lead and Copper Rule. Representatives from the water industry and community groups as well as other experts have found several shortcomings with the Lead and Copper Rule's public education requirements. They noted, for example, that the rule's required notification language is confusing and that a water system has up to 60 days to notify its customers if the system exceeds the action level for lead. EPA is both examining water systems' compliance with the Lead and Copper Rule's public education requirements and considering changing the rule or its accompanying guidance documents and training. While we support this effort, the clear deficiencies of the rule's public education requirements call for more immediate action to assist water systems in their efforts to educate the public. Therefore, we recommend that EPA identify and publish best practices that water systems are using to educate the public about lead in drinking water.

Much is known about the health effects of lead exposure, particularly lead's impact on brain development and functioning in young children. However, according to experts we interviewed, limited studies have been conducted on the health effects of exposure to low levels of lead in drinking water, and these studies are now nearly 20 years old. Acknowledging the need for improved and up-to-date information, officials in EPA's Office of Water and its Office of Research and Development indicate that they are beginning to address certain information gaps about the health risks of lead in drinking water. For example, the Office of Water is planning to prepare a health advisory document for lead to help utilities and state and local officials explain the risks of lead exposure to the public. Additionally, the Office of Water is planning to develop a paper summarizing the results of research conducted on lead exposure since the Lead and Copper Rule was published in 1991. However, the timetable for completing these projects is not clear, and it is also not clear how this work will fit into a broader agency research agenda or if this research needs to involve other key organizations, such as CDC. To address this issue, we recommend that EPA develop a strategy for closing information gaps in the health effects of lead in drinking water that includes timelines, funding requirements, and any needed coordination with CDC and other research organizations.

Background

The Safe Drinking Water Act established a federal-state arrangement in which states may be delegated primary implementation and enforcement authority (“primacy”) for the drinking water program. Except for Wyoming and the District of Columbia, all states and territories have received primacy. For contaminants that are known or anticipated to occur in public water systems and that the EPA Administrator determines may have an adverse impact on health, the act requires EPA to set a nonenforceable maximum contaminant level goal (MCLG) at which no known or anticipated adverse health effects occur and that allows an adequate margin of safety. Once the MCLG is established, EPA may set an enforceable standard for water as it leaves the treatment plant, the maximum contaminant level (MCL). The MCL generally must be set as close to the MCLG as is feasible using the best technology or other means available, taking costs into consideration. Alternatively, EPA can establish a treatment technique, which requires a treatment procedure or level of technological performance to reduce the level of the contaminant.

The fact that lead contamination occurs after water leaves the treatment facility has complicated efforts to regulate lead in the same way as most other drinking water contaminants. In 1975, EPA established an interim MCL for lead of 50 parts per billion (ppb), but did not require sampling of tap water to show compliance with the standard. Rather, the standard had to be met at the water system before the water was distributed. The 1986 amendments to the act directed EPA to issue a new lead regulation, and in 1991, EPA adopted the Lead and Copper Rule.

Instead of an MCL, the rule established an “action level” of 15 ppb for lead in drinking water. To reduce the amount of lead entering the water as it flows through distribution lines and home plumbing to customers’ taps, the rule required that water systems, if needed, treat the water to limit its corrosiveness. Under the rule, the action level is exceeded if lead levels are higher than 15 ppb in over 10 percent of tap water samples.⁴ Large systems, including WASA’s, generally must take at least 100 tap water samples in a 6-month monitoring period, though reduced monitoring schedules are also allowed for some systems. If a water system exceeds the action level, it has 60 days to deliver a public education program that meets EPA

⁴For each monitoring period, a system must report the 90th percentile lead level of homes monitored. For example, if a system monitors 100 homes, it sorts its results from the lowest to the highest concentrations and reports the concentration it observed in the 90th sample.

requirements, including a notice in customers' water bills; delivery of public service announcements to television and radio stations; and the distribution of information to locations likely to serve populations vulnerable to lead exposure, including hospitals, clinics, and local welfare agencies.⁵ In addition, if lead levels exceed the action level after treatment to minimize water's corrosiveness, the water system must annually replace 7 percent of the lead service lines under its ownership and offer to replace the private portion of the lead service line (at the owner's expense) until the tap water 90th percentile lead levels drop below the action level for two consecutive six month monitoring periods.

Drinking water is provided to District of Columbia residents under a unique organizational structure:

- *The U.S. Army Corps of Engineers' Washington Aqueduct* draws water from the Potomac River that it filters and chemically treats to meet EPA specifications. The aqueduct produces drinking water and sells it to utilities that serve approximately 1 million people living or working in or visiting the District of Columbia; Arlington County, Virginia; and Falls Church, Virginia. Managed by the Corps of Engineers' Baltimore District, the aqueduct is a federally owned and operated public water supply agency that produces an average of 180 million gallons of water per day at two treatment plants located in the District.
- *The District of Columbia Water and Sewer Authority* buys its drinking water from the Washington Aqueduct and distributes it through 1,300 miles of water mains to customers in the District and several federal facilities in Virginia. From its inception in 1938 until 1996, WASA's predecessor, the District of Columbia Water and Sewer Utility Administration, was a part of the District's government. In 1996, WASA was established by the District of Columbia as a semiautonomous regional entity.
- *EPA's Region III Office in Philadelphia* has primary oversight and enforcement responsibility for public water systems in the District of Columbia. According to EPA, the regional office's oversight and enforcement responsibilities include providing technical assistance to the water suppliers on how to comply with federal regulations; ensuring

⁵The water system must also offer to sample the tap water of any customer who requests it, though the system is not required to pay for sample collection or analysis.

the suppliers report monitoring results to EPA by the required deadlines; taking enforcement actions if violations occur; and using those enforcement actions to return the system to compliance in a timely fashion.

- *The District's Department of Health*, while having no formal role under the act, has as its mission identifying health risks and educating the public on those risks.

In August 2002, WASA officially reported to EPA that drinking water in the District of Columbia exceeded the action level for lead. This report triggered the Lead and Copper Rule's requirement to deliver a public education program within 60 days and to replace lead service lines at a minimum rate of 7 percent per year.⁶ Because WASA and property owners in the District share ownership of the water service lines, the rule required WASA to replace the portion of the lines that it owns, and to offer to replace the portion of the lines controlled by the homeowners at the homeowners' expense.

Under the Lead and Copper Rule, water systems get credit for lead service line replacement either by actually replacing lines or by finding homes with lead service lines that test under the 15 ppb action level. For fiscal year 2003, WASA decided to physically replace and test lead service lines concurrently. WASA reported that it tested 4,613 homes with lead service lines in fiscal year 2003, and found 1,241 homes at or below the 15 ppb action level but another 3,372 homes with water exceeding the action level.⁷ Local media made these results public in January 2004.

EPA began a special audit of WASA's compliance with the Lead and Copper Rule in February 2004. This audit resulted in a consent order that EPA and WASA signed on June 17, 2004. Congress held a number of hearings in 2004 to investigate drinking water problems in the District.

⁶Under the rule, a water system can stop replacing lead service lines if lead concentrations are below the action level for two consecutive 6-month monitoring periods.

⁷On January 14, 2005, EPA Region III issued a supplemental consent order stating that WASA used an improper methodology to collect many of these samples. The order requires WASA to physically replace by the end of fiscal year 2007 any lines that were deemed "replaced" because they showed a lead level below 15 ppb in these improper tests.

Agencies Have Improved Coordination, but Challenges Remain in Reducing Lead Levels

WASA and other government agencies implementing the act's regulations for lead have taken steps to improve their coordination. According to EPA officials, WASA has thus far met the terms of the order the two agencies signed that required WASA to take a number of corrective actions. WASA has also agreed to implement most recommendations that the D.C. Inspector General made in a January 2005 report to develop internal policies and procedures at WASA that would improve the coordination between EPA, WASA, and the D.C. Department of Health. Improved coordination, however, has not resolved all problems, and EPA and WASA officials remain concerned that drinking water WASA provides still exceeds the action level for lead of 15 parts per billion.

WASA Has Improved Coordination with Other Agencies

Under the June 2004 Consent Order, WASA agreed to take several actions to improve its compliance with the Lead and Copper Rule and, in so doing, enhanced its coordination with EPA and the D.C. Department of Health. The order required WASA to improve its selection of sampling locations and reporting of water testing results to EPA, create a strategy to improve its public education efforts, physically replace an additional 1,615 lead service lines by the end of fiscal year 2006, develop a plan and a schedule to identify additional lead service lines, and, in collaboration with the D.C. Department of Health, develop a plan to set priorities for replacing lead service lines. According to staff in EPA's Region III, WASA appears to be on track to meet the terms of the order. Table 1 identifies some principal requirements of the order and notes the status of WASA's compliance as of January 18, 2005.

Table 1: Summary of Selected June 2004 Consent Order Requirements and Compliance Activities

Required WASA action	Submitted to EPA	EPA action
Submit tap water sampling plan	June 25, 2004	Provided comments to plan on July 14, 2004; no approval required under order
Develop a new public education plan	July 19, 2004	Provided comments to plan on August 2, 2004; no approval required under order
Develop a plan to update inventory of lead service lines	August 2, 2004	Approved September 29, 2004
With D.C. Department of Health approval, develop plan for prioritizing replacement of lead service lines	August 2, 2004	Approved September 29, 2004
Develop plan to encourage homeowners to consent to full replacement of lead service lines	August 2, 2004	Approved August 10, 2004
Develop plan for enhanced database management and reporting	August 16, 2004	Provided comments to plan on September 3, 2004; no approval required under order

Source: EPA.

WASA also agreed to implement 11 of the 12 recommendations contained in the D.C. Inspector General's January 2005 report.⁸ The D.C. Inspector General found that WASA had not developed or maintained internal policies or procedures for implementing requirements set forth in the Lead and Copper Rule, including those for selecting and reporting lead water sample test results. However, the D.C. Inspector General concluded that WASA's current initiatives on lead concentrations in the District's tap water were noteworthy; he also made 12 recommendations to improve WASA's annual monitoring, lead service line replacement, and communication.

WASA agreed to all of the Inspector General's recommendations except one to develop a memorandum of understanding (MOU) with the D.C. Department of Health that defines both agencies' roles and responsibilities, the expert advice each agency can provide in the areas of water quality management, and the frequency and manner of transmission of information between the agencies. WASA did not agree that an MOU was necessary to ensure effective cooperation, and noted that its relationship with the D.C. Department of Health has vastly improved and reflects a more creative and flexible partnership and that the range of substantive issues around which WASA and the D.C. Department of Health must communicate is wide, diverse, and complex. While we agree that WASA's relationship with the D.C. Department of Health has improved, we nonetheless agree with the

⁸District of Columbia, Office of the Inspector General, *Audit of Elevated Levels of Lead in the District's Drinking Water*, OIG No. 04-2-17LA (Jan. 5, 2005).

Inspector General's view that an MOU would serve to define the two agencies' roles and responsibilities and help improve their coordination and partnership.

Lead Levels Remain Above the Action Level

Despite improved coordination, the central problem remains: lead in D.C. drinking water is still over the EPA action level. In February 2004, EPA formed a Technical Expert Working Group made up of representatives from WASA; EPA; CDC; the Washington Aqueduct; Arlington and Falls Church, Virginia; the D.C. Department of Health; and industry consultants. Industry experts traced the likely cause for the increased lead levels to November 2000. At that time, the Washington Aqueduct changed its secondary disinfectant treatment from free chlorine to chloramines to comply with a new EPA regulation that placed strict limits on disinfection by-products. This change in water treatment may have had the unintended consequence of making the corrosion control treatment that was in place no longer adequately protective.⁹ Therefore, lead levels increased in water exposed to lead-containing plumbing and fixtures.

The group recommended the introduction of orthophosphate to the drinking water supply because it concluded that this chemical would form a protective coating inside lead service lines and fixtures to prevent lead from leaching into drinking water. In order to assess the effect of orthophosphate on the water distribution system, in May 2004, EPA approved the Washington Aqueduct's request to apply the corrosion inhibitor to a portion of the District of Columbia drinking water distribution system, and the corrosion inhibitor was introduced June 2004. This portion is called the 4th High Pressure Zone, and it is hydraulically isolated from the remainder of the system.

In early August 2004, based on the results of the partial system test, EPA approved the Washington Aqueduct's request for broader use of the corrosion inhibitor, and on August 23, 2004, the inhibitor was introduced systemwide. On January 10, 2005, WASA submitted to EPA its latest tap water sampling results, covering tap water samples taken from July through December 2004. These results showed that the 90th percentile sample reached 59 ppb, still substantially over the 15 ppb action level for lead. However, EPA and WASA officials report that some reductions of lead

⁹EPA officials believe that the removal of free chlorine, rather than the addition of chloramines, resulted in the increase in corrosion.

levels occurred in the latter half of the monitoring period. WASA data show that 42 samples taken during July through September 2004 had a 90th percentile reading of 82 ppb, while 88 samples taken during October through December 2004 had a 90th percentile reading of 31 ppb. According to EPA, experts have said that it can take 6 months or more to begin seeing a drop in lead levels and a year or more for the orthophosphate treatment to reduce lead levels below the EPA action level.

WASA and Other Agencies Are Taking Steps to Identify At-Risk Populations and Reduce Their Lead Exposure

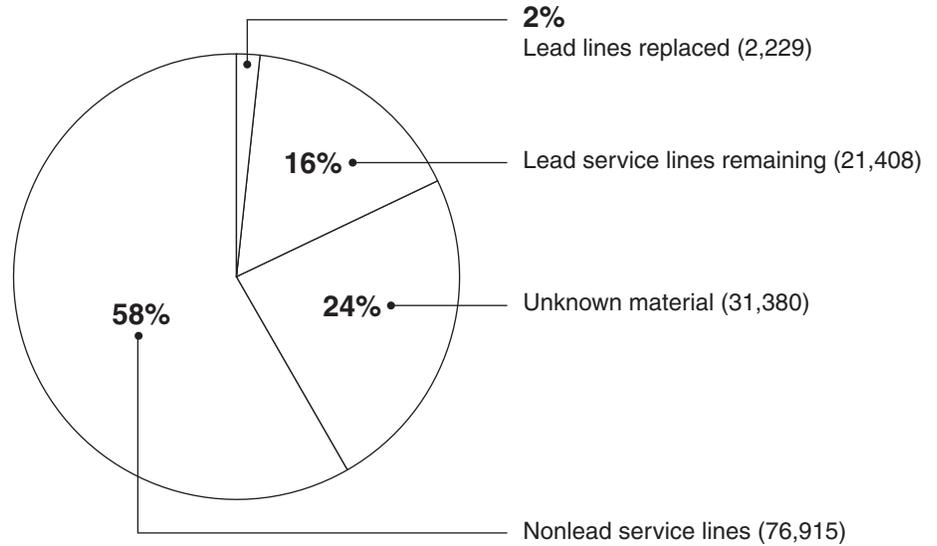
WASA is identifying those most at risk for exposure to lead in drinking water by updating its inventory of lead service lines. To reduce the exposure of District residents to lead in drinking water, WASA is accelerating its rate of lead service line replacement and providing priority replacement of lead service lines for populations particularly vulnerable to the health effects of lead. However, questions remain about the success of the lead service line replacement program, because WASA is replacing only part of the lead service line unless customers pay to have their portion replaced.

WASA Is Updating Its Lead Service Line Inventory

WASA and EPA officials are focusing on lead service lines as the primary source of lead in drinking water in the District of Columbia. Locating these lines allows WASA to identify the people most likely to be exposed. The June 2004 consent order that WASA signed with EPA Region III requires WASA to update its baseline inventory of lead service lines each year.¹⁰ WASA must use this baseline inventory to calculate the 7 percent of lines it replaces each year. In September 2004, WASA revised its baseline inventory to 23,637 lead service lines and reported this number to EPA. However, at that time WASA did not know the composition of 31,380 service lines. The order requires WASA to provide a strategy and timetable for identifying the composition of these unknown lines. During fiscal year 2005, WASA plans to determine the composition of 1,200 unknown lines by digging up or testing a segment of each line. Figure 1 shows the inventory of WASA's service lines as of October 1, 2004.

¹⁰WASA's baseline inventory is the number of lead service lines present on June 30, 2001. This baseline number changes over time as WASA identifies the composition of additional lines.

Figure 1: Inventory of WASA Service Lines



Source: WASA.

To speed the process of identifying the composition of unknown lines, WASA is attempting to develop a methodology to identify the composition without physically digging up the line. WASA plans to statistically analyze line composition data from test pits dug in 2003 through 2005 along with known quantities about each excavated line: the date of service line construction, water test result for lead, and size of service line. WASA hopes that these known quantities can be used to determine the unknown line composition. WASA plans to complete this analysis by August 1, 2005.

WASA Is Accelerating Lead Service Line Replacement and Targeting At-Risk Populations

To reduce residents' exposure to lead in drinking water, WASA is accelerating its schedule for replacing lead service lines. WASA's Board of Directors decided to replace all lead service lines in public space in the District of Columbia by 2010. The total cost of this program is estimated at \$300 million. In fiscal years 2002 through 2004, WASA replaced 2,229 lead service lines in public space, about 9 percent of the total known lead service line inventory.

In its lead service line replacement program, WASA replaces the majority of lines on a block-by-block basis. However, to reduce exposure to lead in drinking water for those residents most vulnerable to lead's health effects,

WASA agreed, as part of the consent order, to develop in consultation with the D.C. Department of Health a system for setting priorities for lead service line replacement and to replace 1,000 lead service lines by the end of fiscal year 2006 on a priority basis. For fiscal year 2005, WASA's first priority for replacement is homes with children younger than 6 who have elevated blood lead levels;¹¹ its second priority is day-care centers; and its third priority is homes that are occupied by children younger than 6, or pregnant or nursing mothers. WASA identified members of this third group by sending a letter to all customers in its database who have a lead service line or a service line of unknown composition. Customers could return the letter to identify themselves as members of these at risk groups, as appropriate, and WASA sorted customer responses to remove those who did not meet the criteria for priority replacement. WASA worked with the D.C. Department of Health to establish criteria for priority replacement, and EPA has approved the program. Table 2 shows the number of priority replacements WASA completed in fiscal year 2004 and plans to complete in fiscal year 2005.

Table 2: WASA's Priority Lead Service Line Replacement Program

Year	Number of lead service lines replaced			Total priority replacements
	Children under 6 with elevated blood lead	Day-care centers	Children under 6, or pregnant or nursing women	
Fiscal 2004 (completed)	135	46	137	318
Fiscal 2005 (estimated)	289	119	592 ^a	1,000^b

Source: WASA.

Notes: WASA priorities for replacement in 2004 were different from the 2005 priorities. WASA's first priority in 2004 was day-care centers, followed by children with elevated blood lead and high-risk residents (children under 6, or pregnant or nursing women).

^aWASA is forwarding 2,097 notices to customers who identified themselves as members of this group, and customers must provide verification. Additionally, not all of these homes will actually have a lead service line, when tested.

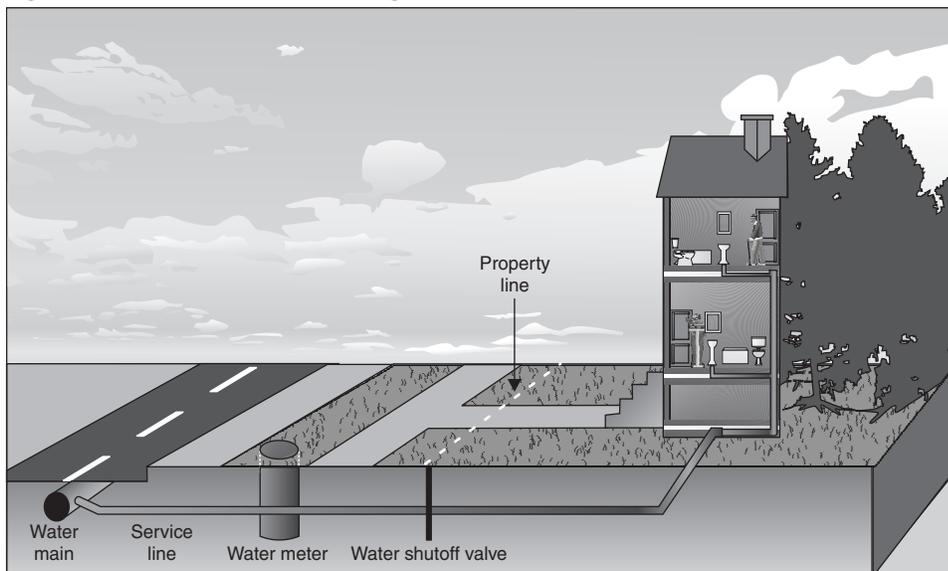
^bThe June 2004 consent order requires WASA to replace 1,000 service lines on a priority basis by the end of fiscal year 2006. WASA officials plan to meet this deadline by the end of fiscal year 2005.

¹¹Elevated blood lead in children younger than 6 is defined as 10 micrograms per deciliter or greater, according to CDC guidelines.

Questions Remain about the Success of the Lead Service Line Replacement Program

WASA is replacing lead service lines in public space—from the water main to the homeowners' property line. In the District of Columbia, homeowners own the portion of the service line that runs from the property line to the home. Homeowners may replace this portion of the line if they choose, but this replacement is not required.¹² WASA can replace the private portion of a lead service line when it replaces its portion of the line. Figure 2 shows the configuration of a service line from the water main to a customer's home.

Figure 2: Lead Service Line Configuration



Source: WASA.

Experts disagree about the effectiveness of removing only part of a lead service line. Studies that EPA cited in the Lead and Copper Rule suggest that long-term exposure to lead from drinking water decreases when a service line is partially replaced. However, after partial replacement of a lead service line, exposure to lead in drinking water is likely to increase in

¹²A District of Columbia law prohibits WASA from providing repairs or maintenance on private property without charge to the owners. However, according to an EPA official, WASA may use EPA funding to replace the privately owned portion of a lead service line. D.C. Code Ann. section 8-205(b).

the short term because cutting or moving the pipe can dislodge lead particles and disturb any protective coating on the inside of the pipe. Some experts believe that lead exposure can increase after partial service line replacement because of galvanic corrosion where the dissimilar metals of the old and new pipes meet. A study at WASA showed that partial lead service line replacement significantly reduced average lead levels, but that flushing was necessary to remove lead immediately after replacement. At an EPA conference on lead service line replacement in October 2004, water industry officials and others stressed the importance of encouraging or mandating full replacement of lead service lines.

As the consent order required, WASA has established a program to encourage homeowners to replace their portion of lead service lines. This program includes

- a low-interest loan program for low-income residents, offered through a local bank;
- grants of up to \$5,000 for low-income residents, offered by the District of Columbia Department of Housing and Community Development; and
- a fixed-fee structure for line replacement of \$100 per linear foot plus \$500 to connect through the wall of the home, to make pricing easier for homeowners to understand.

WASA implemented this program in July 2004, and EPA approved the program on August 10, 2004. Information about these programs is included in the notice that homeowners receive at least 45 days before their lead service line is scheduled to be replaced.

Thus far, few homeowners in the District of Columbia have replaced their portion of lead service lines. In fiscal years 2003 through 2004, only 2 percent of homeowners (48 of 2,217) replaced the private portion of their lead service line. WASA officials attribute the low rate of full line replacement to customers' cost concerns. An EPA Region III official told us it is too early to determine if the District of Columbia's program is increasing the number of customers who replace their portion of the service line, since the program went into place approximately 2 months before the end of fiscal year 2004. However, WASA officials told us that the number of full replacements is increasing since the program was implemented—14 percent of customers (119 of 841) replaced the private portion of their lead service line between October 1, 2004, and January 28,

2005. EPA has asked WASA to report on the number of customers taking advantage of the various incentive programs in the 2005 annual lead service line replacement report.

Madison, Wisconsin, provides an alternative example for maximizing full lead service line replacement. A 1997 study showed that these lines were the source of elevated lead levels in water, and that fully replacing them could reduce lead levels to well below the action level. Madison cannot use orthophosphate corrosion control treatment because this treatment would degrade surface water quality in local lakes. In lieu of corrosion control treatment, the water utility is replacing all lead service lines in the city over 10 years, a total of approximately 6,000 service lines. To ensure that lines are completely replaced, Madison passed an ordinance in 2000 requiring homeowners to replace their portion of the lead service line when the utility replaces its portion. The city reimburses homeowners for half of the cost they incur in replacing their portion of the line, up to a maximum of \$1,000. Assistance is available for customers who cannot afford the replacement. A Madison Water Utility official told us that before the ordinance was passed, less than 1 percent of customers paid to have their portion of the lead service line replaced.

Experiences of Other Water Systems Highlight Ways to Better Educate the Public

Other water systems use innovative methods to educate their customers about lead in drinking water. These practices include using a variety of media to inform the public, forming partnerships with government agencies and community groups, and targeting educational materials to the audience most susceptible to lead exposure through drinking water. These practices tend to go well beyond the provisions of the Lead and Copper Rule, which require public notification language that is difficult to understand and do not require utilities to notify individual homeowners of the lead concentrations in their homes' drinking water.

Other Water Systems Used Innovative Methods to Educate the Public about Lead in Drinking Water

WASA's experience highlights the importance of conducting an effective public education program. In its June 2004 consent order, EPA found that WASA had committed only a few violations of the public education

requirements of the Lead and Copper Rule.¹³ However, community groups and others have criticized WASA for failing to adequately convey information to its customers about lead in drinking water and for failing to communicate a sense of urgency in the materials provided. As we testified in July 2004, EPA acknowledges that it should have provided better oversight of WASA's public education program.

Other water systems we contacted have used innovative approaches to educate the public about lead in drinking water. For example, some systems used a variety of media to inform the public. Officials from the Massachusetts Water Resources Authority (MWRA) appear for interviews on local radio and television talk shows to spread information about lead in drinking water. The Portland (Oregon) Water Bureau provides funding for many lead education initiatives, including materials presented to new parents in hospitals; billboard, movie, and bus advertisements targeted to neighborhoods with older housing; and education materials produced by the Community Alliance of Tenants to educate renters on potential lead hazards. Each of these materials directs people to call a telephone hotline to get information about all types of lead hazards. This hotline is operated by the Multnomah County Health Department and funded by the Portland Water Bureau.

Water industry experts at an EPA conference in September 2004 stressed the importance of partnerships, particularly with health officials, in educating the public about lead in drinking water. Some water systems have already formed partnerships to better educate the public and provide a unified message. Three examples follow:

- MWRA provides training workshops on drinking water issues, including lead in drinking water, for local health officials. These officials can then educate the public about drinking water issues when they arise.
- MWRA also sends the local health department the same drinking water data that it sends to the state drinking water regulator, so local health officials are well informed.

¹³The June 2004 consent order that WASA signed with EPA describes some violations of the public notification requirements of the Lead and Copper Rule, including using language slightly different from that required by the rule and issuing fewer public service announcements than required.

-
- The Portland Water Bureau participates in an integrated program to educate the public and reduce exposure to all sources of lead, including drinking water. The water bureau's partners in this program include the Multnomah County Health Department, the State Lead Poisoning Prevention Program, the Portland Bureau of Housing and Community Development, and community nonprofit agencies.

The Lead and Copper Rule requires water systems that exceed the action level to provide written education materials to facilities and organizations that serve high-risk segments of the population, including people more susceptible to the adverse effects of lead and people at greater risk of exposure to lead in drinking water. Some water systems have gone beyond this basic requirement to better reach high-risk populations. For example, in January 2004, the Portland Water Bureau sent a targeted mailing of approximately 2,600 postcards to the homes of an age most likely to contain lead solder that it identified as having a child 6 years old or younger. These postcards encouraged residents to get their water tested for lead, learn about childhood blood lead screening, and reduce lead hazards in their homes. Water bureau officials said that they obtained the information needed to target the mailing from a commercial marketing company and that the information was inexpensive and easy to obtain. The rule specifies that educational materials be delivered to Women, Infants, and Children (WIC) and Head Start programs, where available. Both Portland and MWRA have cultivated relationships with these programs. MWRA worked with local WIC officials to add information about lead in drinking water to WIC's postpartum program for new mothers, and to prepare an easy-to-understand brochure explaining how to avoid exposure to lead in drinking water. Portland funded efforts with Head Start to provide free blood lead testing and to present puppet shows teaching children how to avoid lead hazards. Table 3 shows how the Portland Water Bureau targets its lead education program to community groups.

Table 3: Portland's Targeted Lead Education Program

Activity	Targeted population						
	Homes at high risk for lead in water	Older homes	Low-income residents	Child-oriented services	Home remodels	Specific populations	Broad population
Annual lead brochure	X	X	X	X	X	X	X
Annual Consumer Confidence Report	X	X	X	X	X	X	X
Postcard outreach to homes built between 1970-1985, with children 6 and under	X						
Childcare outreach	X			X			
Lead education and <i>LeadLine</i> brochure distribution	X	X	X	X	X	X	X
Lead education video		X	X	X			X
Outreach to health providers				X		X	
Landlord training and landlord outreach						X	
Community forums: African-American, Vietnamese, Russian communities		X	X			X	
Billboards, bus ads, and theater ads		X	X				X
Newspaper ads in community newspapers		X	X			X	X
Home Depot, permit center, and community location displays		X			X		X
Location of clinics and workshops		X	X			X	
Head Start outreach			X	X		X	
Canvassing in target areas		X	X			X	
Low-income renters—outreach by Community Alliance of Tenants		X	X			X	
Blood lead testing for children of migrant workers			X	X		X	
Mailing to child-care facilities				X			

Source: Portland Water Bureau.

Some other water systems measure the impact of their public education programs. MWRA has conducted focus groups to judge the effectiveness of its public education program, and routinely refines the information presented about lead in drinking water. The Portland Water Bureau tracks calls received by its lead information hotline and surveys callers to

determine their satisfaction with the program and the extent to which it changed their behavior. An official from St. Paul (Minnesota) Regional Water Services told us that the utility surveys its customers about water quality issues. During the time the utility was conducting public education about lead in drinking water, it surveyed customers each year to ask if customers believed they were receiving enough information about the quality of their water.

Lead and Copper Rule Public Education Requirements Have Several Shortcomings

Responding to concerns about the Lead and Copper Rule's public education requirements, EPA conducted a workshop in September 2004 at which representatives from the water industry and community groups discussed their views of the rule's requirements. Representatives from the water industry also told us they went beyond the rule's requirements to ensure the success of their public education programs. At the EPA workshop and in interviews, water industry officials, experts, and community groups identified the following problems:

- *The public cannot easily understand the required public education language.* Representatives of several water utilities told us the required language was too long and the reading level too advanced for many customers to understand. One expert estimated that understanding the EPA language required at least an 11th grade reading level, while approximately half the adult population of the United States reads at an 8th grade level or lower. Water industry officials suggested customizing education materials about lead in drinking water for those who have limited reading ability.
- *The rule does not require utilities to send results to homeowners whose water is sampled for lead compliance.* EPA officials told us that many water systems do provide this information to customers, but in the past, WASA did not provide this information in a timely fashion. The consent order requires WASA to provide lead results to homeowners within 3 days of receiving the results from the laboratory, and encourages WASA to provide this data within 30 days of collecting the sample.
- *Public notification under the rule is less timely than that required for other violations of the Safe Drinking Water Act.* The rule requires a water system to notify the public within 60 days if it exceeds the action level for lead. Other violations of the Safe Drinking Water Act with the potential to cause serious adverse effects on human health require

public notification within 30 days, including violations of MCLs and treatment techniques.¹⁴

- *EPA has not evaluated the effectiveness of the public education requirements of the rule since it was implemented in 1991.* Water industry officials at the EPA workshop suggested several methods to evaluate the effectiveness of public outreach, including surveying the public to determine its knowledge of lead in drinking water issues and comparing the level of knowledge in areas where public education has and has not been conducted. These officials also suggested that EPA identify public education activities conducted by utilities around the country that are following EPA guidelines and doing additional voluntary education work to identify good practices.

In response to elevated lead levels in the District of Columbia, EPA is conducting a national review of compliance and implementation of the Lead and Copper Rule, including its public education requirements. Additionally, EPA conducted the public education expert workshop to gain information to use in its deliberations about changing the Lead and Copper Rule and possibly its accompanying guidance documents and training. We support EPA's efforts in re-evaluating the public education requirements of the rule, but believe that EPA also needs to provide more practical assistance that water systems can use when educating their customers about lead in drinking water.

Although Lead Exposure Causes Serious Health Effects, Research on Low-Level Exposure to Lead in Drinking Water Is Limited

Much is known about the health effects of lead exposure, particularly lead's impact on brain development and functioning in young children. However, according to experts we interviewed, limited studies have been conducted on the health effects of exposure to low levels of lead in drinking water. Officials in EPA's Office of Water and Office of Research and Development told us they are beginning to address certain information gaps about the health risks of lead in drinking water. However, the timetable for completing this effort is not clear.

¹⁴Public notification for violations with the potential to have serious adverse effects on human health as a result of short-term exposure is required within 24 hours.

Lead Exposure Causes Serious Health Effects, Particularly in Children

Health experts agree that lead is toxic to almost every organ system, and much research has documented its adverse health effects. While many body systems can be severely affected by high chronic and acute lead exposures, lead is dangerous in large part because moderate to low chronic exposure can result in adverse health effects.¹⁵ The threshold for harmful effects of lead remains unknown. Over the years, as new data has become available, CDC has revised its recommendations on the threshold of blood lead levels that should raise concern and trigger interventions. In 1975, CDC's blood lead level threshold of concern stood at 30 micrograms per deciliter. In 1991, CDC lowered the blood lead level of concern to 10 micrograms per deciliter. Research conducted since 1991 provides evidence of adverse effects at even lower levels—at less than 10 micrograms per deciliter among children younger than 6.

Because of their behavior and physiology, children are more sensitive than adults to exposure to lead in a given environment. For example, children generally come into more contact with lead because they spend more time on the ground, where there may be lead-contaminated soil or dust. Mouthing and hand-to-mouth behaviors also increase the likelihood that children may ingest soil or dust. Physiologically, children take in more food and water per pound of body weight, and their absorption of lead is estimated to be 5 to 10 times greater than adults. Finally, children are more sensitive than adults to elevated blood lead levels because organ systems, including their brain and nervous system, are still developing. This ongoing development increases the risk of lead's entry into the brain and nervous system, and can result in prolonged or permanent neurobehavioral disorders.

In contrast, most adult exposures to lead are occupational and occur in lead-related industries, such as lead smelting, refining, and manufacturing. Adults exposed to lead can develop high blood pressure, anemia, and kidney damage. Lead poses a substantial threat to pregnant women and their developing fetuses because blood lead readily crosses the placenta. Pregnant women with elevated blood lead levels may have an increased chance of miscarriage, premature birth, and newborns with low birth weight or neurologic problems.

¹⁵The Agency for Toxic Substances and Disease Registry defines acute exposure as 14 days or fewer, intermediate exposure from 15 to 365 days, and chronic exposure as 365 days or more.

CDC tracks children's blood lead levels in the United States through the National Health and Nutrition Examination Surveys and state and local surveillance data.¹⁶ The surveys between 1976 and 1980 found evidence of an estimated 88 percent prevalence of lead levels greater than or equal to 10 micrograms per deciliter in children aged 1 to 5 compared with an estimated prevalence of 2.2 percent in 1999 to 2000.¹⁷ Health experts generally attribute this decline to the elimination of leaded gasoline and lead solder from canned foods, and a ban on leaded paint used in housing and other consumer products. Data provided by the District of Columbia to CDC for 2001 show that, of an estimated 39,356 children younger than 6, 16,036 were tested for lead. Of those, 437, or 2.73 percent, had blood lead levels greater than or equal to 10 micrograms per deciliter.

More recently, in response to the discovery of high lead levels in drinking water in the District of Columbia, CDC and the D.C. Department of Health studied blood lead levels of residents most at risk for lead exposure.¹⁸ This study was designed to determine the extent to which lead in drinking water was contributing to blood lead levels of District residents. One portion of the study focused on residents of homes with known lead levels in drinking water greater than 300 ppb, much greater than the EPA action level of 15 ppb. Health officials attempted to contact nearly all residents of homes with lead concentrations at this level, and collected blood samples for lead analysis from residents who agreed to the procedure. Of the 201 residents tested, all were found to have blood lead levels less than CDC's levels of concern for adults or children, as appropriate.

Another portion of this study examined blood lead data collected by the District of Columbia Department of Health's blood lead surveillance system. Results of blood lead tests conducted from January 1998 through December 2003 were compared for a nonprobability sample of homes with

¹⁶The National Health and Nutrition Examination Surveys represent a series of cross-sectional surveys, which used stratified, multistage, cluster samples of households with a target population of civilian, noninstitutionalized residents of the United States. The analysis of the surveys was weighted using population estimates obtained from the U.S. Bureau of the Census.

¹⁷Given the low prevalence of elevated blood lead levels and a limited sample size, the CDC estimates that elevated lead levels falls within the range of 1.0 to 4.3 percent, with a 95 percent confidence interval, for the surveys in 1999 to 2000.

¹⁸L. Stokes et al., "Blood Lead Levels in Residents of Homes with Elevated Lead in Tap Water—District of Columbia, 2004," *Morbidity and Mortality Weekly Report*, vol. 53 (Mar. 30, 2004).

known lead service lines and homes with nonlead service lines.¹⁹ During 2000 through 2003, the period when lead levels in drinking water increased, the number of people with blood lead levels greater than 5 micrograms per deciliter decreased for the sample without lead service lines but did not decrease in a statistically significant way for the sample with lead service lines. In the District of Columbia, blood lead levels are generally greater in homes with lead service lines. In general, the older homes most likely to have lead service lines are also those most likely to have other lead hazards, such as lead in paint and dust.

Research on the Health Effects of Lead in Drinking Water Is Limited

A good deal of research has been conducted on the health effects of lead associated with certain pathways of contamination, such as the ingestion of lead paint and the inhalation of dust contaminated with lead. According to a number of public health experts, drinking water contributes a relatively minor amount to overall lead exposure in comparison with other sources. However, the most relevant studies on the isolated health effects of lead in drinking water date back nearly 20 years—including the Glasgow Duplicate Diet Study on lead levels in children, upon which the Lead and Copper Rule is partially based.²⁰

While lead in drinking water is rarely thought to be the sole cause of lead poisoning, it can significantly increase a person's total lead exposure—particularly for infants who drink baby formula or concentrated juices that are mixed with water from homes with lead service lines or plumbing systems. For children with high levels of lead exposure from paint, soil, and dust, drinking water is thought to contribute a much lower proportion of total exposure. For residents of dwellings with lead solder or lead service lines, however, drinking water could be the primary source of exposure. As exposure declines from sources of lead other than drinking water, such as gasoline and soldered food cans, drinking water will account for a larger proportion of total intake. Thus, according to EPA's Lead and Copper Rule, the total drinking water contribution to overall lead levels may range from

¹⁹Nonprobability samples are not randomly selected from the population being studied. This means that every member of the population does not have an equal chance of being selected for the study. Because this study uses a nonprobability sample, the results of the study cannot be generalized to the population of District of Columbia residents.

²⁰R.F. Lacey et al., "Lead in Water, Infant Diet and Blood: The Glasgow Duplicate Diet Study," *The Science of the Total Environment*, vol. 41 (Mar. 1, 1985).

as little as 5 percent to more than 50 percent of a child's total lead exposure.²¹

According to recent medical literature and the public health experts we contacted, the key uncertainties about the effects of lead in drinking water requiring clarification include the incremental effects of lead-contaminated drinking water on people whose blood lead levels are already elevated from other sources of lead contamination and the potential health effects of exposure to low levels of lead.

EPA Is Beginning to Address Certain Information Gaps in the Health Risks of Lead in Drinking Water

EPA has acknowledged the need to improve health risk information available to drinking water systems and local governments about lead in drinking water. According to officials from EPA's Office of Water, one way to improve this information would be to develop a health advisory for lead. EPA health advisories are written documents that provide information on the health effects, analytical methodology, and treatment technology that would be useful in dealing with the contamination of drinking water and have been issued for many other water contaminants, such as cryptosporidium (a water-borne microbe). The advisories serve as informal technical guidance to assist federal, state, and local officials responsible for protecting public health when contamination occurs. For example, a cryptosporidium health advisory was prompted, in part, by an outbreak of the microbe in 1993 in Milwaukee, Wisconsin, where an estimated 400,000 people became ill.

Office of Water officials note that the agency currently does not have a health advisory for lead and believe the problems local District agencies had in communicating the health risks of lead in drinking water highlight the need for one. Office of Water officials also noted a health advisory document for lead would be useful for other water systems and state and local officials in communicating risk if they identify problems with lead during monitoring under the Lead and Copper Rule. In 1985, EPA drafted a health advisory for lead, but never issued it to the public. At present, EPA's Office of Water has drafted a plan to prepare a lead health advisory and have it reviewed by experts within EPA and by external peer reviewers. However the anticipated completion date for the advisory has not been determined.

²¹U.S. Environmental Protection Agency, Lead and Copper Rule, *The Federal Register*, vol. 56, no. 110 (June 1991), 7.

To ensure that the health advisory for lead is up-to-date, the Office of Water also plans to produce a “white paper” that documents how research data were used in setting the action level for lead and updates that assessment using new data on lead exposure and uptake in the body. Officials in these offices told us that the white paper should provide sufficient information to allow health risk at the action level to be discussed in the lead health advisory. They told us that data used to develop the 15 ppb action level in the 1991 rule were based on a small group of studies published before 1989 and on early models of the agency’s Integrated Exposure Uptake Biokinetic Model for Lead (IEUBK), which predicts blood lead concentrations for children exposed to different types of lead sources. The Office of Research and Development is currently developing an “all ages lead model” that supplements the IEUBK model, and should allow for new predictions of fetal blood lead levels derived from maternal exposure levels. According to EPA, the agency plans to have the model peer reviewed first and any issues from the peer review addressed before the model is used in regulatory decision making. These predictions may be incorporated into the white paper being prepared by the Office of Water. However, a timetable for completing the updated model and the white paper has not been determined. Current draft plans for the health advisory and white paper neither discuss how these projects fit into a broader agency research agenda nor identify how they will be funded or if they need to be coordinated with CDC or other research organizations.

Conclusions

In 2004, poor coordination among local District of Columbia agencies and EPA aggravated the problems they had in responding to elevated lead levels and communicating accurate and timely health risk information to affected District residents. Since that time, local agencies and EPA have improved their coordination. Nonetheless, these agencies still face considerable challenges in ensuring the safety of the District’s water supplies. For one thing, while lead levels have come down in recent months, they still remain well above the Lead and Copper Rule’s 15 ppb action level. In addition, only time will tell if or how quickly WASA’s ambitious lead service line replacement program will further lower lead levels in drinking water.

The District’s experience has also exposed weaknesses in the Lead and Copper Rule’s public education requirements. EPA is collecting information about compliance with the rule and is also considering changes to the Lead and Copper Rule and its accompanying guidance documents and training. We support these efforts and believe the clear deficiencies of the rule’s public education requirements—vividly illustrated

in the District of Columbia—call for action to assist water systems in educating their customers about lead.

The District's experience has also underscored gaps in available knowledge about health risks associated with lead-contaminated drinking water. In acknowledging these gaps, EPA has pointed to projects planned by its Office of Water and its Office of Research and Development as key steps to address the problem. However, the timetable for completing these projects is not clear, and it is also not clear how this work will fit into a broader research agenda or if this agenda will involve other key organizations such as CDC.

Recommendations for Executive Action

To provide timely information to communities on how to improve communication of lead health risks, we recommend, as part of its comprehensive re-examination of the Lead and Copper Rule's public education requirements, that the Administrator of EPA direct the Office of Water to identify and publish best practices that water systems are using to educate the public about lead in drinking water.

To improve the health risk information on lead available to water systems and regulatory staff, we recommend that the Administrator of EPA develop a strategy for closing information gaps in the health effects of lead in drinking water that includes timelines, funding requirements, and any needed coordination with CDC and other research organizations.

Agency Comments and Our Evaluation

We provided a draft of this report to EPA for comment. In its March 14, 2005, letter (see app. II), EPA expressed appreciation for the information in the report, identified some of its recent and ongoing efforts to address the problems we identified, and indicated it will give full consideration to our recommendations. Of particular note, EPA agreed with our recommendation that the agency identify and publish best practices that water systems can use to educate their customers about lead in drinking water. EPA said it will work with its regions and water utility associations to identify best practices and disseminate them to a wide audience, and will work with stakeholders to change the mandatory language in its regulations to make sure it is relevant and understandable.

The agency indicated neither agreement nor disagreement with our recommendation to develop a strategy for closing information gaps on the

health risks of lead in drinking water. EPA noted instead it was awaiting revision of the agency's exposure model for evaluating the effects of lead exposure from different media on blood lead levels. It also said it was "working to prepare a health advisory that would inform the discussion" and was developing a summary of toxicokinetic research published since 1991. EPA said these efforts should be completed later this year or early next year. We note that while EPA's planned efforts to address information gaps in knowledge of health risks from lead in drinking water appear to be worthwhile activities, we continue to believe the agency should commit to the kinds of planning steps (such as budgeted resources and timetables) that will help to ensure its planned efforts are addressed in a timely manner and have their intended effect. We also continue to believe that EPA should coordinate its efforts with CDC and other parties to ensure that the most is achieved from all agencies' collective efforts. EPA also provided technical comments and clarifications that have been incorporated, as appropriate.

On February 23, 2005, we met with WASA officials to discuss the factual information we were planning to include in our draft report. At that time, WASA provided oral comments and technical suggestions. We subsequently provided the draft report to WASA for formal comment. WASA, however, did not comment on this draft.

As agreed with your office, unless you publicly release the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies of this report to the appropriate congressional committees; interested Members of Congress; the Acting Administrator, Environmental Protection Agency; and other interested parties. We will also make copies available to others on request. In addition, the report will be available at no charge on the GAO Web site at <http://www.gao.gov>.

Should you or your staff need further information, please contact me at (202) 512-3841 or stephensonj@gao.gov. Individuals making key contributions to this report included Steve Elstein, Samantha Gross, Karen Keegan, Tim Minelli, and Carol Herrnstadt Shulman.

Sincerely yours,

A handwritten signature in black ink that reads "John B. Stephenson". The signature is written in a cursive style with a long horizontal flourish extending to the right.

John B. Stephenson
Director, Natural Resources and Environment

Scope and Methodology

To identify actions that key government entities are taking to improve coordination, we reviewed key documents, such as the consent decrees between the District of Columbia Water and Sewer Authority (WASA) and the Environmental Protection Agency (EPA) and testimony by the involved agencies, that identified steps each agency agreed to take to improve coordination, efficiency, and accountability. We then met with officials of these entities and gathered documentation from them to gauge the progress of planned changes. Additionally, we reviewed reports written by various groups about lead in drinking water in the District of Columbia, including reports by the District of Columbia Inspector General, the D.C. Appleseed Center for Law and Justice, and the law firm of Covington and Burling. Finally, to gain perspective on the issue of coordination, we interviewed officials from other water systems and their federal and state regulatory agencies and consulted with industry groups in the drinking water delivery field.

To identify the extent to which WASA and others are gathering information to determine which adult and child populations are at greatest risk of exposure to lead, we reviewed WASA's efforts to locate lead service lines. We also reviewed the plans that WASA has submitted to EPA to replace lead service lines and materials describing WASA's program to encourage homeowners to fully replace lead service lines. We interviewed WASA and EPA staff about the progress of the lead service line identification and replacement programs, interviewed officials at other water systems to discuss lead service line replacement, and reviewed studies on partial lead service line replacement.

To determine how other drinking water systems that have exceeded the action level for lead conducted public education and outreach, we met with parties knowledgeable about the Lead and Copper Rule, including EPA headquarters and regional staff and relevant industry groups, in part to find water systems with particularly innovative and effective public education and outreach programs. From this group, we focused on water systems in large cities with diverse populations that had exceeded the action level for lead since 2000, according to EPA data. We then interviewed officials from these water systems and reviewed documents to learn about their public education efforts, how they target their efforts, and how they measure success. We also spoke to officials from government and nongovernment entities that partner with these water systems in their education programs. To learn about public education under the Lead and Copper Rule, we attended an EPA workshop where water system managers, environmental and consumer groups, and other experts shared their opinions on best

practices in the industry and EPA's current policies. We also reviewed reports and public testimony pertaining to public education in the District of Columbia and elsewhere.

To evaluate the state of research on lead exposure, we interviewed public health officials and academic researchers that representatives of government and nongovernmental organizations in the fields of drinking water and public health identified as experts on lead. We interviewed these experts to get their perspective on lead's health effects, particularly the health effects of ingestion of low levels of lead and lead in drinking water. We also discussed data gaps on the health effects of lead, the research efforts planned and under way to fill these gaps, and alternative strategies that might better ensure that these gaps are addressed efficiently and effectively. These experts also helped us identify the medical and public health literature we reviewed on the health effects of lead exposure, particularly through drinking water. To learn about efforts to locate and monitor the blood lead levels of individuals exposed to elevated levels of lead in drinking water in the District, we examined a published study and interviewed officials at the District of Columbia Department of Health and the Centers for Disease Control and Prevention. Finally, we interviewed EPA officials and reviewed EPA strategic plans and other documentation to learn about EPA's plans to address key information gaps on the health effects of lead exposure.

Comments from the Environmental Protection Agency



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAR 14 2005

OFFICE OF
WATER

John B. Stephenson
Director, Natural Resources and the Environment
Government Accountability Office
Washington, DC 20548

Dear Mr. ^{John} Stephenson:

Thank you for the opportunity to review the proposed Government Accountability Office (GAO) Report; *The District of Columbia's Drinking Water: Agencies Have Improved Coordination, But Key Challenges Remain in Protecting the Public From Elevated Lead Levels*. We appreciate the information in the report and will give full consideration to your recommendations. We have provided technical comments on specific elements of the report under separate cover. However, I would like to take the opportunity to respond to the issues you evaluated and your specific recommendations.

As you know, we have been working over the past year to better understand implementation of the Lead and Copper Rule nationwide. On March 7, 2005, we announced an initial series of efforts we are undertaking to revise regulations and guidance in order to improve implementation of the rule. We are continuing to collect and analyze additional information to help us target areas where implementation needs to be further improved. We want to ensure that this rule, which has been critical in lowering exposure to lead in drinking water, continues to be successful.

Your first charge was to examine how agencies that implement the LCR in the District are improving their coordination in an effort to reduce lead levels. From EPA's perspective, we have seen significant improvements in coordination between EPA, the DC Water and Sewer Authority (WASA) and Washington Aqueduct over the past year, particularly through the Technical Expert Working Group. This group, which was initially developed to help identify a treatment solution for D.C., has continued to meet in order to discuss the progress of treatment and water monitoring results. We have also had more frequent contact with the D.C. Department of Health regarding drinking water matters in the District and found it beneficial to maintain a relationship with the L.E.A.D. (Lead Emergency Action for the District) Coalition members as one means to keep the community updated on actions taken, research and sampling results and the status of the WASA's compliance with our administrative order.

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Your second charge was to determine the extent to which WASA and other entities are identifying populations at the greatest risk of exposure to lead in drinking water and reducing their exposure. As you noted in your report, WASA has worked to prioritize lead service line replacement for homes with children, pregnant women, or which have very high lead levels. We heard about similar efforts undertaken by utilities during our expert workshops on lead service line replacement and public education that were held during 2004. We believe the effort to prioritize is critical to ensuring that sensitive subpopulations are addressed promptly and will look to share the experiences of utilities that have already developed prioritization programs with utilities that are initiating lead service line replacement to comply with the regulations.

Your third charge was to evaluate how other drinking water systems that exceed the EPA action level conduct public education. As part of our work with WASA, staff from Region 3 and Headquarters likewise surveyed other utilities to learn more about how they tailor public education efforts. At our public education workshop last September, we heard first hand about the specific efforts undertaken by Oregon's Portland Bureau of Water Works and the Massachusetts Water Resources Authority, which are highlighted in your report.

We agree with your recommendation that EPA identify and publish best practices that water systems can use to educate their customers about lead in drinking water. In addition to promoting use of our existing Public Education guidance, of which many were unaware, we will work with Regions and water utility associations to build on the information collected in response to D.C. to identify best practices and disseminate them to a wide audience. An additional area of interest for us is revising the existing public education language in the regulations. Participants at our public education workshop highlighted their concerns with the complexity of the mandatory language. We would like to work with stakeholders to pursue changes to the language to make sure it is relevant and understandable.

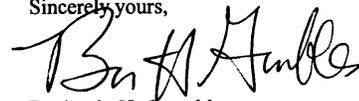
Finally, you were charged with evaluating the state of research on lead exposure as it relates to drinking water. You also recommended that we work in coordination with CDC and other research organizations to develop a strategy for closing information gaps on this issue. Although the Agency has consistently stated that there is no safe level of lead exposure, we have been challenged to communicate the specific risks of lead associated with varying concentrations of lead in drinking water and to put that risk in context with other sources of lead exposure.

As you know, we are awaiting revision of the Agency's exposure model for evaluating effects of lead exposure from different media on blood lead levels, which is key in helping us evaluate potential health effects. We are presently working to prepare a health advisory that we hope will inform the discussion and are also developing a paper that will summarize toxicokinetic research published since the rule was issued in 1991. We expect efforts on all of these items to be completed by later this year or early next year.

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I appreciate the opportunity to coordinate with your staff on this project. Should you need additional information or have further questions, please contact me or Cynthia C. Dougherty, Director of the Office of Ground Water and Drinking Water at (202) 564-3750.

Sincerely yours,



Benjamin H. Grumbles
Assistant Administrator

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