Massachusetts Assistance Program for Lead in School Drinking Water

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Table of Contents

Executive Summary 3
List of Acronyms 7
1. Background on Lead and Copper in Drinking Water 8
1.1 How Lead and Copper Get into Drinking Water 8
1.2 Health Effects of Lead and Copper in Drinking Water 9
1.3 Federal and State Regulation of Lead and Copper in Drinking Water 9
1.4 Assistance for Schools under the Lead Contamination Control Act (LCCA) 10
2. Summary of the Assistance Program for Lead in School Drinking Water 11
3. Funding for the Program 11
4. Program Elements and Implementation 12
4.1 Request for Interest 12
4.2 Inter-Agency Service Agreement with UMass Amherst 12
4.3 Technical Assistance Materials 12
4.3.1 Fact Sheets 13
4.3.2 Other Technical Assistance Materials 14
4.4 Informational Meeting 16
4.5 Sample Plan/Fixture Map 16
4.6 Sampling 17
4.7 Laboratory Analysis of Samples 18
4.8 Communication about Results and Follow-up Actions 19
4.9 Additional Assistance Requested by Individual Schools and Municipalities 19
4.10 Online Reporting Tool 20
4.11 Agency/Entity Roles 20
4.12 Project Management/Governance 21
4.13 Press Interest/Coverage 22
5. Budget 22
5.1 UMass Project Management, Technical Assistance, and Laboratory Analysis 22
5.2 MassDEP Staff Time 23

5.3 Laboratory Analysis Contribution by MWRA 23
6. Outputs/Findings 23
6.1 Program Outputs 23
6.2 Lead and Copper Exceedance Data 24
6.3 Intersections with Public Water Suppliers 30
6.4 Remedial Actions Taken by Schools 30
6.4.1 Sinks 31
6.4.2 Kitchen Kettles 31
6.4.3 Drinking Water Fountains and Coolers 31
6.4.4 Water Bottle Filling Stations 32
6.5 Communications by Schools 32
6.6 Benefits of the Program 33
6.7 Recommendations for MassDEP Programs, Procedures, and Regulations 34
7.0 Resources for More Information 35

Executive Summary

Background

This Report summarizes the Commonwealth of Massachusetts' Assistance Program for Lead in School Drinking Water (Program). The Program was launched by Governor Charlie Baker and Treasurer Deborah Goldberg in April 2016, and concluded in February 2017. The Massachusetts Department of Environmental Protection (MassDEP) was the agency responsible for developing and implementing the Program, which was designed to assist public schools and public early education and child care facilities (schools) in assessing the levels of lead and copper in their facilities' drinking water.

MassDEP and its Program partners proactively reached out across the Commonwealth to solicit public schools to sign up for assistance under the Program. Outreach included press releases (with strong press coverage), statewide emails from the Department of Elementary and Secondary Education (DESE) and the Department of Early Education and Childcare (DEEC), Twitter announcements, and Program information on MassDEP's website. The Program included an educational component that provided schools with the information necessary to establish and implement sampling programs, and to take remedial actions to address elevated lead and copper levels. In implementing this program, MassDEP contracted with the University of Massachusetts (UMass) to provide the majority of the technical assistance and to oversee contracted laboratory analysis services. The Massachusetts Water Resources Authority (MWRA) provided the laboratory analysis services for all participating schools in their service area. MassDEP also worked closely with several other partners, including DESE, DEEC, and the Department of Public Health (MDPH).

Through this Program, water was sampled at schools to determine if the water exceeded the recommended "Action Level" (AL) for lead and copper, and the results were promptly reported to the schools. The Program provided schools with information and resources to address problem fixtures. MassDEP has posted all sampling results on its website.

Key Elements of the Program

Key elements of the program were as follows:

1) **Informational Meetings** – These meetings were held in the local community and were conducted on a school system-wide basis. The meetings provided attendees with the information necessary for school systems to implement the Program.

2) **Technical Assistance Materials** – MassDEP developed a number of training and technical assistance materials, including Fact Sheets, PowerPoint Presentations, Model Forms and Letters, a web page, and an online Reporting Tool.

3) **Sampling** – For each building included in the Program, a map of fixtures to sample, as well as a plan for sampling those fixtures, was developed. Sampling was conducted in a manner to ensure validity of sampling results and alignment with applicable U.S. EPA

guidance. This included ensuring that sampling occurred after water was stagnant for more than eight hours, but less than eighteen hours from a day of normal use (e.g., not during a school vacation period), and that sampling occurred prior to any other use of water in the building on the day of sampling. Generally, two samples were taken from each fixture, a first draw (to identify lead and copper leaching from the plumbing fixture itself) and a 30-second flush sample (to identify lead and copper leaching from upstream in the building plumbing).

4) **Laboratory Analysis of Samples** – Samples collected under the Program were analyzed by state-certified labs, and participating laboratories were required to report all sampling results through MassDEP's electronic reporting system (known as eDEP). Samples were analyzed for lead and copper.

5) **Communication of Results and Follow-up Actions** – MassDEP provided each individual school with the results of all sample analyses. Results were accompanied by an explanation of the analytical results. At that time, schools were also provided with supplemental materials to help them with communication efforts with their community and to provide them with MassDEP contacts for additional support. For any school with results exceeding an AL, MDPH contacted the school and their local health office offering advice and resources on how best to communicate health risks to parents, students, staff, and other local parties.

Key Findings

The Program provided technical assistance and laboratory analysis to 818 schools from 153 different communities. A total of 55,919 samples were collected from 31,832 fixtures. First draw samples were collected from all fixtures; however, for flush samples, some fixtures, such as a single sink with both a drinking fountain and a faucet, required only one sample. The types of fixtures sampled included classroom and bathroom faucets, water fountains, kitchen kettles, water coolers, service connectors, and others.

Sample results were compared against MassDEP's ALs for lead (0.015 mg/l) and copper (1.3 mg/l). Results can be summarized as follows and are described in further detail in this report.

- Of the total samples analyzed, about 7 percent exceeded the AL for lead only, 1 percent exceeded for both lead and copper, and 1 percent exceeded for copper only;
- First draw samples were more likely to exceed an AL than flush samples, with 13 percent of first draw samples exceeding an AL and 4 percent of flush samples exceeding an AL;
- Approximately 72 percent of participating school buildings had one or more fixtures exceeding the AL for lead or copper; whereas 28 percent did not have any AL exceedances.
- Approximately 29 percent of school buildings exceeded the AL for both lead and copper at one or more fixtures;
- 40 percent of school buildings exceeded the AL for lead only, and 3 percent exceeded the AL for copper only.

- Kitchen kettles and classroom faucets were the fixtures most likely to have AL exceedances. Water fountains, water bottle filling stations, nurses' sinks, and bathroom faucets were less likely to have AL exceedances.

Actions Taken by Schools

Per guidance provided by the Program, once schools received their sampling results, they were encouraged to shut off all fixtures with AL exceedances, and to communicate the results as well as short-term action plans to parents and staff. Schools communicated this information through emails, automated informational calls, letters, website postings, printed postings in schools, newspaper articles, and public meetings. Actions taken to address elevated copper or lead levels included removing and replacing fixtures, using signage to indicate fixtures not intended to be used for drinking water, and implementing water line flushing programs. Schools were encouraged to report their actions to MassDEP through the online Reporting Tool.

Budget

Total expenditures for the Program are projected to be approximately $2.1 million. Costs were incurred for project management, administrative support, technical assistance, and laboratory analysis. Funding was provided by the Massachusetts Clean Water Trust. In addition to these expenses, the cost of some laboratory analyses was covered by the MWRA, and MassDEP provided the equivalent of 4-5 full-time staff to support the Program.

Recommendations for the Future

As a result of the Program, MassDEP is considering some new activities to further address lead and copper in school drinking water. The agency wants to make enhancements to current tools and assistance materials that will help schools implement future programs. Specific recommendations are as follows:

- **With available funds from the program, continue a modified assistance program to provide another round of technical assistance and laboratory analysis to schools that did not participate in the Program in 2016, and also to enhance existing assistance materials**. About $600,000 of the original funding is available.

- **Working with stakeholders, MassDEP is considering where enhanced coordination and data sharing with public water suppliers to support testing in schools is appropriate**. Consideration is being given to the universe of PWSs with corrosion control who perform routine sampling, how often lead and copper sampling occurs, and requiring online reporting by PWSs to MassDEP. Based on experience working with schools in different sized communities, MassDEP's goal is to implement a program that allows for earlier detection of exceedances and the promotion of timely transmission and transparency of the data the agency receives. As MassDEP considers possible changes affecting PWSs, the agency is committed to consulting with its external advisory committee for the Safe Drinking Water Act, which consists of representatives from

public health, EPA, PWSs and consultants, to discuss advantages and disadvantages of various possible approaches.

List of Acronyms

AL	Action Level
CoC	Chain of Custody
Cu	Copper
DEEC	Department of Early Education and Childcare
DESE	Department of Elementary and Secondary Education
FAQ	Frequently Asked Questions
ISA	Inter-Agency Service Agreement
LCCA	Lead Contamination Control Act
LCR	Lead and Copper Rule
MassDEP	Massachusetts Department of Environmental Protection
MDPH	Massachusetts Department of Public Health
MCWT	Massachusetts Clean Water Trust
MRWA	Massachusetts Rural Water Association
MWRA	Massachusetts Water Resources Authority
Pb	Lead
POU	Point of Use
PWS	Public Water Supply
RFI	Request for Interest
SDWA	Safe Drinking Water Act
SRF	State Revolving Fund
TAP	Technical Assistance Provider
UMass	University of Massachusetts
U.S. EPA	United States Environmental Protection Agency

1. Background on Lead and Copper in Drinking Water

1.1 How Lead and Copper Get into Drinking Water

Lead (Pb) and copper (Cu) are heavy metal elements that occur in natural minerals and are extracted and purified for use in a wide range of materials, including components of plumbing piping and fixtures used to convey potable water from sources to consumers. These elements are typically not present at significant levels in raw (untreated) water or in the treated water that enters a drinking water distribution system. However, various components of the service connection to a building (such as a Lead Service Line), as well as the piping, solder, and fixtures within a building (premise plumbing), may be composed of materials that contain lead or copper. When elevated levels of lead or copper are found in samples of water collected from fixtures (faucets or drinking water fountains) within buildings, it is likely to have originated from components of the service connection and/or premise plumbing.

Lead and copper in plumbing materials are in their elemental form and are very insoluble. However, the chemical composition of drinking water, microbial activity, and electric current, can all contribute to corrosion of the lead and copper metal, creating dissolved complexes and solid precipitates. Lead and copper corrode from plumbing materials at different rates and extents depending on local water quality and the age and composition of metals in the plumbing materials. The levels of certain water quality parameters[1] can impact corrosion.

Water use patterns in buildings can result in significant time periods of water stagnation at the service connection and within some or all of the building plumbing. For example, water is largely stagnant while people are sleeping in homes and while schools or office buildings are not in use, such as overnight and during weekends and vacations. The levels of lead and copper that enter the stagnant water depend on the concentrations of certain water quality parameters in the water (described above), the amount of time the water is in contact with the plumbing materials, and the amount of lead and copper in the plumbing materials. The levels of lead and copper in a building's water typically increase with length of stagnation time. In addition, a sudden increase in flow or a physical disturbance of the piping (e.g., during plumbing work) can increase the levels of lead and copper.

Recognizing that elevated levels of lead and copper in drinking water have historically almost always been the result of service lines and premise plumbing, the U.S. government began efforts to limit possible exposure to lead (and copper) in drinking water. The 1986 Safe Drinking Water Act (SDWA) Amendments limited the allowable concentration of lead in plumbing materials, including the banning of lead containing solder. This law decreased the allowable lead in brass plumbing material to not more than 8 percent by weight. In 2011, the federal Reduction of Lead in Drinking Water Act further decreased the allowable levels of lead in plumbing materials to 0.25 percent of the water-exposed material and required labeling of products to indicate compliance with this standard.

[1] pH, dissolved inorganic carbon, dissolved oxygen, chlorine species, phosphate, and sulfate.

1.2 Health Effects of Lead and Copper in Drinking Water

Research has shown that even low levels of lead can harm the developing brains of infants, young children, and developing fetuses. Public health officials have long recognized the goal of minimizing lead exposure. The Massachusetts Department of Public Health (MDPH) carefully monitors lead exposure to children by mandatory periodic measurements of blood lead levels through the age of four years. According to MDPH, most exposure to lead is from paint dust, paint chips, and soil contaminated with lead. However, lead can also get into the human body by drinking or cooking with water containing lead. Exposure of young children to lead via drinking water, especially formula-fed infants, can be significant. More health information on lead in drinking water can be found in the MDPH "Lead in Drinking Water FAQ." (http://www.mass.gov/eohhs/docs/dph/environmental/lead/lead-drinking-water-faq.pdf)

Copper is an essential nutrient for humans and it is safe to have low levels of copper in drinking water. Unsafe levels of copper in drinking water can result in nausea, vomiting, diarrhea, and stomach cramps. Some infants and children, people with liver disease, and people with Wilson's disease have more difficulty eliminating copper from their bodies and have a higher chance of experiencing negative health effects, such as kidney and liver damage. More health information on copper in drinking water can be found in the MDPH "Copper in Drinking Water FAQ." (http://www.mass.gov/eohhs/docs/dph/environmental/exposure/copper-drinking-water-faq.pdf).

1.3 Federal and State Regulation of Lead and Copper in Drinking Water

Current state and federal regulatory requirements for lead and copper in drinking water pertain only to Public Water Suppliers (PWS). A PWS is an entity that provides water for human consumption through pipes or other constructed conveyances to at least 15 service connections or regularly serves an average of at least 25 people for at least 60 days a year. The United States Environmental Protection Agency (U.S. EPA) has granted the Massachusetts Department of Environmental Protection (MassDEP) primary implementation and enforcement responsibility for the SDWA program in Massachusetts, known as "primacy." In order to retain primacy, MassDEP has promulgated regulations that are no less stringent than the federal regulations promulgated by U.S. EPA. MassDEP is the primary agency overseeing regulatory compliance by PWSs for drinking water quality.

In 1991, the U.S. EPA promulgated the Lead and Copper Rule (LCR) to decrease the health risk of lead and copper in drinking water obtained from building premise plumbing. LCR includes both lead and copper, because the same mechanism that leaches lead from plumbing into the drinking water can also leach copper. LCR sets Action Levels (ALs) for drinking water at 0.015 milligrams per liter (mg/L) for lead and 1.3 mg/L for copper. The LCR requires PWSs to conduct sampling and analysis of water in a representative number of households after an overnight stagnation period. LCR requires that 90 percent of the household samples have lead and copper concentrations below the respective ALs. If the 90^{th} percentile values exceed the ALs, the PWS must take certain prescribed actions, including implementing optimal corrosion control treatment and public education regarding flushing of fixtures prior to water use and other information. Under MassDEP's LCR regulations, PWSs are also required to take samples at two fixtures from two schools within their service area during each LCR sampling round. The results of the school sampling under LCR are not factored into the PWS's 90^{th} percentile, but the PWS is required to

notify the schools of their results and offer assistance on possible actions to reduce levels below the ALs. MassDEP actively oversees PWS compliance with LCR. Information on MassDEP's LCR program, including PWS LCR sampling results, can be found on the MassDEP website at http://www.mass.gov/eea/agencies/massdep/water/drinking/lead-in-drinking-water.html.

MDPH's Childhood Lead Poisoning Prevention Program (CLPPP) was established for the prevention, screening, diagnosis, and treatment of lead poisoning, including the elimination of sources of poisoning through research and educational, epidemiologic, and clinical activities as may be necessary. Under the Massachusetts Lead Law, MGL c. 111, §§ 189A-199B, and the Lead Regulations (105 CMR 460.00), physicians must screen children for lead between the ages of 9 and 12 months and again at 2 and 3 years of age. Children who live in communities considered high-risk for lead poisoning are also required to be tested at age 4. All childhood blood lead test results are reported to CLPPP. By tracking blood lead levels, CLPPP identifies children with elevated blood lead levels and offers medical case management, community health worker visits, and housing inspections to identify and then remove or reduce sources of lead in the home. CLPPP requires these interventions for lead poisoned children (i.e., blood lead level ≥25 µg/dL). In late 2016, CLPPP added routine screening for lead in drinking water and testing for lead service lines to the inspection process. Proposed regulatory amendments for CLPPP will reduce the definition of lead poisoning from a blood lead level of 25 µg/dL or greater to a level of 10 µg/dL or greater. State-wide tracking of blood test results allows CLPPP to monitor progress toward eliminating childhood lead poisoning, identify high-risk populations, monitor trends in lead exposure by geography, and develop and evaluate interventions and programs. More information can be found on the CLPPP website (http://www.mass.gov/eohhs/gov/departments/dph/programs/environmental-health/exposure-topics/lead/).

1.4 Assistance for Schools under the Lead Contamination Control Act (LCCA)

In 1988, the U.S. Congress passed the Lead Contamination Control Act (LCCA), which directs U.S. EPA and its state designees to assist school system administrators, schools and programs, to identify and reduce or eliminate lead contamination in their facilities' drinking water. Unlike LCR, the LCCA is an assistance-based, non-regulatory program. As federal designee, MassDEP is responsible for educating school/facility officials about the LCCA and coordinating statewide efforts to reduce or eliminate lead in drinking water at schools and childcare facilities.

MassDEP has promoted and supported the voluntary LCCA program for assessing lead and copper in school drinking water since its initial passage. MassDEP has set a goal for schools to have 100 percent of samples with lead and copper levels below the U.S. EPA LCR ALs of 0.015 mg/L and 1.3 mg/L, respectively. Note that the federal guidelines for lead in school drinking water under the LCCA have a goal of 0.020 mg/L, but MassDEP opted to set the lead goal for school drinking water to be the same as the LCR AL. MassDEP provides guidance that schools assess each drinking or cooking water fixture and identify and eliminate, if feasible, those plumbing components that contain lead. If replacement with lead-free components is not possible, then use of flushing programs or possibly point-of-use (POU) lead removal treatment is suggested. As part of MassDEP's LCCA program, every five years the agency requests that all schools submit a survey regarding their LCCA program. Additional information on the Massachusetts LCCA program is available at the following link, under the "Schools &

Childcares" tab: http://www.mass.gov/eea/agencies/massdep/water/drinking/lead-in-drinking-water.html.

2. Summary of the Assistance Program for Lead in School Drinking Water

The Massachusetts Assistance Program for Lead in School Drinking Water (Program) was launched by Governor Charlie Baker and Treasurer Deborah Goldberg in April 2016. MassDEP was the agency responsible for developing and implementing the Program, which was designed to assist public schools and public early education and child care facilities (hereafter referred to as "schools") in assessing the levels of lead and copper in their facilities' drinking water.

Under the Program, the Commonwealth helped public school systems and districts (hereafter referred to as "school systems") take water samples for both lead and copper from fixtures within their buildings used for drinking, food preparation, and medical purposes. Samples were analyzed at state-certified laboratories at no cost to the community. This provided participating schools with baseline information on lead and copper levels in drinking water within their buildings. In addition, the Program included an educational component that provided school systems with the information necessary to establish and implement school sampling programs, and to take remedial actions to address elevated lead and copper levels. All public schools in Massachusetts were eligible to participate in this voluntary program. Some schools, including some that did not participate in the Program, have existing and on-going programs to address lead and copper in drinking water.

3. Funding for the Program

The Massachusetts Clean Water Trust (MCWT) provided the majority of the funding for the Program. MCWT is a quasi-governmental organization that was created by the Massachusetts legislature to administer the Commonwealth's State Revolving Fund (SRF) programs. Its Trustees are the State Treasurer, the Secretary of Administration and Finance, and the Commissioner of MassDEP. MCWT provides SRF financing for sewer projects, septic systems, drinking water projects, and a variety of other pollution abatement projects for communities across the Commonwealth. The MCWT provided $2.75 million to MassDEP for the technical assistance Program.

In addition to the funding provided by MCWT, the Massachusetts Water Resources Authority (MWRA) offered laboratory analysis and supplemental technical assistance at no charge to school systems located in communities that receive drinking water from MWRA. MWRA is a public authority established by the Massachusetts legislature to provide wholesale water and sewer services to 61 metropolitan Boston communities. Approximately 11 percent of the samples collected, representing 103 school buildings, received laboratory analysis from MWRA.

Finally, MassDEP committed significant staff time to support implementation of the Program. From April 2016 through February 2017, more than 32 MassDEP staff worked on the Program, spending numerous hours equivalent to 4 to 5 full-time staff positions.

4. Program Elements and Implementation

The following section summarizes the elements of the Program and its implementation. The Program components described below are: soliciting participating schools through a Request for Interest; contracting assistance providers through an Inter-Agency Service Agreement with UMass Amherst; developing technical assistance materials; conducting kick-off Informational Meetings; assisting schools with sampling, reporting of laboratory results to schools, using an online Reporting Tool; and providing additional technical assistance to schools on follow-up actions.

4.1 Request for Interest

On May 3, 2016, MassDEP, in conjunction with the Department of Elementary and Secondary Education (DESE) and the Department of Early Education and Child Care (DEEC), released a Request for Interest (RFI) soliciting public schools that wanted to receive technical assistance and sample analysis for lead and copper in drinking water at no out-of-pocket cost to the school system. The RFI was made available electronically and respondents were asked to provide information concerning the primary point of contact for the RFI response and relevant information concerning each building to be included in the Program. DESE and DEEC helped notify all 7,000 public schools and public EECFs about the opportunity to participate.

4.2 Inter-Agency Service Agreement with UMass Amherst

In May 2016, MassDEP entered into an Inter-Agency Service Agreement (ISA) with the University of Massachusetts, Amherst (UMass) for implementation of the Program. Pursuant to the ISA, MassDEP partnered with UMass to provide the services of: 1) Program Directors to oversee implementation of the ISA; 2) Project Managers to coordinate implementation of the ISA; 3) Technical Assistance Providers (TAPs) to work with school personnel; and 4) coordination with contracted state-certified laboratories. The responsibilities of UMass under the ISA included: 1) preparing for and participating in weekly calls with MassDEP to discuss and coordinate implementation and progress of the Program; 2) working with MassDEP to finalize the informational materials to be provided to schools participating in the Program; 3) scheduling and conducting Informational Meetings for school systems to provide training on all aspects of the Program; 4) overseeing and assisting with sample collection and analysis; and 5) coordinating laboratory services and the delivery of samples to labs.

4.3 Technical Assistance Materials

To facilitate implementation of the Program, numerous training and technical assistance materials were created, including fact sheets, PowerPoint presentations (including an on-line PowerPoint video with voiceover), and model forms and letters. In addition, MassDEP created a web page dedicated to the Program, as well as an online Reporting Tool and a publicly-

accessible spreadsheet showing sampling results. All of these implementation materials and tools are discussed below.

4.3.1 Fact Sheets

MassDEP and UMass developed a number of fact sheets to assist schools participating in the Program. These fact sheets covered key aspects of the Program and were made available electronically on the Program's dedicated web page. A short synopsis of each is provided below:

Plumbing Profile (Map of LCCA Taps)

Provides information on how to create a Plumbing Profile and Map of LCCA Taps. LCCA taps are fixtures that are used for drinking, food preparation, or medical purposes, and these are the fixtures recommended for sampling under the LCCA. A Plumbing Profile evaluates a building's plumbing system, and can be used to identify potential sources of lead and copper that could leach into a building's water. A separate Plumbing Profile must be completed for each building, and existing Plumbing Profiles need to be revised to reflect any new construction or modifications to the building following completion of the original Plumbing Profile. A Map of LCCA Taps identifies each LCCA fixture on a map or schematic of the building. A uniform coding system was developed for schools to identify each fixture on the Map, and each fixture is identified consecutively (001, 002, etc.), starting where the water main enters the building and proceeding to the farthest point away from where the water main enters the building. A separate Map of LCCA Taps needs to be completed for each building, and existing Maps need to be revised to reflect any new construction or modifications to the building following completion of the original Map. The Map of LCCA Taps is used to create a Sampling Plan for each building that uses the same uniform coding system to identify the fixtures to be sampled. Essentially, the Sampling Plan is a row-by-row list of each fixture in numerical order corresponding to the Map of LCCA Taps. This fact sheet can be accessed online at: http://www.mass.gov/eea/docs/dep/water/drinking/plumbingp-fs.doc.

Sampling for Lead and Copper

Provides information on how to sample water for lead and copper for purposes of the Program. The topics include: 1) steps to create and implement a sampling program; 2) appropriate times to collect samples; 3) how to collect and label samples, including initial (first draw) samples and 30-second flush samples; 4) how to label the actual fixtures that will be sampled; 5) how to collect follow-up samples; and 6) how to complete and use the Chain of Custody (CoC) form. This fact sheet can be accessed online at: http://www.mass.gov/eea/agencies/massdep/water/drinking/how-to-collect-a-drinking-water-sample-for-lead-and-coppe.html.

Follow-up Steps Based on Lead and Copper Sampling Results above the Action Level

Identifies steps to be taken in response to lead or copper sampling results that exceed the AL. These steps include: 1) short-term and long-term corrective measures to prevent exposure; 2) notifying the public water supplier and the MassDEP Drinking Water Program of the sampling

results; 3) conducting outreach to staff and parents with a letter informing them of the results and describing plans to address the results that exceed the AL; and 4) conducting follow-up sampling. This fact sheet also includes sample letters for conducting outreach to staff and parents. This fact sheet can be accessed online at: http://www.mass.gov/eea/docs/dep/water/drinking/followup-fs.doc.

Flushing – A Short-Term Solution to Reduce Lead and Copper

Discusses the use of flushing as a short-term solution to reduce lead and copper in the water in response to an AL exceedance. Flushing involves opening and running fixtures to remove water that has been standing in the interior pipes and the fixture itself. Selecting flushing as a short-term measure requires knowledge of the plumbing in the building, sampling and resampling, daily record keeping, re-evaluating and adjusting the flushing plan as appropriate, and reporting. This fact sheet can be accessed online at: http://www.mass.gov/eea/docs/dep/water/drinking/alpha/a-thru-h/flushfs.pdf.

4.3.2 Other Technical Assistance Materials

Informational Meeting PowerPoint Presentation

MassDEP prepared the PowerPoint presentation that was used to educate participating schools about all elements of the Program at the initial Informational Meeting held for each participating school system. (See Section 4.4 below for additional information about the Informational Meetings.) This PowerPoint presentation can be accessed online at: http://www.mass.gov/eea/docs/dep/water/drinking/info-lead.pdf.

Lead and Copper in School Drinking Water Sampling Results Spreadsheet

A spreadsheet that includes all sampling results, on a fixture by fixture basis, reported to MassDEP through its electronic data reporting system (eDEP) was created. It also displays any remediation actions that schools report they have taken. This spreadsheet was updated regularly throughout the duration of the Program, and it can be accessed online at: http://www.mass.gov/eea/agencies/massdep/water/drinking/lead-and-copper-in-school-drinking-water-sampling-results.html.

Summary Results of Lead and Copper Drinking Water Testing at Massachusetts Schools

This document summarizes all sampling results reported to MassDEP through its electronic data reporting system (eDEP) on a school by school basis. This summary was updated regularly throughout the duration of the Program, and it can be accessed online at: http://www.mass.gov/eea/docs/dep/water/drinking/lcca-schools-list.pdf.

Summary of Actions Taken by Schools Participating in the Program for Lead in School Drinking Water

This spreadsheet includes a short description of actions taken by Program participants in response to exceedances of the lead and/or copper AL. It consists of information reported to MassDEP by the schools, or gathered from school websites. This spreadsheet was updated regularly throughout the duration of the Program, and it can be accessed online at: http://www.mass.gov/eea/agencies/massdep/water/drinking/testing-assistance-for-lead-in-school-drinking-water.html.

LCCA Chain of Custody Form

This is a model CoC form for use by schools participating in the Program. It can be accessed online at: http://www.mass.gov/eea/docs/dep/water/drinking/lcca-chain.xls.

Lead in School Drinking Water Sampling Protocol Guidance Video

This video PowerPoint with voiceover demonstrates the procedures for collecting lead and copper drinking water samples. It was developed by MassDEP for agency contractors, but the sampling guidance is useful for anyone collecting lead and copper drinking water samples at schools. It can be accessed online at: https://youtu.be/0sjah9gQsj8.

Lead and Copper Online Reporting Tool

This is an online Reporting Tool for schools to use for tracking and reporting sample locations, test results, and remedial actions, as well as facilitating the creation of CoC forms and bottle labels for use in sample collection. There is also a detailed User's Guide for the Reporting Tool. The online Reporting Tool and User's Guide can be accessed online at: https://script.google.com/a/macros/madwpdep.org/s/AKfycbxP99K-Cd5B3ioE7nswn0peOEndcGrXwVk6zJcS5iHxzGO55B1k/exec. (See Section 4.10 below for additional information about the online Reporting Tool.)

Dedicated Web Page for the Assistance Program

MassDEP created a dedicated web page for the Program to make all information and materials related to the Program easily accessible in a centralized location. All of the technical assistance materials discussed in this section of the Report can be accessed from the Program's web page at: http://www.mass.gov/eea/agencies/massdep/water/drinking/testing-assistance-for-lead-in-school-drinking-water.html.

MDPH – Lead in School Drinking Water FAQ

MDPH, in consultation with MassDEP, developed the "Lead in Drinking Water FAQ for School and Childcare Facilities." This fact sheet answers frequently asked questions about lead and health, how lead may get into the drinking water at schools or childcare facilities, and how children, teachers, and staff can avoid exposure. The document can be accessed online at: http://www.mass.gov/eohhs/docs/dph/environmental/lead/lead-school-drinking-water-faq.pdf and is also available in Spanish.

MDPH – Copper in School Drinking Water FAQ

MDPH, in consultation with MassDEP, developed the "Copper in Drinking Water FAQ for School and Childcare Facilities." This fact sheet answers frequently asked questions about copper and health, how copper may get into the drinking water at schools, and how children, teachers, and staff can avoid exposure. The document can be accessed online at: http://www.mass.gov/eohhs/docs/dph/environmental/exposure/copper-school-drinking-water-faq.pdf and is also available in Spanish.

4.4 Informational Meeting

All school systems that responded to the RFI were contacted by UMass to schedule Informational Meetings. The Program encouraged school systems to invite participation from superintendents, principals, facility directors, representatives of local Boards of Health, representatives of the local PWS, plumbing inspectors, school committee members, school nurses, and other interested local officials. UMass conducted a total of 147 Informational Meetings covering 170 communities.[2] These meetings were held in the local community and were conducted on a system-wide basis. The meetings provided attendees with the information necessary for school systems to implement the elements of the Program. The fact sheets, PowerPoint presentation, model forms and letters, online Reporting Tool, MassDEP web page, and MDPH FAQs were reviewed as part of the Informational Meetings. Each meeting lasted approximately two hours, and everyone who would be participating in implementing the Program for the school system was encouraged to attend. Attendees varied between school systems, but in most cases included superintendents, principals, and facility directors. A subset of Informational Meetings was attended by PWS personnel, and a smaller subset was attended by elected officials, local health officers, and school nurses. The number of people attending Informational Meetings ranged from one to 25, but typical attendance was about five people. If the Informational Meeting was held in a school building, the meeting was often followed by a water sample collection demonstration.

4.5 Sample Plan/Fixture Map

Following the Informational Meeting, a Map of LCCA Taps and a Sampling Plan was developed for each building that would be included in the Program. The level of technical assistance required to develop the Map and Sampling Plan varied widely. Some school systems were able to complete these documents on their own, some school systems participated in completing these documents with hands-on assistance by a Program TAP, and some school systems relied upon a Program technical assistance provider to complete the documents. The time required to create a Map of LCCA Taps and corresponding Sample Plan for a single school building ranged from 15 minutes to several hours, depending on the size of the school building and the number of LCCA Taps in the building. Once completed, the Map and Sampling Plan was entered into MassDEP's

[2] Some cities/towns had more than one Informational Meeting because they have more than one school system/district (e.g., charter schools), while other Informational Meetings covered more than one town due to multi-community school systems/districts.

online Reporting Tool by UMass TAPs or school personnel. In most cases, school personnel required assistance from Program personnel on using the online Reporting Tool.

All locations where students had access to drinking water or where water was used for food preparation or medical care were labeled and included in the Map of LCCA Taps and Sampling Plan. The most common type of fixture sampled was a classroom sink, which often included both a faucet and a water fountain for drinking. However, fixture types ranged from kitchen kettles[3] and produce wash sinks to ice machines and hallway water fountains. Schools were encouraged to post signs near bathroom sinks and near other non-drinking water fixtures (such as janitor slop sinks) indicating that those faucets are intended for handwashing only. The Program provided thousands of adhesive signs for schools to use in the immediate term for this purpose. Faucets such as these where people will not be using the water for drinking, food preparation, or medical care, and that are posted with signs, are not considered LCCA Taps and need not be sampled.

4.6 Sampling

Advance preparation for sampling included the creation of CoC forms and bottle labels by Program personnel, and the delivery of the sampling bottles to the schools. The CoC forms were printed by Program personnel prior to collection of samples using the sample locations previously entered into the MassDEP online Reporting Tool. Information contained on the CoC form includes the school name and address, Department of Education organization code, samplers' names, sample identification number (location, code and type), date and time sampled (completed in the field for each sample), analyses requested, and signature blocks for each person having custody of the sample from sample collection through delivery of the sample to the lab. A separate CoC form was used for each school building that was sampled, and each sample had a unique location code number.

Bottle labels for each sample to be collected were also prepared using the MassDEP online Reporting Tool. Each label corresponds to a sample location listed on the Map of LCCA Taps, Sampling Plan, and CoC form. The sampling date and time identified on the label must match those identified on the CoC form. Delivery of the samples to the laboratory was handled in a variety of ways, including delivery by UMass TAPs, school or public water supplier personnel, and laboratory personnel.

To ensure the validity of the sampling results and to ensure alignment with applicable U.S. EPA guidance, sampling had to occur: 1) after more than eight hours but less than 18 hours of water stagnation prior to sample collection; 2) prior to any other use of water in the building; and 3) while the building was in normal use (e.g., not during vacations or other times when the building was not being used by the normal school-year population of students and staff). This resulted in a limited window within which to sample, and prevented sampling during the summer months and other school breaks. As a result, sampling generally occurred between 5:00 and 7:00 a.m. Tuesday through Friday, or on Saturday morning. The amount of time required to sample a building depended upon the number of fixtures to be sampled, the size of the building, the

[3] A kitchen kettle is a large vessel of water that is heated to cook, warm, or steam food such as vegetables, soup, and rice.

samplers' familiarity with the building, the experience of the samplers, the number of sampling teams, and the number of samplers on each sampling team. The level of technical assistance required to help schools conduct the sampling varied widely. Some school systems were able to sample on their own (often with the assistance of the local PWS), some systems participated in the sampling with hands-on assistance by a TAP, and some systems relied upon one or more TAPs to conduct the sampling aided by at least one school staff member to provide building access and fixture location assistance. In addition to the UMass TAPs, MassDEP staff and contractors were utilized in the sampling efforts when additional staff beyond the TAPs were required to meet the demand for sampling.

In accordance with applicable U.S. EPA guidance, samples were collected in 250 milliliter wide-mouth plastic bottles supplied by the laboratory without pre-acidification. Generally, two samples were taken from each fixture, a first draw and a 30-second flush sample. The first draw sample was collected as soon as water flowed out of the faucet. The 30-second flush sample was collected after allowing the water to run for 30 seconds at a normal rate of flow. This sampling approach allowed for the comparison of the concentration of lead or copper in the water as soon as a fixture was turned on and after a 30-second flush, which helped determine if an AL exceedance was caused by leaching from the fixture itself (or the plumbing in the immediate vicinity of the fixture) or by plumbing conditions further away from the fixture. Some fixtures had multiple closely connected water fixtures, such as a faucet and a water fountain on a classroom sink, two adjacent water fountains (high and low), or two adjacent water fountains and a bottle filling tap. In these cases, first draw samples were taken from all fixtures, while only one fixture was used to collect the flush sample since this flush sample was representative of the adjacent fixtures.

All sample bottles were labeled with the town name, school name, Department of Education organization code, sample location number, and whether the sample was a primary (first draw) sample or a 30-second flush sample. Sample location numbers were followed by a "P" for primary samples and an "F" for 30-second flush samples (e.g., 001P, 001F).

4.7 Laboratory Analysis of Samples

UMass handled the logistics involved in: 1) retaining the services of state certified laboratories to analyze samples under the Program; 2) ensuring that sampling bottles were made available at sampling locations for sampling events; and 3) ensuring that sampling bottles were delivered to the laboratories for analysis along with a completed CoC form. In all, UMass contracted with 12 laboratories to analyze samples under the Program. In addition, MWRA analyzed samples free of charge for a number of communities in the Program.

To participate in the Program, laboratories were required to report all sampling results through MassDEP's electronic reporting system (known as eDEP). Use of eDEP provided for an automated review of the submissions for both administrative completeness (e.g., all the required fields were populated, each field's data type matched the expected type, the organization code matched a known school), as well as technical sufficiency (e.g., each result was generated by a certified laboratory using an approved method with acceptable detection limits and holding times).

Laboratory analyses for lead and copper concentrations were conducted using U.S. EPA-approved methods, typically either Inductively Coupled Plasma Mass Spectrometry (ICPMS) or graphite furnace atomic adsorption. For each sample analyzed, two analyses were conducted, one for lead and one for copper.

4.8 Communication about Results and Follow-up Actions

MassDEP provided the results of all sample analyses for each individual school to the school point-of-contact via email. Submissions from eDEP were packaged into school-specific Excel spreadsheets that highlighted individual fixtures with results over an AL. The email communication explained the analytical results, offered supplemental materials to assist each school's communication efforts with its community, and identified MassDEP contacts for additional support. In addition, for any school with one or more fixture over an AL, MDPH sent an email to the local health department and the school principal and superintendent offering materials and support on how best to communicate the health risks associated with exposure to elevated levels of lead and copper in drinking water.

Transparency was a key aspect of the Program, which was emphasized during the Informational Meetings. Accordingly, sample results were published on MassDEP's website two weeks after MassDEP emailed the results to the school. This two-week timeframe provided schools with a reasonable opportunity to conduct communications and outreach with students, families, staff, and other local stakeholders concerning the results and remedial actions taken and to be taken.

4.9 Additional Assistance Requested by Individual Schools and Municipalities

In most cases, schools contacted MassDEP or UMass after receiving sampling results to discuss the meaning and significance of the results. Most schools with results over an AL also sought advice and assistance from MassDEP or UMass on the appropriate next steps, including implementing short-term and long-term remedial actions, conducting follow-up sampling, providing notification to the school community, and entering these actions into the online Reporting Tool. Assistance was often of a technical nature, explaining to facility directors how to interpret laboratory results, and how to identify the likely causes of lead or copper exceedances. In certain instances, it was necessary to explain that numerous copper exceedances may be due to new copper plumbing or to electrical grounding connected to a copper pipe. In some instances, it was determined that schools had improperly sampled from fixtures that should be considered non-potable (sinks in science labs, art rooms, or janitor slop sinks), and therefore results were not indicative of lead and copper levels in drinking water.

At times, it was necessary for Program personnel to help school personnel re-learn the use of the online Reporting Tool after laboratory results came back, so that they could enter their actions taken in response to sample locations that had AL exceedances. Some schools needed reminders that they must use certified, e-DEP compliant laboratories for follow-up sample analyses and that they should sample in accordance with Program guidelines (e.g., during normal use, with appropriate stagnation times). Some schools also needed to be reminded that the costs of follow-up sample analysis were not covered by the Program.

A number of local health departments, school nurses, principals, and superintendents contacted MDPH for risk communication support. Many callers asked questions about health effects and blood lead testing. Some callers asked what advice to give to parents and staff with health questions. MDPH recommended that parents and staff with general questions about lead or copper and health be directed to MDPH for additional information. MDPH advised callers that it is not necessary to test all children following the detection of lead or copper in school drinking water. However, if a child has never been screened for lead or if he or she has specific health concerns, parents and staff should consult with their doctors. MDPH was requested to give presentations about the health effects of lead and copper at public meetings for three school districts and conducted training during a Massachusetts Facilities Administrators Association meeting.

4.10 Online Reporting Tool

MassDEP developed the Lead and Copper Reporting Tool[4] as an online resource for schools that chose to participate in the Program with the intent of rolling it out in the future to any school that either was already running a local LCCA program or chooses to start one in the future. The Reporting Tool provides each school with a one-stop location to store critical LCCA documents, establish and maintain sampling locations, store sampling results, and record any remediation activities conducted in response to elevated levels of lead and/or copper.

Each school system is assigned a unique PIN that grants it private access to the tool where they can establish records to track individual schools within their school systems. The basic structure consists of a school record with individual sampling location records within it. The tool allows for upload of documents such as building maps, plumbing profiles, and sampling plans to allow schools to centralize the storage of these important records. Once all the coded sampling locations are entered for a school, a user can run three reports that make for an easier and more accurate sampling event. The CoC Report transfers all active sampling locations into a typical CoC template that can be carried into the field, completed during sampling, and provided to the laboratory along with the sample bottles. The Bottle Label Report provides a file that can be used to create labels for the sample bottles. The Sample Plan Report produces a PDF of all the current sampling locations.

Once a school has received its sampling results, the tool allows it to record any remediation performed in response to elevated lead and/or copper results. A default pick list covers communication efforts, flushing programs, fixture or other plumbing changes, and resampling efforts. Each action can be associated with the date it was performed.

4.11 Agency/Entity Roles

[4] The tool was built in-house using G Suite and Google Cloud Platform services/products. The front end user interface was built using Google Apps Script and published as a web app through G Suite. It connects to a back end database built using CloudSQL, an implementation of MySQL. Any documents uploaded by users and the tool's report templates are stored in Google Drive. Water quality results are manually transferred from eDEP using MS Access queries to obtain csv files. These extracts are then uploaded into the tool using the Google Cloud Platform web console first into Cloud Storage and from there into CloudSQL.

Partnerships were a critical element to the success of the Program. Program partners included: **MassDEP**, **UMass**, **MDPH**, **DESE**, **DEEC**, and **MWRA**. **MassDEP** played the lead role in the Program's development, including crafting of the Program materials and communications, maintaining the Program website, working with **DESE** and **DEEC** on soliciting schools to participate in the Program, and providing data, fiscal, and overall Program management. Prior to the kickoff of the Program, **MassDEP** developed the Program materials, including the online Reporting Tool. As the program was implemented and questions arose, **MassDEP** developed additional guidance materials. **MDPH** developed school-focused fact sheets addressing frequently asked questions on lead and copper in drinking water.

DESE and **DEEC** assisted **MassDEP** with notifications to schools about the availability of the Program and to provide Program updates. **MDPH** reached out to its network of school nurses and local health officials to provide similar information and encourage their participation in the Program. At the same time, **MassDEP** reached out to PWSs throughout the state, encouraging them to offer their assistance to participating schools where possible.

MassDEP contracted with **UMass** to implement the Program through an ISA. **UMass** hired personnel, contracted with the Massachusetts Rural Water Association (MRWA) for TAPs, arranged for contracts with commercial laboratories for sample analyses, and communicated extensively with **MassDEP** for Program management and implementation. UMass personnel conducted informational meetings, and assisted schools with all aspects of the Program through sample collection, including arranging the specific laboratory for each school system.

In addition to the laboratories contracted by **UMass**, **MWRA** provided analytical services for all schools located within communities partially- or fully-served by **MWRA**. **MWRA** also provided technical assistance directly to schools and/or local water departments. **MassDEP** staff worked closely with **MWRA** and the **UMass**-contracted laboratories to ensure that all Program samples were properly coded and submitted electronically via eDEP.

Many schools requested assistance with the actual sampling event. This assistance was provided by **UMass** and/or **MassDEP** staff, or by **MassDEP** contractors. School sampling events required significant coordination and oversight by **MassDEP** and **UMass**.

MassDEP, **UMass**, and **MDPH** all provided technical assistance to schools and/or local PWSs on follow-up to laboratory results. This included assistance regarding remedial actions and assistance with stakeholder communications.

4.12 Project Management/Governance

The bulk of the Program elements were implemented by teams from both MassDEP and UMass. The MassDEP team included several technical staff, as well as a number of managers. The UMass Project Management team included two Co-Principal Investigators/Project Directors, two Co-Project Managers, and two administrative support staff.

The complexity and timeline of the Program required close coordination within MassDEP, and between MassDEP and UMass. Steps were taken to ensure that such coordination occurred. First, there were weekly meetings/calls involving the MassDEP personnel working directly on the Program (MassDEP team) and the UMass Program Directors and Project Managers to discuss

Program implementation. Topics discussed during these meetings/calls included: 1) implementation priorities and strategies; 2) identification of issues arising during implementation that needed to be addressed/resolved; and 3) implementation reporting and tracking.

Second, the MassDEP team met weekly with MassDEP senior management to discuss: 1) the status of the Program, including reporting and tracking of ongoing efforts; 2) resource issues and demands; 3) Program costs and budget; 4) implementation priorities, strategies, and difficulties; and 5) issues arising during implementation that needed to be addressed/resolved. In addition, on a weekly basis, the MassDEP team provided MassDEP senior management with an internal report summarizing the number of: 1) participating communities; 2) participating school buildings; 3) Informational Meetings completed; 4) buildings where sampling was completed or scheduled; and 5) buildings with AL exceedances for lead and/or copper. Finally, the MassDEP team met weekly to discuss on-going Program implementation issues, including identifying issues that needed to be raised and discussed with UMass and MassDEP senior management, and identifying, assigning, and tracking tasks required for continued implementation of the Program.

4.13 Press Interest/Coverage

Due to the national attention on Flint, Michigan, the issue of lead in drinking water was a focus for many local media outlets looking for Massachusetts-specific news related to this fast-spreading national story. When the Program was launched, it was picked up by a number of media outlets across the state. Between April 2016 and March 2017, MassDEP activities related to lead in drinking water were among the contents of 82 press clippings from 39 media outlets. These ranged from national outlets like *CNN*, *The Guardian,* and the *Associated Press*, to major daily publications like the *Boston Globe*, the *Springfield Republican,* and the *Worcester Telegram & Gazette*, to small local publications like the *Arlington Advocate*, the *Boston Patch,* and the *Hamilton-Wenham Chronicle*. Most of the articles focused on the Program and often contained the results for individual school facilities in a particular circulation area. Bay State-based television stations such as *Fox 25 News*, *WWLP Channel 22* in Springfield and *WCVB TV Channel 5* carried broadcasts featuring the Program and the results that showed that a high percentage of participating schools had one or more fixtures with lead or copper above an AL. At the time of this Report, media in Massachusetts continue to express interest in the Program and its sampling results, with a focus on what local school districts are doing to address lead and copper exceedances that are uncovered during the Program.

5. Budget

5.1 UMass Project Management, Technical Assistance, and Laboratory Analysis

The figures below are based upon information available to MassDEP as of the time this Report was completed. Figures are expected to change as MassDEP receives final billing information.

The Program was active from May 2016 through February 2017. The total cost of the Program is estimated to be $2,100,000 for project management, administrative support, UMass TAPs, laboratory analysis, and state contractors. Program costs for UMass management and administrative support were approximately $272,000, and the cost for the UMass TAPs was

approximately $350,000 including labor, travel, and supplies[5]. The total expenditure for sample analysis by the 12 laboratories under contract to UMass was approximately $1,410,000. Another $60,860 was spent for state contractors to conduct hands-on sampling for schools that needed such assistance. In addition, the MWRA laboratory provided laboratory analysis for schools in its service area. Those costs were covered by MWRA and are not included in the Program budget.

5.2 MassDEP Staff Time

More than 32 MassDEP staff devoted significant time to the Project. In total, the staff hours spent was the equivalent of 4 to 5 full time staff positions.

5.3 Laboratory Analysis Contribution by MWRA

As previously mentioned, MWRA provided laboratory services for schools in its service area. This amounted to more than 6,300 samples from 103 school buildings in 20 communities, constituting approximately 11 percent of all samples collected. In addition to the results reported in this report as part of the DEP program, MWRA tested a number of schools that did not directly use the DEP technical assistance. All those results were also submitted to MassDEP via eDEP, and are available on MassDEP's school website. Overall, the tally of samples completed by the MWRA Lab as part of its ongoing testing program, as of March 31, 2017, was as follows: 13,678 samples from 306 schools across 35 communities.

6. Outputs/Findings

6.1 Program Outputs

In response to the RFI, a total of 185 different municipalities and 163 different school systems signed up for assistance at 1,066 different schools. The number of buildings where assistance was sought within a school system ranged from 1 to a maximum of 76.

A total of 147 Informational Meetings were conducted. Fourteen different school systems in 16 communities that responded to the RFI decided to opt out of the Program prior to receiving an Informational Meeting. An additional 16 communities from 13 different school systems had Informational Meetings but then decided not to continue with the subsequent components of the Program[6].

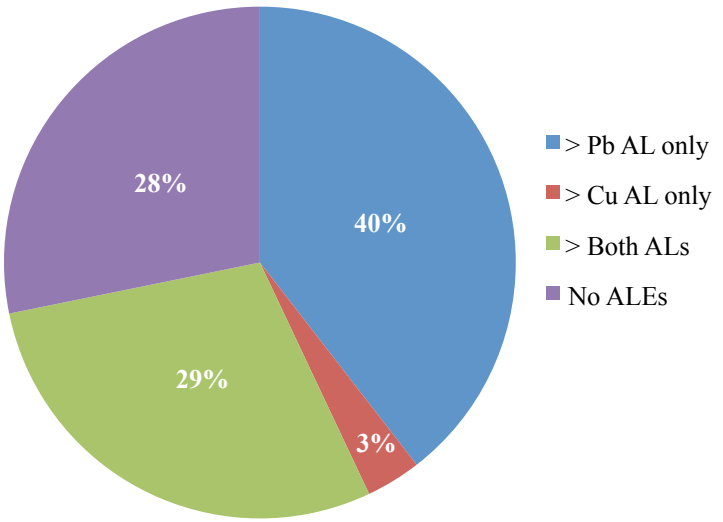
Samples were collected at a total of 818 different schools from 153 different municipalities. A total of 55,919 samples were collected, ranging from a minimum of 2 to a maximum of 431 samples at an individual school building, with an average of 69 samples per school building. A total of 31,832 fixtures were sampled under the Program. The average number of fixtures sampled per building was 39.

[5] There were a total of 13 TAPs hired by UMass. Total hours for TAPs were about 6,000.
[6] In addition, one school system with 76 schools is still considering whether or not to sample under the Program.

6.2 Lead and Copper Exceedance Data

The Program collected lead (Pb) and copper (Cu) samples from 811 school buildings[7]. As can be seen in Figure 1, approximately 72 percent of these buildings had one or more fixtures exceeding the AL for lead and/or copper; 29 percent of these buildings exceeded the AL for both lead and copper at one or more fixtures; 40 percent exceeded the AL for lead only, 3 percent exceeded the AL for copper only, and 28 percent did not have any AL exceedances.

Figure 1: Exceedances of Lead and Copper Action Levels in Schools



For lead, approximately 32 percent of all school buildings had levels at or below the AL of 0.015 mg/L at all fixtures. The maximum lead concentrations measured at schools ranged from no detection to 42 mg/L (Figure 2). For copper, 68 percent of all school buildings sampled had levels at or below the AL of 1.3 mg/L at all fixtures. The maximum copper concentration measured at schools ranged from no detection to 53.2 mg/L (Figure 3).

[7] Some of the 818 participating schools were co-located in one building, meaning that there were 811 individual school buildings sampled.

Figure 2: Maximum Lead Concentration in School Samples

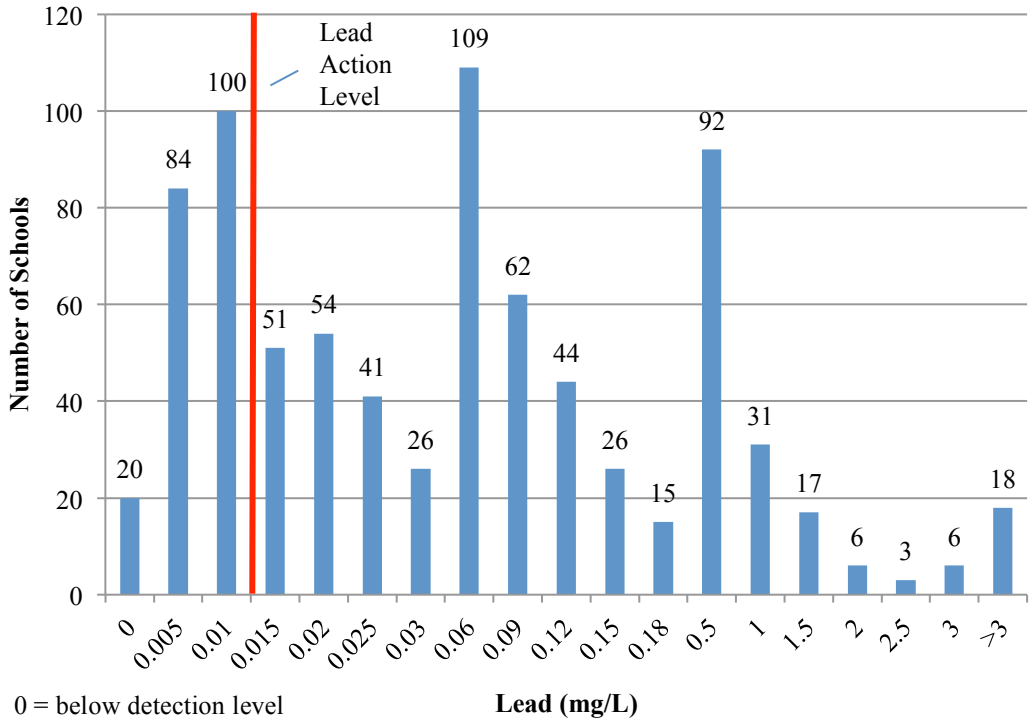
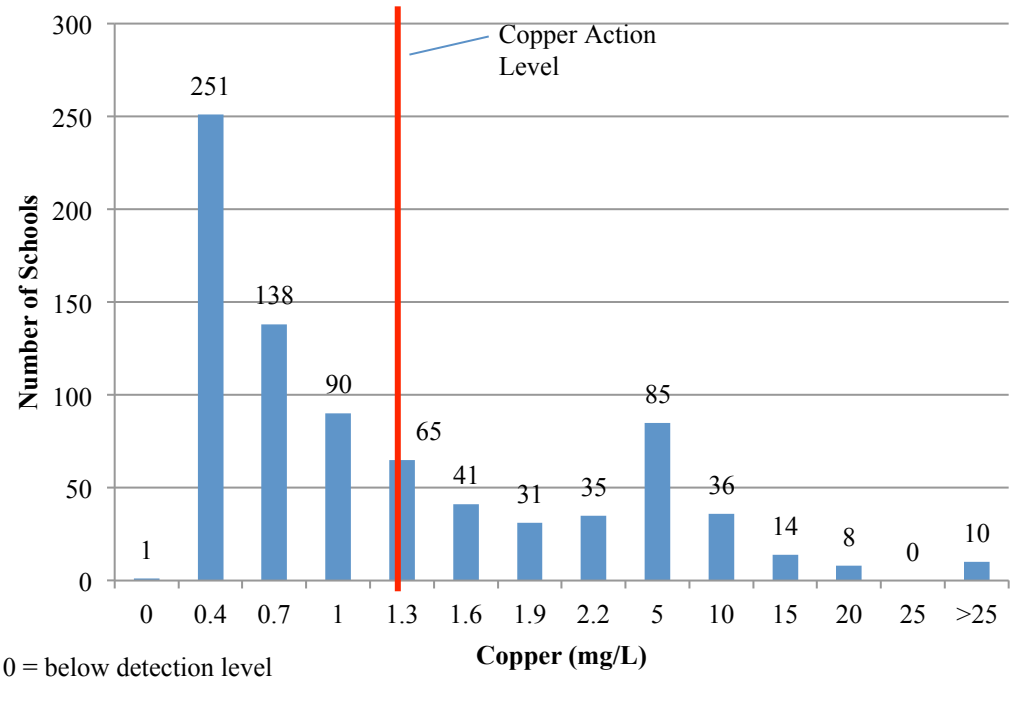
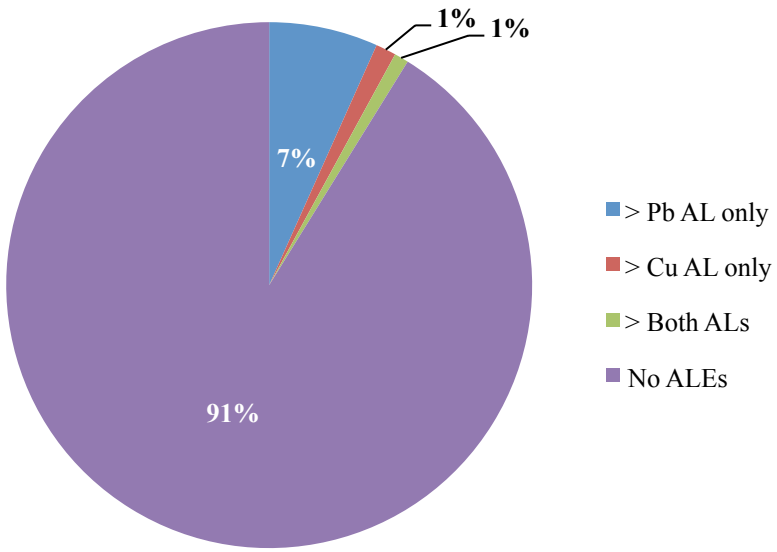


Figure 3: Maximum Copper Concentration in School Samples



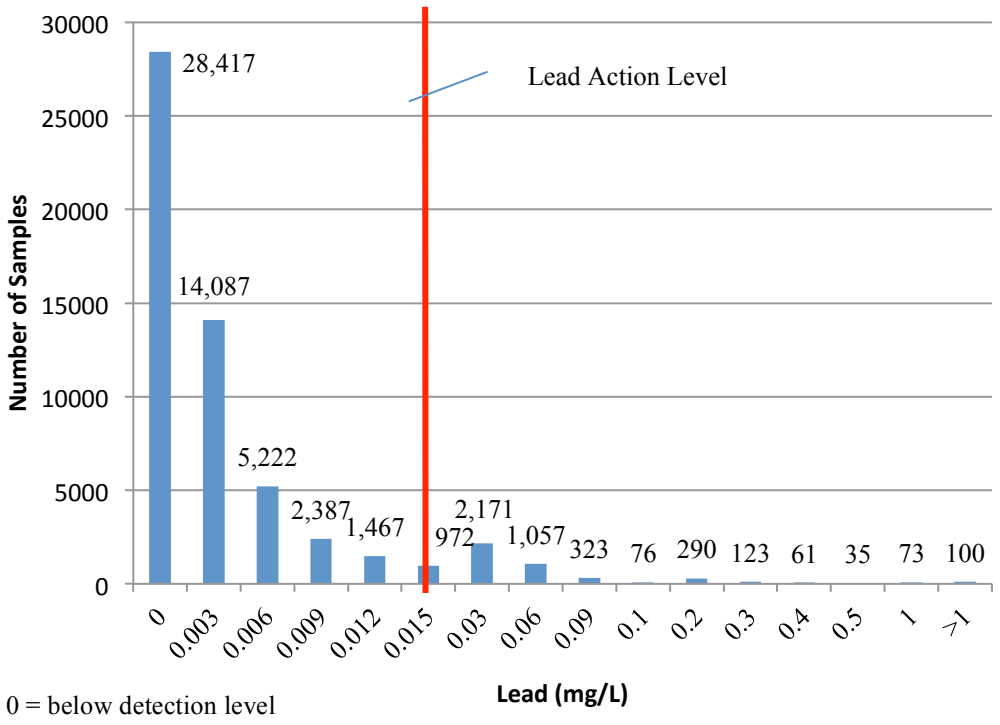
A total of 55,919 individual samples were collected as part of the Program. Most individual fixtures had two samples collected – an initial draw and a 30-second flush. Approximately 1 percent of the total samples collected exceeded the ALs for both lead and copper, 7 percent exceeded only the lead AL, 1 percent exceeded only the copper AL, and 91 percent did not have any AL exceedances (Figure 4).

Figure 4: Exceedances of Lead and Copper Action Levels in School Samples



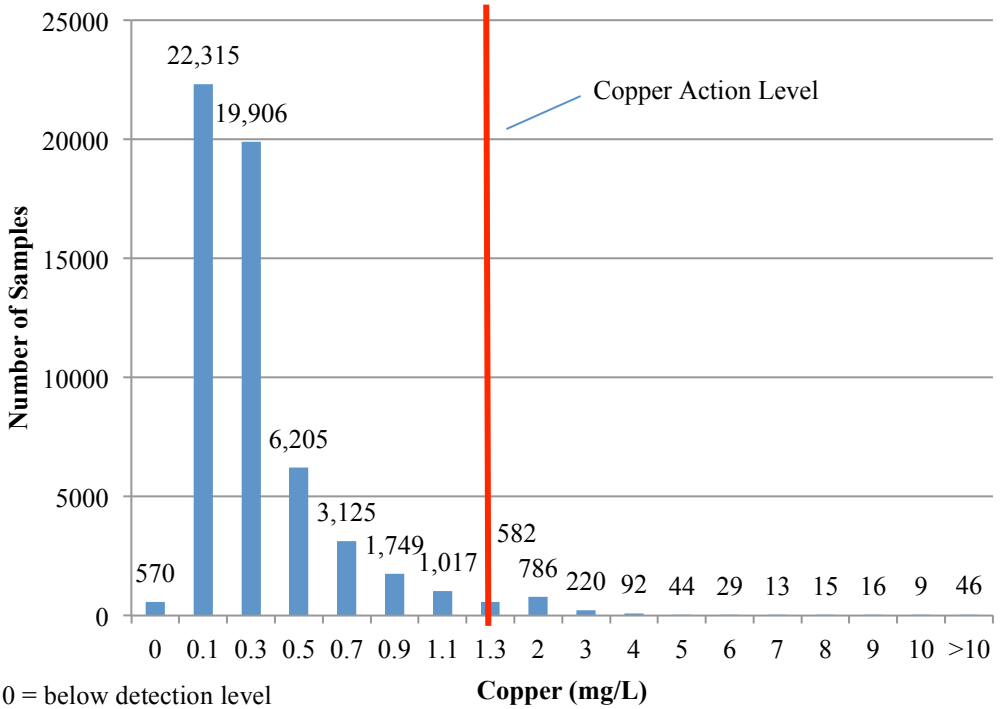
Approximately 92 percent of all individual samples taken measured at or below the lead AL of 0.015 mg/L. Lead concentrations in all samples ranged from no detection to 42 mg/L (Figure 5). Approximately 98 percent of all individual samples measured at or below the copper AL of 1.3 mg/L. Copper concentrations in all samples ranged from no detection to 53.2 mg/L (Figure 6).

Figure 5: Lead Concentrations in All School Samples



0 = below detection level

Figure 6: Copper Concentrations in All School Samples



0 = below detection level

Twelve different fixture types were sampled as part of the Program, with the greatest number of samples coming from classroom faucets, drinking water fountains, and water coolers[8] (Table 1).

Table 1: Fixture Types Sampled in the Program

Fixture Type	Number of Samples
Classroom Faucet	21,385
Drinking Water Fountain	14,556
Water Cooler (Chiller Unit)	6,863
Kitchen Faucet	4,201
Other Location	2,101
Nurse's Office Sink	1,791
Bathroom Faucet	1,196
Kitchen Kettle (cold water line)	1,079
Kitchen Kettle (hot water line)	4
Home Economics Room, Cold	527
Kitchen Ice Maker	138
Service Connector[9]	16

Overall, first draw samples were more likely to exceed an AL than flush samples, with 13 percent of all first draw samples exceeding an AL and only 4 percent of all flush samples exceeding an AL. When comparing the percentage of fixtures that showed elevated lead and/or copper concentrations, there are clear differences between the samples from different types of fixtures (Figures 7 and 8). For the first draw and flush samples, kitchen kettles were the most likely to exceed an AL, although kitchen kettles constituted a small portion of the total fixtures sampled. Of the 1,079 samples from kitchen kettles, 32 percent of first draw samples exceeded an AL, and 7 percent of flush samples exceeded an AL. Of the 21,385 samples from classroom faucets, an AL was exceeded 18 percent of the time for first draw samples and 3 percent of the time for flush samples. A total of 14,556 were taken from drinking water fountains, and these exceeded an AL 11 percent of the time for first draw samples and 4 percent of the time for flush samples. In contrast, kitchen ice makers and water coolers were the least likely to exceed an AL.

[8] A water cooler is a unit that refrigerates drinking water prior to delivering it.
[9] A service connector is the pipe that runs between the water main in the street and the building receiving water. Because only 16 buildings sampled from service connectors, no conclusions about the frequency of AL exceedances can be drawn from these results.

Figure 7: Action Level Exceedance in Fixture Types (First Draw Samples)

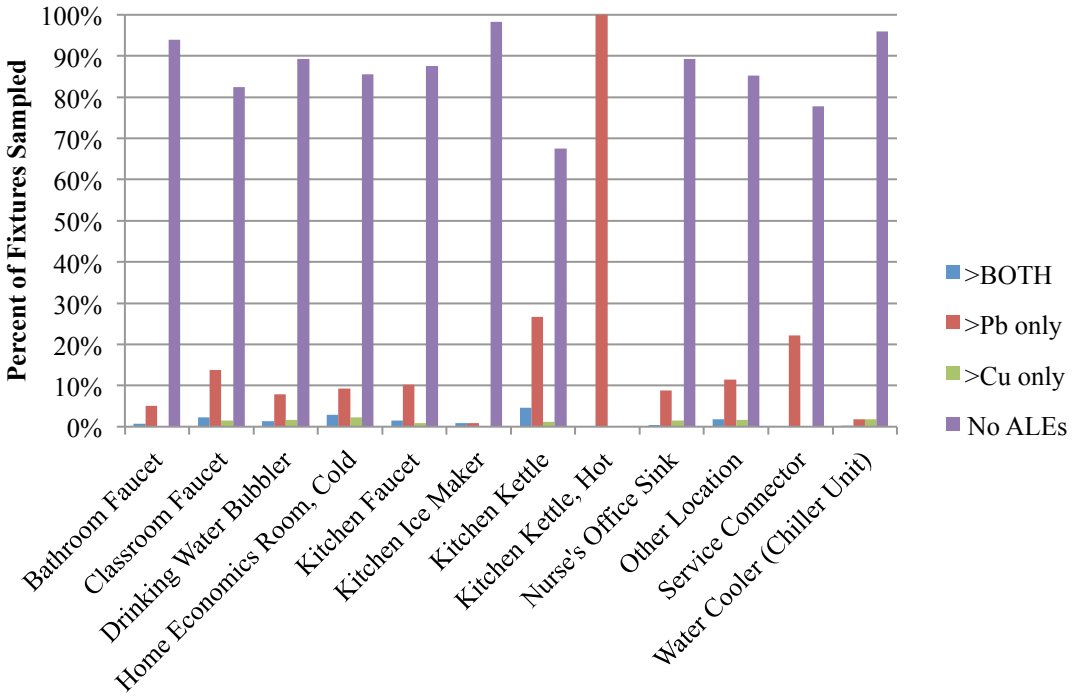
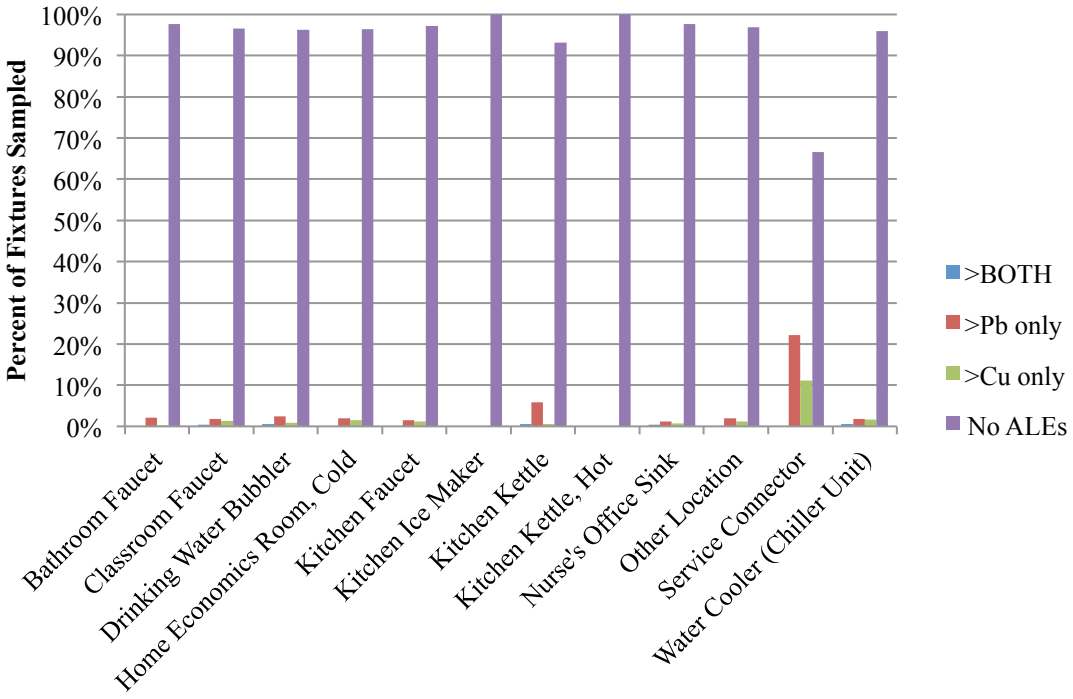


Figure 8: Action Level Exceedances in Fixture Types (Flush Samples)



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6.3 Intersections with Public Water Suppliers

Massachusetts regulations under the LCR require PWSs subject to the rule to routinely collect samples from at least two drinking water fixtures at a minimum of two local schools in the PWS service area during each LCR monitoring period. These PWSs also engage and educate local schools and school districts on steps schools can take when lead and/or copper in school drinking water is above the AL. Collaboration between schools and their PWS is critical when addressing these issues. PWSs are certified and experienced drinking water professionals available to provide technical assistance to their local schools. PWSs are also a great asset to schools as they learn about the LCCA program. When MassDEP becomes aware of a school sampling result above the lead or copper AL, the agency encourages schools to work with their local PWS to evaluate the issue and take corrective action.

Throughout the duration of the Program, PWSs were often an important member of the local team. MassDEP encouraged schools to invite their PWSs to the initial Informational Meeting, and MassDEP urged schools to keep their PWSs abreast of all activities and communications. A number of PWS officials made themselves available to work with participating schools and MassDEP in sampling and addressing lead and copper issues. As a result of the Program, one school district sent approximately a dozen district staff to be trained and certified as drinking water system operators. Upon receiving school system sample results from their service area, a handful of PWSs identified the need for more stability in corrosion control treatment practices due to elevated copper levels.

A number of schools that participated in the Program were MassDEP-registered PWSs with their own source of water. These schools are regulated in accordance with Massachusetts Drinking Water Regulations (310 CMR 22.00) and were notified in advance that any sampling performed under the Program could possibly result in changes to their LCR compliance requirements.

6.4 Remedial Actions Taken by Schools

Upon receiving their sampling results, the Program encouraged schools to carry out the following actions immediately. Schools were encouraged to quickly discontinue consumption of water from any fixture exceeding an AL by shutting the fixture off or labeling it for handwashing only. Next, schools were encouraged to quickly communicate the results and any remedial actions to parents and staff, and also to develop a short-term remedial action plan. Short-term plans assured parents and staff that the water being provided to children and staff will be below the ALs. After implementing the short-term plan, schools were encouraged to begin work on a long-term plan. The recommended long-term remedial action plan for all schools was to replace any fixture or plumbing that contains lead or lead solder, including older brass fittings that contain a high percentage of lead. Replacement may be a lengthy process, depending on the extent of the problem, and can be expensive if it involves all the piping in a building. The Program advised that copper exceedances are different from lead exceedances because the long-term remedial action plan is not replacement. The remedial action plan for copper focuses on determining why the copper pipe is corroding and causing the exceedance (such as improper grounding of electrical wiring), and then correction of the problem.

MassDEP relied on remedial action information that was voluntarily reported to MassDEP via the online Reporting Tool or other communications. The type of short-term remedial actions needed depended on: the type of fixtures; first draw versus flush samples; the number and the locations of the fixtures in the school that had exceedances; and whether the exceedances were lead or copper. Based on voluntarily reported information, short-term remedial actions taken by schools included: posting "hand washing only" signs above classroom and bathroom sinks; shutting off fixtures until they could be replaced; providing bottled water; disconnecting unneeded fixtures; and/or establishing a daily flushing program. A daily flushing program can be narrow or broad in scope as it may include just a handful of fixtures, a single wing of a school, or the entire school building. The Program recommends re-testing after implementing remedial actions so that schools can be assured that their remedial actions are working.

The following summarizes information provided to MassDEP by participating schools on the remedial actions taken at the most common types of fixtures.

6.4.1 Sinks

Some school systems tested classroom sinks that were either not in use or being used infrequently, and many of these types of sinks had sampling results with high levels of lead. As a remedial action, the schools were often able to remove the fixtures in their entirety.

During the sampling phase, a few school systems also took samples from bathroom sinks. Some schools decided to post "hand washing only" signs above these sinks as the remedial action in response to an AL exceedance. One school system that had a number of bathroom sinks exceeding the AL for lead opted to replace all of the fixtures over the AL.

6.4.2 Kitchen Kettles

The drinking water fixtures at schools that were most likely to exceed the AL for lead were kitchen kettles. A kitchen kettle is a large vessel of water that is heated to cook, warm, or steam food such as vegetables, soup, and rice. About 1,079 samples were taken from kitchen kettles. Approximately 27 percent of first samples from these fixtures exceeded the AL for lead, whereas 6 percent of flush samples exceeded the AL for lead. There could be several explanations for the high percentage of exceedances; one possibility is that the kettles are not used as often as other drinking water fixtures at schools, so the water is stagnant in the pipes for a longer time. The most common response from schools to a lead exceedance for a kitchen kettle was to establish a flushing program.

6.4.3 Drinking Water Fountains and Coolers

A number of schools found elevated levels of lead at drinking water fountains and coolers located in hallways and inside classrooms. Some school systems found that classroom water fountains were less frequently used than hallway water fountains and were unneeded because there was sufficient drinking water available in the hallways. For unneeded fixtures, many schools disconnected them from the water supply or removed them entirely. Other school systems temporarily shut off water fountains in hallways and quickly arranged for the installation

of replacements. Finally, some school systems installed new filtered drinking water fountains, water coolers, or water bottle filling stations with filters capable of removing lead.

6.4.4 Water Bottle Filling Stations

The drinking water fixtures at schools that were least likely to exceed the AL for lead were water bottle filling stations. Sampling data from 275 water bottle filling stations at schools across the Commonwealth revealed that 92 percent (253) of these had non-detectable levels of lead. Only 2 percent (5) of the stations had lead levels that exceeded the AL. Follow-up conversations between MassDEP staff and school personnel indicated that the majority of stations with exceedances were not equipped with filters.

There has been increasing interest among schools in the installation of water bottle filling stations. Bottle filling stations can be installed with or without filters to remove lead. School districts reported to MassDEP that they have other motivations for installing these stations besides improving drinking water quality, such as encouraging kids to drink more water instead of sugary drinks.

6.5 Communications by Schools

The vast majority of the school systems whose sampling results exceeded an AL contacted MassDEP for assistance, and about 35 schools with samples over the AL contacted MDPH for assistance. These school systems discontinued use of the problematic fixtures and communicated to parents and staff. Although the Program's Informational Meetings for school systems explained the follow-up remedial actions and associated communications, many school systems sought additional guidance on how to convey the information to parents and staff once they had the results in front of them.

MassDEP obtained knowledge about communications by schools via the online Reporting Tool, technical assistance conversations between agency personnel and school staff, or by viewing the schools' websites. Based on the information available to MassDEP staff, school systems communicated their sampling results to parents and staff via a variety of methods including: emails, automated informational calls, letters, website postings, postings around the schools, and newspaper articles. A few school systems created their own web pages where parents could see all of the sample results for the school system and find more information about lead and copper in drinking water. A handful of school systems held public meetings (in some cases asking Program personnel and/or MDPH personnel to attend) and one school set up a dedicated email account for parents to email questions. School systems commonly provided links to the MassDEP and MDPH websites in their communication materials. School systems reported to MassDEP that they found the FAQs from the MDPH to be very useful and often provided them to parents and staff.

School systems reported that they appreciated being provided with template letters for use in communicating sampling results and remedial actions to parents and staff. Some schools were also interested in seeing examples of how other schools communicated with parents and staff. School systems often customized the MassDEP template letters by adding their own language, and some schools also reported translating letters into Spanish.

6.6 Benefits of the Program

The most significant benefit the Program provided was protecting the public health of school children and staff across the Commonwealth. Water used for drinking, cooking and in offices where nurses and other medical staff provide services was sampled in 818 schools to determine if the water exceeded the AL for lead and/or copper, and the results were promptly reported to the schools. Schools then had the information and tools to address problem fixtures. In addition, the Program emphasized the importance of transparency: MassDEP posted all sampling results on its website and schools proactively and timely communicated the sampling results and remedial actions taken to students, families, and staff.

In a few instances, multiple schools within a single PWS service area had more than one exceedance of the lead and/or copper ALs. As a result, MassDEP personnel reviewed water quality parameters throughout the PWS service area, and in some cases, this review indicated that corrosion control may not have been optimized and was contributing to the problem. While these PWSs did not exceed regulatory ALs under the LCR, they were asked by MassDEP to re-visit their corrosion control practices and the associated water quality parameters.

Another significant benefit was the cost savings to the participating school systems. If the participating 818 schools had conducted this same level of sampling without the Program, the cost of laboratory analysis alone would have been more than $1,410,000, which is the estimated cost of the laboratory analysis under the Program by UMass-contracted labs. This figure does not account for laboratory analysis provided to participating schools by MWRA. In addition, the technical support and expert advice provided under the Program would have been an expense borne by the school systems had they sought such assistance from paid technical assistance providers.

Given the communications from schools and municipalities to their stakeholders, as well as messaging from MassDEP to schools, and the local and statewide press coverage about the Program and associated activities, awareness about lead and copper in school drinking water among school staff, local officials, and the general public increased considerably. One indicator of this increase is the number of responses to the voluntary LCCA checklist. Under its LCCA program, MassDEP sends a checklist to all school systems every five years seeking information about their efforts to identify and address fixtures that exceed ALs. MassDEP issued its most recent 5-year survey in January 2016. Before the launch of the Program, from January 2016 through April 2016, MassDEP had received 422 LCCA checklist responses. By the end of the Program in March 2017, the checklist responses had increased to 1,551.

MassDEP anticipates going forward many schools will institute on-going lead and copper sampling programs. MassDEP recommends that all schools sample all LCCA fixtures every three years. MassDEP believes that school systems that participated in the Program will be more likely to institute on-going sampling programs, and that school systems that did not participate in the Program will be more likely to move toward implementing such programs. Based upon the increased awareness of lead and copper in drinking water, MassDEP expects that school committees, parent-teacher groups, municipal officials, and others will work to ensure routine sampling programs. School systems that participated in the Program were provided with training and technical assistance materials that will enable them to implement sampling programs on their

own. For school systems that did not participate in the Program, there is now a full suite of technical assistance materials currently available on MassDEP's website.

MDPH has also expanded activities regarding lead exposure from drinking water. After the conclusion of the Program, MDPH will continue outreach to schools with elevated levels of lead and copper in drinking water. MDPH has also added lead service line identification and drinking water testing for lead into its Childhood Lead Poisoning Prevention Program (CLPPP) home inspections. Water testing is conducted for lead-poisoned children and an offer of water testing is made for all other children with elevated blood lead levels.

Another benefit of the Program is the increased use of eDEP by certified drinking water labs. Use of eDEP by laboratories for reporting analysis results is encouraged by MassDEP, but is voluntary. However, use of eDEP was required for all laboratories analyzing samples under the Program and, as a result, additional laboratories began to use eDEP. MassDEP hopes that these laboratories will continue to utilize eDEP reporting not only for future lead and copper analysis, but for all drinking water analysis reporting.

6.7 Recommendations for MassDEP Programs, Procedures, and Regulations

As a result of the Program, MassDEP is considering some new activities to further address lead and copper in school drinking water. The agency wants to make enhancements to current tools and assistance materials that will help schools implement future programs. Specific recommendations are as follows:

- **With available funds from the Program, continue a modified assistance program to provide another round of technical assistance and laboratory analysis to schools that did not participate in the Program in 2016-17, and also to enhance existing assistance materials**. About $600,000 of the original funding may still be available.

- **Working with stakeholders, MassDEP is considering where enhanced coordination and data sharing with public water suppliers to support testing in schools is appropriate**. Consideration is being given to the universe of PWSs with corrosion control who perform routine sampling, how often lead and copper sampling occurs, and requiring online reporting by PWSs to MassDEP. Based on experience working with schools in different sized communities, MassDEP's goal is to implement a program that allows for earlier detection of exceedances and the promotion of timely transmission and transparency of the data the agency receives. As MassDEP considers possible changes affecting PWSs, the agency is committed to consulting with its external advisory committee for the Safe Drinking Water Act, which consists of representatives from public health, EPA, PWSs and consultants, to discuss advantages and disadvantages of various possible approaches.

Over the course of the Program, MassDEP identified a handful of areas where new or improved procedures or guidance were needed. Some of these enhancements were put in place during the course of the Program. These changes are summarized below.

- **Changes to school sampling guidance to address fixtures where no guidance had been previously available.** Specifically, MassDEP developed new guidance for sampling of kitchen kettles, and for sampling at sinks that contain both a water fountain and a faucet.

- **Development of guidance for schools that implement daily flushing programs as a short-term remedial measure.** As flushing is a common short-term measure, this guidance was a key need for schools.

- **Creation of two FAQs documents specifically about lead and copper in school drinking water.** In developing revised guidance, MassDEP engaged the U.S. EPA and others for review. As these materials were updated they were posted to MassDEP's website at: http://www.mass.gov/eea/agencies/massdep/water/drinking/testing-assistance-for-lead-in-school-drinking-water.html.

- **Development of guidance on use of Point of Use (POU) Filtration Devices (such as water bottle filling stations with built-in filters) at schools.** As of the writing of this report, MassDEP was working with U.S. EPA and others on finalizing a Best Management Practice (BMP) document for POU devices at schools. When finalized, this BMP document will be available on MassDEP's website.

In addition to the recommendations outlined above, it should be noted that at the time of drafting this report, there were at least two bills being considered in the Massachusetts legislature with new requirements for drinking water testing and/or remediation at schools. It is possible that other related bills will be proposed and debated in the coming months/years. MassDEP will continue to provide technical support to the Legislature upon request, and the agency will fulfill any new statutory obligations upon passage of any new legislation.

7.0 Resources for More Information

MassDEP Drinking Water Program
617-292-5770
Program.Director-DWP@state.ma.us

Informational Meeting PowerPoint Presentation
http://www.mass.gov/eea/docs/dep/water/drinking/info-lead.pdf.

Lead and Copper in School Drinking Water Sampling Results Spreadsheet
http://www.mass.gov/eea/agencies/massdep/water/drinking/lead-and-copper-in-school-drinking-water-sampling-results.html.

Summary Results of Lead and Copper Drinking Water Testing at Massachusetts Schools
http://www.mass.gov/eea/docs/dep/water/drinking/lcca-schools-list.pdf.

Summary of Actions Taken by Schools Participating in the Program for Lead in School Drinking Water

http://www.mass.gov/eea/agencies/massdep/water/drinking/testing-assistance-for-lead-in-school-drinking-water.html.

LCCA Chain of Custody Form
http://www.mass.gov/eea/docs/dep/water/drinking/lcca-chain.xls.

Lead in School Drinking Water Sampling Protocol Guidance Video
https://youtu.be/0sjah9gQsj8.

Lead and Copper Online Reporting Tool
https://script.google.com/a/macros/madwpdep.org/s/AKfycbxP99K-Cd5B3ioE7nswn0peOEndcGrXwVk6zJcS5iHxzGO55B1k/exec.

Dedicated Web Page for the Assistance Program
http://www.mass.gov/eea/agencies/massdep/water/drinking/testing-assistance-for-lead-in-school-drinking-water.html.

MDPH – Lead in School Drinking Water FAQ
http://www.mass.gov/eohhs/docs/dph/environmental/lead/lead-school-drinking-water-faq.pdf

MDPH – Copper in School Drinking Water FAQ
http://www.mass.gov/eohhs/docs/dph/environmental/exposure/copper-school-drinking-water-faq.pdf.