Lead and Copper Water Sampling Plan

University of Michigan

Ann Arbor Campus

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Occupational Safety and Environmental Health
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Introduction

This water sampling project is being initiated at the University of Michigan’s Ann Arbor campus by the UM department of Occupational Safety and Environmental Health (OSEH) to assess the potential for lead, copper and iron contamination in the drinking water provided to all campus and Health System buildings. This project will determine if there is a risk of exposure to lead and copper in the drinking water and how best to manage it. The prioritization of campus buildings will be based initially on vulnerable populations and then moving into a location based listing in order to optimize the sampling resources. On-campus child care centers will be the initial focus of this project, as young children are most at risk of health complications due to lead exposure, followed by family housing locations. The next areas to be sampled will be the facilities that provide food and/or housing for students. The remaining campus academic, research, administrative, support and recreational buildings will then be sampled by location.

There are no federal laws, at this time, requiring testing of drinking water at colleges or universities. Although, in light of the recent water crisis in Flint, the University administration feels it is prudent to assess the drinking water quality of the work and living environments for faculty, staff, students and visitors. No water testing guidance is available for occupational settings; therefore the existing guidance for residential properties will be applied during this project.

Background

Municipal drinking water is provided to the University of Michigan’s Ann Arbor campus by the City of Ann Arbor Water Treatment Plant. The water provided to the campus meets the state and federal Safe Drinking Water Act (SDWA) standards for potential contaminants as it leaves the treatment plant, including lead and copper, according to the Annual Water Quality Report issued by the City of Ann Arbor.

In addition, the City has undertaken sampling of various parts of their drinking water infrastructure following the U.S. Environmental Protection Agency (EPA) Lead and Copper Rule to determine if there are older sections of concern for potential lead contamination. The purpose of the EPA Lead and Copper Rule is to protect public health by minimizing lead and copper levels in drinking water, primarily by reducing water corrosivity. Lead can leach into drinking water after leaving the water treatment plant if the water comes in contact with plumbing materials containing lead.

Lead may be present in various parts of the plumbing system such as lead solder, brass fixtures and lead pipes. The most common source of lead leaching is due to corrosion, a reaction between the water and the pipes or components containing lead. Dissolved oxygen, low pH, low mineral content and other water quality characteristics can affect the extent of corrosion. The potential for lead to leach into drinking water increases the longer water remains in
contact with lead plumbing and fixtures. Due to the potential for increasing lead concentrations in drinking water, the best location to sample for lead is at the point of use.

The EPA has established an Action Level (AL) for lead at 15 parts per billion (ppb), and a maximum contaminant level (MCL) of 1,300 ppb for copper. All facilities sampled under the Lead and Copper Rule protocol will follow these levels and facilities that exceed the AL or MCL will be further assessed for remediation actions.

For this project iron will also be assessed as it is a common water quality complaint from the campus community, especially following water mains repairs, hydrant flushing and construction projects. Iron is not considered to be a health hazard, but may cause cosmetic or aesthetic effects (taste, color and odor) in drinking water.

Health Effects of Lead and Copper Ingestion

Young children, infants and fetuses are particularly vulnerable to lead. Low levels of exposure have been linked to reduced IQ, hearing impairment, reduced attention span and poor classroom performance. High levels of lead exposure can cause damage to the brain, red blood cells and kidneys.

Adult exposure to lead has been linked to impaired neurological, gastrointestinal and renal function. Pregnant women are especially vulnerable to lead exposure since lead can significantly harm the fetus, causing lower birth weight and slowing down normal mental and physical development.

Exposure to high levels of copper can cause stomach and intestinal distress, liver or kidney damage and complications of Wilson’s disease in genetically predisposed people.

Prioritization of Buildings for Sampling

Young children, those 6 years and younger, are at particular risk for lead exposure because they absorb lead more readily than adults. Children’s nervous systems are still undergoing development and thus are more susceptible to the effects of toxic agents. This project will prioritize the sampling plan to analyze the water consumed by children during the initial phase. As the project continues, evaluation of sample results may require adjustments to the sampling schedule.

Schedule for Water Sampling

1. Child Care Centers
   a. Towsley Children’s House
   b. North Campus Children’s Center
   c. Health System Children’s Center
   d. Northwood Community Center (1000 McIntyre Dr.)
2. Building Sampling Requested by the City of Ann Arbor Water Treatment Services Unit
   a. Martha Cook
   b. Mary Markley
   c. Chemistry ’48
   d. South Quad
   e. C.S. Mott Children’s Hospital and Von Voigtlander Women’s Hospital
   f. Taubman Health Care Center
   g. Cardio Vascular Center
3. Northwood Family Housing
4. C.S. Mott Children’s Hospital
5. Food Service Operations
6. Student Residence Halls
7. All other buildings on campus based on location to maximize resources
   a. Medical Campus
   b. North Campus
   c. Central Campus
   d. South Campus

Sampling Responsibilities

The UM OSEH Department will oversee the sample planning, field sampling activities and the final reporting. The actual water sampling activities will be handled by designated environmental consultants under the direction of an OSEH project lead. RTI Laboratories Inc., a certified water testing laboratory, will analyze the samples for lead, copper and iron.

Brett Goecke, Senior Industrial Hygienist, will be the OSEH project lead, managing the sampling plan and coordinating sampling dates with the designated environmental consultants. The expertise of Building Facility Managers and Plant Operations Plumbing staff will assist with the sampling activities.

Sampling Plan: Child Care Centers

Child care centers have intermittent water use patterns. The facilities are often closed on nights and weekends allowing the water to remain in the distribution system for extended periods of time. The increase in water retention may result in higher lead concentrations in the water supply. Given the potential increase in lead in the water in locations where children may spend a great deal of time, the EPA has created a guidance document specifically for testing school water supplies. School and child care centers have similar use patterns. Therefore the University of Michigan has decided to adopt the school sampling protocol provided by the EPA. The guidance document is called 3Ts for Reducing Lead in Drinking Water in Schools.

1. Sample water from cold water lines only. Do not sample the hot water system for this project. Sample all fixtures where water is consumed.
2. Create a sampling sequence – the order of collection for the small-volume samples of all drinking water fixtures used for drinking, cooking or oral health care.
   - Identify incoming building water lines.
   - Determine the layout of the route the cold water takes after it leaves the water service line(s) entry point and the direction it travels through the building. Assumptions may need to be made, since many supply lines are not visible under floors or in walls and ceilings.
   - Identify on the sampling plan the fixture closest to the water service line(s) entry point to be collected first, then identify the next closest fixture as second, and move away from the water service line(s) entry point until the fixture farthest away is identified to be sampled last on the sampling plan. This will minimize the chance that a sampling location will be flushed by an upstream fixture. (The order in which you assessed fixtures most likely will not be the same order in which you sample.)

3. All fixture water samples collected should be 250 milliliters (mL) in volume. School samples are smaller than the one liter sample collected by public water suppliers for compliance with the Lead and Copper Rule. A smaller sample is more effective at identifying the sources of lead at an outlet because a smaller sample represents a smaller section of plumbing. A smaller sample is also more representative of water per serving consumed by a child. A 250 mL sample from a faucet would not include portions of the plumbing behind the wall that the faucet is mounted on, for example, compared to a 1 liter sample normally collected, which would include a longer line of plumbing with its valves and tees and elbows and soldered joints.

4. Collect all water samples before the facility opens and before any water is used. Ideally, the water should sit in the pipes unused for at least 8 hours but not more than 18 hours before a sample is taken. However, water may be more than 18 hours old at some outlets that are infrequently used. If this is typical of normal use patterns, then these outlets should still be sampled.

5. Make sure that no water is withdrawn from the taps or fountains from which the samples are to be collected prior to their sampling.

6. Do not collect samples in the morning after vacations, weekends, or holidays because the water will have remained stagnant for too long and would not represent the water used for drinking during most of the days of the week.

7. If the sink has an aerator, do not remove the aerator prior to sampling.

8. Assign a unique sample identification number to each sample collected - use the building number, room number and name the fixture from which the sample was taken, i.e. “DF” for drinking fountain. Record the identification number on the sample bottle and on your recordkeeping form. The following information must be included on the recordkeeping form:
   - Type of sample taken, e.g., initial first draw, follow-up flush, etc.
   - Date and time of collection
   - Name of the sample collector
   - Location - building number, room number, fixture name and/or location
• Name of the manufacturer that produced the outlet, and the outlet’s model number, if known.

9. After samples have been taken throughout the building, return to the sample tap closest to the water service connection (water main as it enters the building). In this location the water should be flushed (run until it runs clear and cold). At that point pull a sample that will be representative of the water that is supplied to the building. Label the sample as a flush sample.

10. Submit all samples to RTI Laboratories Inc. for analysis for lead, copper and iron.

Follow Up Sampling (If Required)

1. If initial test results indicate >5ppb of lead is present, then follow up sampling will be necessary to determine if the source of lead is the fixture or the interior plumbing. If the sample exceeds 1,300 ppb of copper the fixture will require more sampling.

2. The follow up samples must be taken after the water has remained in the system for 8-18 hours. Therefore the samples must be taken in the morning before the building opens.

3. First collect one sample from the fixture following the protocol used in the initial sampling survey to verify the analytical results.

4. Second, run the water for 30 seconds. This flushing of the system will remove the water that was in contact with the fixture and capture the water that was in contact with the plumbing lines prior to the fixture. Do not begin flushing with a high rate of flow; slowly open the fixture to achieve a full flush, and then slowly reduce the flow just prior to sampling. Sudden changes in flow could stir up sediments or cause sloughing of pipe films that would not be characteristic of typical water use patterns.

5. Use a 250 mL water bottle to collect this sample. Use a small steady flow of water that is characteristic of drawing a glass of water.

6. Document the sample as indicated above.

7. Submit all samples to RTI Laboratories Inc. for analysis for lead and/or copper if copper was identified as a potential issue.

Sampling Plan: Residential and Health Care Facilities

The sampling for residential and health care facilities will follow the US EPA Lead and Copper Rule: Monitoring and Reporting Guidance for Public Water Systems, March 2010. The rule and guidance were designed for residential properties. Two samples will be taken, a first draw and a flush draw sample.

1. Sample only fixtures where water is used for drinking or food preparation. Do not sample hot water or bathroom fixtures.

2. Create a sampling sequence.
   • Identify incoming building water lines.
• Determine the layout of the route the cold water takes after it leaves the water service line(s) entry point and the direction it travels through the building. Assumptions may need to be made, since many supply lines are not visible under floors or in walls and ceilings.
• Inventory the Fixtures for Sampling – identify on the sampling plan the fixtures that provide water drinking water or water used for cooking purposes.
• Ten percent of the building fixtures are to be sampled with representation of a variety of fixtures present. Collect a minimum of two samples.
• Create a sampling sequence – the order of collection for all of the drinking water fixtures. Sample the fixture closest to the water service line(s) entry point first. The samples must be taken from the closest fixture first, moving out toward the most distant fixtures to minimize the chance that a sampling location will be flushed by an upstream fixture. To optimize the investigation of the plumbing system, at least one water sample should be taken from a fixture as far away from the incoming water line as possible.

3. Water must remain unused in the plumbing system for 8-18 hours prior to taking the sample. Fixtures that have low frequency of use should NOT be sampled. Do not sample after long periods of facility closure, i.e. Monday mornings and holidays. The first use after closure does not represent a typical exposure pattern.

4. Two samples will be collected at each location.
   • The first draw sample must be taken when the tap is first turned on after being out of use for 8-18 hours.
   • Flush the water line for two minutes and then collect a flush draw sample.

5. All water samples collected should be 1 liter in volume using a wide mouth sampling bottle.

6. If the sink has an aerator, do not remove the aerator prior to sampling.

7. Do not begin flushing with a high rate of flow; slowly open the fixture to achieve a full flush, and then slowly reduce the flow just prior to sampling. Sudden changes in flow could stir up sediments or cause sloughing of pipe films that would not be characteristic of typical water use patterns.

8. Assign a unique sample identification number to each sample collected - use the building number, room number and name the fixture from which the sample was taken, i.e. “DF” for drinking fountain. Record the identification number on the sample bottle and on your recordkeeping form. The following information must be included on the recordkeeping form:
   • Type of sample taken, e.g., initial first draw, follow-up flush, etc.
   • Date and time of collection
   • Name of the sample collector
   • Location – building number, room number, fixture name and/or location
   • Name of the manufacturer that produced the outlet, and the outlet’s model number, if known
9. After samples have been taken throughout the building, return to the sample tap closest to the water service connection (water main as it enters the building). In this location the water should be flushed (run until it runs clear and cold). At that point pull a sample that will be representative of the water that is supplied to the building. Label the sample as a flush sample.

10. Submit all samples to RTI Laboratories Inc. for analysis for lead, copper and iron.

Follow Up Sampling (If Required)

1. If initial test results indicate a lead level at or above the AL for lead of 15 ppb, then follow up flush sampling will be necessary to determine if the source of lead is the fixture or the interior plumbing. If the sample exceeds 1,300 ppb of copper the fixture will be require more sampling.

2. The follow up samples must be taken after the water has remained in the system for 8-18 hours. Therefore the samples must be taken in the morning before the building opens.

3. First collect one sample from the fixture following the protocol used in the initial sampling to verify the analytical results.

4. Second, run the water for 2 minutes. This flushing of the system will remove the water that was in contact with the fixture and capture the water that was in contact with the plumbing lines prior to the fixture. Do not begin flushing with a high rate of flow; slowly open the fixture to achieve a full flush, and then slowly reduce the flow just prior to sampling. Sudden changes in flow could stir up sediments or cause sloughing of pipe films that would not be characteristic of typical water use patterns.

5. Use a 1 liter water bottle to collect the sample. Use a small steady flow of water that is characteristic of drawing a glass of water. Document the sample as indicated above.

6. Submit all samples to RTI Laboratories Inc. for analysis for lead and/or copper if copper was identified as a concern.

Sampling Plan: Academic, Research, Administrative, Support and Recreational Settings

The sampling for residential and health care facilities will follow the US EPA Lead and Copper Rule: Monitoring and Reporting Guidance for Public Water Systems, March 2010. The rule and guidance were designed for residential properties. Many of the use patterns for the campus buildings do not reflect a residential facility. Therefore the sampling procedure for non-residential locations will require a pre-flush of the fixture the evening prior to sampling. Two samples will be taken, a first draw and a flush draw sample.

1. Sample only fixtures where water is used for drinking or food preparation. Do not sample hot water or bathroom fixtures.

2. Create a sampling sequence.
• Identify incoming building water lines.
• Determine the layout of the route the cold water takes after it leaves the water service line(s) entry point and the direction it travels through the building. Assumptions may need to be made, since many supply lines are not visible under floors or in walls and ceilings.
• Inventory the fixtures for sampling – identify on the sampling plan the fixtures that provide water drinking water or water used for cooking purposes.
• Ten percent of the building fixtures are to be sampled with representation of a variety of fixtures present. There is a minimum of two samples.
• Create a sampling sequence – the order of collection for all of the drinking water fixtures. Sample the fixture closest to the water service line(s) entry point first. The samples must be taken from the closest fixture first, moving out toward the most distant fixtures to minimize the chance that a sampling location will be flushed by an upstream fixture. To optimize the investigation of the plumbing system, at least one water sample should be taken from a fixture as far away from the incoming water line as possible.

3. Flush the water through the fixture for two minutes the evening prior to sampling. Once flushed, the fixture must be labeled as “Do Not Use”. Do not begin flushing with a high rate of flow; slowly open the fixture to achieve a full flush. Sudden changes in flow could stir up sediments or cause sloughing of pipe films that would not be characteristic of typical water use patterns.

4. Water must remain unused in the plumbing system for 8-18 hours prior to taking the sample. Fixtures that have low frequency of use should NOT be sampled. Do not sample after long periods of facility closure, i.e. Monday mornings and holidays. The first use after closure does not represent a typical exposure pattern.

5. Two samples will be collected at each location.
   • The first draw sample must be taken when the tap is first turned on after being out of use for 8-18 hours.
   • Flush the water line for two minutes and then collect a flush draw sample.

6. All water samples collected should be 1 liter in volume using a wide mouth sampling bottle.

7. If the sink has an aerator, do not remove the aerator prior to sampling.

8. Do not begin flushing with a high rate of flow; slowly open the fixture to achieve a full flush, and then slowly reduce the flow just prior to sampling. Sudden changes in flow could stir up sediments or cause sloughing of pipe films that would not be characteristic of typical water use patterns.

9. Assign a unique sample identification number to each sample collected - use the building number, room number and name the fixture from which the sample was taken, i.e. “DF” for drinking fountain. Record the identification number on the sample bottle and on your recordkeeping form. The following information must be included on the recordkeeping form:
   • Type of sample taken, e.g., initial first draw, follow-up flush, etc.
• Date and time of collection
• Name of the sample collector
• Location – building number, room number, fixture name and/or location
• Name of the manufacturer that produced the outlet, and the outlet’s model number, if known

10. After samples have been taken throughout the building, return to the sample tap closest to the water service connection (water main as it enters the building). In this location the water should be flushed (run until it runs clear and cold). At that point pull a sample that will be representative of the water that is supplied to the building. Label the sample as a flush sample.

11. Submit all samples to RTI Laboratories Inc. for analysis for lead, copper and iron.

**Follow Up Sampling (If Required)**

1. If initial test results indicate a lead level at or above the AL for lead of 15 ppb, then follow up flush sampling will be necessary to determine if the source of lead is the fixture or the interior plumbing. If the sample exceeds 1,300 ppb of copper the fixture will be require more sampling.

2. The follow up samples must be taken after the water has remained in the system for 8-18 hours. Therefore the samples must be taken in the morning before the building opens.

3. First collect one sample from the fixture following the protocol used in the initial sampling to verify the analytical results.

4. Second, run the water for 2 minutes. This flushing of the system will remove the water that was in contact with the fixture and capture the water that was in contact with the plumbing lines prior to the fixture. Do not begin flushing with a high rate of flow; slowly open the fixture to achieve a full flush, and then slowly reduce the flow just prior to sampling. Sudden changes in flow could stir up sediments or cause sloughing of pipe films that would not be characteristic of typical water use patterns.

5. Use a 1 liter water bottle to collect the sample. Use a small steady flow of water that is characteristic of drawing a glass of water. Document the sample as indicated above.

6. Submit all samples to RTI Laboratories Inc. for analysis for lead and/or copper if copper was identified as a concern.

**Sampling Equipment and Supplies**

• One 250 mL sample bottle for each fixture (child care centers)
• Two 1 liter bottles for each fixture (non-child care centers)
• Bins to transport samples
• Waterproof ink pens to write on bottle labels
• Chain of custody forms
• Sampling Sequence
• Stop watch (follow up sampling)
Possible Remediation Strategies

In the event the sampling identifies concerns with lead or copper in a facility, a number of remediation strategies are available for implementation. The method selected will be based on the extent of the issue and available resources. It may be necessary to implement interim strategies prior to full correction if a project becomes too large. Any actions proposed will be addressed through normal UM policies on project management through discussion between OSEH, Plant Operations, and other units that are involved.