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Lead In School's Drinking Water

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STATEMENT OF PURPOSE

The purpose of this manual, **Lead in School Drinking Water**, is to assist you, the school official, in the following four ways:

1. by providing general information on the significance of lead in school drinking water and specifically its effects on children;

2. by providing information on how to detect the presence of lead in your schools' water and how to pinpoint its source;

3. by providing advice on the steps you can take to reduce or eliminate lead in your schools' drinking water; and

4. by providing the information necessary to train your personnel in sampling and remedial programs.

The school official responsible for testing for and remedying lead in drinking water will vary by location. Examples include: superintendents of schools, principals, heads of buildings and grounds or facilities departments, science department chairpersons, or those hired by the school (district) for this purpose.

Lead in drinking water is a complex issue. It is our hope that this manual will also assist you in responding to local concerns about your schools' drinking water and in preparing informational materials (such as bulletins and handouts) for your community.

WHY LEAD IS A PROBLEM FOR CHILDREN

Children in your school may be drinking water with high concentrations of lead.

Medical research shows lead to be a toxic metal which can be harmful to human health even at low exposure levels. Young children, infants, and fetuses are particularly vulnerable to lead because the physical and behavioral effects of lead occur at lower exposure levels in children than in adults. A dose of lead that would have little effect on an adult can have a big effect on a child. In fact, overexposure to lead can permanently impair a child's mental and physical development. Comparatively low levels of exposure have been linked to damage to the central and peripheral nervous system, learning disabilities, shorter stature, impaired hearing, and impaired formation and function of blood cells.

Many children with lead poisoning have no symptoms; others have only non-specific symptoms such as headache, stomach-ache, or irritability. At its worst, lead poisoning can result in stupor, coma, kidney damage, or severe brain damage.

The degree of harm depends upon the total exposure to lead from all sources. In recent years, government initiatives such as federal controls on lead in gasoline have significantly reduced our overall exposure to lead. However, children as well as adults are still exposed to lead from a number of sources – air, soil, dust, food (which may contain lead absorbed from air or food containers), and water. Lead in drinking water can be a significant contributor to overall exposure to lead, particularly for infants whose diet consists of liquids made with water, such as baby food formula.

LEAD IN SCHOOL DRINKING WATER

A SPECIAL CONCERN

Lead levels in school drinking water merit special concern for several reasons.

Children are more at risk than adults from exposure to lead. Not only are children particularly susceptible to the toxic effects of lead, but their **cumulative** exposure to lead from various sources is likely to be greater. This is partly because play activities may bring children into contact with many potential sources of lead contamination such as dirt or soil. In addition, growing children tend to absorb more of the lead they consume than adults.

The "on-again, off-again" water use patterns of most schools can result in elevated lead concentrations – particularly when school resumes after vacations or weekends. Water that remains stagnant in interior plumbing during a weekend or vacation, or even from the close of one school day to the opening of the next, is in longer contact with lead solder or pipes and thus may contain higher levels of lead. For this reason, a school's water system should be thoroughly flushed before it is used by the children returning from vacation or after the weekend. *(A discussion of flushing begins on page 21.)*

The only way to be sure of the amount of lead in the drinking water supply at your school is to have the water tested by a competent state-certified laboratory using EPA-approved methods. Contact your state department of health or environment for a list of certified laboratories in your area.

Before making specific arrangements to have your schools' drinking water tested, you should develop a profile of its plumbing and potential for lead contamination. The questionnaire on page 11 will help you determine whether lead may be a problem in your school's water. A copy should be completed for each school within your district.

THE SAFE DRINKING WATER ACT

SDWA and the public water supplier

The Safe Drinking Water Act (SDWA) of 1974 requires the U.S. Environmental Protection Agency (EPA) to set drinking water standards to protect the public health. Major amendments to this law, passed in 1986, banned the use of lead materials in new plumbing and in plumbing repairs, and required water suppliers to notify the public about lead in drinking water. In August, 1988, EPA proposed new regulations to reduce even further concentrations of lead in drinking water. These proposed regulations, to be finalized in 1989, combine Maximum Contaminant Level (MCL) and corrosion control treatment requirements to achieve this reduction.

The Lead Contamination Control Act of 1988

On November 1, 1988, a major new amendment to SDWA, known as the Lead Contamination Control Act of 1988, became law. This amendment requires the EPA to provide guidance to states and localities to test for and remedy lead contamination in drinking water in schools and day care centers. It also contains specific requirements for the testing, recall, repair and/or replacement of water coolers with lead lined storage tanks or with parts containing lead and attaches civil and criminal penalties for the manufacture and sale of water coolers containing lead. In addition, the new law authorizes grants to states to support state and local activities in this area.

PROPOSED REGULATIONS

Standards to Limit Lead in Water Delivered by the Water Supplier

Revised federal standard for lead in drinking water — 5 ppb

It is important to remember that only public water suppliers are regulated under SDWA. A public water supplier is defined as an organization or individual that supplies drinking water to 25 or more people or through at least 15 service connections. ***Schools which own their water supply are considered public water suppliers and are subject to the provisions of this law.***

The Maximum Contaminant Level **(MCL)** is the maximum level of a contaminant permitted in water delivered to a user by a public water system. Under the proposed new regulations, *drinking water delivered by a public water system must have lead levels equal to or less than 5 parts per billion (ppb).* This level is measured at the point the water enters the supplier's distribution system, i.e., as it leaves the treatment plant. If a water system exceeds the MCL for lead, the supplier will be required to bring the concentration down to acceptable levels by either installing a best available technology or by taking other steps such as drilling a new well or blending water from other sources. [Note: ppb is often expressed as micrograms per liter (ug/l). One ppb is equal to one microgram per liter (ug/l) or .001 milligrams per liter (mg/l).]

Contact your water supplier first

Schools which purchase their water should first ask their water supplier what the lead level of the water is when it leaves the treatment plant. If the lead level exceeds 5 ppb, discuss with your water supplier what steps it is taking or will soon undertake to comply with the standards and thereby reduce lead levels at your taps *(see page 4)*.

State programs help school officials test for lead contamination

The Lead Contamination Control Act of 1988 requires that States establish programs to help local educational agencies test for and remedy lead contamination in drinking water from water coolers and other sources of lead and authorizes EPA to make grants available to States for this purpose. EPA's goal is to eliminate or reduce lead in drinking water to the lowest feasible level. For this reason, EPA recommends that you contact your state department of health or environment for more information. EPA recommends that if you suspect lead may be a problem, you begin testing the drinking water in your school now and quickly take remedial steps whenever the lead level at any drinking water outlet exceeds 20 ppb.

Schools which provide their own water and are therefore considered to be public water suppliers are subject to specific requirements under the regulations. As a public water supplier, you may be required to reduce lead levels of water entering your distribution system to below 5 ppb and institute corrosion control and/or other treatment. Contact your state department of health or environment or the regional EPA office for further assistance.

Requirements to Minimize Lead Due to Corrosion

Water suppliers are required to test water regularly

Under the proposed regulations, water suppliers would be required to test regularly the water they distribute to consumers. This testing is to be done not only as the water leaves the treatment plant, but also as it emerges from residential taps.

If the average amount of lead in samples taken at the tap exceeds 10 ppb, or if the pH of the water is less than 8.0, the public water supplier would be required to make the water non-corrosive. This is because lead enters drinking water most often as a by-product of the corrosion of lead pipes, solder, fixtures, or other parts of a plumbing system. The public water supplier would also be required to

Other Requirements (continued)

implement a public education program to help consumers reduce lead in drinking water at their taps through measures beyond corrosion control. Many of these measures are discussed later in this manual in the section entitled PERMANENT SOLUTIONS. [Note: pH is a measure of the water's acidity. The higher the pH, the less acidic (and less corrosive) the water.]

Again, EPA recommends that you contact your school's water supplier for information on the quality, testing program, and treatment of your water. ***If your school owns its own water supply, you will be responsible for carrying out the provisions of the proposed regulations.***

THE "LEAD BAN" AND NOTIFICATION REQUIREMENTS OF SDWA AMENDMENTS OF 1986

The "Lead Ban"

The Lead Ban

The Safe Drinking Water Act Amendments of 1986 require the use of "lead-free" pipe, solder, and flux in the installation or repair of any public water system, or any plumbing in a residential or non-residential facility connected to a public water system. Under these amendments, solders and flux are considered "lead-free" when they contain not more than 0.2 percent lead. (In the past, solder normally contained about 50 percent lead.) Pipes and pipe fittings will be considered "lead-free" when they contain not more than 8.0 percent lead.

Check to see if your state has implemented the 'lead ban'

Although states were required to adopt this "lead ban" by June, 1988, you should check with your state's department of health or the environment to see if the provisions are in effect. Also, check with plumbers or contractors who are making additions or repairs to the plumbing to assure that only lead-free materials are used. Test kits are available which will determine the presence of lead solder in the plumbing. Any violations of the ban should be reported to state officials. You should also insist that lead soldered joints in new construction or recent repairs be replaced with lead-free ones.

Notification Requirements

Notification Requirements under SDWA

If your school owns its own water supply and the school's distribution/ plumbing system contains any materials that can be a source of lead contamination, school officials are required by law to notify the consumers (all school staff, students, and parents or guardians of all students) *regardless of the lead levels in the drinking water.* This notice shall be given to the consumers either by

(1) three newspaper notices (one for each of three consecutive months); and

(2) once by mail notice; or

(3) once by hand delivery; or

(4) by continuous posting in a conspicuous place for 3 consecutive months.

The SDWA deadline for such actions was June 19, 1988. Since this deadline has already passed, notice should be given immediately, if you have not already done so.

The notice must contain specific language. For assistance and details, contact your state department of health or environment. EPA's Office of Water has published a Handbook for Special Public Notification for Lead for Public Drinking Water Suppliers. Copies are available from EPA Regional Offices, your state department of health or environment, or the National Technical Information Service, Springfield, VA 22161.

HOW LEAD GETS INTO YOUR WATER

Lead gets into drinking water in two ways: by being present at the source or through corrosion of lead parts in a distribution/plumbing system.

At the Source

Lead in source waters

Most sources of drinking water have no lead or very low levels of lead (under 5 ppb). However, lead occurs naturally in the ground and in a few cases can get into well water. Lead can enter surface waters through direct or indirect discharges from industrial or municipal waste water treatment plants or when lead in air settles into water or onto city streets and eventually (via rain water) flows into storm sewers. Lead from these sources is removed easily using existing treatment plant technology.

Through Corrosion

Lead as a by-product of corrosion

It is more likely that lead has entered your school's water supply through the corrosion of lead pipes, solder, fixtures, or other parts of the plumbing system which distributes the water within the buildings. Experts regard the corrosion of lead solder as the major cause of lead contamination of drinking water today.

Corrosion, a reaction between the water and the lead pipes or solder, is commonly caused by "soft" water (which lathers soap easily) and acidic (low pH) water. However, all kinds of water may be potentially corrosive to lead, and thus result in high levels of lead in the water. For this reason, corrosion control is an important requirement of the EPA's proposed regulations to reduce lead in drinking water.

Factors affecting extent of lead contamination

FACTORS AFFECTING THE EXTENT OF LEAD CONTAMINATION

The extent of lead contamination is affected by a number of factors including:

- the corrosivity of the water;
- the amount of lead contained in the plumbing, the faucets, or apparatus dispensing the water;
- the contact time of the water with materials containing lead;
- whether or not electrical systems are grounded to the water pipes;
- the age of the plumbing.

Lead contamination may not occur uniformly throughout a school. Large variations in lead concentrations may be found among individual outlets in a school where the sources of contamination differ because of differences in flow rates and/or building materials.

Lead levels may vary from outlet to outlet

Where the source of the contamination is at the beginning of the distribution system, as with lead service connectors, high lead levels in the drinking water may be widespread throughout the building. (A service connector is the pipe that carries water from the public water main to the building.) High lead levels may also be found in sections of the distribution system where the water is infrequently used or where recent repair or installation of plumbing used lead solder. *(Examples of various plumbing configurations in buildings are illustrated in the attached diagrams and are explained on page 28 of this manual.)*

WHEN TO EXPECT LEAD CONTAMINATION

Expect widespread contamination if ...

In general, you can expect widespread lead contamination in your school's drinking water if:

- ❑ the building's plumbing is less than 5 years old and lead solder was used in the construction;
- ❑ the water is corrosive;
- ❑ sediment in the plumbing and screens contains lead;
- ❑ lead pipes are used throughout the building;
- ❑ the service connector is made of lead.

Expect localized contamination if ...

In general, you can expect localized contamination if:

- ❑ the building's plumbing is more than 5 years old;
- ❑ the water is non-corrosive;
- ❑ there are pipes or fittings containing lead in some locations;
- ❑ recent repairs or additions to plumbing used materials containing lead (solder, brass, etc);
- ❑ numerous solder joints are installed in short sections of pipe;
- ❑ there are areas of low flow or infrequent use;
- ❑ sediment in the plumbing and screens at isolated locations contains lead;
- ❑ water coolers have tanks lined with lead or other construction materials made of lead.

DEVELOPING A PLUMBING PROFILE OF YOUR SCHOOL

The plumbing profile — an essential part of your overall program

Completing a survey of your school's plumbing is an essential part of an overall program to identify high risk areas for lead in your drinking water. In addition, this survey will help you

- make decisions about water supply and pipe materials in the school;
- prioritize sample sites;
- make overall policy decisions regarding steps to initiate remedial action;
- inform parents and employees about what the school system is doing about lead in the drinking water.

The survey on the following pages is designed to help you make early decisions about your buildings. Answers to these questions are discussed in depth in the section entitled "What Your Answers Mean" which begins on page 13.

DEVELOPING A PLUMBING PROFILE OF YOUR SCHOOL

The following questionnaire will help you determine whether lead is likely to be a problem in your schools. It will also help you identify which locations have the highest risk of lead contamination. Copies of this questionnaire should be completed for each school within your district. The questions and their significance are discussed in depth on the follow pages.

1. When was the school built? _____

2. After the construction of the original building, were any new buildings or additions added? If so, when? _____ _____

3. If built since December, 1986, was lead-free plumbing and solder used in accordance with the lead ban? _____

4. When were the most recent plumbing repairs made? _____

5. What is the service connector made of? _____

6. Specifically, what are the pipes made of? (note the locations)

copper	_____	plastic	_____
galvanized metal	_____	lead	_____
other	_____	brass	_____

7. What materials does the solder connecting the pipes in your system contain? (Note locations with lead solder) _____

8. Are brass fittings, fixtures, faucets, or valves used in your drinking water system? (Note their location) _____

9. How many of the following outlets provide water for consumption? (Note their location)

water coolers	_____	drinking fountains	_____
ice makers	_____	kitchen faucets	_____
other	_____		

10. What brands and models of water coolers provide water in your school? _____

11. Do the faucets have accessible screens? _____

CONTINUED

Plumbing Profile
(page 2)

12. Have these screens been cleaned? _____

13. Can you detect signs of corrosion, such as frequent leaks, rust-colored water, or stained dishes or laundry? _____

14. Is any electrical equipment "grounded" to water pipes? _____
    (Note their location)

15. Have there been complaints about bad (metallic) taste? _____

16. When were water samples from your building last tested for contaminants? _____

    What kind of contaminants? _____ _____ _____ _____
    Was lead found? _____
    At what concentration? _____
    What was the pH level? _____
    Is testing done regularly? _____

17. Who supplies your school's drinking water? _____

    A. ***If purchased,*** you should ask your supplier:

    Does the water system have any lead piping? _____
    How corrosive is the water? _____
    Is the water supply being treated now? _____

    B. ***If the school supplies its own water,*** you should ask

    Is the water supply treated to reduce corrosivity? _____
    If so, what type of treatment is used? _____
    Is the water treated for any purpose other than corrosion control? _____
    If so, for what? _____

WHAT YOUR ANSWERS MEAN

The answers to these questions are important because lead in drinking water is most often a problem in school buildings with plumbing that is either very new (less than 5 years old) or very old.

1. When was the school built?

Old Buildings — Up through the early 1900's, lead pipes were commonly used for interior plumbing in public buildings and private homes. Plumbing installed before 1930 is most likely to contain lead. Between 1920 and 1950, galvanized pipes were also used for plumbing. After 1930, copper generally replaced lead as the most commonly used material for water pipes. However, the use of lead solder with copper pipes remains widespread, even today. **Experts regard the corrosion of lead solder as the major cause of lead contamination of drinking water today.**

2. Any new buildings or additions?

If so, when were they built?

New buildings — are not likely to have lead pipes in their plumbing systems, but they are very likely to have copper pipes with lead solder at the joints between pipes. In states where the 'lead ban' is being implemented effectively, new plumbing should contain no lead materials. You should be on the look-out, however, for renegade lead installation, as **new plumbing** containing lead can produce very high lead levels. Report violations of the lead ban to your state department of health or environment.

3. Was lead free plumbing and solder used?

Lead enters the water supply through two different reactions. The first is the reaction between the lead and the water itself. Where the water is not too corrosive, mineral deposits may form a coating on the inside of water pipes. The coating insulates the water from the lead solder and lead levels caused by this reaction decrease. Unless such a coating is formed (or until a corrosion control system is effective), there is direct contact between the water and any lead in the plumbing system.

The second process is the galvanic reaction between the copper in the pipes and the lead in the solder. This reaction is vigorous in new piping and lead levels can be extremely high. After about five years, lead levels are governed largely by the corrosiveness of the water. Non-corrosive water will allow a protective layer to form and the reaction slows down.

4. When were the most recent plumbing repairs made?

For these reasons, if the school (or an addition, or new plumbing or repair) is less than five years old and lead solder or other materials were used in the plumbing, you may have elevated lead levels. **If water supplied to the building is corrosive, however, lead solder can remain a problem, regardless of the plumbing's age.**

5. What is the service connector made of?

Lead piping was often used for the service connectors that join buildings to public water supplies. The service connector is the pipe that carries drinking water from a public water main to the school building. *(See attached diagrams.)* Some localities, as recently as 1986, required the use of lead service connectors. Although minerals may accumulate on these pipes, vibrations can cause flaking of any protective mineral build-up and thus allow lead contamination.

6. What are your school's water pipes made of?

Survey your building for exposed pipes, preferably accompanied by an experienced plumber who should be able to readily identify the composition of pipes on site. (Most buildings have a combination of different plumbing materials.) In general:

Lead pipes are dull gray in color and may be easily scratched by an object such as a key or knife. Lead pipes are a major source of lead contamination in drinking water.

Galvanized metal pipes are gray or silver-gray and are usually fitted together with threaded joints. In some instances, compounds containing lead have been used to seal the threads joining the pipes. Debris from this material which has fallen inside the pipes may be a source of contamination.

7. What materials comprise the solder connecting your pipes?

Copper pipes are red-brown; corroded portions may show green deposits. Copper pipe joints have been typically soldered together with lead. Experts regard the corrosion of lead solder as the major cause of lead contamination of drinking water today. Implementation of the "lead ban" will drastically cut lead contamination in repairs and new plumbing.

Plastic pipes, especially those manufactured abroad, may contain lead. If plastic pipes are used, be sure they meet National Sanitation Foundation (NSF) standards and are free of plasticizers which contain lead. (Note: copies of this standard may be obtained from NSF, 3475 Plymouth Road, P.O. Box 1468, Ann Arbor, MI 48106.)

8. Any brass fittings, fixtures, faucets or valves?

Brass pipes, faucets, valves and fittings are a golden yellow color, similar to copper in appearance, or are plated with chrome. Brass is composed of two metals, commonly copper and zinc. Brass fittings commonly used in drinking water outlets, such as faucets and water coolers, in general contain up to 8 percent lead. However, some older brass fixtures may contain higher percentages of lead and lead solder in their interior construction. It is important to verify that these fittings are lead-free.

9. Types of drinking water outlets?

10. Brand and model of water coolers?

In addition to lead components in the plumbing system, lead solders or lead in the brass fittings used in some faucets, water fountains, and refrigerated water coolers may be a source of lead. It is important to identify the locations of all such drinking water outlets.

Water coolers may be a major source of lead contamination. Under the Lead Contamination Control Act of 1988, water coolers with lead lined tanks are considered to be "imminently hazardous consumer products" and manufacturers and importers of these coolers must repair, replace, or recall them and provide a refund by November 1, 1989. The law also requires that solder, flux, and storage tank interior surfaces in contact with drinking water contain not more than 0.2 percent lead. Other parts of water coolers which may come into contact with drinking water may not contain more than 8.0 percent lead. In addition, this amendment to SDWA attaches criminal and civil penalties for the manufacture and sale of water coolers containing lead.

Contact your state department of health or environment for a list of brands and model numbers of water coolers found to contain lead. Use the list to help prioritize your sampling. If your water cooler is listed as having a lead-lined tank, sample the water immediately (see page 35 for directions) as these coolers have the highest risk of lead contamination.

11. Do the faucets have accessible screens?

12. Have they been cleaned?

Sediments containing lead which are trapped on screens can be a significant source of lead contamination. Sediments should be tested for the presence of lead and the screens should be cleaned frequently.

13. Signs of corrosion?

Frequent leaks, rust colored water, and stains on fixtures, dishes and laundry are signs of corrosive waters. Blue/green deposits on pipes and sinks indicate copper corrosion; brown stains result from the corrosion of iron. Where such symptoms occur, high levels of lead, copper, and iron may be present in the water.

14. Is any electrical equipment grounded to the water pipes?

If electrical equipment, such as telephones, has been installed using water pipes as a ground, the electric current travelling through the ground wire will accelerate the corrosion of the interior plumbing containing lead. The practice should be avoided, if possible. However, if existing wires are already grounded to water pipes, the wires should not be removed from the pipes unless a qualified electrician installs an alternative grounding system. Check with your local

building inspector. Your state or local building code may require grounding of the wires to the water supplies. Improper grounding of electrical equipment may cause severe shock.

15. Have there been complaints about "bad" (metallic) taste?

Although you cannot see, taste, or smell lead dissolved in water, the presence of a bad or "metallic" taste may indicate corrosion and possible lead contamination.

16. When was the water in your building last tested for contaminants?

Results of analysis of the water quality, such as pH, calcium hardness, and carbonate alkalinity, can provide important clues about the corrosivity of the water. In addition, these results can help the water supplier develop the most effective treatment of the water for corrosion control. Effective corrosion control treatment may include reducing the water's acidity, increasing its alkalinity, and/or adding a corrosion inhibitor such as zinc orthophosphate. The best choice among possible treatments will vary depending on the local water quality.

Is the water corrosive?

It is important to know if and how the school's water is treated. Some kinds of treatment can make the water more corrosive, while others will reduce the problem. Treatment of the public water to reduce corrosion can reduce lead levels throughout the system and can save both you and the supplier money by reducing damage to plumbing.

17. Who supplies your school's drinking water?

If your school purchases its water, contact your supplier to find out whether the water is corrosive and what the lead level of the water delivered to you is. If the water supplied to you exceeds the MCL for lead, your supplier will be required to bring the level down to acceptable levels by either installing a best available technology or by taking other steps such as drilling a new well or blending water from other sources. You should work with your supplier to ensure that everything possible is being done to avoid lead contamination either from source water or from corrosion of the plumbing.

If you supply your own water, contact your state department of health or environment or a qualified water treatment professional for assistance. If the pH of your water supply is less than 8, or if the average lead level from a liter of water is greater than 10 ppb, under the proposed regulations you will be required to lower the lead concentration to an acceptable level and implement corrosion control. Be sure that your treatment of the school's water does not increase the corrosivity of the water to lead.

GETTING YOUR SCHOOL'S WATER TESTED

If after completing a profile on your school's plumbing, you determine that you are likely to have lead contamination, you should have your water tested. **Testing is the only sure way of telling whether or not there are harmful amounts of lead in the school's drinking water.**

How to begin

Contact your local water utility or your local or state department of health or environment for information and assistance. As mentioned previously, the Lead Contamination Control Act of 1988 requires states to establish programs to help school officials identify and address the problem of lead in school drinking water. Funding for testing may also be available. In some instances, the local water supplier or the state or local department of health or environment may collect and analyze water samples from your school, or they will refer you to a state-certified laboratory using EPA-approved procedures.

A few laboratories will send trained personnel to collect the samples. In most cases, however, the laboratory will provide sample containers and instructions on how to collect the samples. Detailed sampling instructions begin on page 26 of this manual. Discuss the sampling instructions in this manual with the laboratory to make sure they are following similar procedures. **Make sure that the personnel collecting the samples are thoroughly familiar with the instructions and that they follow the instructions exactly** – otherwise, the results may not be reliable.

The cost of testing ranges from $7 to $30 per sample.

GENERAL PROCEDURAL CONSIDERATIONS

A two step program

EPA recommends that the sampling program be done in two steps, especially in large buildings where many samples will be taken. In the first step, screening samples are taken to identify the location of outlets providing water with high lead levels. In the second step, follow-up water samples are taken from problem locations. By comparing results of initial and follow-up samples, you should be able to identify the source of the lead contamination.

General procedural considerations

Collect samples before school opens and before any water is used. These samples, referred to as "morning first-draw samples," are representative of the water that is consumed at the beginning of the day or after infrequent use. If these samples show no lead contamination, the water the children are drinking is probably safe.

Do not take samples immediately after vacations, week-ends or holidays unless specifically directed to do so. These samples, although they may contain higher lead levels than ones collected during regular school weeks, are not representative of water in contact with the plumbing overnight, and therefore make it more difficult to locate the source of any lead contamination. **EPA recommends that all schools flush drinking water outlets after week-ends and vacations *(flushing directions begin on page 22)*, unless additional tests are made to determine lead levels for this period.**

Prioritize sampling: take samples from high risk outlets first

In general, a larger number of samples will result in the best assessment of the source and extent of the lead in drinking water. EPA recommends that you prioritize the sample sites on the basis of likelihood of contamination. Your completed plumbing profile *(pages 11 and 12 of this manual)* will help you identify these sites in each building.

Sample sites which are most likely to have lead contamination include:

- ❑ areas containing lead pipes;
- ❑ areas of recent construction and repair in which lead solder or materials containing lead were used;
- ❑ areas where the plumbing is used to ground electrical circuits;
- ❑ areas where corrosive water having low pH and alkalinity is distributed;
- ❑ water coolers identified by EPA as having lead-lined storage tanks or lead parts;
- ❑ areas of low flow and/or infrequent use (where water is in contact for a long time with plumbing containing lead or with particulate matter and lead debris).

(See also section entitled "WHEN TO EXPECT LEAD CONTAMINATION" which begins on page 10.)

WHEN THE TEST RESULTS COME IN

The Lead Contamination Control Act of 1988 requires school departments to make available to the public, teachers, other school personnel, and parents the results of any testing for lead contamination, and to notify parent, teacher, and employee organizations of the availability of these results.

In light of recent studies which reveal that even very low levels of lead in drinking water can have subtle adverse effects on children, **EPA recommends that action be taken to limit exposure or reduce lead in water whenever lead levels exceed 20 ppb.**

If no problem is found...

If test results from all outlets show that the lead levels in your school's drinking water do NOT exceed 20 ppb, EPA recommends that you take additional samples in the morning before school opens after week-ends or vacations. As mentioned earlier, water sitting in the pipes for a long time may have higher lead levels than during normal use. An alternative to additional testing is to flush the water supply after week-ends and vacations. **Flushing the water system should be omitted only if further analysis from first draw samples taken on Monday morning or after vacations indicate lead levels below 20 ppb.** Detailed directions for flushing begin on page 22 of this manual.

If a problem is found...

If test results show lead levels in excess of 20 ppb, you should start step 2 of the sampling process to track down the sources of the lead contamination. In this second step, follow-up samples are taken from those outlets which show elevated lead levels. Directions for follow-up samples begin on page 37. **Identification of the sources of lead contamination is essential to finding solutions that will work.**

If the lead level of any water fountain or outlet exceeds 20 ppb, take it out of service immediately until the level of contamination is reduced to below 20 ppb.

If your school purchases its water from a public water system, you should first notify your water supplier, your school board, and your state and local governments. Find out what your supplier is doing to reduce lead concentrations in the source water and what corrosion control or other treatment is planned. By working closely with your water supplier, you will also avoid unnecessary expenditures.

If your school owns its own well or other water source, you must begin to take steps to ensure that the provisions of SDWA which apply to you are carried out (see page 4). You are required by law to notify the consumers – all school staff and the parents or guardians of all students. If you have not already done so, contact your state department of health or environment for specific instructions regarding this notification. *(Refer to page 7 of this manual for additional information on notification requirements under the law.)*

OTHER STEPS YOU CAN TAKE

Interim measures

Until more permanent solutions bring lead levels down, you should implement interim measures to reduce lead contamination in your school's drinking water. These interim measures are necessary until corrosion control or other treatment by the water supplier is effective or until new piping within your buildings develops a protective coating. **You should periodically monitor the lead levels of your school's drinking water until levels decrease below 20 ppb and before you decide which interim measures to discontinue.**

1. Clean debris from all accessible screens frequently. As mentioned earlier, sediments containing debris can be a source of lead contamination.

2. Use only cold water for the preparation of food and beverages in school cafeterias and cooking classes. Hot water dissolves lead more quickly than cold water and is likely to contain higher levels of lead. If hot water is needed, it should be drawn from the cold-water tap and heated on a stove.

3. Purchase bottled water. This can be an expensive alternative. Bottled water sold in interstate commerce is regulated by the Food and Drug Administration, not by EPA. Water that is bottled and sold within a state is under state regulation. **EPA recommends that schools require a written statement from the bottled water distributor guaranteeing that lead levels in the water do not exceed 5 ppb.**

4. Do not use water that has been in contact with your school's plumbing for more than six hours, such as overnight, or after week-ends or vacations. Have the water system "flushed" by the school custodian or maintenance personnel. Before school begins, flush those outlets where test results indicated lead levels over 20 ppb. If the test results show widespread contamination within your building, flushing the interior plumbing may also be necessary.

Flushing

In some cases, a thorough flushing of the plumbing system on a daily basis will keep lead levels below 20 ppb throughout the day. This is because most of the lead in drinking water usually comes from the plumbing in the school building, not from the local water supply. Flushing is important because the longer water is exposed to lead solder or pipes, the greater the possible lead contamination. However, if the water is highly corrosive, or if the plumbing is new, supplemental testing should be done at the end of the school day to make sure that lead levels stay below 20 ppb. You may need to flush the system twice daily — once in the morning before school opens and a second time before the lunch period. **If lead levels return to their original levels within four hours of flushing, flushing is not a practical temporary solution.**

There are advantages and disadvantages to flushing. Flushing is often the quickest and easiest solution to high lead levels, especially when contamination is localized in a small area or in a small building. It does not require installation or maintenance of water treatment equipment and it does not require complex instructions.

Disadvantages to flushing

The most obvious disadvantage to flushing is the potential waste of water involved in the flushing procedures. If water supplies are limited in your area, some alternatives to daily flushing include:

- flushing the pipes only after week-ends or vacations, when lead levels may be highest (use only if lead levels do not exceed 20 ppb on a daily basis);
- thoroughly flushing several designated drinking water outlets daily, while taking all others temporarily out of service;
- using bottled water.

Another obvious disadvantage to flushing is the amount of time and staff needed to perform the task:

- If the water is very corrosive, flushing may have to be done more than once a day since lead levels in the water can return to high levels very quickly. In order to determine the number of additional flushes required, additional samples will have to be taken. It is probably not practical to flush the water more than twice a day.

- If contamination is widespread in a large building, flushing will take a lot of time and can waste water.

- Supervisors will have to check on the personnel performing the flushing to ensure that instructions are followed correctly and that accurate records are maintained and reviewed. Taking occasional follow-up samples from the outlets is one method of checking.

- Routine daily flushing of water coolers is not feasible because they take such a long time to flush.

Directions for flushing

FLUSHING DIRECTIONS:

Remember that each drinking water outlet must be flushed individually; flushing a toilet will not flush your water fountains. All flushing should be recorded in a log submitted daily to the office in charge of this program.

1. To flush the interior plumbing, locate the faucet furthest away from the service line on each wing and floor of the school building, open the faucets wide, and let the water run for 10 minutes (for best results, calculate the volume of the plumbing and the flow rate at the tap and adjust the flushing time accordingly);

2. Open valves at all drinking fountains without refrigeration units and let the water run for roughly 30 seconds to one minute;

3. Let the water run on all refrigerated water fountains for 15 minutes (because of the long time required, routinely flushing refrigerated fountains may not be feasible);

4. Open all kitchen faucets and let the water run for 30 seconds.

PERMANENT SOLUTIONS

You can take a number of actions to reduce permanently or eliminate the sources of lead which originate in your building's plumbing. Some of these actions may allow the elimination or reduction of routine flushing. Each school system needs to examine these options and make its own decision based on such factors as cost, availability of water, and manpower requirements. Of course, to avoid unnecessary expense, you should first contact your water supplier about its plans for treating the public water supply. If you own your water supply, you must comply with the provisions of SDWA *(see pages 4-7)*.

■ **Water that is soft and/or acidic can be treated at the local treatment plant to make it less corrosive**. This option is particularly effective because when water is treated to make it less corrosive, lead levels are reduced throughout the system. Treatment to reduce corrosion will also save you and the water supplier money by reducing damage to plumbing.

In some areas, corrosion control alone may not be enough to solve the problem. Follow-up testing should be done after corrosion control treatment begins. If lead levels remain high, additional remedial actions may be necessary.

■ **Corrosion control devices for individual buildings, such as calcite filters, soda ash or phosphate solution tank and feeder units are commercially available**. These point-of-entry treatment devices which are best suited to a school system which provides its own water typically cost $1600-2500 for an average size school. If you purchase your water supply, contact your water supplier to see what corrosion control treatment is planned for the general water supply. Under the proposed regulations, the water supplier would be responsible to treat the water to make it non-corrosive.

Factors to be considered in selecting a device for your school include performance record and the corrosion-reduction capabilities of the device. Contact your state department of health or environment for assistance and advice about selecting and installing point-of-entry devices. Typically, the manufacturer will recommend a practical maintenance program once the device is installed. A good maintenance and quality assurance program is the best way to be sure that the device performs its intended function.

Permanent solutions:

- **Carbon, sand, cartridge filters, and water softeners will not prevent corrosion. In fact, water softeners can contribute to corrosion of copper pipes unless installed at the tap.**

- **Lead levels can be reduced at the tap.** Point-of-Use treatment devices such as reverse osmosis devices and distillation units are commercially available. Because these devices also soften water, they should be installed only at the tap. Units may be either purchased or leased. They can be expensive, their effectiveness varies, and they may be vulnerable to vandalism. They also require a maintenance contract for regular upkeep to assure their effectiveness. The National Sanitation Foundation (NSF) has a testing program to evaluate the performance of point-of-use treatment devices. Before purchasing any such device, contact your State department of health or environment and NSF *(see page 14)*.

- **Existing wires already grounded to the water pipes can be removed by a qualified electrician and an alternative grounding system installed.** Electrical current accelerates the corrosion of lead in the piping materials. However, you should make sure that your state or local building codes allow removal of electrical grounding from water pipes. In some instances, removal of grounding from water pipes may create a shock hazard unless an acceptable alternative ground is provided.

- **If the sources of lead contamination are localized and limited to a few outlets, replacing these outlets may be the most practical solution.**

- **Time-operated solenoid valves can be installed and set to automatically flush the main pipes of the system, known as headers.** Drinking water fountains cannot be flushed automatically, but may be manually flushed by staff.

- **Lead pipes within the system and those portions of the lead service connectors under the water supplier's jurisdiction can be**

Permanent solutions (continued)

replaced. Contact your water utility about this replacement. However, your school may be responsible for replacing a portion of a lead service connector that is under its own administrative jurisdiction, rather than under the jurisdiction of the water supplier.

■ **In some schools, the plumbing system might be modified so that water supplied for drinking or cooking is redirected to bypass sources of lead contamination.**

■ **If other treatment fails, or is impractical, bottled water may be purchased for all consumption by students, teachers, and other school personnel.** Be sure that the bottled water you buy meets drinking water standards *(see page 20)*.

■ **Make sure that any plumber who does repair or replacement work on the school's plumbing system uses only lead-free solders and other materials**, as required by law. Before any repair job to the plumbing is accepted, have a plumbing inspector verify that lead-free materials have been used. Test kits to determine if the plumber used lead-free solder are available at reasonable prices *(about $40 — see page 6)*.

part 2

SAMPLING PROTOCOL

Suggested Sampling Procedures to Determine the Location and Source of Lead in School Drinking Water

PURPOSE

The importance of testing

Testing is the only sure way of telling whether or not there are harmful amounts of lead in your school's drinking water. As explained earlier, lead has most likely entered your school's drinking water through corrosion of the service connections, pipes, fixtures and other parts of the plumbing system distributing water *within* your buildings — rather than from the water supply itself. The sampling procedures outlined here will help you determine the location and source of the lead in water obtained from specific components of the system, such as water fountains, central chiller units, water coolers, bottled water dispensers, ice making machines, faucets, internal plumbing, and service connections. Give a copy of the protocol to each person who will take the samples or evaluate the findings.

Although the methods outlined in this protocol are similar to the sampling procedures used by water suppliers to determine compliance with the requirements of the Safe Drinking Water Act, **this protocol is not to be used to determine whether a water supplier meets the federal standards.**

This protocol has been field tested and found to provide results which are generally reliable. Despite the fact that lead levels of samples taken at various times from the same sample site may vary, the results are usually similar. Thus, if test results exceed 20 ppb, you can expect lead levels of subsequent samples to warrant remedial action. The opposite is also true.

[Note: ppb is often expressed as micrograms per liter (ug/l). One ppb is equal to one microgram per liter (ug/l) or .001 milligrams per liter (mg/l).]

BEFORE YOU BEGIN

Approach the sampling systematically

Analysis of samples should be done by a state-certified laboratory using EPA-approved methods. *(Contact your local water utility or state department of health or environment for information and assistance.)*

To keep the number of samples to a minimum, approach the task systematically:

a. Prior to sampling, study the layout of the plumbing system of your

building. The configuration of the interior plumbing can vary depending on the layout of the building. *(Examples of various plumbing configurations in buildings are illustrated in the attached diagrams.)* Locate service intakes, headers, laterals, fixture supply pipes, drinking water fountains, central chiller units, storage tanks, riser pipes and different drinking water loops.

Understand the plumbing layout of your buildings

In multi-story buildings, the water is elevated to the floors by one or more riser pipes. Water from the riser pipes is usually distributed through several different drinking water loops. In addition, in some buildings, water may be stored in a tank prior to distribution. In single-story buildings, the water comes from the service connection via main plumbing branches, often called headers. These in turn supply water to laterals. Smaller plumbing connections from the laterals and loops supply water to the faucets, drinking fountains, and other outlets.

The terms "upstream" and "downstream" are used frequently in this protocol. For sampling purposes, water within a plumbing system moves "downstream" from the source, i.e. the distribution main in the street.

Identify areas with highest risk of lead contamination

b. Complete the plumbing profile on pages 11 and 12 of this manual. This will enable you to identify areas of highest risk and prioritize your sites accordingly. *(See also the section entitled WHEN TO EXPECT LEAD CONTAMINATION which begins on page 10.)* Sample sites which are most likely to show lead contamination include:

- ❑ areas where the plumbing is used to ground electrical circuits;
- ❑ areas where corrosive water having low pH and alkalinity is distributed;
- ❑ areas of low flow and/or infrequent use (where water is in contact for a long time with sediments or plumbing containing lead);
- ❑ areas containing lead pipes or areas of recent construction and repair in which lead solder or materials containing lead were used;
- ❑ water coolers identified by EPA as having lead lined storage tanks or other parts containing lead.

If the analyses of these samples indicate contamination of the drinking water by lead, additional sampling from other sites deemed less vulnerable to lead contamination may be indicated.

A TWO-STEP PROCESS

EPA recommends that the sampling program be done in two steps.

Initial screening samples identify location of lead contamination

Step 1:

The purpose of this first step is to **identify the outlets** which provide drinking water showing significant lead levels. In step 1, **screening samples** from drinking water outlets within the building are collected and analyzed.

Step 2:

The purpose of step 2 is to **pinpoint the sources** of lead in the drinking water from outlets which showed significant lead levels in the initial screening samples. In step 2, **follow-up samples** are collected and analyzed from these outlets. If necessary, additional samples from the interior plumbing within the building are taken.

Follow-up samples identify source of lead contamination

Once the sources of contamination are known, appropriate remedial actions may be taken.

Ultimately, the choice of performing the sampling in one or two steps is up to the personnel performing the sampling. Small facilities with relatively few sites to be sampled may be able to perform all of the sampling at once. *(A flow chart outlining the overall general sampling strategy is attached.)*

The number of samples taken from a building depends upon the size of the building, the number of outlets used to supply drinking water, and the extent of the contamination. More outlets with elevated lead levels will require correspondingly more follow-up samples to pinpoint the sources of contamination. **In general, a larger number of samples will result in the best assessment of the source and extent of lead in drinking water.**

LABORATORY ANALYSIS AND HANDLING OF SAMPLE CONTAINERS

Follow laboratory's instructions exactly

The sample containers should be prepared in a clean laboratory environment by qualified laboratory personnel using the appropriate purity chemicals. Do not attempt to prepare your own sample containers unless your school has qualified personnel and an appropriate facility. The laboratory should provide you with enough sample containers. Follow the instructions provided for handling the sample containers to ensure accurate results. Do not rinse the sample containers before filling. The laboratory has prepared the containers to receive the samples you will take and they may contain a chemical needed to preserve the samples properly until they reach the laboratory. Avoid any contact with this chemical. Be careful not to overfill the sampling containers with water. *(For information about the preparation of sample containers and sample preservation, refer to the Appendix, page 50.)*

Label all of the sample bottles with the location of the sample site. Also note the manufacturer's name and model number of water fountains, water coolers, central chillers, and any other water dispensing outlets from which samples are taken.

General sampling procedures

GENERAL SAMPLING PROCEDURES

(1) Collect all samples before school 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 the sample is taken. However, in some areas of infrequent use, water from a particular outlet may not have been used in more than 18 hours. Despite this, the sample would still be representative of the normal water consumption pattern.

(2) Make sure that no water is withdrawn from the taps or fountains from which the samples are to be collected prior to sampling. Samples collected from the designated sites after they have been used will indicate lower lead levels than may be actually encountered.

(3) Unless specifically directed to do so, do not collect samples in the morning after vacations, week-ends or holidays. These samples will contain higher lead levels than those collected at other times and are not representative of normal water consumption patterns. Finding the source of any lead contamination through follow-up samples would thus be more difficult. *(For more details, see pages 18 and 19.)*

HOW TO BEGIN

First, contact your water supplier. Under the proposed regulations *(see page 4)*, water delivered by a public water supplier would be required to have lead levels equal to or less than 5 ppb when it leaves the treatment plant. If the lead level of the water exceeds 5 ppb, your water supplier would be required to bring the lead concentration down. If your school supplies its own water, the school is considered a public water supplier and is subject to the provisions of this law. *(See the section entitled THE SAFE DRINKING WATER ACT, page 4.)*

If your supplier verifies that the drinking water leaving the treatment plant has lead levels of 5 ppb or less, take a sample of the water coming into your building. If the lead level exceeds 20 ppb, the problem may be a lead service connector or the distribution main. (The service connection is the plumbing connection between the distribution main in the street and the plumbing in the building.) If the test result is low (5 ppb or less), any problem will be from the interior plumbing of your building.

SAMPLING SERVICE CONNECTIONS

Until recently in some locations, lead pipes up to 2 1/2 inches in diameter were used for service connectors. Other materials used for service connectors include copper, galvanized steel, plastic, and iron. Lead service connectors can produce significant lead levels in your drinking water.

EPA recommends using the tap **closest to the service connector** for sampling. This is especially important in larger facilities where more than one service connection is present.

Sampling service connections

Sample 1S

Take this sample before school opens. Open the tap closest to the service connection. Let the water run and feel the temperature of the water. As soon as you feel the water change from warm to cold, collect the sample. Because water warms slightly after standing in the interior plumbing, this colder water sample represents the water that had been standing just outside of the building and in contact with the service connector. Fill the sample container with 250 mL of water unless otherwise directed by the laboratory.

The distribution main rarely causes lead contamination

Sample 1M

This sample is representative of the water that has been standing in the distribution main. Take it from the same location as sample 1S. Let the water run and feel the temperature of the water. When you feel the water change from warm to cold, allow the water to run for an additional 3 minutes and then collect the sample. Fill the sample container with 250 mL of water.

Interpreting the Results

- **If the lead level of sample 1S significantly exceed 5 ppb (for example 10 ppb) and is higher than in sample 1M**, lead is contributed from the service connector. Check for the presence of a lead service line. In the absence of a lead service connector, lead goosenecks or other appurtenances containing lead in line with the service connection may be the source of contamination. Usually no significant amount of lead (above 5 ppb) comes from the distribution main.

- **If the lead level of sample 1M significantly exceeds 5 ppb (for example 10 ppb)**, lead in the water may be attributed to the source water, sediments in the main, or possibly from lead joints used in the installation or repair of cast iron pipes. If the water supplied is from a well, a lead packer in the well may also contribute lead to the water.

- **If the lead level of samples 1S and 1M are very low, close to 5 ppb**, very little lead is picked up from the service line or the distribution main. If any of the initial screening samples of Step 1 indicate a problem with lead contamination, the source of that contamination is in the interior plumbing and/or outlets (or sediments containing lead which are trapped in the plumbing or on screens), not the water supply or the service connection.

STEP 1 — TAKING INITIAL SCREENING SAMPLES

Identifying the location of drinking water outlets with lead contamination

SAMPLING INDIVIDUAL OUTLETS

Next collect **initial screening samples** for analysis from individual outlets in areas you have identified as having a high risk of contamination. These outlets include drinking water fountains (including water coolers), ice making machines, water faucets and any place where sediment has collected in the plumbing or on screens.

DRINKING WATER FOUNTAINS

Drinking water fountains

There are four main types of drinking water fountain systems:

1. The **Bubbler** or **Drinking Fountain.** Water is supplied to the bubbler or fountain directly from the building's plumbing.

2. A **Central Chiller Unit** cools water for a number of drinking fountains or bubblers in the building.

3. A **Water Cooler** is equipped with its own cooling and storage system. Water is supplied to the water cooler from the building's plumbing.

4. A **Bottled Water Dispenser** is a type of water fountain whose water is supplied from bottled water.

Note: Do not close the valves to the water fountains to prevent their use. Minute amounts of scrapings from the valves will produce inaccurate results showing higher than actual lead levels in the water. Take all samples with the taps fully open.

Bubblers without central chiller

BUBBLERS OR DRINKING FOUNTAINS

Bubblers without Central Chiller

Fill sample containers with 250 mL of water.

Initial Screening Sample Number 1A

This sample is representative of the water that may be consumed at the beginning of the day or after infrequent use. It consists of water that has been in contact with the bubbler valve and fittings and the section of plumbing closest to the **outlet** of the unit.

Take this sample before school opens and before any water is used. Collect the water immediately after opening the faucet without allowing any water to run into the sink. Follow up samples should be taken from those water fountains where test results indicate lead levels over 20 ppb.

Bubblers with central chiller

Bubblers with Central Chiller

Fill sample containers with 250 mL of water.

Initial Screening Sample Number 1B

This sample is representative of the water that is consumed at the beginning of the day or after infrequent use. It consists of water that has been in contact with the bubbler valve, the fittings, and the section of plumbing closest to the **outlet** of the unit.

Take this sample before school opens and before any water is used. Collect the water immediately after opening the faucet without allowing any water to run into the sink. Follow up samples should be taken from those water fountains where test results indicate lead levels over 20 ppb.

Water coolers

WATER COOLERS

The two types of water coolers used are the wall mounted and the free standing. Water in the cooler is stored in a pipe coil or in a reservoir. Refrigerant coils in contact with either of these storage units cool the water. Sources of lead in the water may be: the internal components of the cooler, including a lead-lined storage unit; the section of the pipe connecting the cooler to the lateral; and/or the interior plumbing.

The Lead Contamination Control Act of 1988 contains specific requirements for the testing, recall, repair and/or replacement of water coolers containing lead. Contact your state department of health or environment to see if the manufacturer and model number of your unit(s) is on the list of water coolers identified by EPA as containing lead. *(Refer to pages 4 and 15 of this manual for additional information.)*

Fill all sample containers with 250 mL of water.

Initial Screening Sample Number 1C

This sample is representative of the water that may be consumed at the beginning of the day or after infrequent use. (Although in some areas of infrequent use the water may not have been used in more than 18 hours, the sample is still representative of the normal water consumption pattern.) It consists of water that has been in contact with the valve and fittings, the storage unit, and the section of plumbing closest to the **outlet** of the unit.

Take this sample before school opens and before any water is used. Collect the water immediately after opening the faucet without allowing any water to waste. Follow-up samples should be taken from those water coolers where test results indicate lead levels over 20 ppb.

Bottled water dispensers

BOTTLED WATER DISPENSERS

Fill all sample containers with 250 mL of water.

Initial Screening Sample Number 1D

This sample is representative of the water that may be consumed at the

beginning of the day or after infrequent use. It consists of water that has been in contact with the dispenser valve and fittings incorporated in the outlet of the unit.

Take this sample before school opens and before any water is used. Collect the water immediately after opening the faucet without allowing any water to waste. Follow-up samples should be taken from those bottled water dispensers where test results indicate lead levels over 20 ppb.

Ice Making Machines

ICE MAKING MACHINES

Initial Screening Sample Number 1E

Fill a suitable container (250 mL or larger, wide-mouthed bottle or Whirl-Pak TM) prepared by the laboratory at least three quarters full of ice. Do not touch the ice with your hands. Use the non-metal scoop or disposable plastic gloves provided by the lab.

If lead levels in the samples taken from the ice-making machine exceed 20 ppb, take follow-up sample number 2E to determine if the source of the lead is the plumbing or the ice-making machine itself.

Water faucets

WATER FAUCETS

Fill all sample containers with 250 mL of water.

Initial Screening Sample Number 1F

This sample is representative of the water that may be consumed at the beginning of the day or after infrequent use. It consists of water that has been in contact with the fixture and the plumbing connecting the faucet to the lateral.

Take this sample before school opens and before any water is used. Collect the water immediately after opening the faucet without allowing any water to run into the sink. Follow-up samples should be taken from those water faucets where test results indicate lead levels over 20 ppb.

STEP 2 — TAKING FOLLOW-UP SAMPLES

Take follow-up samples from all drinking water outlets where test results indicate lead levels over 20 ppb. If the results of the initial screening samples indicate extensive contamination of the drinking water by lead, you should take additional samples from other sites not previously tested. EPA recommends that any drinking water fountain or tap with lead levels over 20 ppb be taken out of service immediately until the lead levels are reduced to below 20 ppb.

Refer to page 30 for general sampling procedures to be followed when taking follow-up samples.

BUBBLERS OR DRINKING FOUNTAINS

Bubblers without Central Chiller

Bubbler without central chiller

Take follow-up samples from those water fountains where initial sample test results indicate lead levels above 20 ppb. Fill all sample containers with 250 mL of water.

Follow-up Sample Number 2A

This sample is representative of the water that is in the plumbing upstream from the bubbler. Take this sample before school opens and before any water is used. Let the water from the fountain run for 30 seconds before collecting the sample.

Interpreting the Results

To determine the **source** of lead in the water, compare the test results of samples 1A and 2A.

- **If the lead level in sample 1A is higher than in sample 2A**, a portion of lead in the drinking water is contributed from the bubbler.

- **If the lead level in sample 2A is very low, close to 5 ppb**, very little lead is picked up from the plumbing upstream from the outlet. The majority or all of the lead in the water is contributed from the bubbler.

Bubbler without central chiller (continued)

• **If the lead level in sample 2A significantly exceeds 5 ppb** (for example, 10 ppb), lead in the drinking water is also contributed from the plumbing upstream from the bubbler.

• **If the lead level in sample 2A exceeds 20 ppb**, EPA recommends sampling from the header or loop supplying water to the lateral to locate the source of the contamination. *(Refer to the section entitled INTERIOR PLUMBING on page 45.)*

Bubbler with Central Chiller

Bubbler with central chiller

Take follow up samples from those water fountains where initial screening sample test results indicate lead levels over 20 ppb. Fill all sample containers with 250 mL of water.

Follow-up Sample Number 2B

This sample is representative of the water that is in the plumbing upstream from the bubbler. Take this sample before school opens and before any water is used. Let the water from the fountain run for 30 seconds before collecting the sample.

Interpreting the Results

To determine the **source** of lead in the water, compare the test results of samples 1B and 2B.

• **If the lead level in sample 1B is higher than in sample 2B**, a portion of lead in the drinking water is contributed from the bubbler.

• **If the lead level in sample 2B is very low, close to 5 ppb**, very little lead is picked up from the plumbing upstream from the outlet. The majority or all of the lead in the water is contributed from the bubbler.

• **If the lead level in sample 2B significantly exceeds 5 ppb**, (for example, 10 ppb), the lead in the drinking water may be contributed from the plumbing

supplying the water from the chiller to the bubbler, from the chiller, or from the plumbing supplying water to the chiller.

• **If the lead level in sample 2B exceeds 20 ppb**, EPA recommends sampling from the chiller unit supplying water to the lateral to locate the source of the contamination *(see procedures for samples 3B and 4B from central chiller unit).*

Central chiller unit

CENTRAL CHILLER UNIT

Fill all sample containers with 250 mL of water.

Follow-up Sample Number 3B

This sample is representative of water that has been in contact with the plumbing supplying water to the chiller. Take this sample before school opens and before any water is used. Take the sample from a tap or valve as close to the **inlet** of the chiller as possible. Collect the water immediately after opening the tap or valve, without allowing any water to waste.

Follow-up Sample Number 4B

This water sample consists of water that has been in contact with the chiller unit and the plumbing upstream which supplies water to the chiller. Often, water supplied to the bubblers is recirculated to the chiller unit. In this instance, sample 4B consists of a mixture of water from the water supply and recirculated water from the plumbing supplying water to the bubblers.

Take the sample from a tap or valve as close to the **outlet** of the chiller as possible. Collect the water immediately after opening the tap or valve, without allowing any water to waste.

Interpreting the Results

• **If the lead level in sample 2B is higher than in sample 4B**, lead is contributed from the plumbing supplying the water from the chiller to the water fountain.

Central chiller unit (continued)

• **If the lead level in sample 4B is greater than in sample 3B,** a portion of the lead may be coming from the chiller. Note: sludge and sediments containing high levels of lead may accumulate in chiller tanks. If the test results indicate that lead is contributed from the chiller unit, check for the presence of debris and sludge. Remove any of these materials from the chiller, flush the chiller unit, and re-sample the water.

If the lead level in sample 3B exceeds 20 ppb, EPA recommends additional sampling from the distribution system supplying water to the chiller to locate the source of contamination. *(Refer to the section entitled INTERIOR PLUMBING on page 45.)*

• **If the lead level in sample 3B is very low, close to 5 ppb**, very little lead is picked up from the plumbing upstream from the chiller. The majority or all of the lead in the water may be attributed to the chiller and the plumbing downstream from the chiller.

Water coolers

WATER COOLERS

Follow-up samples are taken from those water coolers where test results indicate lead levels over 20 ppb. Fill all sample containers with 250 mL of water. These samples will help you determine what the **source** of contamination is. Be aware that:

• Some water coolers have storage tanks lined with materials containing lead. You should contact the manufacturer of any water cooler units you have purchased, or are planning to purchase, for written guarantees that no lead has been used in the unit. A list of brands and model numbers of coolers which contain lead has been prepared by EPA and is available from your state department of health or environment. *(Refer to page 4 for additional information.)*

• Sediments and debris containing lead on screens or in the plumbing frequently produce significant lead levels *(Follow-up Sample 4C).*

• Lead solder in the plumbing can also contribute to the problem.

Water coolers
(continued)

Follow-up Sample Number 2 C

This water sample is representative of the water that is in contact with the plumbing upstream of the cooler. Take this sample **after school closes.** Let the water from the fountain run for 15 minutes before collecting the sample. **You must flush for 15 minutes to ensure that no stagnant water is left in the storage unit.**

Follow-up Sample Number 3C

Because the water in the cooler was flushed the previous afternoon, this sample is representative of the water that was in contact with the cooler overnight, not in extended contact with the plumbing upstream. (In this, it may differ from Initial Screening Sample 1C.)

Take this sample **before school opens** and before any water is used. **This sample must be taken the morning after you collect sample 2C.** Collect the water immediately after opening the faucet without allowing any water to waste.

Interpreting the Results

• **If the lead level in sample 3C is higher than in sample 2C**, the water cooler is contributing lead to the water.

• **If the lead level in sample 3C is higher than in sample 2C AND the lead level in sample 1C is higher than in sample 3C**, the plumbing upstream from the water cooler may also be contributing lead to the water.

• **If the lead level in sample 3C is identical or close to that of sample 2C**, the water cooler probably is not contributing lead to the water.

• **If the lead level in sample 1C is higher than in sample 3C, AND if the lead levels in sample 2C and 3C are close or identical**, the plumbing upstream from the cooler and/or the plumbing connection leading to the cooler, or both, are contributing lead to the water.

• **If the lead level in sample 2C is in excess of 10 ppb and is equal to or greater than the lead levels in samples 1C and 3C**, the source of the lead may be sediments contained in the cooler storage tank, screens, or the plumbing upstream from the cooler.

Water coolers
(continued)

To verify the source of lead, take the following steps.

1. Take a 30 second flushed sample from a tap upstream from the cooler or compare sample 2C with the results obtained from follow-up samples taken from outlets upstream from the cooler. If low lead levels are found in these samples (close to 5 ppb), the source of lead may be sediments in the cooler or the plumbing connecting the cooler to the lateral, or lead solder in the plumbing between the taps.
2. If the flushed samples from the upstream outlets have lead levels in excess of 5 ppb, then the cooler and the upstream plumbing may both contribute lead to the water.

To confirm whether the cooler is a source of lead, take and analyze sample 4C.

Follow-up Sample Number 4C

Turn off the valve leading to the cooler. Disconnect the cooler from the plumbing and look for a screen at the **inlet**. Remove the screen. If there is debris present, check for the presence of lead solder by sending a sample of the debris to the laboratory for analysis.

Some coolers also have a screen installed at their bubbler **outlet**. Carefully remove the bubbler outlet by unscrewing it. Check for a screen and debris, and have a sample of any debris analyzed.

Some coolers are equipped with a drain valve at the **bottom of the water reservoir**. Water from the bottom of the water reservoir should be sampled and any debris analyzed.

Collect sample 4C from the disconnected plumbing outlet in the same manner as you collected sample number 1C. Compare the results from sample 4C to those of the other samples.

Interpreting the Results

- **If the lead level in sample 4C is less than 5 ppb,** then lead is coming from the debris in the cooler or the screen.

- **If the lead level in sample 4C is significantly higher than 5 ppb,** the source of lead is the plumbing upstream from the cooler.

Get written assurance of lead levels from bottled water distributor

BOTTLED WATER DISPENSERS

Fill all sample containers with 250 mL of water.

Follow-up Sample Number 2D

Collect this sample directly from the bottle which supplies the water to the unit. This will enable you to determine the **source** of lead in the water.

Interpreting the Results

- **If the lead level in sample 1D is higher than in sample 2D**, lead may be coming from the dispenser unit.

- **If the lead level in sample 2D is identical or close to sample 1D,** the source of lead is the bottled water.

Note: The proposed regulations limit the amount of lead in source waters to 5 ppb. The Food and Drug Administration, which regulates the interstate sale of bottled water is expected to adopt similar regulations. EPA recommends that you do not drink bottled water containing lead levels over 5 ppb and that you contact your distributor for written assurance that the bottled water does not exceed this level.

Ice making machines

ICE MAKING MACHINES

If the lead level in the sample taken from the ice-making machine exceeds 20 ppb, take follow-up sample number 2E to determine if the source of the lead is the plumbing or the ice making machine itself.

Follow-up Sample Number 2E

Disconnect the icemaker from the plumbing and look for a screen at the inlet. Remove the screen. If debris is present, forward a sample of the debris to the laboratory for analysis. The laboratory will determine if lead solder is present. **If the debris contains lead, the screen should be cleaned frequently as a regular routine.**

Collect the sample from the disconnected plumbing as close to the ice maker as possible. Fill the sample container with 250 mL of water.

Ice making machines (continued)

Interpreting the Results

• **If the lead level in sample 2E is close to 5 ppb**, the source of the lead in the ice is the ice maker.

• **If the lead level in sample 2E significantly exceeds 5 ppb**, (for example, 10 ppb), lead is also contributed from the plumbing upstream from the ice maker.

• **If the lead level in sample 2E exceeds 20 ppb**, EPA recommends sampling from the distribution system supplying water to the ice maker. *(Refer to the section entitled INTERIOR PLUMBING on page 45.)*

WATER FAUCETS

Fill all sample containers with 250 mL of water.

Water faucets

Follow-up Sample Number 2F

This sample is representative of the water that is in the plumbing upstream from the faucet. Take this sample before school opens and before any water is used. Let the water from the faucet run for 30 seconds before collecting the sample.

Interpreting the Results

• **If the lead level in sample 1F is higher than in sample 2F**, the source of lead is the water faucet and/or the plumbing upstream from the faucet.

• **If the lead level in sample 2F is very low, close to 5 ppb**, very little lead is coming from the plumbing upstream from the faucet. The majority or all of the lead in the water is from the faucet and/or the plumbing connecting the faucet to the lateral.

• **If the lead level in sample 2F significantly exceeds 5 ppb**, (for example, 10 ppb), lead may be contributed from the plumbing upstream from the faucet.

SAMPLING INTERIOR PLUMBING

In general, if lead levels exceed 20 ppb in follow-up samples taken from the drinking water outlets, additional samples from designated sample sites in the interior plumbing should be taken. These sites include the laterals, loops and/or headers, and riser pipes. The configuration of the interior plumbing will vary depending on the layout of the building. *(For illustration, refer to the attached diagrams.)*

The sampling should proceed systematically upstream from the initial follow-up sample sites. The goal is to isolate those sections of the interior plumbing which contribute lead to the water by comparing the results of these samples with results of previous samples.

Fill all sample containers with 250 mL of water.

LATERALS:

Laterals

Laterals are the plumbing branches between a fixture or group of fixtures, such as taps, water fountains, etc.

Sample 1G

Open the tap that has been designated as the sample site for the lateral pipe. Let the water run for 30 seconds before collecting the sample. The purpose of flushing the water is to clear the plumbing between the sample site and the lateral pipe which will assure collection of a representative sample.

Note: Sample 1G corresponds to follow-up samples taken from other outlets such as 2A, 2E, and 2F. Compare the results of these samples from outlets upstream and downstream of sample 1G for additional information on the source of the lead within the interior plumbing.

Interpreting the Results

- **If the lead level in sample 1G exceeds 20 ppb**, collect additional samples from the plumbing upstream (the service line, the riser pipe, the loop or header supplying water to the lateral).

Laterals (continued)

Note: High lead levels may also be caused by recent repairs and additions using lead solders, or by sediments and debris in the pipe. Debris in the plumbing is most often found in areas of infrequent use and a sample should be sent to the laboratory for analysis.

- **If the lead level of sample 1G is the same as the lead level in a sample taken downstream from sample site 1G**, lead is contributed from the lateral or from interior plumbing upstream from the lateral. Possible sources of lead may be the loop, header, riser pipe, or service connection.

- **If the lead level in sample 1G is very low, close to 5 ppb**, the portion of the lateral upstream from sample site 1G and the interior plumbing supplying water to the lateral are not contributing lead to the water.

- **If the lead level in sample 1G significantly exceeds 5 ppb (for example, 10 ppb), and is less than the lead level in a sample taken downstream from sample site 1G**, a portion of the lead is contributed downstream from the sample site.

LOOPS AND/OR HEADERS

Loops and headers

A loop is a closed circuit of a plumbing branch which supplies water from the riser to a fixture or a group of fixtures. A header is the main pipe in the internal plumbing system of a building. The header supplies water to lateral pipes.

EPA recommends that water samples from each loop and/or header be collected because use patterns may vary among locations within a building. Construction materials may also vary among loops, especially in larger schools where additions and repairs have been made to the original structure.

Sample number 1H (header) or 1I (loop)

Locate the sampling point furthest from the service connection or riser pipe on a floor. Open the faucet and let it run for 30 seconds before collecting this sample. The purpose of flushing the water is to clear the faucet and plumbing between the sample site and the loop and/or header pipe, thus assuring collection of a representative sample.

Loops and headers (continued)

Interpretation of Results

• **If the lead level is over 20 ppb**, collect additional samples from the plumbing upstream supplying water to the loop or header. Compare the sample results with those taken from the service line or the riser pipe which supplies water to the loop and/or header.

High lead levels may also be caused by recent repairs and additions using lead solders, or by sediment and debris in the pipe. Debris in the plumbing is most often found in areas of infrequent use and a sample should be sent to the lab for analysis.

• **If the lead level in sample 1H or 1I is equal to the lead level in a sample taken downstream from sample site 1H or 1I**, the lead is contributed from the header or the loop and from the interior plumbing upstream from the head or loop. Possible sources of lead may be the loop, header, riser pipe, or service connection.

• **If the lead level in sample 1H or 1I is close or equal to 5 ppb**, the portion of the header or loop upstream from sample site 1H or 1I and the interior plumbing supplying water to the loop or header are not contributing lead to the drinking water. The source of lead is downstream from the sample site.

• **If the lead level in sample 1H or 1I significantly exceeds 5 ppb (for example 10 ppb), and is less than the lead level in a sample taken downstream from sample site 1H or 1I**, a portion of the lead is contributed downstream of the sample site.

Riser Pipes

RISER PIPES

A riser is the vertical pipe that carries the water from one floor to another. Fill all sample containers with 250 mL of water.

Sample Number 1J

Open the tap closest to the riser pipe. Let the water run for 30 seconds before collecting the sample. The purpose of flushing the water is to clear the

Riser pipes
(continued)

faucet and plumbing between the sample site and the riser pipe which will assure collection of a representative sample.

Interpreting the Results

- **If lead levels exceed 20 ppb**, collect additional samples from the plumbing upstream from the riser. High lead levels in the riser pipes may also be caused by recent repairs and additions using lead solder.

- **If the lead level in sample 1J equals the lead level in a sample taken downstream from sample site 1J**, the source of the lead is the riser pipe or the plumbing and service connection upstream from the riser pipe.

- **If the lead level in sample 1J is close or equal to 5 ppb**, the portion of the riser pipe and plumbing upstream from sample site 1J and the service connection are not contributing lead to the water. The source of the lead is downstream of the sample site.

- **If the lead level in sample 1J significantly exceeds 5 ppb (for example, 10 ppb) and is less than the lead level in a sample taken downstream from sample site 1J**, a portion of the lead is contributed downstream of the sample site.

GLOSSARY

Bubbler: A water fountain fixture connected to the water supply. A bubbler does not contain a refrigeration unit.

Chiller: A central refrigeration unit providing cold water to bubblers.

Corrosion: A dissolving and wearing away of metal caused by a chemical reaction (in this case, between water and the piping that the water contacts).

Flux: A substance applied during soldering to facilitate the flow of solder. Flux often contains lead and can itself be a source of lead contamination in water.

Header: The main pipe in the internal plumbing system of a building. The header supplies water to lateral pipes.

Lateral: A plumbing branch between a fixture or group of fixtures (taps, water fountains, etc.) and the header.

Loop: A closed circuit of a plumbing branch which supplies water from the riser to a fixture or a group of fixtures.

Public Water System: Any system that supplies water to 25 or more people or has 15 or more service connections (buildings or customers).

Riser: The vertical pipe that carries the water from one floor to another.

Service Connector: The pipe that carries tap water from the public water main to a building. In the past, these were often made of lead.

Solder: A metallic compound used to seal the joints between pipes. Until recently, most solder contained about 50 percent lead. Lead-free solders often contain one or more of the following metals: antimony, tin, copper, or silver. Several alloys are available that melt and flow in a manner similar to lead solder.

Water cooler: Any mechanical device affixed to drinking water supply plumbing which actively cools water for human consumption. The reservoir can consist of a small tank or a pipe coil.

PRESERVATION OF SAMPLES AND SAMPLE CONTAINERS

Contamination of sample containers by dust, dirt, or other impurities containing lead can produce inaccurate test results in an otherwise conscientious sampling program. Contamination of a water sample by the container may indicate higher lead levels than are actually present in the drinking water.

Another source of error that may affect the result of analysis is the adsorption of lead from the water onto the surface of the container, which will reduce the amount of lead in the water sample. In such instances, analytical results will indicate lower lead levels in the sample than actually are present.

In order to avoid analytical errors, pay particular attention to proper collection and handling of the sample before analysis. Preparation of sample containers is described in detail in an EPA manual entitled, "Methods for Chemical Analysis of Water and Wastes." In brief, the sample container, whether borosilicate glass, polyethylene, polyproplyene, or Teflon should be thoroughly washed with detergent and tap water, rinsed with 1:1 nitric acid and tap water, 1:1 hydrochloric acid and tap water, and finally deionized distilled water — in that order.

Make sure that the containers are kept sealed between the time of their preparation and the collection of the sample. This will assure that no contaminants from the outside are introduced. In order to avoid the loss of lead from the sample through adsorption onto the sample container wall, acidify the sample with concentrated nitric acid to a pH of less than 2. If the nitric acid cannot be used at the time of the collection of the sample because of shipping restrictions, preserve the sample by icing, and ship it immediately to the laboratory. Upon receipt, the laboratory must acidify the sample with concentrated nitric acid to a pH of less than 2.

For more detail, refer to EPA manuals entitled

"Methods for Chemical Analysis of Water and Wastes," EPA- 600/4-79-020, March, 1979 (available from U.S. EPA, R & D Publications, 26 W. Martin Luther King, Cincinnati, OH 45268) and

"Manual for the Certification of Laboratories Analyzing Drinking Water," EPA-570/9-82-002, October, 1982 (available from U.S. EPA, Drinking Water Hotline, 800-426-4791).

Initial Screening Sample	Follow-Up Sample(s)	Type of Outlet or Plumbing
1S	1M	Service Connection to Distribution Main
1A	2A	Bubbler without Central Chiller
1B	2B	Bubbler with Central Chiller
	3B, 4B	Central Chiller Unit
1C	2C, 3C, 4C	Water Cooler
1D	2D	Bottled Water Dispenser
1E	2E	Ice Making Machine
1F	2F	Water Faucet
		INTERIOR PLUMBING
	1G	Lateral
	1H	Header
	1I	Loop
	1J	Riser

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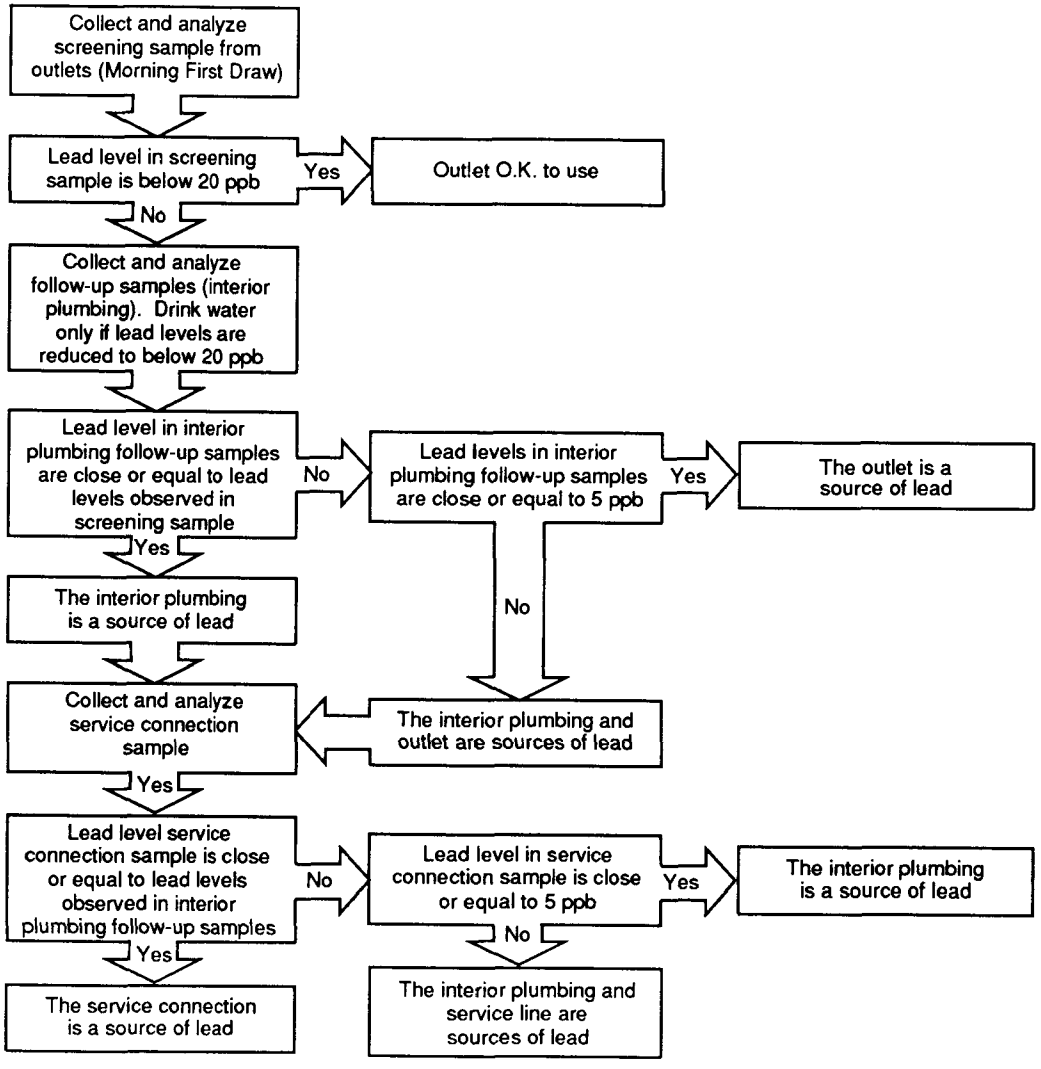
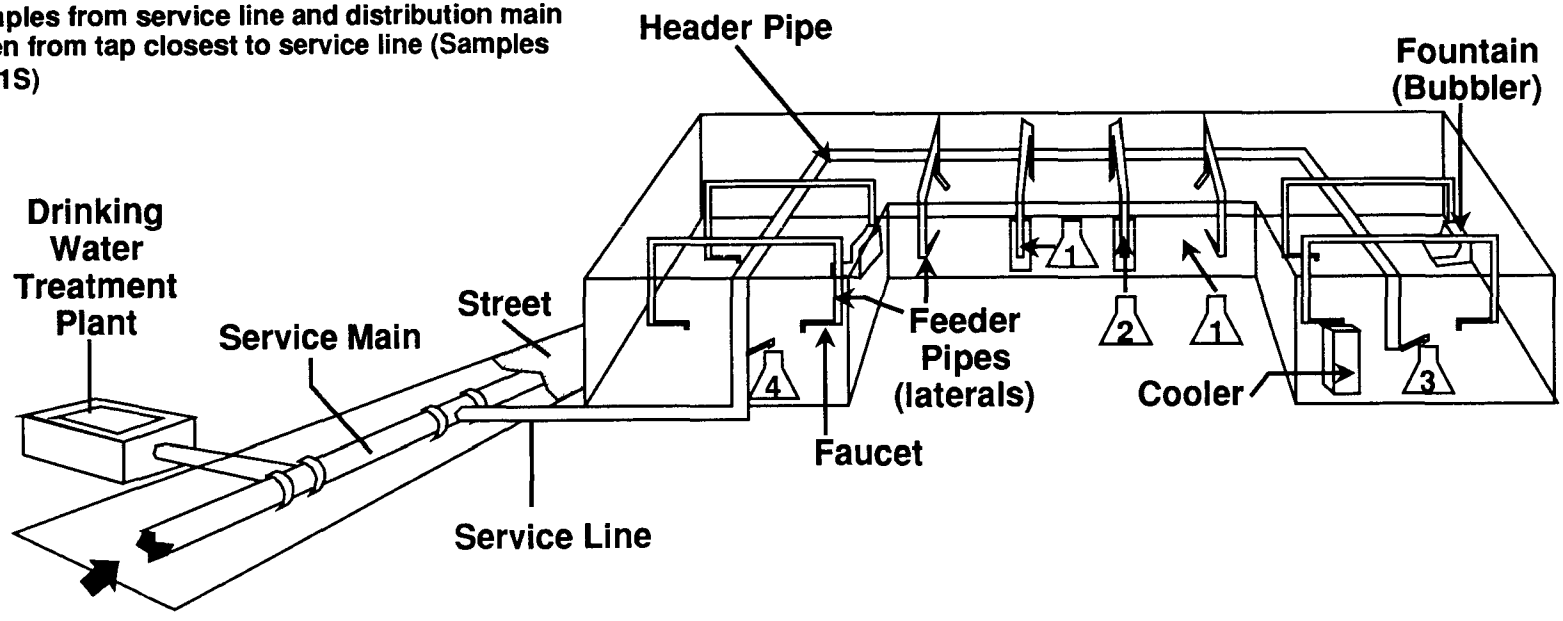
Overall Sampling Strategy



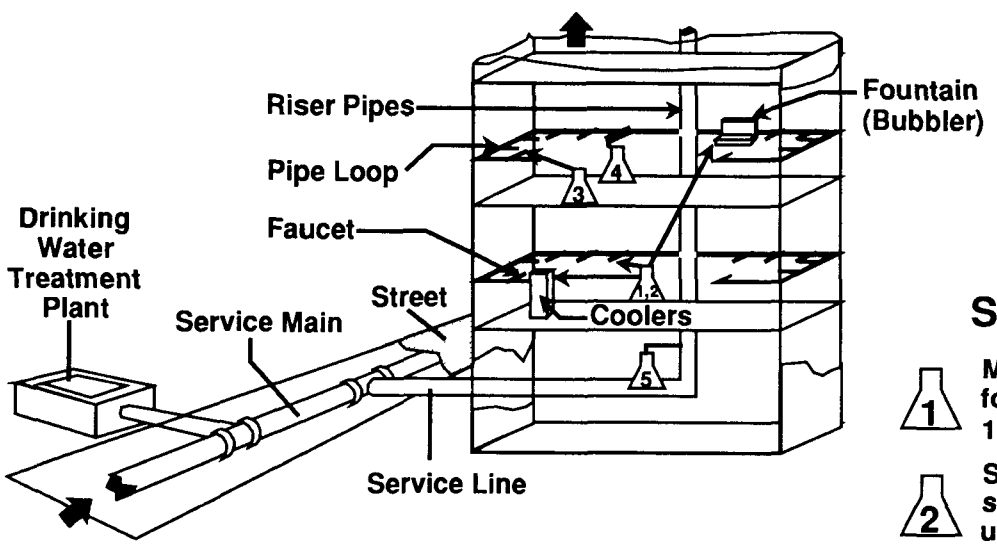
Single-Level Building

Single Level Building Suggested Sample Sites

1. Morning first draw from coolers, taps, fountains, etc. (Screening Samples 1A, 1B, 1C, 1D, 1E, 1F)
2. Samples from lateral after 30 second flush from designated outlet (Follow-up Samples 2A, 2E, 2F, 2G)
3. Sample from header pipe taken from tap farthest from service line (Sample 1H)
4. Samples from service line and distribution main taken from tap closest to service line (Samples 1K, 1S)



High Rise Building



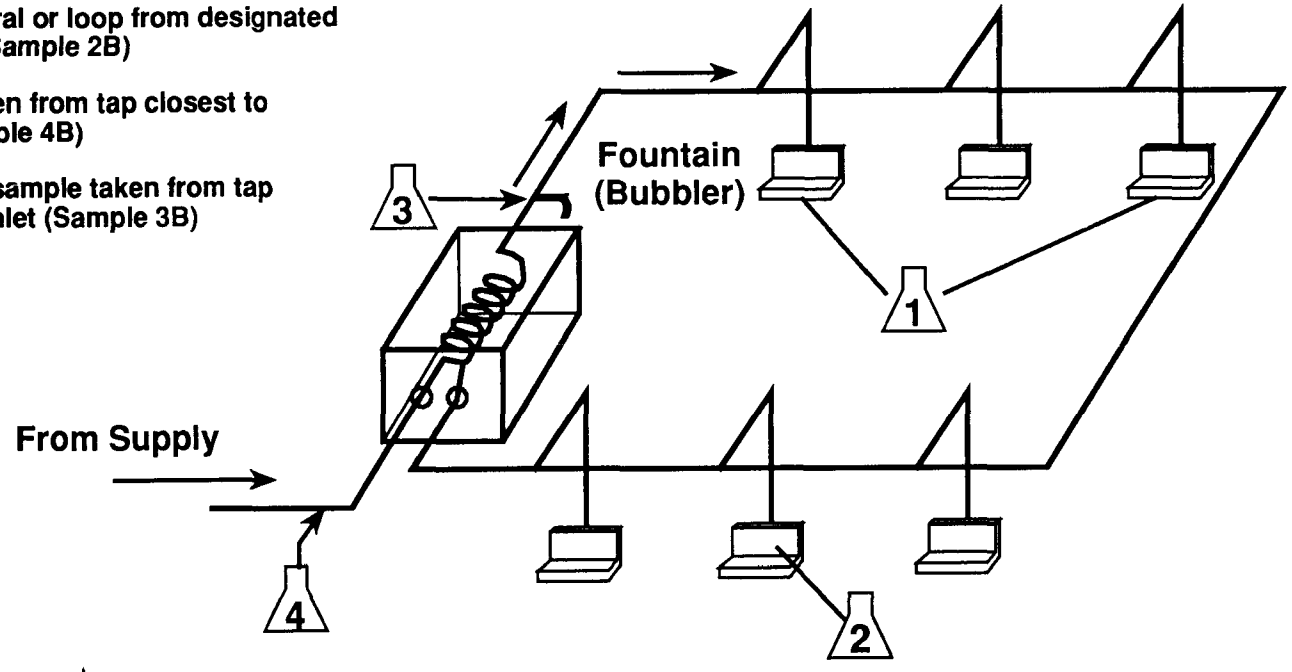
High Rise Building Suggested Sample Sites

- 1 — Morning first draw from coolers, taps, fountains, etc. (Screening Samples 1A, 1B, 1C, 1D, 1E, 1F)
- 2 — Samples from lateral or loop - tap after a 30 second flush from designated outlet (Follow-up Samples 2A, 2E, 2F, 2G)
- 3 — Sample from loop taken from tap farthest from riser pipe (Sample 1I)
- 4 — Riser pipe sample taken from tap closest to riser pipe (Sample 1J)
- 5 — Samples from service line and distribution main taken from tap closest to service line (Samples 1K, 1S)

Water Supply to Water Fountain and Bubblers from Central Chiller

Suggested Sample Sites

1. Morning first draw from coolers, taps, fountains, etc. (Screening Samples 1B)
2. Samples from lateral or loop from designated outlet (Follow-up Sample 2B)
3. Chiller sample taken from tap closest to chiller outlet (Sample 4B)
4. Interior plumbing sample taken from tap closest to chiller inlet (Sample 3B)



Record of Sampling

Name of Building_____

Contact Person for this report_____

Initial Screening Samples

Sample #	Type of Outlet	Mfg/Model Serial #	Date Installed	Location	Date Collected	Time:	Lead ppb

Record of Follow-up Sampling

Name of Building_____

Contact Person for this report_____

Follow-up Samples

Sample #	Type of Outlet	Mfg/Model Serial #	Date Installed	Location	Date Collected	Time:	Lead ppb