Section 2 Preliminary Assessment and General Testing Strategy

Now that you understand the potential dangers of lead contamination in drinking water and about the laws and programs in place to address this problem, it is time to consider assessing what steps you might take in your facility to identify and correct any sources of lead. The testing protocol EPA recommends that you undertake includes such activities as:

(1) Development of a plumbing profile.

(2) Development of a sampling plan.

(3) Conduct of initial and follow-up sampling and analysis of test results.

(4) Determination of interim and long-term remedies.

(5) Communication of lead testing results and, if applicable, corrective measures to the building community.

The first two activities can be considered part of the planning or building assessment stage and are described in this section. Steps 3 and 4 involve testing and correction of problems and are described in greater detail in the next two sections; the testing protocol for various types of drinking water outlets is presented in Part 2 of this document. Finally, Step 5 represents a communication activity to let those members of your building community know what you are doing to protect them from possible exposure to lead in drinking water. This subject is discussed in Section 5 of this Part.

Development of a Plumbing Profile

Before testing and correcting lead problems, it is useful to assess the factors that can contribute to lead contamination and the extent to which contamination might occur in your facility. You can best accomplish these objectives by developing a plumbing profile of your building. Conducting a survey of your building's plumbing will enable you to:

- Understand whether you may have a widespread contamination problem or only localized concerns.
- Identify and prioritize sample sites.
- Plan, establish, and prioritize remedial actions, as necessary.

Exhibit 5 consists of a questionnaire that has been designed to help you plan your testing strategy. Planning your strategy will enable you to conduct testing in a cost-efficient manner. Exhibit 6 provides interpretations of possible answers to the questionnaire to aid you in developing your sampling plan. The extent to which all questions can be answered will greatly aid you in carrying out your sampling program.

Exhibit 5 Sample Plumbing Profile Questionnaire

Sample Plumbing Profile Questionnaire

The following questionnaire will help you determine whether lead is likely to be a problem in your facility and, if so, whether these problems are likely to be localized or widespread. These determinations will enable you to prioritize your sampling effort based on those outlets you believe to pose the greatest risks. The significance of your answers to these questions is discussed in Exhibit 6 entitled, *What Your Answers to the Plumbing Profile Mean.*

(1) When was the building constructed?

(2) After the construction of the original building, were any new buildings or additions added? If so, when? If built since 1986, were lead-free plumbing and solder used in accordance with the lead-free requirements of the 1986 Safe Drinking Water Act?

(3) When were the most recent plumbing repairs made (note locations)?

(4) With what materials is the service connector made?

(5) Specifically, what are the potable water pipes made of in your facility (note the locations)?

Lead	Plastic
Galvanized Metal	Brass
Copper	Other

(6) What materials do the solders connecting the potable water pipes in your system contain (note locations with lead solder)?

(7) Are brass fittings, faucets, or valves used in your drinking water system (note the locations)?

(8) How many of the following outlets provide water for consumption (note the locations)?

Water Coolers	Bubbler
Ice Makers	Kitchen Taps

(9) What brands and models of water coolers currently provide water in your facility (note the locations)?

(10) Do the faucets have accessible screens (note locations)?

(11) Have these screens been cleaned (note locations)?

(12) Can you detect signs of corrosion, such as frequent leaks, rust-colored water, or stained dishes or laundry?

(13) Is any electrical equipment grounded to water pipes (note locations)?

(14) Have there been any complaints about bad (metallic) taste?

(15) Check building files to determine whether any water samples have been taken from your building for any contaminants (check with your public water supplier).

Name of contaminant(s)?
Were samples tested for lead?
What concentrations of lead were found?
What is the pH level of the water?
Is testing done regularly at your facility?

(16) Who supplies your facility's drinking water?

If your facility purchases its water, you should ask your public water supplier:

- Is the water supply in compliance with Federal and State standards for lead?
- What are the results of the system's tap water sampling efforts?
- Have 10 percent or more of these samples exceeded EPA's action level for systems of 15 ppb?
- What is the system doing to minimize corrosion?
- Are the system's treatment practices likely to have resulted in a protective coating being formed on the inside of water pipes in your facility?
- Does the water distribution system have any lead piping, and does the system plan to remove these sources of lead?

If your facility owns or operates its own water supply, ask the treatment operator:

- Is the supply in compliance with current Federal and State standards for lead?
- What tap samples have been taken for lead?
- What were the results of tap sampling and are there problems?
- Is the water being treated to minimize corrosion?
- For what other conditions is the water being treated?

Exhibit 6 What Your Answers to the Plumbing Profile Mean

What Your Answers to the Plumbing Profile Mean

This exhibit discusses the significance of possible answers to the plumbing profile questionnaire appearing in Exhibit 5. This discussion illustrates that a variety of factors affect the extent of lead contamination including: (1) the corrosiveness of the water supply; (2) the amount of lead contained in the plumbing, taps, or outlets dispensing water (i.e., age and condition of the plumbing); (3) the contact time between the water and the materials containing lead; and (4) whether electrical systems are grounded to water pipes.

(1) When was the building constructed?

Old Buildings—Up through the early 1900s, 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. Up until the mid- to late-1980s (until the lead-free requirements of the 1986 Safe Drinking Water Act took effect), lead solders were typically used to join these copper pipes. The efforts of your public water supplier over the years to minimize the corrosiveness of the water may have resulted in mineral deposits forming a coating on the inside of the water pipes (scaling). This coating insulates the water from the plumbing and results in decreased lead levels in water. If the coating does not exist or is disturbed, the water is in direct contact with the lead in the plumbing system.

(2) Are there any new buildings or additions? If so, when were they built? Were lead-free plumbing and solder used?

New Buildings—New buildings are not likely to have lead pipes in their plumbing systems, but they are very likely to have copper pipes with solder joints. Buildings constructed prior to the late 1980s, before the lead-free requirements of the 1986 Safe Drinking Water Act, are likely to have joints made of lead solder. Buildings constructed after this period should have joints made of lead-free solders. You should question the solders used by plumbers who make repairs or additions to your facility. Report any violations of the lead-free requirements to your local plumbing inspector or to the state drinking water program. Furthermore, insist that any lead materials installed be replaced by lead-free materials.

Some brass faucets, fittings, and valves, although they contain less than 8 percent lead in the alloy as required under the SDWA, can contribute a significant amount of lead to drinking water. *See a more detailed discussion of this issue under the response to Question 7. Request lead leaching test results from the distributor or manufacturer before purchasing any brass plumbing materials.*

If lead-free materials were not used in new construction and/or plumbing repairs, very high lead levels can be produced. If the water is non-corrosive, scaling may have occurred (or be occurring) and will minimize lead exposure. However, if the mineral coating does not exist, the lead is in direct contact with the water.

(3) When were the most recent plumbing repairs made?

Corrosion occurs (1) as a reaction between the water and the pipes and (2) as a reaction between the copper and solder (metal-to-metal). This latter reaction is known as galvanic corrosion. The reaction can be vigorous in new piping. If lead solders were used in the piping or some brass faucets, valves and fittings containing alloys of lead were installed *(see response to Question 7 below for a further discussion of the brass issue)*, lead levels in the water may be high. After about 5 years, however, this type of reaction slows down and lead gets into water mainly as a result of water being corrosive. If the water is non-corrosive, scaling is likely to have occurred and to have reduced opportunities for lead to get into the water supply.

For these reasons, if the building (or an addition, new plumbing, or repair) is less than 5 years old and lead solder or other materials (e.g., brass faucets containing lead alloys) were used, you may have elevated lead levels. **If water supplied to the building is corrosive, lead can remain a problem regardless of the plumbing's age.**

(4) Of what materials is the service connector constructed?

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 a building. Some localities actually required the use of lead service connectors up until the lead-free requirements of the 1986 Safe Drinking Water Act took effect. Although a protective layering of minerals may have formed on these pipes, vibrations can cause flaking of any protective build-up and, thus, allow lead contamination to occur.

(5) What materials are used in your facility's water pipes? and

(6) What materials compose the solder connecting your pipes?

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:

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

Galvanized metal pipes are gray or silver-gray in color 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.

Copper pipes are red-brown in color. Corroded portions may show green deposits. Copper pipe joints were typically joined together with lead solders until the lead-free requirements of the 1986 Safe Drinking Water Act took effect. Full implementation of these lead-free requirements 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 NSF International standards and are free of plasticizers that contain lead. *(Note: NSF International is an independent, third-party testing organization; copies of NSF International standards can be obtained by writing NSF International, 3475 Plymouth Road, P.O. Box 1468, Ann Arbor, MI 48106.)*

(7) Any brass fittings, faucets, or valves?

Brass pipes, fittings, faucets, and valves are golden yellow in color, similar to copper in appearance, or 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. While this percentage is considered lead-free under the 1986 Safe Drinking Water Act, some contamination problems still may occur. In addition, some older brass faucets may contain higher percentages of lead and lead solder in their interior construction and pose contamination problems.

The degree to which lead will leach from brass products containing alloys with less than 8 percent lead is dependent upon the corrosiveness of the water and the manufacturing process used to develop the product. A recent study comparing the lead leaching performance of several faucets manufactured under different processes and having various lead contents revealed that fabricated faucets tend to contribute less lead to the water than faucets manufactured by the permanent mold process, regardless of the amount of lead in the alloy.

EPA is working with industry and a private, third-party testing organization toward the development of a voluntary industry standard on this issue that would result in minimal amounts of lead being leached from these products. If you purchase any brass plumbing products, ask the distributor or manufacturer to provide information about tests it has performed on the product. Refrain from buying any product from a manufacturer that is unwilling to provide the testing information.

(8) What types of drinking water outlets are located in your facility?

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

(9) What are the brand and model of the water coolers?

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 are to repair, replace, or recall these coolers. 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 that may come into contact with drinking water are not to contain more than 8 percent lead. In addition, the law attaches criminal and civil penalties for the manufacture and sale of water coolers containing lead.

The CPSC negotiated an agreement with Halsey Taylor through a consent order agreement published in June 1990 to provide a replacement or refund program that addresses all the water coolers listed by EPA as having lead-lined tanks. Halsey Taylor was the only company identified by EPA as manufacturing some water coolers with lead-lined tanks.

See Appendix C of this manual for a summary of EPA's list 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, do not use the water for drinking and sample the water immediately *(see page 63 for sampling instructions)* as these coolers pose the highest risk of contamination.

(10) Do the faucets have accessible screens? and

(11) Have the screens been cleaned?

Lead-containing sediments that 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.

(12) Are there signs of corrosion?

Frequent leaks, rust colored water, and stains on fixtures, dishes, and laundry are signs of corrosive water. 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.

(13) 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 traveling through the ground wire will accelerate the corrosion of any 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 on this matter. Your State or local building code may require grounding of the wires to the water pipes. Improper grounding of electrical equipment may cause severe shock.

(14) 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.

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(14) 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.

(15) When was the water in your building last tested for contaminants, if ever?

Results of analyses of water quality, such as measures of pH, calcium hardness, and carbonate alkalinity, can provide important clues about the corrosiveness of the water. If your facility owns or operates its own water supply, such test results can help you decide on effective treatment approaches. 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 upon your water quality conditions.

If your facility purchases its water, contact your public water supplier to find out what they are doing to comply with the National Primary Drinking Water Regulation for lead. *See also the response to Question 16 below for further information.* It is important to know whether and how the water entering your facility is treated. Some kinds of treatment can make the water more corrosive, while others will reduce the problem. Treatment of 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.

(16) Who supplies your facility's drinking water?
Answers to the types of questions included on the plumbing profile questionnaire will give you an idea of the type of water you are receiving. From this assessment, you will then have a better sense of how to organize your testing activities.

If your facility purchases its water, contact your public water supplier to:

- Find out whether the system is in compliance with Federal and State lead requirements.
- Learn the results of the system's latest tap water sampling efforts and whether 10 percent or more of these samples have exceeded EPA's action level of 15 ppb (i.e., what are the typical lead levels in water being delivered throughout the community).
- Learn what activities the system employs to minimize the corrosiveness of the water supply; identify what type of water you might be receiving in your facility (e.g., is it corrosive or non-corrosive water? Is the water soft or acidic?).

- Learn whether protective coatings are likely to have formed on the inside of your plumbing based on the treatment practices of the public water supplier. Identify whether the water distribution system contains lead pipes and whether/when the water system plans to remove these lead materials.

If your facility owns or operates its own water supply, you should already be aware of your legal requirements to control corrosion and minimize lead at the tap. If you are uncertain of your responsibilities, contact your State drinking water program *(see Appendix A for a directory of State programs)*. Some of the questions you might pose to the treatment operator include:

- Is the system in compliance with Federal and State requirements for lead?
- Where were tap water samples collected in the building, and what are the results of this sampling effort?
- Does the facility have a lead problem on the basis of the tap water samples?
- Is the water system being treated for corrosion purposes? Are there any other types of treatment being pursued that could contribute to lead getting into the water supply?

After reviewing the plumbing profile questionnaire and background regarding what your answers to the profile could mean (Exhibits 5 and 6), you have learned that lead contamination may not occur uniformly throughout a building. Large variations in lead concentrations may be found among individual outlets in a facility because of differences in flow rates and/or building materials.

In general, you can expect **widespread lead contamination** in your drinking water when:

- The building's plumbing is less than 5 years old and lead solder was illegally used (i.e., after the "lead-free" requirements of the 1986 Safe Drinking Water Act took effect).
- Brass fittings, faucets, and valves were installed throughout the building less than 1 year ago (even though they may contain less than 8 percent lead as required under the lead-free requirements of the Safe Drinking Water Act).
- The water is corrosive.
- Sediment in the plumbing and screens contains lead.
- Lead pipes are used throughout the building.
- The service connector (i.e., the pipe that carries water from the public water system main to the building) is made of lead.

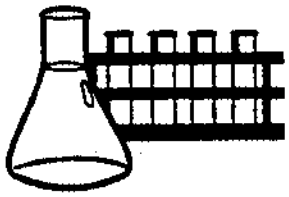
In general, you can expect **localized contamination** if:

- The water is non-corrosive.
- Lead pipes are used in some locations.
- Some brass fittings, faucets, and valves have been installed in the last year (even though they may contain less than 8 percent lead).
- Numerous lead solder joints were installed in short sections of pipe before 1986 or were illegally installed after 1986 (i.e., after the lead-free requirements of the Safe Drinking Water Act took effect).
- There are areas in the building's plumbing with low flow or infrequent use.
- Sediment in the plumbing and screens at isolated locations contains lead.
- Some water coolers have lead parts or contain lead-lined tanks *(consult Appendix C for a discussion of the water cooler issue and EPA's listing of coolers)*.

Development of a Sampling Plan

After identifying potential problem areas in your facility, through completion of a plumbing profile, the next step is to have the water tested. Testing is the only sure way to know whether lead is a problem in your facility. However, it is first useful to develop a sampling plan before embarking on the actual testing. The sampling plan activity will enable you to approach taking water samples in a systematic fashion. Key issues to consider in devising a sampling plan include the following:

- Who will be in charge of the sampling effort?
- Who will collect and analyze samples and maintain records?
- Where will the samples be taken?



Leadership for Sampling Effort

It is important to designate a leader to take full responsibility of the sampling program and to ensure that it is conducted properly. If outside consultants or laboratory representatives are used to conduct testing, you must first ensure that they understand and are knowledgeable of the testing protocol described in this manual. Contact your State or local health department or drinking water program if you need advice on how to identify a reputable consultant.

Collection and Analysis of Samples and Recordkeeping Requirements

Deciding who will collect samples will be based, in part, on who will analyze the samples. Some State drinking water programs or public water suppliers may provide both services, although there is no requirement that they do so. In general, most facilities will need to contract with an analytical laboratory to conduct analyses of any samples collected. There are some important considerations when hiring a laboratory. First, the laboratory should be certified by the State or EPA to conduct drinking water analyses. Contact your State drinking water program *(Appendix A)* or EPA's Safe Drinking Water Hotline *(Appendix D)* for a list of certified labs in your area. Once you have identified possible laboratories, consider the following issues prior to making a selection:

- Will the lab take samples for you or will they provide training and sample containers for collectors designated by you? If you will use your own sample collectors, be certain to secure sample training from the laboratory to ensure that your test results will be reliable. Testing activities can be useless if sample collectors do not follow proper sampling procedures.

- What is the lab's knowledge of the lead testing protocol for schools and non-residential buildings? This protocol is described in the next section. Make sure laboratories thoroughly understand this protocol and do not confuse it with the lead testing protocol used by public water suppliers (for whom the labs may also work), because the two protocols are <u>different</u>. Ask the lab for references of other facilities for whom it has provided lead testing services. Contact these facilities to ascertain the quality of the lab services provided.

- What is the cost of the lab's services? Costs for laboratory analysis of samples should range between $10 and $30, depending upon the extent of the service to be provided (e.g., if only analyses are conducted or if other services such as sample collection are provided). You may want to contact several labs to compare prices and services. In most cases, labs will charge less per sample if they have numerous samples to test. You might consider combining your lead testing efforts with those of another facility to secure a possible bulk analytical rate from a particular lab.

- What is the lab's time frame for providing sample results?

- What documentation will the lab provide to note sample results, and how will this material aid you in maintaining records for each outlet tested? Record keeping is a crucial activity. If lead contamination problems are found, sample records and test results will assist you in pinpointing the sources of problems. Be certain to have control over the development and maintenance of records. *Appendix E contains a sample recordkeeping form and identifies the type of information you should consider recording.*

- Establish a written agreement or contract with the laboratory for all of the services to be provided.

Although actual costs or laboratory analysis of samples may range for $10 to $30 per sample, other costs must also be considered (e.g., costs of personnel to profile the plumbing system, design the sampling plan, collect samples, and determine and implement remedies). These costs are highly site-specific and depend on a number of factors including the size of your facility, the number of drinking water outlets being tested, and technicians' salaries. One school system in New York estimated total costs for their sampling effort to range from $2,190 to $3,295 per school. This estimate assumed 40 personnel hours for every 60 samples collected and also included lab analytical costs.

Determining Sample Locations

You must decide, based on your responses to the plumbing profile and your knowledge of the facility, where to take samples and how to prioritize the sample sites. If resources for testing are limited, this is an especially crucial step. Generally, testing should be conducted at those outlets that are most likely to have contamination since they would represent the greatest hazards to human health. Samples sites that 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.
- In buildings 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).

It may be helpful to diagram the plumbing in your facility and the outlets that will require testing. The configuration of interior plumbing can vary depending on the layout of a given building. Examples of plumbing configurations for a single-level building and a multilevel building are illustrated in Exhibits 7 and 8, respectively. Locate service connectors, headers, laterals, loops, drinking water fountains (bubblers and coolers), riser pipes and different drinking water loops *(see Appendix B for a glossary of these plumbing terms)*, and decide in what order you wish to take samples.

In multistory 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 water fountains, and other outlets. For sampling purposes, water within a plumbing system moves "downstream" from the source (i.e., from the distribution main in the street through the service connection and through the building).

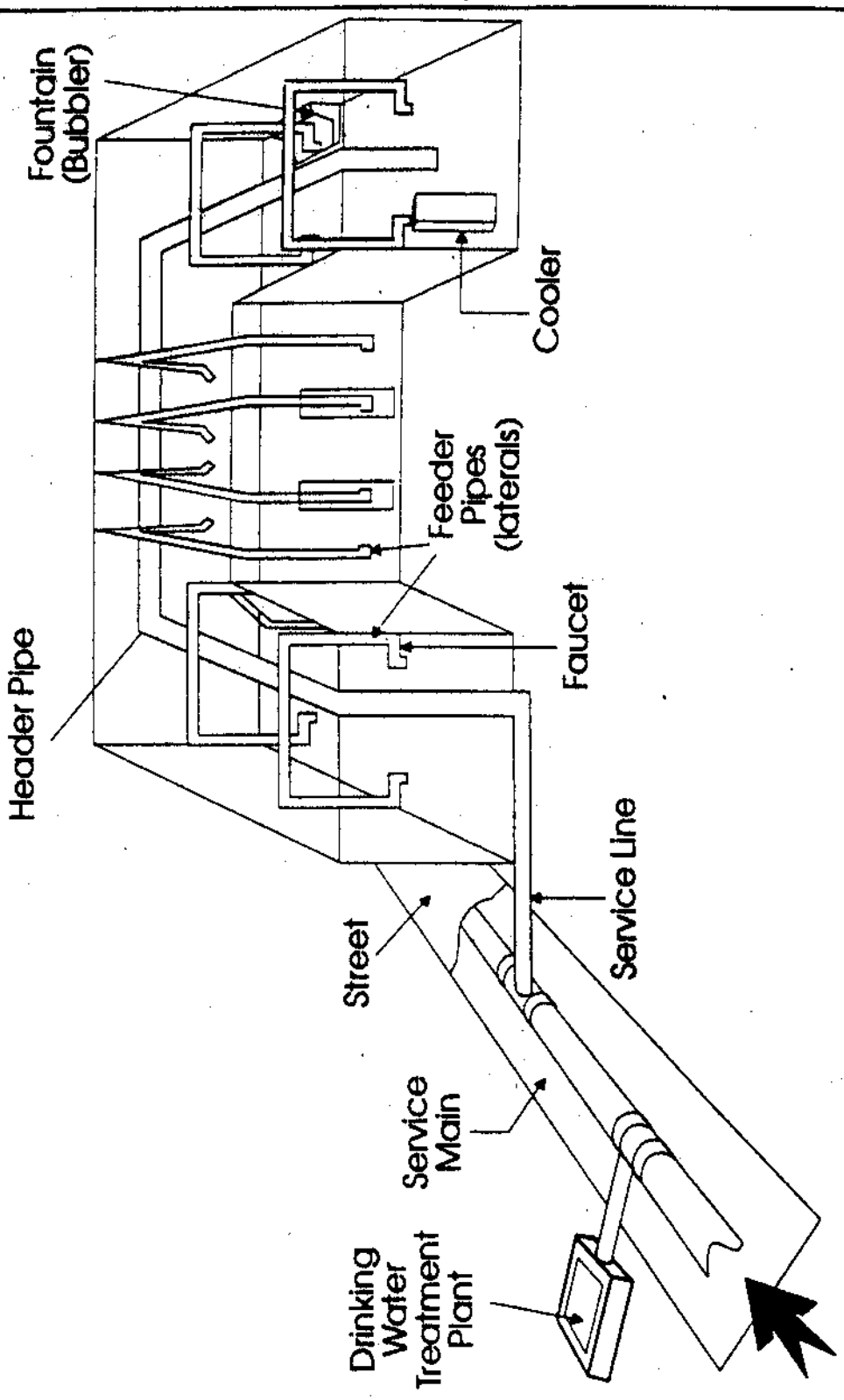


Exhibit 7 Plumbing Configuration for a Single-Level Building

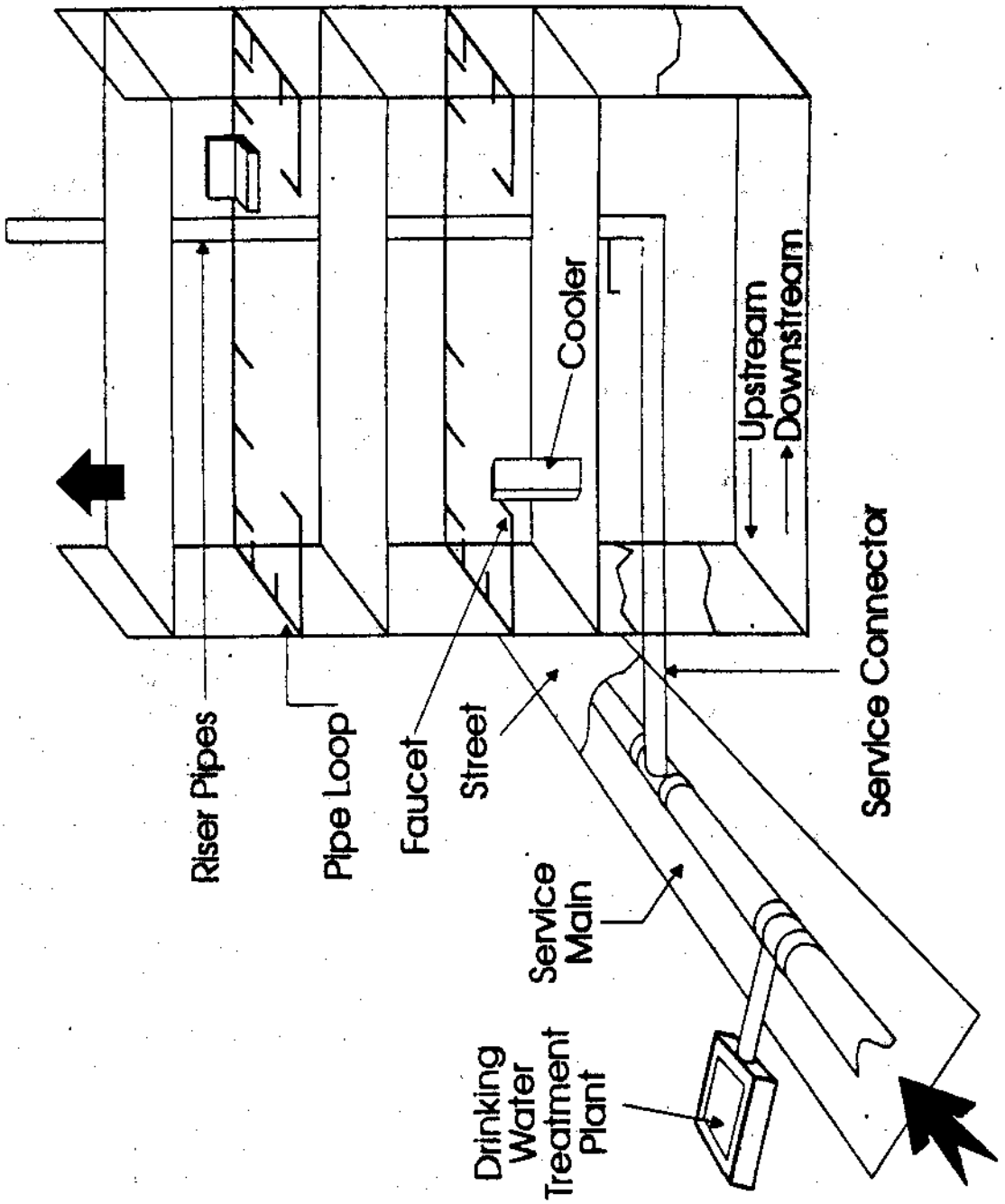


Exhibit 8 Plumbing Configuration for a Multilevel Building