# Backflow Prevention and Cross-Connection Control

# Frequently Asked Questions

**1. Why does CUB have a Backflow Prevention and Cross-Connection Control Program?**

Under the provisions of the Safe Drinking Water Act of 1974, the Federal Government has established through the EPA (Environmental Protection Agency) national standards for safe drinking water. The states are responsible for the enforcement of these standards as well as the supervision of public water supply systems and the sources of drinking water. As the water supplier in this area, CUB is held responsible for compliance to the provisions of the Safe Drinking Water Act, including a warranty that water quality provided by CUB's operation is in conformance with the EPA standards at the source and delivered to the customer without the quality being compromised as a result of its delivery through the distribution system.

The goal of CUB is to provide safe water to every customer under all foreseeable circumstances. Safeguarding the quality of water being distributed to our customers is one of our highest priorities. The Tennessee Department of Environment & Conservation (TDEC), acting as the state's agent to ensure compliance with the US EPA, requires CUB to have a formal Cross-Connection Control Program in place as a condition for the issuance of a license to operate our water system.

**2. Is CUB the only public water utility in Tennessee enforcing backflow regulations?**

No. ALL public water systems in the State of Tennessee are required to develop and implement cross-connection control programs.

**3. What is a cross-connection?**

A cross-connection is any temporary or permanent connection between a public water system or consumer's potable (i.e., drinking) water system and any source or system containing nonpotable water or other substances. An example is the piping between a public water system or consumer's potable water system and an auxiliary water system, cooling system, well, or irrigation system. Another example would be a garden hose attached to a faucet and the other end lying in a swimming pool, or drum with contaminated water **(see photos below).**

**Garden Hose Lying in a Swimming Pool.**

**Hose left in a drum filled with contaminated water.**

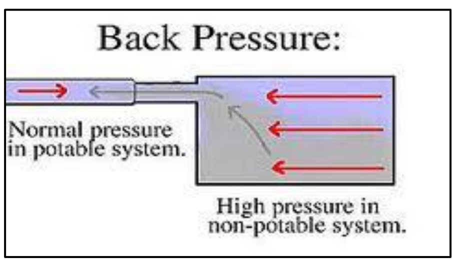
**4. What is backflow?**

Backflow is the undesirable reversal of flow of nonpotable water or other substances through a cross-connection and into the piping of a public water system or consumer's potable water system. There are two types of backflow that can reverse normal flow.



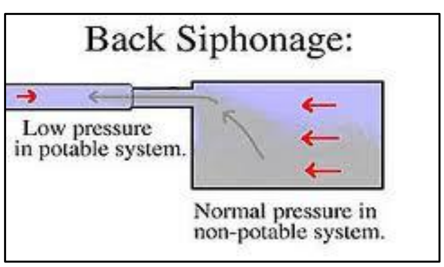
A. **<u>Back Pressure</u>**

Back Pressure is backflow caused by a downstream pressure that is greater than the upstream or supply pressure in a public water system or consumer's potable water system. Backpressure (i.e., downstream pressure that is greater than the potable water supply pressure) can result from an increase in downstream pressure, a reduction in the potable water supply pressure, or a combination of both. Increases in downstream pressure can be created by pumps, temperature increases in boilers, etc. Reductions in potable water supply pressure occur whenever the amount of water being used exceeds the amount of water being supplied, such as during water line flushing, firefighting, or breaks in water mains. This is why CUB does not allow fire hydrants with steamer connections to be installed on water mains smaller than 6 inches in diameter.



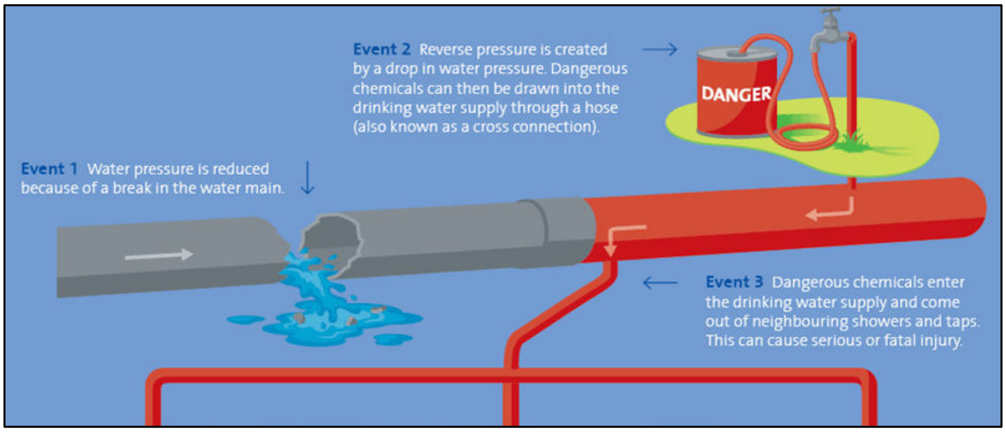

B. **<u>Back Siphonage</u>**

Back Siphonage is backflow caused by a negative pressure (i.e., a vacuum or partial vacuum) in a public water system or consumer's potable water system. The effect is similar to drinking water through a straw. Backsiphonage can occur when there is a stoppage of water supply due to nearby fire-fighting, a break in a water main, routine maintenance flushing, or any other situation that causes a significant loss in water system pressure.



### 5. Why do water system operators need to control backflow?

Backflow into a public water system can pollute or contaminate the water in that system. That is, backflow into a public water system can make the water in that system unusable or unsafe to drink, and each water supplier has a responsibility to provide water that is safe to drink under all foreseeable circumstances. Furthermore, consumers generally have absolute faith that water delivered to them through a public water system is always safe to drink. For these reasons, each water supplier must take reasonable precautions to protect its public water system against backflow.




**Dangers of Cross-Connections**

### 6. Where are backflow assemblies required?

Backflow assemblies are primarily required for commercial and industrial properties that pose a potential risk or hazard to CUB's water system. Assemblies are also required for residential or commercial fire-lines (sprinkler systems), and irrigation systems. Assemblies must be considered "approved" by TDEC and CUB.

### 7. What is an "approved" backflow prevention device or assembly?

"Approved" backflow prevention devices and assemblies are those that meet AWWA standards, and are approved by ASSE (American Society of Safety Engineers) and the University of Southern California Foundation for Cross-Connection Control and Hydraulic Research (USC-FCCC). Only devices on the USC-FCCC list are considered "approved" assemblies by TDEC and CUB. A device not on this list will not be allowed by CUB.

### 8. Are all residential homes required to have backflow assemblies?

At this time, only those residential homes that have irrigation systems, sprinkler systems, hard-piped swimming pools or jacuzzis, and any auxiliary water supplies, such as water wells, are required to have backflow assemblies on those systems.

### 9. Why are irrigation systems considered to be hazardous to the water system?

Irrigation systems include, but are not limited to agricultural, residential, and commercial applications. The TDEC classifies lawn sprinkler systems and irrigation systems as a potential "high hazard" for several reasons. Sprinklers, bubbler outlets, emitters, and other equipment are exposed to substances such as fertilizers, fecal material from pets or other animals, pesticides, and other chemical and biological contaminants. Sprinklers may remain submerged under water after use or storms. Should the water system pressure suddenly decrease, such as in the case of a water main break, line flushing, or during a major fire involving multiple fire hydrants, these harmful substances can be back-siphoned into the water distribution system. They may be subject to various on-site conditions such as additional water supplies, chemical injection, booster pumps, and elevation changes. All of these conditions must be considered when determining backflow protection. Some hazards relating to irrigation systems are:

1. Fertilizers: Ammonia salts, ammonia gas, phosphates, potassium salts.
2. Herbicides: 2,4-D, dinitrophenol, 2,4,5-T, T-pentachlorophenol, sodium chlorate, borax, sodium arsenate, methyl bromide.
3. Pesticides: TDE, BHC, lindane, TEPP, parathion, malathion, nicotine, MH, and others.
4. Fecal matter: Animal (domestic and non-domestic).

**10. What type of backflow prevention assemblies are allowed for irrigation systems?**

The appropriate protection is a Reduced Pressure Principle (RP) backflow prevention assembly. TDEC classifies irrigation systems has potential "high hazards" and therefore must have a RP backflow preventer assembly.

** Note:*

*Double Check Valve Assemblies (DCVA) are not allowed for "high hazard" situations. Irrigation systems are considered as a "high hazard" and require RP assemblies.*

*Customers should take necessary actions to ensure that their backflow prevention assembly does not get damaged during freezing temperatures.*

REDUCED PRESSURE ASSEMBLIES

**11. How do I know if I already have a backflow prevention assembly?**

Generally, the backflow prevention assembly is located as close as possible to the water service connection, but must remain on private property. Irrigation assemblies are usually installed outdoors and in a "loop" of the irrigation system itself, and extend above the ground.

**12. What if I determine that I have a backflow prevention device, but CUB has no record of its installation?**

It is a customer's responsibility to contact CUB to let them know of the installation of a backflow preventer so that the device can be inspected and tested. CUB will then place the assembly on its list for annual testing.

**13. Is my home or my business "grandfathered" in?**

There is no "grandfathering" of backflow devices which are out of compliance with current regulations. The TDEC considers backflow regulations to be a health and safety issue. These issues must be addressed in a timely manner for the safety of the public water supply and the health of our customers.

**14. How long will a backflow assembly last before it fails?**

This varies with the type and model of assembly. Most will last from 10 to 35 years. The average is about 20 years.

**15. What causes a backflow device to fail?**

The most common reason for failure is deterioration of the rubber gaskets and o-rings. This typically occurs from 5-10 years after the installation. In new devices, a piece of debris or the calcification of water can cause the device to stop working prematurely.

**16. Who is responsible for installing, testing, and repairing a backflow prevention device?**

Property <u>owners</u> are required to install, maintain, and repair backflow prevention devices. The property owner must contract from this work to be performed by a properly certified backflow Contractor and to let CUB know that the work is being done. CUB and its certified backflow contractor are then responsible for initial testing, annual testing, and re-testing.

**17. I am a tenant. Am I responsible for the installation of a backflow prevention device?**

No. Property owners, not tenants, are responsible for installing backflow prevention assemblies.

**18. How do I install a backflow prevention device?**

Installation will require the services of a licensed and certified backflow plumbing contractor.

**19. Where can I purchase a backflow prevention device?**

Your backflow contractor can provide a device or you can purchase an assembly from a plumbing supply house, and then have your contractor install. The new device must pass a test performed by CUB of its contractor immediately after the installation.

**20. How much will installations, inspections, testing, and repairs cost?**

For inspections and testing CUB has contracted with a TDEC-certified Contractor. CUB will add a small fee to the Contractors price to recover administrative cost to manage its on-going Cross-Connection Program.

Although CUB monitors the installation and maintenance of these assemblies, as required by TDEC, CUB does not have any influence or control over the contractors pricing for installations and repairs. Costs can vary from one testing contractor to another, and depend on the type, and size of the assembly. Currently the testing prices we have been quoted are averaging from $35 to $100. Repairs range from $85 or more for an assembly on a ¾ inch line to $600 for an 8" line. The cost is also dependent on several factors, including the size of the device, where the device is located, its age, the type of device, etc. You may want to call several certified testers to obtain quotes for your test. There are hundreds of approved devices. CUB is unable to provide specific costs for installations for each approved backflow device, but has developed the following price <u>estimates</u> based on average industry prices for parts and labor:

- Residential irrigation system backflow preventer: $60 to $300
- Commercial irrigation system: $500 to $2,000
- Fire-lines: $4,000-$10,000
- Small commercial buildings (1-story): $800 to $5,000.
- For small buildings (2 story) installation could cost between $3,750 and $5,500.
- For small to mid-size buildings (car washes, laundromats, and small manufacturers) installation could cost between $5,000 and $7,000.
- For mid-size buildings (office complexes, large manufacturers or department stores) installation could cost between $7,500 and $15,000.
- For large buildings (High rises, hospitals) installation could cost $15,000 or more.

CUB does not endorse, guarantee, or warrant any installation or repair work performed by contractors. All interactions between customers and contractors are private transactions between these two entities. Customers are encouraged to call several licensed and certified contractors to obtain quotes for installations and repairs.

**21. How often do I have to have my backflow assembly tested?**

The TDEC requires that all backflow assemblies be tested at least annually, or every 12 months. Backflow devices are mechanical devices with working internal pieces. Backflow assemblies, like all mechanical assemblies, are subject to failure which is why TDEC (and therefore CUB) requires that they be tested at least once a year. In addition, newly installed backflow assemblies, and backflow assemblies that are repaired or relocated must also be tested.

**22. Will I receive notification when my device will be tested?**

CUB's contractor will generally notify customers of when they plan to test their particular device or devices. Such testing will occur on each device every 12 months, at about the same time each year. New devices will be tested once the installation is complete. Repaired devices must be re-tested following each repair. CUB tracks the backflow assembly information in its database to ensure each device is tested annually.

**23. Will I get a copy of the test report for my device?**

CUB's contractor will send a copy of the test report of the customer's backflow prevention assembly to CUB and will leave a copy of the test results with the customer for their records.

**24. What happens if my backflow assembly fails the test?**

If your assembly fails the test, you should make arrangements to have the assembly repaired or replaced as required and in a timely manner. CUB's contractor will then re-test the repaired device to ensure it is functioning properly. Neither CUB nor its contractor repair devices. Repairs are the responsibility of the property owner. Customers are encouraged to call several licensed and certified contractors to obtain quotes for repairs.

CUB does not endorse, guarantee, or warrant any installation or repair work performed by contractors. All interactions between customers and contractors are private transactions between these two entities.

**25. Are any other devices that can be used for residential homes?**

Yes – Outdoor faucets and hose bibs that have threaded connections where a garden hose can be attached can be protected by using a frost-proof automatic draining outdoor faucet with built in backflow preventer or by the use of a screw on hose connection vacuum breaker (HVB) that can be purchased at local hardware or home supply stores. A HVB will be required for residential homes that have swimming pools or Jacuzzis that are not hard-piped. HVB's do not have to be tested by a contractor each year. However, if a swimming pool or Jacuzzi is hard piped and connected to CUB's water supply then a RP backflow preventer assembly is required.

**Outdoor faucets with built in backflow protection**

**Screw on type Hose Bibb Vacuum Breakers**

***Note: Customers should take necessary actions to ensure that their backflow prevention device or plumbing does not get damaged during freezing temperatures.*

**26. Why are hose connection vacuum breakers (HVB's) on faucets and hose bibbs needed?**

Backflow can occur either by back siphoning or back pressure from garden hoses. To prevent this, hose bibbs or faucets that are connected to a municipal water supply must be equipped with hose connection vacuum breakers (HVB's) to prevent water in the hose from moving back into the water supply.

Backflow can occur due to siphoning if the pressure in the water supply suddenly drops to a low level. This can happen if the municipal water pumping system fails, a municipal water line breaks or when fire trucks pump from fire hydrants. In each of these cases, the pressure in the water supply lines may drop below atmospheric pressure as the lines drain, creating a vacuum which can pull water (and any pollutants or contaminants) from a garden hose into the water supply lines.

Backflow can also occur due to back pressure if the pressure in a garden hose exceeds that in the supply pipeline. This can occur if pumps such as chemical injectors are connected to the garden hose. **<u>Backflow due to back pressure can also occur even when pumps are not used</u>.** For example, if a spray nozzle which can be shut off is used on the end of the garden hose, and that spray nozzle is closed but the faucet is left open, the pressure in the hose will equilibrate with the water supply pressure, and the hose will expand in response to the supply pressure. However, a sudden large water usage in the house or at another location can cause the supply pressure to drop. This will cause the hose to contract, forcing water from the hose back into the municipal supply. Pressure can also build up in a pressurized hose if air is trapped in the hose and then expands as it heats in the sun. This pressure buildup can force water from the hose backwards into the water supply pipelines. Hose connection vacuum breakers will prevent backflow from occurring from these sources by opening to relieve the pressure build-up as soon as the pressure in the hose becomes greater than the supply pressure.

A HVB is a small valve assembly that protects an individual water outlet (see pictures below). They are simple to install by threading the assembly onto the male hose threads of the faucet or hose bibb. HVB's are normally constructed of brass with hose threaded connectors. They are relatively inexpensive, costing approximately $5 - $10 and are available at most hardware home supply stores. They must be ASSE approved and customers should ensure that the ASSE letters are stamped on the backflow prevention device.

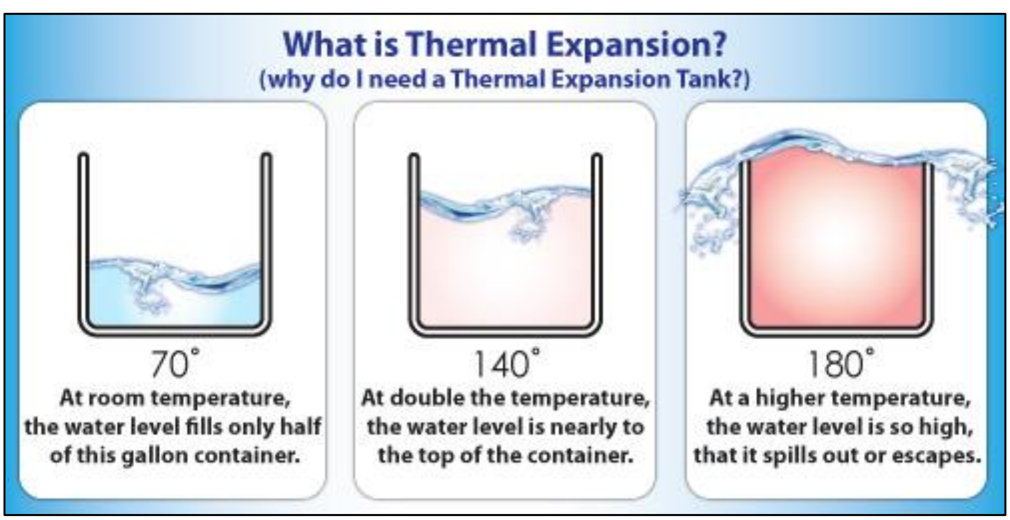
HVB's are easy to install and maintain. They work by venting water to the atmosphere when backflow conditions occur. Because they are simple, spring-operated devices, little maintenance should be required. HVB's should be inspected periodically to ensure that they are working properly. These simple checks for proper operation can readily be made each time the system is used: check for leaks while the system is operating and check for proper operation of the check valve and atmospheric vent whenever the system is shut off. With little maintenance, HVB's should provide several years of reliable service, preventing backflow of water and pollutants from garden hoses back to the water supply.

**Note: An HBV is not a substitute for, nor should it be used for backflow prevention for in-ground irrigation systems.*

***Note: Customers should take necessary actions to ensure that their backflow prevention device or plumbing does not get damaged during freezing temperatures.*

**27. What is Thermal Expansion & how is it related to backflow devices?**

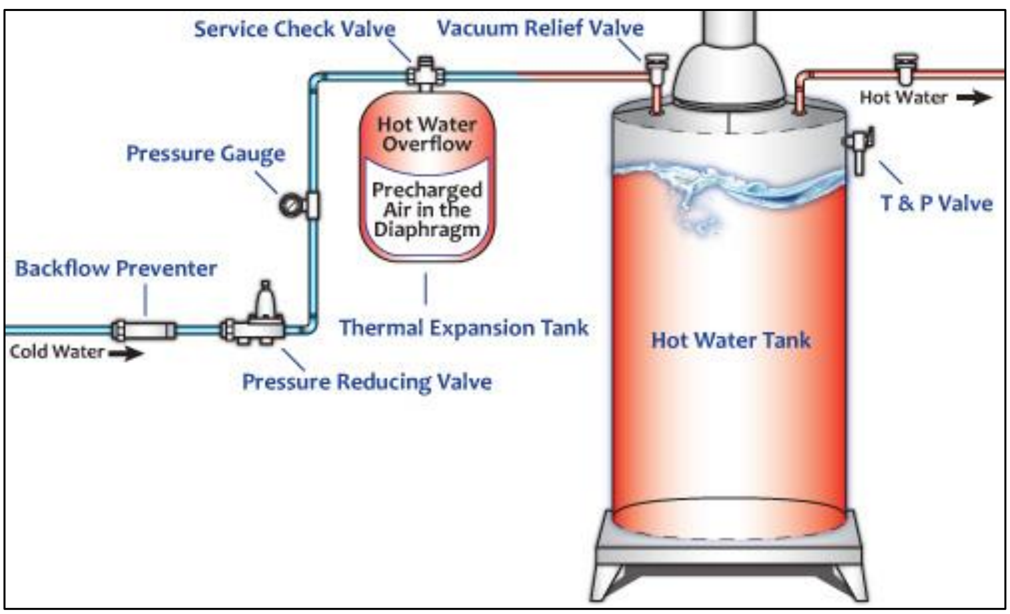
When water is heated it expands. For example, water heated from 90ºF to a thermostat setting of 140ºF in a typical 40 gallon hot water heater will expand by almost one-half gallon. This is because when water is heated, its density decreases and its volume expands. Since water is not compressible, the extra volume created by expansion must go someplace. During no-flow periods in a system, pressure reducing valves, backflow preventers, and other one-way valves are closed, thus eliminating a path for expanded water to flow back to the system supply. Hence, pressure in the private water system increases.



Before a backflow protection device was in installed, your hot water heater warmed the water in the tank causing it to expand and this “thermal expansion” caused the water to be pushed back into the public water supply. This is an example of backflow, which cannot be allowed to occur.

If your plumbing system is weak from age or faulty by installation, it could leak or otherwise fail once the system is “closed” by installation of a backflow device. Thermal expansion of water in a closed plumbing system can create a number of annoying and potentially dangerous problems. These include: the build-up of unusually high pressure in a system (even when a pressure reducing valve is installed); pressure surges; and the chronic or continuous dripping of a temperature and pressure (T&P) relief valve. A T&P valve, also commonly referred to as a “pop off” valve, is located on a customer’s hot water tank. It operates to relieve the pressure build-up in the tank, and the result of its operation is water on the floor at the water heater. Also, dripping faucets and leaking toilet tank ball cock fill valves are also symptomatic of thermal expansion.

Although most customers will never experience these problems, CUB strongly encourages its customers to ensure private plumbing systems are up to current building code standards, and to consult a certified plumber if they have any doubts about their plumbing’s condition. A plumber may recommend the installation of a thermal expansion tank, near their hot water heater, to relieve thermal expansion if a customer is experiencing plumbing problems such as those described above.




**Typical residential setup showing location of Thermal Expansion Tank**

## CASE HISTORIES OF CROSS-CONNECTION PROBLEMS

Outlined below are a few backflow incidences that have occurred in Tennessee in recent years. These are given as examples of contamination problems both to those within the customers' premises and the public depending upon the public supply. Many other examples can be found in newspapers and technical publications. Those interested in other case histories are referred to various AWWA publications, EPA's Cross-Connection Control Manual, USC Foundation for Cross-Connection Control and Hydraulic Research Manual, and to the publications distributed by various vendors of backflow prevention assemblies.

### 1. Lead Poisoning in Memphis

In Memphis in 1983, several employees at a battery plant suffered lead poisoning and were unable to work for an extended period of time after drinking water from the plant's drinking fountains. Investigations revealed that a small line had been connected between the plant's potable water line and a slurry wash-down pump for priming the pump. This line was installed around and over-the-top (air gap separation) to a tank used in priming the pump because of operational problems of the controls. The plant's entire potable water system was contaminated with lead but a reduced pressure backflow preventer on the service line prevented the contamination from entering the Memphis Light Gas and Water public water supply mains. This establishment had been previously visited and was required to install a reduced pressure backflow preventer (RP) assembly on the service line entering the premises, as well as internal protective measures.

After this instance, the Memphis cross-connection inspectors required a RP on the internal line serving the plant's manufacturing areas for the protection of the plant's potable water supply. All of the internal water lines and water fixtures were required to be replaced.

### 2. Backflow at Roane State Community College

In January 1977, several students at Roane State Community College located at Rockwood, Tennessee complained of bad taste and a burning sensation after drinking water from the school's drinking fountains. Some of the students required medical attention. An investigation revealed that a valve on a ½ inch water supply line cross connected with the chilled water system had apparently been accidentally left opened allowing chemically treated water to enter the potable water lines. After the cross-connection was corrected, the school's entire water supply system was flushed extensively. It was found, however, that within less than an hour after flushing, all chlorine residual would be dissipated. After it became obvious that the school's efforts to clean the water line of the residual effects of the corrosion control inhibitor were ineffective, State Health Department personnel assisted in feeding a strong chlorine solution to the water entering the school's internal piping system. Each fixture was systematically flushed with a strong chlorine solution between 100- 200 ppm throughout the plumbing system and was allowed to stand several hours before it was expelled. This disinfection procedure was successful in burning out the chemical residuals adhering to the pipe lines and no more trouble was encountered in maintaining a free chlorine residual approximately equal to that supplied by the public water throughout the facility.

During this instance, school was dismissed for at least one day. The school, having no resident facilities, managed to operate with water being available only for the bathrooms during the cleanup period. All food available on campus was provided by catered sandwiches and snacks and only bottled drinks were available until the cleanup was finalized.

### 3. Copper Poisoning in Morristown.

Some of the workers involved in remodeling a movie theater became sick after drinking soft drinks from the soda fountain. A malfunctioning control valve on the drink dispenser allowed $CO_2$ to backflow into copper water supply lines. The water from these lines used in the drinks contained sufficient copper to cause copper poisoning.

### 4. Chlordane Contamination in Chattanooga

In 1976, a dead-end water line serving about forty-seven homes in a middle class residential neighborhood distributed water containing as high as 1,200 mg/l of chlordane. The Tennessee American Water Co. promptly disconnected those customers in the area served by the affected line and began warning the customers of the contamination problem and assisting them until cleanup efforts were completed. Tests revealed that only the customers on a dead-end line downstream of a pressure-reducing valve were affected. Cleanup required the replacement of about 4,700 feet of water main, meters and customer service lines, replacement of the customer's hot water heaters with new ones and, in some cases, replacement of internal water lines. After installation of temporary meters and reduced pressure backflow preventers, the water company flushed the internal plumbing for about eight hours each day. Flushing continued until chlordane levels of less than 3 ppb were obtained after water stood in the lines overnight. Service to some of the customers could not be restored for about four to five weeks. The chlordane apparently entered the system through a hose used to fill a 2.5-gallon garden type sprayer.

The Tennessee American Water Company handled the cleanup well from a public relations standpoint. Fortunately, the water company came through this instance without being involved in any legal suits. Cleanup operations cost several hundred thousand dollars. The Chattanooga Basin Office of the Division of Public Health, as well as the personnel of the Central Division of Laboratories, devoted themselves full time on this problem for some four to six weeks.

The fact that this backflow instance occurred within a water system where an excellent cross-connection control program was in place does not minimize the importance of an ongoing program. This occurred in a strictly residential area in spite of the water system's efforts to prevent such occurrences. The Tennessee American Water Company would have been in a precarious situation if they had not had an effective program and acted responsibly to safeguard their customers from backflow hazards so common in industries, institutions and commercial customers. This instance made the headlines, but the water system was not taken to task because they had recognized the need of an active cross-connection control program and they were actively at work trying to prevent backflow from occurring.

## 5. <u>Anti-Freeze in Tracy City and Camden</u>

A maintenance worker at a shop located behind the Tracy City Elementary School was using a garden hose with an adapter to add water to a tractor tire to which five gallons of ethylene glycol (regular automotive antifreeze) had been added. The worker left the tire unattended for a short period of time while the water was still running into the tire and returned to find the tire deflated. Fortunately, school was not in session or else the school's water supply would likely have been contaminated with heavy doses of ethylene glycol. A booster station located on the school property had apparently created a negative pressure thereby drawing the glycol into a six-inch water main.

In the winter of 1984-85, a cross-connection in a cooling tower using ethylene glycol resulted in the drinking water within a foundry located in Camden, Tennessee, becoming contaminated. This apparently only affected the plant's internal water lines without backflow entering the public water supply's mains.