Backflow Prevention and Cross-Connection Control as an Effective Risk Management Best Practice

By: National Water Specialties Company (NAWSC)
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New Jersey Water Association 2021

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The Law – New Jersey Statutes

In pertinent part, the New Jersey Safe Drinking Water Act, N.J.A.C. 7:10 (Statutory authority: N.J.S.A. 13:1D-1 et seq., 58:11-9.1 et seq., 58:11-23 et seq., and 58:12A-1 et seq, Date last amended: November 6, 2017) sets forth:

SUBCHAPTER 10. PHYSICAL CONNECTIONS AND CROSS CONNECTION CONTROL BY CONTAINMENT

7:10-10.1 Purpose and scope
7:10-10.2 General provisions and prohibitions
7:10-10.3 Approved physical connection installation requirements
7:10-10.4 Installation
7:10-10.5 Physical connection permit application and renewal procedures
7:10-10.6 Inspection and testing requirements and procedures for physical connection installations
7:10-10.7 Physical connection permit modifications; termination of physical connection permits on removal of physical connection installations
7:10-10.8 Requirements for approval as a certifying agency
7:10-10.9 Cross-connection control by containment
7:10-10.10 Requests for adjudicatory hearings

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New Jersey Statutes, continued.

SUBCHAPTER 10. PHYSICAL CONNECTIONS AND CROSS CONNECTION CONTROL BY CONTAINMENT

7:10-10.1 Purpose and scope

(a) This subchapter establishes the permit, design, and testing requirements of a backflow prevention device at facilities with physical connections between public community water systems and facilities which have sources of water which may be contaminated or of questionable or unknown quality over which the supplier of water has little or no control for the purpose of protecting the public community water system from backflow from such waters. This subchapter also establishes a framework for a public community water system to implement a cross-connection control program that would require the installation of a containment backflow prevention device at facilities with cross-connection hazards as outlined in N.J.A.C. 7:10-10.9.

(b) The requirements of this subchapter apply in conjunction with the requirements of the Plumbing Subcode of the New Jersey State Uniform Construction Code, N.J.A.C. 5:23-3.15, for the prevention of illegal plumbing cross-connections, and with any other state or local requirements for the practice or procedure known as "cross-connection control by containment" whereby a backflow prevention device may be required to protect a public community water system from contamination as a result of plumbing cross-connections, or any other cross-connections.

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New Jersey allows for Local Systems to Adopt their own individualized plan

Given the language of 7:10 – 10.9 (Cross Connection Control by Containment) – an owner of a public community water system may require any of its customers to install backflow prevention devices on the public community water system service line(s) when . . . the owner of a public community water system who requires the installation of a backflow prevention device pursuant to (a) above shall have a cross connection control plan in effect which has been developed in accordance with the United States Environmental Protection Agency's "Cross-connection Control Manual," June 1989, EPA 470/9-89 007, as revised and/or supplemented from time to time, **and which has been approved by the Department**. (emphasis added)

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Cross-Connection Defined

An arrangement allowing either a direct or indirect connection through which backflow, including backsiphonage and backpressure, can occur between the drinking water in a public water system and a system containing a source or potential source of contamination, or allowing treated water to be removed from any public water system, used for any purpose or routed through any device or pipes outside the public water system, and returned to the public water system.

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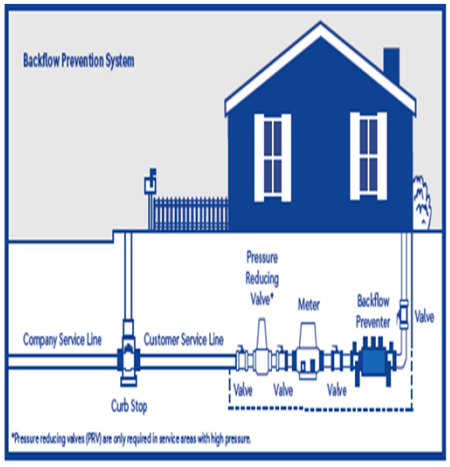
Types of Backflow - Backpressure



- **Backpressure**

- Backpressure incidents can occur when the pressure on an individual system exceeds the pressure in the distribution system, resulting in undesirable gasses or liquids being introduced into the drinking water supply.
- Some examples include:

● A car wash that re-circulates soapy water

● A manufacturing plant that uses substantial water pressure for production

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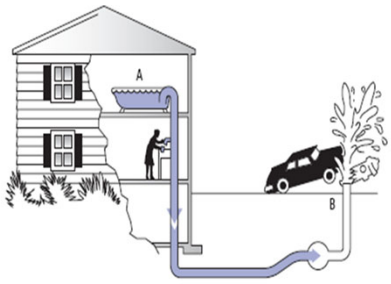
Types of Backflow - Backsiphonage



- **Backsiphonage**
- When a negative or reduced pressure is applied at a building's tap, creating the potential for contaminants to be siphoned into the drinking water system.
- A pressure change could be caused by:

● Heavy water usage on the system (i.e. fighting a large fire)

● Water main breaks

● Unauthorized use of a fire hydrant

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DEGREE OF HAZARD

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Table 630.1
Determination of Degree of Hazard
Cross-connections that meet or may meet the following conditions shall be rated at the corresponding degree of hazard.

High Hazard	Low Hazard
The contaminant would be toxic, poisonous, noxious, unhealthy, or of unknown quality.	The contaminant would only degrade the quality of the water aesthetically or impair the usefulness of the water.
A health hazard would exist.	A health hazard would not exist.
The contaminant would disrupt the service of piped water for human consumption.	The contaminant would not disrupt service of piped water for human consumption.
Backflow would be by either backpressure or backsiphonage.	Backflow would occur by backsiphonage.
Examples: lawn irrigation systems, fire sprinkler systems with chemical additives or antifreeze, sewage, used water, nonpotable water, auxiliary water systems, and mixtures of water and other liquids, gases, or other chemicals.	Examples: food residuals, coffee machines, non-carbonated beverage dispensers, and residential fire sprinkler systems constructed of materials designed for potable water flow.

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TITLE 7 OF THE NEW JERSEY ADMINISTRATIVE CODE.
APPENDIX A - FACILITIES WITH CROSS-CONNECTION HAZARDS

- The following is a list of the types of facilities which are considered as possible cross-connection hazards.
- **I. Medical Facilities**
- 1. Hospitals
- 2. Clinics
- 3. Laboratories
- 4. Veterinary hospitals/clinics
- 5. Nursing and convalescent homes
- 6. Physical therapy clinics
- 7. Morgues
- 8. Mortuaries
- 9. Autopsy facilities
- 10. Embalmers
- 11. Medical offices with radiographic, physical therapy, and/or laboratory facilities.
- **II. Treatment plants**
- 1. Sewage treatment plants
- 2. Waste water treatment plants
- 3. Industrial waste treatment plants
- 4. Pumping stations (sewage, waste water, industrial waste)
- **III. Commercial manufacturing/storage**
- 1. Automotive plants
- 2. Aircraft/Missile plants
- 3. Beverage bottling plants
- 4. Breweries/distilleries
- 5. Chemical plants (manufacturing, use, storage, treatment, disposal)
- 6. Car wash facilities (automatic or self-serve)
- 7. Dairies and cold storage plants
- 8. Metals manufacturing plant (Cleaning, processing, refining, fabricating)
- 9. Paper and paper product plants
- 10. Petroleum or gas processing or storage facilities
- 11. Photographic film processing plants
- 12. Plating plants
- 13. Power plants
- 14. Radioactive materials or substances plants or handling facilities
- 15. Rubber plants (natural or synthetic rubber production)
- 16. Sand, gravel, concrete or asphalt plants
- 17. Technical schools, colleges, and universities
- 18. Solar heating systems (direct or auxiliary)
- 19. Temporary services (street cleaners, tank trucks) using hydrants
- 20. Waterfront facilities (docks, marinas, etc.)
- 21. Food processing (manufacturing, canning, packaging)
- **IV. Buildings**
- 1. Building with sewage ejectors
- 2. Building with water booster pump and/or water storage tank
- 3. Supermarkets
- 4. Restaurants
- 5. Schools, research facilities, and any buildings with laboratories
- 6. Buildings with fire service
- 7. Warehouses used for storage of hazardous materials
- 8. Factories
- 9. Shopping malls

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Backflow Events Lead to Increased Enforcement of Cross Connection Control and Backflow Prevention Laws

Boil water advisory lifted for Sussex Borough customers in Wantage

By Eric Obernauer New Jersey Herald
Posted: May. 2, 2018 7:15 pm

A boil water advisory in effect since Monday has been lifted by the Sussex Borough Water Department. The lifting of the advisory, which had been issued for about 25 residents and businesses in the Colesville section of Wantage that receive their water from Sussex Borough, means those who were impacted may resume using tap water for drinking, cooking, and other normal activities.

The state Department of Environmental Protection had ordered the advisory Monday after a power outage and computer failure caused by a rainstorm over the weekend temporarily knocked the borough's Colesville water treatment plant offline.

As a result, the Colesville water tank -- one of two storage tanks that serve customers of the borough's water system -- saw its pressure fall to levels below those considered safe. The borough's main storage tank in Sussex Borough was not affected. Low water pressure can lead to backflow problems that can enhance the risk of bacteria and other contaminants entering the system.

At the time the boil water advisory was issued Monday, borough officials had anticipated requiring up to 48 hours for the Colesville storage tank to be refilled to a safe level. The boil water advisory was lifted Wednesday afternoon . . .

Failure in Flint: The Moral Responsibility of Public Servants

By Terry Newell

The public health crisis due to high lead levels in the water supply of Flint, Michigan has claimed many victims. The most damaged have been Flint's residents, especially its children. They could have done nothing to prevent what Governor Rick Snyder's spokesman, Dave Murray, belatedly called "a failure of government — at the local, state and federal levels." The debacle in Flint also claimed the jobs of the city's director of public works, the state's Director of Environmental Quality, the EPA regional director, and besmirched the reputation of the state-appointed emergency manager for Flint and the governor himself. The key difference here is that they *could* have prevented it. As Virginia Tech engineering professor Marc Edwards, whose dogged testing and testifying to the dangerous lead levels in Flint helped push the government finally to act, put it: "People have realized they've been lied to, and EPA knew about this, and the state knew about this. . . What you have is . . . a total loss of trust in government."

It would be comforting to view what took place in Flint as just a series of technical and scientific errors — lack of clarity about when and how to prevent the corrosion in pipes that allowed lead to leach out of them, varying views about when and how to test water quality, confusion about standards and their application. These may have been contributing factors, but the root cause of the problem in Flint was moral, not technical failure.

Such failure occurs when moral values are ignored or subordinated in decision making. In April 2014, Flint switched its water supply from the Detroit system to the Flint River, to save money in the cash-strapped, predominantly minority, economically depressed city. Residents soon began to complain about the color, taste and odor of the water as well as about rashes showing up on their children. Health concerns were repeatedly dismissed by the state. Cost savings took precedence over safety as a moral value.

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Is COVID in the water system and did COVID change anything with respect to backflow?

Food Environ Virol (2009) 1:10–14
DOI 10.1007/s12560-008-9001-6

ORIGINAL PAPER

Survival of Coronaviruses in Water and Wastewater

Patricia M. Gundy · Charles P. Gerba · Ian L. Pepper

Abstract: The advent of severe acute respiratory syndrome and its potential environmental transmission indicates the need for more information on the survival of coronavirus in water and wastewater. The survival of representative coronaviruses, feline infectious peritonitis virus, and human coronavirus 229E was determined in filtered and unfiltered tap water (39.2 and 73.4 degrees F) and waste-water (73.4 degrees F). This was compared to poliovirus 1 under the same test conditions. Inactivation of coronaviruses in the test water was highly dependent on temperature, level of organic matter, and presence of antagonistic bacteria. **The time required for the virus titer to decrease 99.9% (T99.9) shows that in tap water, coronaviruses are inactivated faster in water at 73.4 degrees F (10 days) than in water at 39.2 degrees F (>100 days). Coronaviruses die off rapidly in wastewater, with T99.9 values of between 2 and 4 days**. Poliovirus survived longer than coronaviruses in all test waters, except the 39.2 degrees F tap water. (University of Arizona, Published 2008)

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Is COVID in the water system and did COVID change anything with respect to backflow?

ELSEVIER

Water Research

Volume 43, Issue 7, April 2009, Pages 1893-1898

Survival of surrogate coronaviruses in water

Lisa Casanova [a], William A. Rutala [b], David J. Weber [b], Mark D. Sobsey [a]

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https://doi.org/10.1016/j.watres.2009.02.002

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Abstract

The emergence of a previously unknown coronavirus infection, Severe Acute Respiratory Syndrome (SARS), demonstrated that fecally contaminated liquid droplets are a potential vehicle for the spread of a respiratory virus to large numbers of people. To assess potential risks from this pathway, there is a need for surrogates for SARS coronavirus to provide representative data on viral survival in contaminated water. This study evaluated survival of two surrogate coronaviruses, transmissible gastroenteritis (TGEV) and mouse hepatitis (MHV). These viruses remained infectious in water and sewage for days to weeks. At 77 °F, time required for 99% reduction in reagent-grade water was 22 days for TGEV and 17 days for MHV. In pasteurized settled sewage, times for 99% reduction were 9 days for TGEV and 7 days for MHV. At 39.2 °F, there was <1 log10 infectivity decrease for both viruses after four weeks. **Coronaviruses can remain infectious for long periods in water and pasteurized settled sewage, suggesting contaminated water is a potential vehicle for human exposure if aerosols are generated.**

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Its not Covid, the "party in the pipes" caused by the lockdowns that is the issue! Think Legionella.

Biofilm - In the human environment, biofilms can grow in showers very easily since they provide a moist and warm environment for the biofilm to thrive. Biofilms can form inside water and sewage pipes and cause clogging and corrosion. Biofilms on floors and counters can make sanitation difficult in food preparation areas. Biofilm in soil can cause bioclogging. Biofilms in cooling- or heating-water systems are known to reduce heat transfer. Biofilms in marine engineering systems, such as pipelines of the offshore oil and gas industry, can lead to substantial corrosion problems. Corrosion is mainly due to abiotic factors; however, at least 20% of corrosion is caused by microorganisms that are attached to the metal subsurface (i.e., microbially influenced corrosion).

The CDC has acknowledged that opportunistic premise plumbing pathogens (OPPPs) are the primary cause of waterborne disease in the United States.

Legionella pneumophila, one type of OPPP, can develop in water supply systems and result in Legionnaires' disease, a severe form of pneumonia. About 5,000 cases of this disease are reported each year in the U.S.

Legionella are naturally occurring bacteria found in freshwater sources, such as rivers and lakes, where the bacteria generally are present in low amounts and do not lead to disease.

However, Legionella can multiply to dangerous levels under certain conditions and potentially cause Legionnaires' disease, or Legionellosis. People contract this disease by inhaling small droplets of the contaminated water through mist or vapor.

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Containment Level Protection

- **Containment protection** is when the public water system is protected at the service connection only. Containment protection will ensure that backflow will not occur out into the public water distribution system. However, backflow could still occur inside the building, downstream of the backflow prevention device, putting occupants at risk. Containment protection usually means that a backflow preventer was installed just downstream of the meter. Many cross-connection control plans will only require containment protection. People need to understand that containment protection will not provide total protection.

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ISOLATION LEVEL PROTECTION

- **Isolation protection** (point of use isolation) is protection at each *cross-connection* within the building. This means backflow protection of some kind must be installed on all cross-connections that are identified after (downstream) the meter. Air gaps and devices from the "vacuum breaker family", as well as those devices that are used for containment, are commonly used for isolation protection. In most cases internal protection requirements are governed by plumbing codes like The International Plumbing Code (ITC) 2009.

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Cross-Connection Control Plan Components

Qualified Personnel:	You started that process today. Periodic quality training is required.
Public Education:	Education is essential for both preventing backflow incidents and to convince the public that backflow is a serious threat to the public water system and to public health.
Standard Forms:	Samples are available online or through State agencies.
Legally Defensible Record Keeping:	Even a small public water system could have hundreds of backflow assemblies in their system that they need to track.
Certified Testers:	Devices will never be tested properly without local certified testers.
Enforcement:	Consistent enforcement is an absolute, otherwise your plan will fall into non-compliance and subject your system to regulatory action.

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10 Steps to a Cross-Connection Control Program

Step 1: Understand Cross-Connection Control Concepts
Step 2: Establish a Legal Foundation
Step 3: Establish a Priority System
Step 4: Understand Customer Implementation Costs
Step 5: Develop Implementation Timetable
Step 6: Review your Proposed Plan with Government Regulators
Step 7: Educate the Public
Step 8: Notify Affected Customer
Step 9: Monitor Program Installation & Testing Requirements
Step 10: Maintain Records

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Degree of Hazard

- Determining the degree of hazard of a given cross-connection is very important in ensuring that the correct backflow device is selected to control the cross-connection. Degree of Hazard is a way of assigning the level of risk that a given cross-connection creates.

There are generally only two degrees of hazard:

- Low Hazard
- High Hazard

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Establish a priority system

- To begin this process, use your billings and your properly trained distribution system maintenance personnel to develop three master lists with the following titles:

  A: Hazardous Facilities – High Hazards
  B: Aesthetically Objectionable Facilities – Low Hazards
  C: Non-Hazardous Facilities – Low Hazards

- Then use distribution system records to identify areas that have been prone to main breaks, leaks, and low pressure.
- The information gathered can be transferred to a distribution system map to locate customers in categories A and B. This may highlight more vulnerable areas of the distribution system.

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Establish a priority system (cont.)

Now you can establish a priority list, which could be broken down into the following five levels:

First Priority:	*Hazardous facilities* located within the most vulnerable portion of the distribution system – High Hazards
Second Priority:	*Hazardous facilities* **not** within the most vulnerable area – High Hazards
Third Priority:	Aesthetically objectionable facilities located within the most vulnerable area (pollutants only) – Low Hazards
Fourth Priority:	Aesthetically objectionable facilities not within the most vulnerable areas of the distribution system – Low Hazards
Fifth Priority:	**Non-traditional** residential connections – High or Low Hazards

A thoughtfully drafted priority system will make implementation much easier and will make efficient use of your time.

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Typical Forms for Implementing a CCC Program

A. Program Implementation Notice
B. Cross-Connection Control Survey Report Form
C. Inspection Results Notice, and need to install a backflow prevention assembly
D. Need to Conduct Periodic Test Notice with return report form
E. Follow-up Letter (Second Notice) for item D.
F. Discontinuance of Service Notice
G. Repair or Replace the Backflow Prevention Assembly Notice
H. New Service Investigation and Report Forms
I. Assembly / Installation Approval Form
J. Approved Backflow Prevention Assembly Testers List
K. Temporary Shutdown of Water Service Notice
L. Test Report Form

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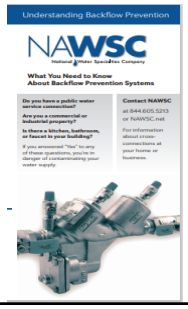
Educate the Public

This step could begin at any time during the implementation process. A good general public education flyer, brochure, or pamphlet would be the best way to start. Adding information onto the water system's website is another way to facilitate educating the public.



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Monitor Program Progress

Follow-up monitoring of program progress should be done at least bi-annually during the implementation period and at least annually thereafter.

Items you should be monitoring during the implementation

- Follow-up on individual customer compliance agreements.
- Are you on schedule to meet your timetable deadlines?
- Are you maintaining your cross-connection control data- base?
- Is enforcement being used consistently when necessary to achieve compliance?

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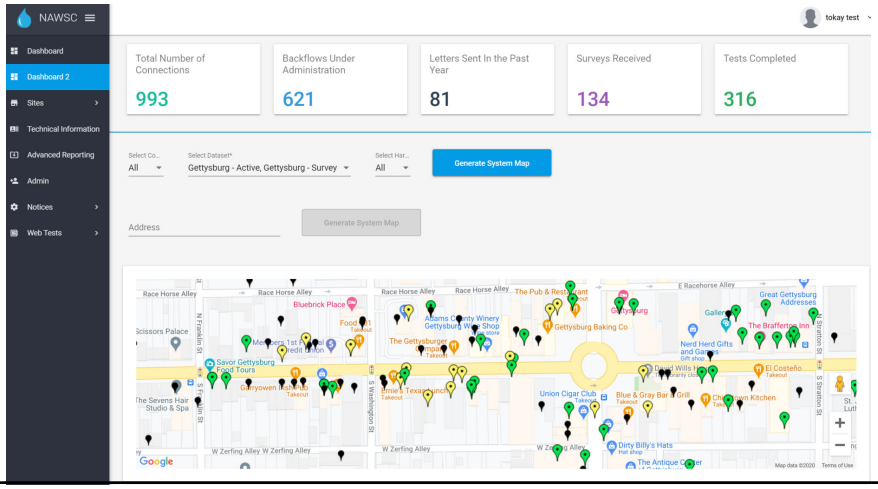
NAWSC's CCC-SMART – Cross-Connection Control Management in Real-Time – Individual Street View



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Initiate Testing – Installation is not Enough

For in-line testable devices, which mean devices with test cocks that can be tested with a differential pressure gauge, testing should be conducted annually. Annual testing of backflow prevention assemblies is industry standard. Most CCC programs across the United States require annual testing because major certification organizations such as the American Society of Sanitary Engineers (ASSE) and the International Plumbing Code (IPC), require backflow prevention assemblies to be tested routinely at least on an annual basis.

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Record Keeping

- How long are Cross-Connection Control Records kept?
  - 10 years is standard in this field and confer with your solicitor.
- Cross-Connection Control records can make or break a program.
- Must be accurate.
- The following are records that should be kept in order to show proof of adequate program.

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Record Keeping

- Master List of all Establishments with assemblies used for premise isolation, including location, assembly used, make, model, size, serial number etc.;
- Correspondence between water system and its customers
- Copy of Approved Plan and or Approved Policy/ordinance
- Test reports for each assembly
- Copies of Certificates of Competency/Licensure for each tester
- Copies of test kit certifications and yearly calibrations
- Yearly Testing/Inspection Reports
- Backflow incident reports
- Records on initial surveys, recommendations, follow-up, corrective action, routine reinspections, etc.
- A file system designed to call to the attention of the cross-connection control personnel when testing and reinspections of premises are needed.
- Public education pamphlets and information.

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