Safety Services

CIPHI's 75th Annual conference

Safe Drinking Water Course

Cross Connection Control

and

Backflow Prevention

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Plumbing and Gas
Safety Codes Officer

– May 3, 2009

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Cross Connection Control and Backflow Protection

OBJECTIVES:

- What is a Cross Connection?
- Why is a Cross Connection Control program necessary?
- What are the Legal Implications?
- Who is the Authority Having Jurisdiction?
- What type and where should backflow preventers be used?
- Examples.

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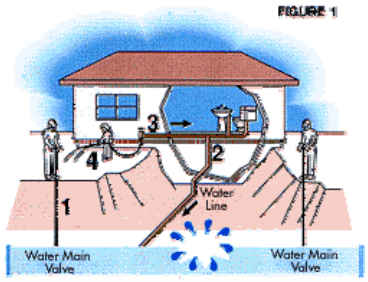
What is a Cross Connection?

- An actual or potential connection between the potable water distribution system and any source of pollution or contamination.



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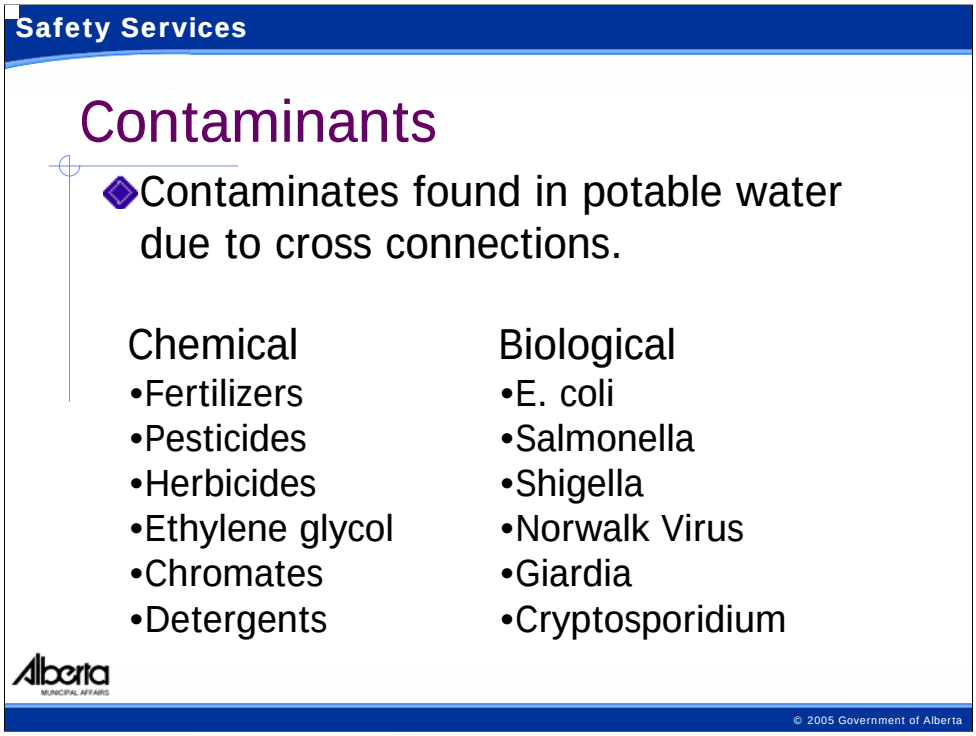
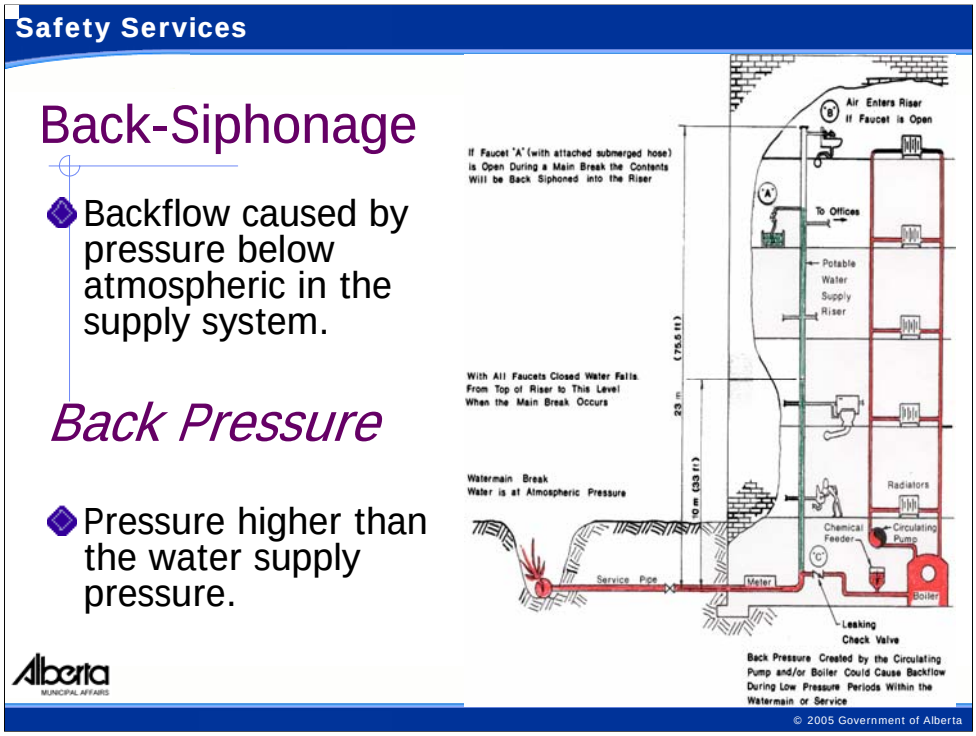
•Bypass arrangements, jumper connections, or any temporary or permanent connection through which backflow may occur are considered cross connections.



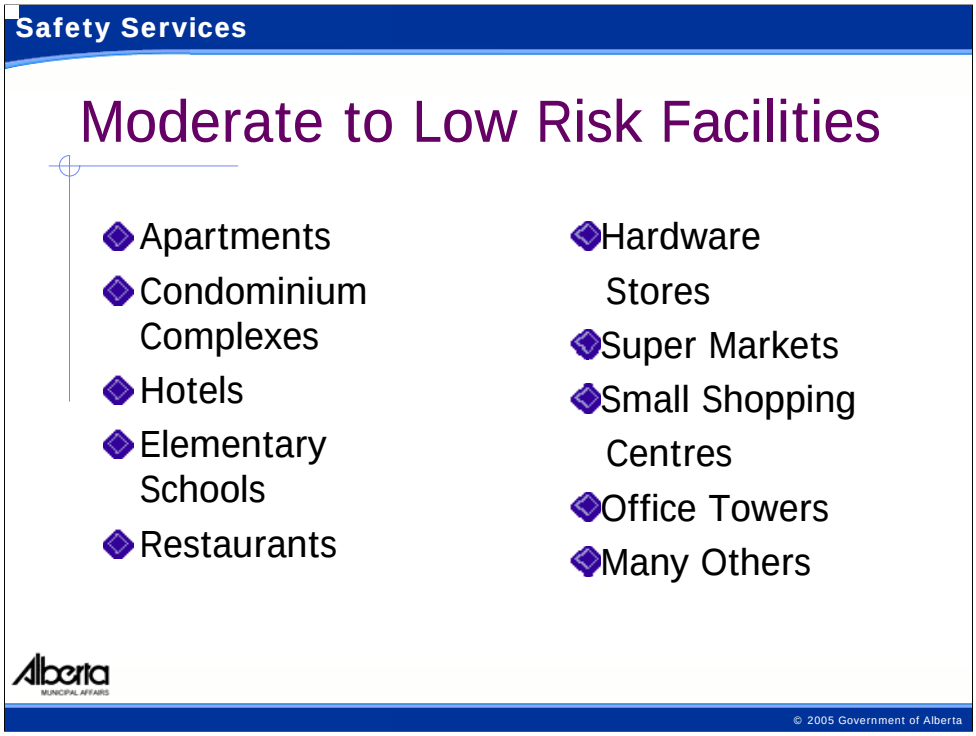
These are but a few of the serious contaminates found in the potable water supply after a cross connection incident.



The piping in green shows a container/fixture on 4th flr that has a hose in it. When the water main breaks and the water to the main is turned off and the water drains out of the system, a negative pressure is created that siphons the contents of the fixture back into the building water system and all the way to the municipal distribution mains. This container could contain contaminates that are toxic. Regardless of whether it is highly toxic or drinkable water it is still considered used water and must not be allowed to enter the potable water system. Toilet tank water could also be siphoned if the ballcock does not have an anti-siphon feature built into it or if it isn't installed properly. The ballcock's critical level must be installed 25 mm above the top of the overflow tube. It has been demonstrated when a toilet plunger is used to unclog a plugged bowel contents of the bowel can be forced up into the tank.

The hot water heating system, that may have chemicals added, could also be drawn back into the potable water lines under a back-siphonage condition. The heating system water could also be forced back into the potable water system if the pressure in the heating system is higher than the potable water system pressure. This is a back pressure condition. A backflow preventer must be installed on the water line to the heating system. In addition, individual backflow preventers must be installed at each fixture, whether it's a bathtub, lavatory, toilet, or other piece of equipment.

These are a few of the high risk facilities that require a high level of backflow prevention.



Moderate to minor risk facilities require less stringent backflow prevention. However, after an inspection of the facility it maybe determined that a higher level of protection is required as in a high risk facility.

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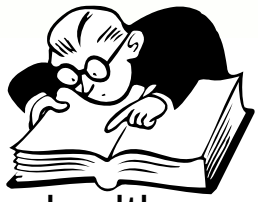
Degrees of Hazard



MINOR

- Low probability of becoming a health hazard (water aesthetically displeasing).

MODERATE

- Low probability of becoming a severe hazard.

SEVERE

- Could cause illness or death.

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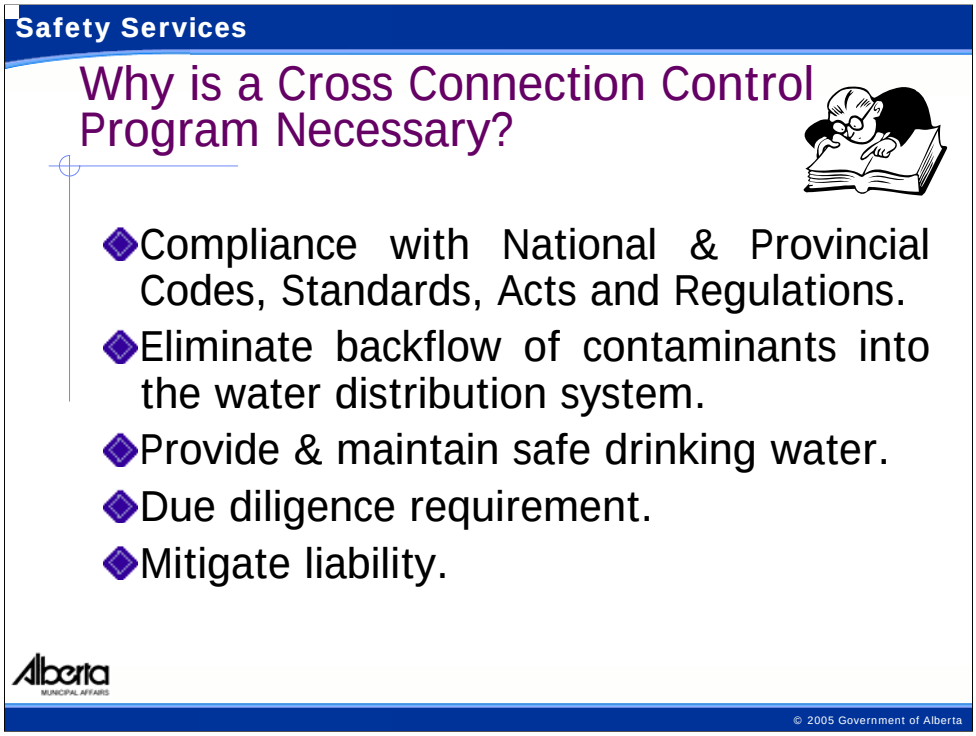
The degree of hazard associated with a contaminated source must also be taken into account.

• For instance, a fixture or piece of equipment that is classified as a minor hazard would not have the same type of backflow preventer that a moderate or severe hazard require. A minor hazard may cause the water to look, smell or taste bad but it is not considered a health risk.

•A moderate hazard is not a health hazard but has the potential to become one.

•A severe hazard could cause injury if someone consumed or came in contact with the contaminated water.



- There are many Codes, Acts etc, that address protection of the potable water system.
- Health, Environment, Municipalities, Water Purveyors, and anyone involved in potable water must adhere to these documents. Parties that could administer a CCC Program include the Water Purveyor, the Municipality or the Health Department. Generally it is the water purveyor who implements the program, as they have a vested interest in supplying safe potable water to their customers.
- Backflow preventers must be installed and maintained to ensure contaminants do not enter the potable water system.
- Due diligence – "is the level of judgment, care, prudence, determination, and activity that a person would reasonably be expected to do under particular circumstances".
- **Due diligence is measured by 3-factors**

1. Foreseeability – could a reasonable person have foreseen that something could go wrong?
2. Preventability – was there an opportunity to prevent the injury of accident?
3. Control – who was the responsible person who could have prevented the accident or incident?

Failure to prove that you have been diligent in complying with safety legislation can result in significant penalties.

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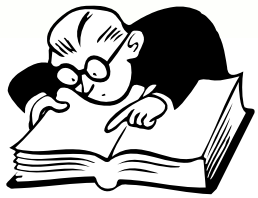
Acts, Regulations



- Alberta Safety Codes Act adopted the National Plumbing Code of Canada with some amendments.

National Plumbing Code of Canada

- 2.6.2 – Protection of potable water from Contamination

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National Plumbing Code of Canada – 2005 was adopted in Alberta on September 2, 2007. Section 2.6.2 of this code refers to the protection from contamination. This section also states the backflow prevention devices must be installed and maintained in accordance with the CSA B64.10, “Manual for the Selection and Installation of Backflow Prevention Devices”.

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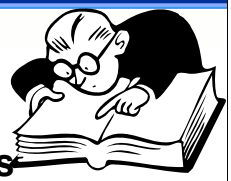
Standards



National Plumbing Code requires backflow preventers follow the Canadian Standards Association

"B64.10 Manual for the Selection and Installation of Backflow Prevention devices."

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The CSA B64.10 Standard provides detailed information on the type of backflow prevention devices that must be used on various fixtures, processes and equipment. It also indicates when devices must be tested and how to test them.

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Standards

CSA B64 Standard & AWWA – Canadian CCC – Manual

- Selection of Backflow preventers
- Installation of backflow preventers
- Testing of backflow preventers
- CCC Specialists/ Testers Course

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The Standard not only identifies the type of devices that must be used it also describes how they must be installed. Testable backflow preventers must be tested by properly trained and certified testers. AWWA's Cross Connection Control Committee have developed courses for testers. An individual successfully completing the course receives a CCC specialist certificate that is recognized by communities that have CCC programs.

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Testing of Cross Connection Control Devices

- All devices must be tested when installed.
- All devices must be tested annually or more often when required by the AHJ.

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Even though new backflow preventers are installed they must be tested. New water lines must be cleaned before they are put into service. Debris in the cleaning process could become lodged in the backflow preventer's check valve causing it to not seat properly allowing contaminates to enter the potable water supply. Annual tests are required to ensure they are working properly. If a backflow preventer is placed in a line that is known to cause a backflow preventer to fail the AHJ may require more frequent tests.

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CCC Testers / Specialists Training

Supported by WCS–AWWA–CCC Committee

City	-	Institute
Edmonton	-	NAIT
Calgary	-	SAIT
Red Deer	-	College
Medicine Hat	-	College

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Courses are available at these Alberta Institutes. There are similar courses offered in provinces across Canada.

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Standards

Alberta Municipal Standards & Guidelines (2006)

- Section 1.6.3 When an existing cross-connection poses a potential health or system hazard, the owner shall shut off water service until the cross-connection has been eliminated or controlled by the installation of a proper backflow prevention assembly.

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Alberta Environment is responsible for the Drinking Water and Wastewater Programs for large public systems in Alberta. AENV considers the establishment of standards and guidelines for municipal waterworks, wastewater and storm drainage facilities an integral part of our regulatory program directed at ensuring public health and environmental protection. This document sets out the regulated minimum standards and requirements for municipal waterworks in Alberta.

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Standards

Alberta Municipal Standards & Guidelines
Section1.9.3. **Cross-Connection Control**

- There shall be no physical connection between any waterworks systems and a sanitary or storm sewer that may allow the passage of wastewater into the potable water supply. **Further, to prevent potential contamination, and avoid re-growths, no cooling water shall be returned into the potable water system.**

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The recirculation of potable water, used for cooling purposes, back into the municipal mains is not addressed in the plumbing code but is in this standard. Alberta Municipal Affairs has received calls asking about this piping arrangement and have told the individual it is not allowed.

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Standards

Alberta Municipal Standards & Guidelines

- Section 1.9.3.4 – Backflow Preventers shall be installed in accordance with the latest edition of the WCS – AWWA – CCC Manual.

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The Standard refers to the Western Canada Section of The American Water Works Association Cross Connection Control Manual for the installation of backflow preventers. This manual is now a Canadian manual used by all technical institutes and colleges providing CCC courses. The manual provides additional information not found in the CSA B64.10 standard.

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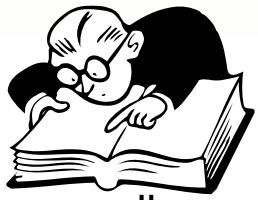
Bylaws



- Local/Municipal Water Bylaws generally regulates Cross Connection Control.
- Presently: Calgary, Camrose, Canmore, Edmonton, Red Deer, Lethbridge, Medicine Hat, Okotoks and Redcliff are some places that have CCC in their Bylaw.

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•Provinces have given municipalities the power to adopt bylaws. Unless a bylaw is passed to adopt a cross connection control program they could not enforce it. Bylaws generally identify where backflow preventers must be installed, when they must be tested and penalties for not installing or testing devices. CCC Programs, in a lot of instances, are adopted after there have been incidents of municipal water main contamination.

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CCC Responsibilities

Engineer / designer

- Backflow preventers required in design.

Plumber

- Installation & testing of backflow preventers.

Safety Codes Officer / CCC Inspector

- Ensure proper devices installed and tested.

Owner

- Responsible for having the device tested and maintained.

Health Inspector

- Identify contamination incidents.

Every one from the designer, to the owner and various inspectors must play a role in ensuring potable water does not become contaminated.

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Backflow Preventers?

There are 2 types of Backflow Preventers:

- Non-Testable Devices
- Testable Devices

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•Non-testable devices are generally used to protect the potable water system from minor and moderate hazards. Some non-testable devices can be used in a severe hazard situation but they are backed up by an additional backflow preventer that can be used to protect against severe hazards.

•Not all testable backflow preventers can be used in severe hazard condition

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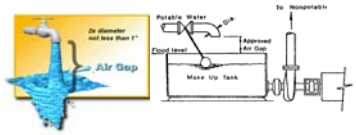
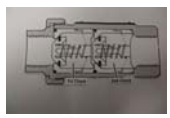
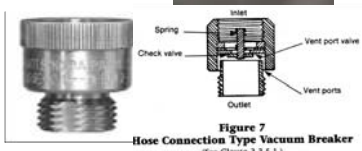
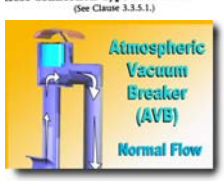
Non-Testable Backflow Preventers

- Air Gap (AG)
- Dual Check (DuC)
- Hose Connection Vacuum Breaker (HCVB)
- Atmospheric Vacuum Breaker (AVB)









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•An air gap, although not a device, is one of the best and most inexpensive means of protecting the potable water supply. There is a physical air break of at least one inch or twice the diameter of the supply pipe from the flood level rim of the fixture or equipment. It can be used to protect against all hazards. However, if the an air gap is installed in an atmosphere that may become toxic such as in a laboratory fume hood it would have to be backed up by another device out side the fume hood. It has its shortfalls if water pressure is needed downstream of the air gap in which case a pump would have to be installed. Air gaps are seen on basins bathtubs and other fixtures where the tap is above the flood level rim of the fixture.

•Dual check valves have two check valves built into them and can be used to isolate a house from the municipal water supply.

•HCVB's must be installed on all Hose bibs. If installed outdoors they should automatically drain the water to avoid freezing and ultimate breakage of the device.

•AVB's are installed on mop sinks, lab sinks, toilets etc. to prevent contaminates being siphoned back into the potable water supply.

•A HCVB and an AVB cannot have pressure on the device for more then 8 hours and are only used in back-siphonage conditions.

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Testable Backflow Preventers

- RP - Severe

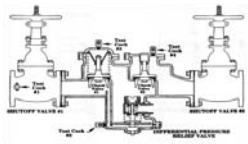
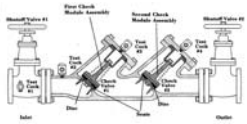


Figure 11
Typical RP Backflow Preventer
(See Clause 3.3.7.1.)

- DCVA - Moderate



- PVB – Severe

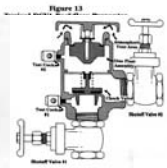


Figure 5
Pressure Type Vacuum Breaker
(See Clause 3.3.4.1.)

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•A reduced pressure principle backflow prevention device (RP) can be used on all types of hazards. This device is used extensively on severe hazard. An example of where an RP is used is on a heating system that has chemicals added to the heating media.

•A double check valve assembly (DCVA) is used on moderate hazards such as a fire sprinkler system that has no chemicals added.

•A pressure vacuum breaker (PVB) is a device that is not widely used. It is mostly used to protect an irrigation system. That being said it is used sparingly in other applications. An ordinary PVB requires a drain nearby to catch any spillage from the relief ports. If spillage is a problem a spill resistant PVB must be installed. PVB's can be used on a severe hazard but are generally backed up by another device at the water service entrance.

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Back Pressure & Siphonage Device Application

- RP
- DCVA
- DCAP
- DuC

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These are some of the more popular devices used when a back pressure is a possibility or when continuous pressure is placed on the device. They can also be used when a back siphonage condition is a possibility. Soft drink carbonators have a Dual Check Valve with Atmospheric Port (DCAP) that is specially designed for this purpose. Copper or brass DCAP devices should not be used in this application as the carbonic acid created attacks the copper and brass parts.

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Back-Siphonage Device Application

- Air Gap (AG)
- Hose Connection Vacuum Breaker (HCVB)
- Pressure Vacuum Breaker (PVB)
- Atmospheric Vacuum Breaker (AVB)

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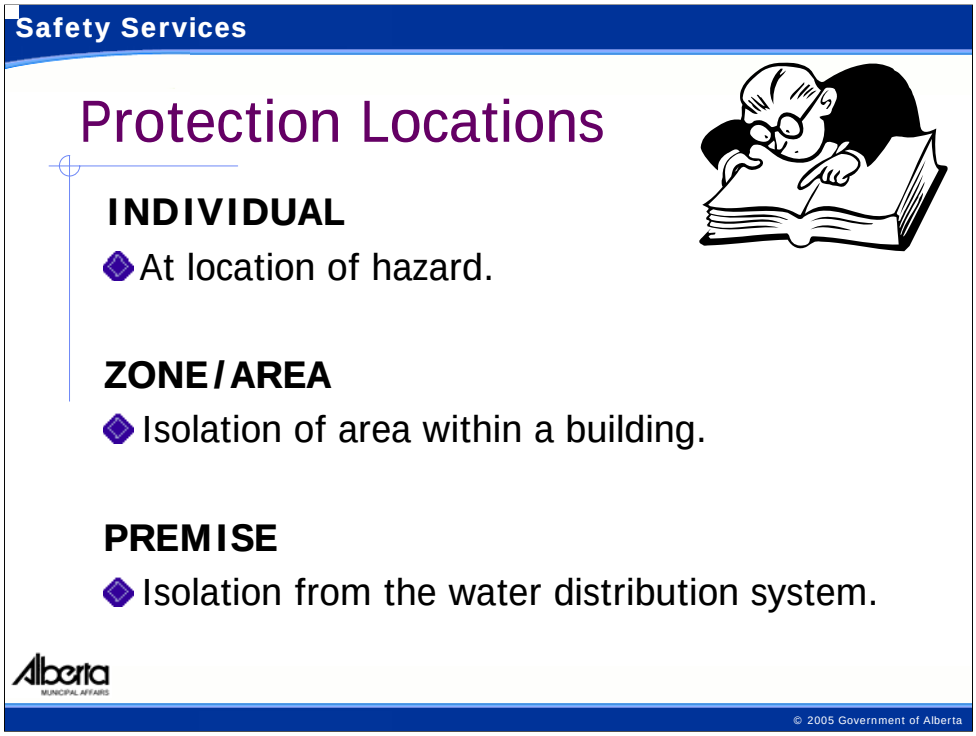
These devices cannot be used where there is back pressure on the device.

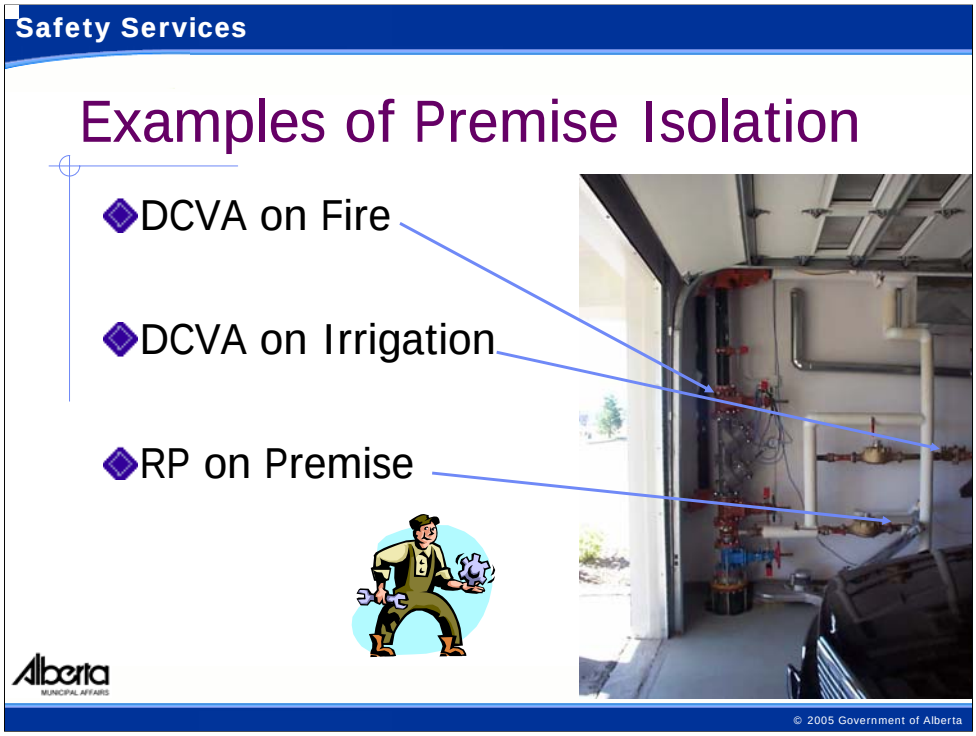


One or all of these methods maybe used to protect a water supply from becoming contaminated. A typical example of all three is in a hospital.

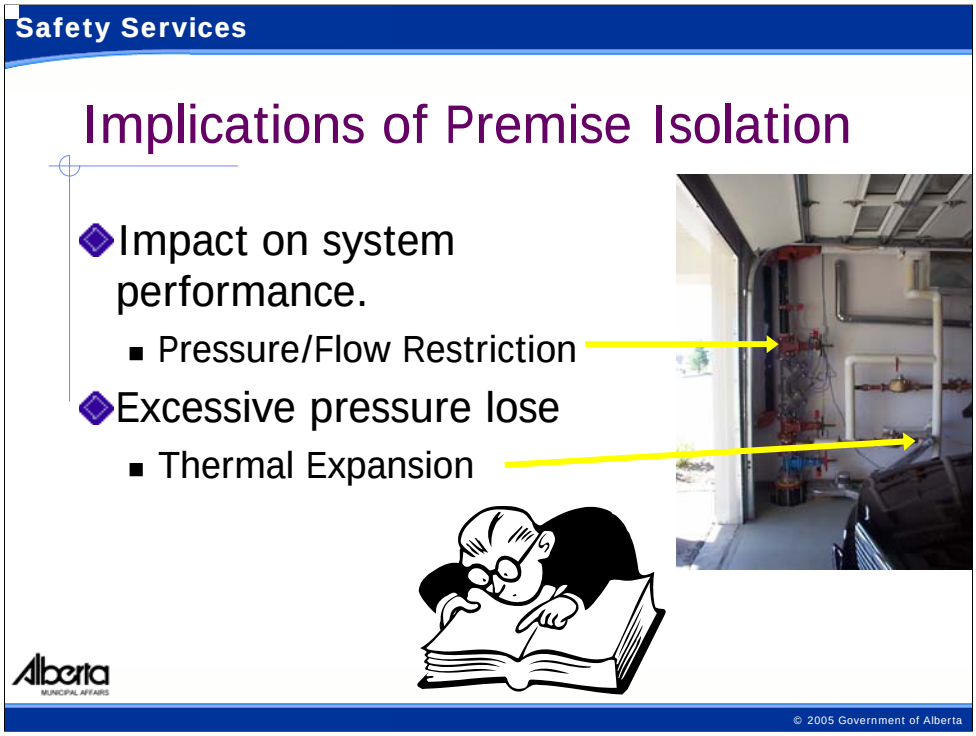
•Individual backflow preventers are required at the fixture or equipment.

•Zone or area isolation is used to isolate a section of the hospital such as the morgue or operating rooms.

•Premise isolation is immediately after the water meter. Backflow preventers must be tested annually and repaired as needed. Where 24 hr water service is necessary, such as in a hospital, a bypass line is required around the backflow preventer. This bypass also requires the same type of backflow preventer.



This piping arrangement is typical for many residential, commercial and industrial facilities. Along with the devices shown additional devices are required at each fixture or piece of equipment.



All backflow preventers impact water pressure and performance of the system. Some devices can reduce the pressure as much as 20 psi. The installation of a device could seriously impact a fire protection system if the water pressure is reduced. When a backflow preventer is installed, especially in an existing fire protection system, the entire system must be checked by a professional engineer to ensure the fire system is still capable of performing properly.

If premise isolation is part of the water system, equipment must be added to compensate for the excess pressure created by a hot water heater, i.e. an expansion tank. Hot water expands creating excessive pressure in the piping system.

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How many Cross Connections in a Potable Water System?

Depends on the number of total connections to the water system.

Fire, domestic, irrigation, sinks, basins toilets, aspirators, carbonators, hose bibs etc.

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The list above are a few examples of where cross connections could contaminate the potable water. In an average home there are over a dozen potential cross connections. In hospitals and other commercial and industrial facilities there could be thousands. Due diligence by all parties involved in the design, installation and inspection of these facilities is essential to keep our potable water safe.

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Cross Connection Instances

Winnipeg – 2006

- Cooling system water enters Health Care facility potable water. A bypass valve left open.

Edmonton - 2002

- High Rise experiences brackish water from taps after a water main break. Fire system water siphoned through a single check valve separating the potable water from the fire system.
- Blue caustic water from heating system enters potable water system.

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•Residents of a major health care facility in Winnipeg noticed a sweet smell coming from a tap. Staff found a ball valve had been mistakenly opened that allowed cooling system water to enter the potable water system. No illnesses were reported but the incident impacted the facilities operation for several days while the system was flushed.

•Residents of an Edmonton high rise noticed brackish water coming out of their taps after a water main break. Apparently, a single check valve separating the fire system and the potable water failed. There were no reported illnesses.

•An Edmonton high rise required repairs to the domestic water lines. When the valve at the meter was turned off and the water piping drained, caustic water from the heating system back flowed into the potable water system. When the water was turned on blue caustic water came from the taps. Fortunately, no one was injured, but it took 1-2 weeks to clear the potable system as the caustic embedded itself in the calcium and magnesium deposits in the water lines.

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Cross Connection Instances

Regina – 1997

- Meter reader notices meter turning backwards in major production facility.

Redcliff –1989/ 1990

- Carwash, soapy water in main.
- Greenhouse – fertilizer, repairs, 1 ill for 1 wk.

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•A meter reader noticed that the meter was turning backwards. The reversed flow occurred during annual maintenance of the plant. The plants process water consisted of well water supplemented by city water. No process water was required during maintenance but the well pump continued to operate overcoming the city's water pressure forcing well water into the city mains. The existing single check valve failed. A proper backflow preventer was installed. Note: A private water system cannot be connected with a municipal water system; an air gap separation is required.

•A failed backflow preventer, together with a drop in Redcliff's water main pressure allowed soapy water to enter the public water supply. Residents in the area complained about soapy water after the water pressure was restored.

•Water was turned off and drained to make repairs to a water main in Redcliff. The lack of a backflow preventer in the water line serving a green house allowed fertilizer to back siphon into the distribution pipe. When the water to the main was restored some of the fertilizer remaining in the municipal system mixed with the water and was delivered to other customers. An individual drinking the contaminated water became violently ill and missed a week of work.

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Cross Connection Instances

Medicine Hat – 1989

- Large Comm. Building – combined back pressure & back siphonage of glycol into City Main, wrong device, 2 people sent to hospital.

Calgary – 1987

- Main break , back siphoned chemicals, into water main and elementary school, no injury.

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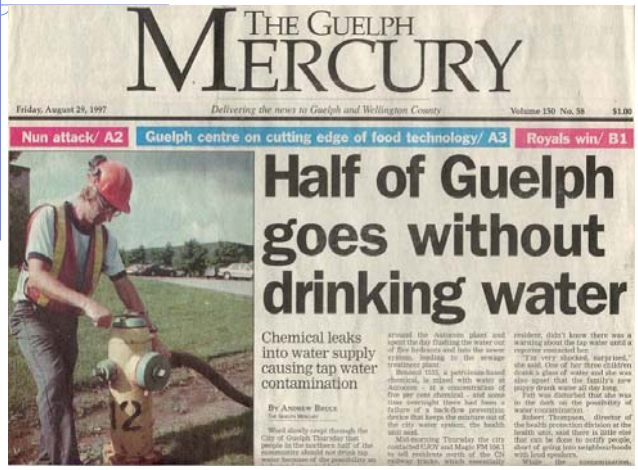
•Single check valves were used to separate the potable water piping from a boiler heating system which had ethylene glycol in it. The single non-testable check valves failed allowing the glycol to enter the potable water piping and Medicine Hat's water mains. Several surrounding residents complained about the water quality and two people inside the building were sent to hospital. Fortunately, no one was serious hurt.

•An elementary school in Calgary experienced a backflow condition during a water main break. The schools chemically treated water in the heating system was forced into the potable water system. After the repairs were made to the water mains and the water turned on, contaminates made their way to drinking fountains and washrooms. These contaminates contained chromates, a highly toxic substance. Fortunately, the students were sent home when the water main break occurred and no one was hurt. The school remained closed for several days while the system was repeatedly flushed.

Could this happen to you?



THE GUELPH MERCURY

Friday, August 29, 1997 — Delivering the news to Guelph and Wellington County — Volume 150 No. 58 — $1.00

Nun attack/ A2 | Guelph centre on cutting edge of food technology/ A3 | Royals win/ B1

Half of Guelph goes without drinking water

Chemical leaks into water supply causing tap water contamination

By Andrew Brecl

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Guelph's population in 1996 was about 96,000. A town which had 48,000 residents without water were bound to have a lot of complaints.

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Who do you call?

Water Purveyor

Health Inspector

Accredited Municipality's Plumbing Inspector

Non-Accredited Municipality - Alberta Municipal Affairs

Municipal Affairs Web Site
www.municipalaffairs.gov.ab.ca/ss/Permit

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•When a contamination occurs in a building the water purveyor should be called immediately if there is a possibility that the contaminate could backflow into the municipal distribution system.

•The Health Inspector may have to be called.

•In an accredited municipality the municipal office should be called to have their plumbing inspector investigate the incident if warranted.

•In non-accredited municipalities Alberta Municipal Affairs (AMA) should be contacted so that either one of AMA's inspectors or an agency contracted to do inspections for AMA could investigate the incident.

•To determine whether a municipality is accredited go to the AMA's web site. There is a drop down menu that lists all the municipalities in Alberta. Select the municipality to determine its accreditation status. If it is accredited call the municipal office; if not contact AMA.

CCC Summary

- To eliminate contaminants back flowing into the potable water system through a cross connection.
- Provide & maintain safe drinking water.
- Comply with National & Provincial codes, standards, acts & regulations.
- Due diligence requirement.
- Mitigate liability.
- Type of devices required for the hazard.
- Examples

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Questions

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Conclusion

THANK YOU

The End

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