ASHLAND WATER ADVISORY COMMITTEE
February 27, 2018
AGENDA

I. **CALL TO ORDER:** 4:00 PM, Siskiyou Room, 51 Winburn Way Ashland, OR

II. **ANNOUNCEMENTS**

III. **APPROVAL OF MINUTES:** October 24, 2017

IV. **PUBLIC FORUM**

V. **OLD BUSINESS**

A. T.I.D. Canal Piping Project Update

B. Water Treatment Plant Evaluation Update

VI. **NEW BUSINESS**

A. Cross Connection Control Program Presentation

VII. **ADJOURNMENT:** 6:00 PM

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Ashland Water Advisory Committee

Contact List as of February 2018

Name	Title	Telephone	Mailing Address	Email Address
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John Williams	Chair	541-482-8003		ashlandjohn@gmail.com

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ASHLAND Water Advisory Committee
MINUTES
October 24, 2017

These minutes are pending approval by this Committee

CALL TO ORDER
Williams called the meeting to order at 4:03 PM

Committee Members Present: Pat Acklin, Alex Amarotico, Joe Graf, Kate Jackson, Rich Miller, Don Morris, Michael Morris (Council liaison), Donna Rhee, John Williams (chair)

Committee Members Absent: Lesley Adams, Darrell Boldt, Michael Morrison

Staff present: Paula Brown, Scott Fleury, Steve Walker, Kevin Caldwell, Julie Smitherman, Jessica Bain, Tara Kiewel

Staff absent: Greg Hunter

Consultants: Jeff Ballard P.E. (RH2), Lisa Maddaus P.E. (Maddaus Water Management)

ANNOUNCEMENTS
None

APPROVAL OF MINUTES
September 26, 2017

Committee Members Amarotico/Acklin m/s to approve minutes as.
All ayes. Minutes approved.

Brown updated the committee about the request for proposal (RFP) for the water treatment plant study that was going to be brought to this meeting. In lieu of an RFP Brown is working directly with RH2 to negotiate a proposal to bring to the committee in January or February with cost estimates.

PUBLIC FORUM
None

WATER MASTER PLAN – CONSERVATION MODEL
Julie Smitherman, Water Conservation Specialist and Lisa Maddaus P.E., Maddaus Water Management presented a Water Efficiency Program review. See attached presentation.

Brown asked for the reasoning behind sun setting the lawn replacement program. Smitherman explained that the community is being saturated and anyone interested in this program will have participated by 2020. The lawn replacement program is high cost for both the City and customers similar savings could be found from an irrigation conversion program.

Acklin questioned why the Hot Water on Demand measure did not make it into the B Category of programs to implement. Smitherman said this program had minimal savings.

Graf mentioned if we significantly reduce the amount of water going into the sewer what does that do to the amount of water going into Bear Creek. Smitherman said we need to make sure we don't have any unintended

consequences and we need to look at all sides. Morris added that if are taking less water out of the environment then there is more water in the streams.

Williams asked if the projected water demand scenarios included any growth projected for the City. Smitherman explained that there was .50 percent per year of growth calculated and based on a Demographer report from Jackson County.

Graf questioned the customer cost numbers for lawn replacement and Smitherman explained that the customer cost range is from $1,000 to $30,000 depending on the size and type of landscape. Brown asked if we had real customer costs for 2015-2016 lawn replacements and Smitherman said she does have those numbers.

Brown asked if there was any measure that we didn't select on that list that Maddaus would have recommended. Maddaus said that she would have looked at the customer water use reports and communication education. The trend is for utilities to share more information and analytics on how customers use water in order to make informed decisions on water usage. Maddaus also mentioned the water loss control is a measure she would have recommended. Brown mentioned that if anyone on the committee wants more information on any of the measures and programs that Smitherman could provide the information.

Williams asked which programs affect summer usage the most and mentioned the rain catchment program. Smitherman said this program is site specific and size of the tank will determine and drive how much water will be available for the landscape. Smitherman mentioned a grey water program could come in handy for watering trees.

Graf asked for clarification regarding the projected water demand scenarios and questioned the overall savings projections and Plan B may not be sufficient. Graf said if we assume due to climate we are going to see significantly lower input of water coming into our watershed or a decrease in storage of snow we will need to save more that this model shows. Smitherman said that we can adjust the model as needed. Maddaus explained that there is a difference between responding to climate change and frequency of flood and drought cycles and this is long rang infrastructure planning and we will also have a drought plan that will be on top of this.

Brown mentioned that we had a drought and recession hitting at the same time and that our community responded really well and reduced water usage significantly to meet our goals. Brown believes the demand scenarios model is conservative. Smitherman explained that it is common for communities to see a rebound in water usage after a drought and recessions and asked for the Committees feedback regarding the demand scenario.

Miller felt it is a good case that is well thought out and adjustable and that our community is different and responds well. Williams said with the City's Climate Energy Action Plan (CEAP) goals we could probably justify going with the C plan. Williams also mentioned the the City is making and effort to fireproof the town. Smitherman is attending the Wildfire Mitigation Committee meetings and partnering to make sure we are all on the same page.

Graf said he thinks the numbers are good for demand in this plan and said he is prepared that we may have to go to Plan C if supply is not meeting demand. Brown said we could put a note in that we should look at Plan C as a goal for the City.

Jackson asked about lower income households meeting the climate change goals we have set. Smitherman explained the toilet rebate program as well as the free show heads, faucet aerators, and moisture meters that we

give away. This is a really good program, and we get reimbursed by Bonneville for. Brown mentioned that updates to plumbing codes will give savings. There is a measure in Program C for leak repair for low income. Maddaus said that most Communities are most successful when they implement 10-12 measures do and concentrate efforts.

AWAC CHARGE
Brown asked the Committee to look at the charge and if there was anything that needed to be changed.

Brown will be updating Council at the Nov. 6, 2017, Study Session and will go over the history and work of this Committee. Brown told the Committee that the goal is to have the Water Master Plan completed in July and to have a decision on the water plant. The Committee would conclude in July because the charge will have been completed. Brown thanked the Committee and for all of their work on behalf of the City.

NOVEMBER/DECEMBER MEETING DATES
Brown proposed that the Committee meet again in January. All agreed.

Next Committee meeting Jan. 23, 2018 4:00 pm

ADJOURNMENT: 5:45 PM

Respectfully submitted,
Tara Kiewel
Public Works Administrative Assistant

February, 27th, 2018

RH2 ENGINEERING
40 YEARS SINCE 1978

AWAC - CROSS CONNECTION CONTROL

Jeff Ballard

CROSS CONNECTION CONTROL

What are Cross Connections?

A cross connection is any actual or potential physical connection between a potable water supply and any pipe, vessel, tank, plumbing fixture, equipment or device containing (or potentially containing) a non-potable liquid, solid or gas through which it is possible for used, polluted or contaminated water or any other substance to enter into the potable water system by backflow.

CROSS CONNECTION CONTROL

Direct and indirect Cross Connections?

- A direct cross connection is subject to both back pressure and backsiphonage. An example would be an irrigation system with chemical injection and booster pumps.
- An indirect cross-connection is subject to backsiphonage only. A garden hose submerged in a an ornamental fishpond, swimming pool or rain barrel are examples of an indirect cross-connection.

CROSS CONNECTION CONTROL

Multi-Barrier Approach

- Source Supply protection
- Treatment
- Disinfection
- Storage
- Distribution System Design
- Water Quality Monitoring
- Cross-connection control
- System operator
- Emergency planning

Stig Regli, EPA

"Cross connections are the largest contributor to distribution system outbreaks. Cross connections caused 50% of the distribution system outbreaks from chemical and biological contamination"

(USEPA Distribution System Workshop, February 2007)

CROSS CONNECTION CONTROL

Legal Aspects

- The simplest way to maintain a legally defensible cross-connection control and backflow prevention program is to take ***reasonable care*** according to ***Industry standards*** to protect the drinking water.

  Reasonable Care- is the degree of care, diligence or precaution that a reasonable person would take.

  Industry Standard – May include the most recent editions of the PNWS-AWWA Cross Connection Control Manual; the AWWA M-14 Manual, plumbing codes, state regulation, and other relevant industry publications.

CROSS CONNECTION CONTROL

Ashland Cross Connection History

1971- Ordinance 1676 established cross connection restrictions

1995- Ordinance 2773 increased restrictions and regulations

2008- Ordinance 2964 Updated the Cross Connection program to where it is today.

2012- Cross-Connection Control Program guidelines were established

Today the City has 3493 devices installed and 9028 service connections in the system.

CROSS CONNECTION CONTROL

Phase – I - Premises Requiring Isolation

- Agricultural (for example, farms, dairies)
- Beverage bottling plants**
- Car washes
- Chemical plants
- Commercial laundries and dry cleaners
- Premises where both reclaimed and potable water are used
- Film processing plants
- Food processing plants
- Medical centers (for example, hospitals, medical clinics, nursing homes, veterinary clinics, dental clinics, blood plasma centers)
- Premises with irrigation systems that use the water supplier's water with chemical additions (for example, parks, playgrounds, golf courses, cemeteries)
- Laboratories
- Metal plating industries
- Mortuaries
- Petroleum processing or storage plants
- Piers and docks
- Radioactive material processing plants and nuclear reactors
- Wastewater lift stations and pumping stations
- Wastewater treatment plants
- Premises with piping under pressure for conveying liquids other than potable water and the piping is installed in proximity to potable water piping
- Premises with an auxiliary water supply that is connected to a potable water supply

CROSS CONNECTION CONTROL

Phase – II - Existing Property Assessment

- Create Survey to send out to customers
- Focus on areas of higher hazard (TID, industrial, wells or streams)
- Focus on High Hazard (Health Hazard due to contamination)
- Phase surveys to mitigate overloading of existing staff
- Add this as an additional effort during existing site visits
- Public Outreach to emphasize the importance of community support for this program

CROSS CONNECTION CONTROL

Phase – III - Maintain Cross Connection Program

- Annual testing
- Annual Reporting monitoring
- Enforcement
- Continued Education Program

CROSS CONNECTION CONTROL

Installation Challenges

Standard Installation

Possible Installation

- Old Services can create challenges
- Large diameter installation can create challenges

CROSS CONNECTION CONTROL

Questions and Decisions

- Who will complete annual testing?
- Who will monitor annual Reporting?
- How aggressive should the program be?
- Should Goals be established?
  - Standard of Care
  - Industry Standards

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Cross-Connection Control Program

A. PURPOSE

The purpose of the Cross Connection Control Program is to protect customers of the City of Ashland's water system by eliminating potential sources of contamination resulting from illegal cross connections. Guidelines established in this program, ensure the requirements are met as identified in the City of Ashland's Municipal Code Chapter 14.05- Water Regulation and Cross Connection. This program shall also comply with the Federal Safe Drinking Water Act (P.L. 93-*523)* and the Oregon Administrative Rules (Chapter 333-061-0070) as they pertain to cross connections with the public water supply.

B. POLICY

City of Ashland Municipal Code Chapter 14.05- Water Regulation and Cross Connection addresses requirements for restricting and controlling potential cross connections to the City of Ashland's water system. The City of Ashland shall review this section of the Municipal Code from time to time to assure compliance with current requirements of the State of Oregon Administrative Rules relative to cross connections. All revisions to the City's Cross Connection Control Program shall be reviewed and approved by the City's Public Works Director and, if required by the City Council.

The City of Ashland shall maintain a database of potential direct cross connections with auxiliary water sources used for irrigation such as private wells, streams, and Talent Irrigation (TID) services within the City limits. The database shall be reviewed at least semi-annually. These auxiliary water services will need to be surveyed at least once every five years to monitor potential for direct cross connection to the City water supply.

All other City of Ashland residential property will be surveyed at least once every eight years.

City of Ashland non-residential properties will be surveyed every three years, or when the property is sold or changes managers/owners.

City of Ashland Cross Connection Specialists will conduct inspections for cross connection compliance.

The City of Ashland Water Department shall maintain all records of inspections for cross connection program compliance. The City of Ashland Water Department shall establish and maintain information describing assemblies and procedures suitable for eliminating potential cross connections to the City of Ashland's water supply system. Depending on the "Degree of Hazard", any property found to be in violation of the current requirements of the City of Ashland Municipal Code for cross connections shall be given an

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appropriate amount of time to correct the violation. Enforcement of the Cross Connection Control Program shall be under the authority of the City of Ashland Public Works Director, or his designee.

All new residential, commercial and industrial construction plans within the City of Ashland shall be reviewed by the City of Ashland Building Division for compliance with the Cross Connection Control Program. Existing properties shall be identified according to section "C" of this document.

C. EXISTING PROPERTY ASSESSMENT

The City of Ashland understands that to get this phase of the program started, we need information. We have elected to acquire this through a survey. A survey shall be sent out to each resident, property owner or tenant within the City of Ashland. This will include customers outside the city limits, but within the urban growth boundary, that are served by our water system.

Due to the population of the City of Ashland and our limited staffing, we understand that we could get overwhelmed with information if we did a mass mailing to every customer within our system. In order to insure that this does not happen, we have decided to take a phased approach and use the existing twenty-seven (27) water meter routes within the City of Ashland. The initial process will start with areas that we consider "higher risk". These would include areas with known or suspected auxiliary water sources for irrigation, such as Talent Irrigation Water (TID), wells, or streams.

Information shall be kept in our files, located at 90 North Mountain Avenue, Ashland, Oregon. We will record all information gathered from the returned surveys and prioritize each property based on "Degree of Hazard" according to Section D of this document. Each customer shall then be notified in writing of the status of their property. This notice shall include a timeline for resolving any issues that may be found during the survey or inspection.

D. DEGREE OF HAZARD AND APPROVED ASSEMBLIES

Degree of Hazard and Approved Assemblies

The City of Ashland recognizes that varying degrees of hazard are caused by different cross-connections. The conditions that identify the "Degree of Hazard" are classified as either a contamination hazard or pollution hazard. A "contaminant" is defined as any physical, chemical, biological, or radiological substance or matter in water that creates a health hazard; and, a "pollutant" is defined as a substance that creates an impairment of the quality of the water to a degree which does not create a hazard to the public health, but which does adversely affect the aesthetic qualities of the water.

The University of Southern California, Foundation for Cross-Connection Control and Hydraulic Research publishes the Manual of Cross-Connection Control 10th Edition. USC-FCCCHR also issues "Certificates of Approval" to backflow prevention assemblies that meet manufacturing standards and pass their laboratory and field tests. A list of approved assemblies is available at the City of Ashland's Public Works Department. The assemblies, which are permitted, for use in each class of hazard and a description of the classes are as follows:

A. Low Degree of Hazard (Non-health hazard due to pollution)

If backflow were to occur, the resulting health significance would be limited to minor changes in the aesthetic quality such as taste, odor or color. The foreign substance must be non-toxic and non-bacterial in nature with no significant health effects. The allowed assemblies are: Air gap, non-pressure type vacuum breaker, pressure type vacuum breaker, double check valve assembly and reduced pressure assembly. The City of Ashland may allow up to 90 days for installation of an approved assembly.

B. High Degree of Hazard (Health hazard due to contamination)

If backflow were to occur, the resulting effect on the water supply could cause illness or death if consumed by humans. The foreign substance may be toxic to humans either chemically, bacteriological or radiological. Toxicity may result from either short or long-term exposure. The City of Ashland shall notify customer that the cross connection shall be disconnected or removed immediately.

At the discretion of the inspector, if an irrigation hazard is identified at the end of an irrigation season and shall not be used until the next irrigation season, the inspector may give additional time to remedy the situation, as long as the hazard is eliminated prior to use of the irrigation service during the next irrigation season. (Example- TID service that will not get used until the following year)

See the following "Table 48" and "Table 49"from the Oregon Administrative Rules 333-061-0070, Cross Connection Control requirements for further clarification on what devices are approved for installation. All facilities shown on Table 48 are classified as areas with a High "Degree of Hazard".

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TABLE 48

PREMISES REQUIRING ISOLATION BY AN APPROVED AIR GAP *OR* REDUCED PRESSURE PRINCIPLE TYPE OF ASSEMBLY HEALTH HAZARD
1. Agricultural (e.g. farms, dairies)
2. Beverage bottling plants**
3. Car washes
4. Chemical plants
5. Commercial laundries and dry cleaners
6. Premises where both reclaimed and potable water are used
7. Film processing plants
8. Food processing plants
9. Medical centers (e.g., hospitals, medical clinics, nursing homes, veterinary clinics, dental clinics, blood plasma centers)
10. Premises with irrigation systems that use the water supplier's water with chemical additions (e.g., parks, playgrounds, golf courses, cemeteries, housing estates)
11. Laboratories
12. Metal plating industries
13. Mortuaries
14. Petroleum processing or storage plants
15. Piers and docks
16. Radioactive material processing plants and nuclear reactors

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17. Wastewater lift stations and pumping stations
18. Wastewater treatment plants
19. Premises with piping under pressure for conveying liquids other than potable water and the piping is installed in proximity to potable water piping
20. Premises with an auxiliary water supply that is connected to a potable water supply
21. Premises where the water supplier is denied access or restricted access for survey
22. Premises where the water is being treated by the addition of chemical or other additives

* Refer to OAR 333-061-0070(8) premise Isolation Requirements.

** A Double Check Valve Backflow Prevention Assembly could be used if the water supplier determines there is only a non-health hazard at a beverage bottling plant.

TABLE 49

Backflow Prevention Methods Used For Premise Isolation	
Degree of Identified Hazard	
Non-Health Hazard (Pollutant)	**Health Hazard (Contaminant)**
BACKSIPHONAGE OR BACKPRESSURE	BACKSIPHONAGE OR BACKPRESSURE
Air Gap (AG)	Air Gap (AG)
Reduced Pressure Principle Backflow Prevention Assembly (RP)	Reduced Pressure Principle Backflow Prevention Assembly (RP)
Reduced Pressure Principle-Detector Backflow Prevention Assembly (RPDA)	Reduced Pressure Principle-Detector Backflow Prevention Assembly (RPDA)
Double Check Valve Backflow Prevention Assembly (DC)	

E. ELIMINATION OF CROSS CONNECTIONS

When potential cross connections are found to exist, the owner, his agent, occupant, or tenant will be notified in writing to eliminate and/or disconnect the same within the time limit established by the City of Ashland. Degree of protection required and maximum time allowed for compliance will be based upon the "Degree of Hazard" to the public water supply system. (See appendix A- Partial List of Plumbing Hazards; Appendix B- Illustrations of Backsiphonage; Appendix C- Illustrations of Backpressure)

a. Based upon recommendation from the City of Ashland, the consumer, or his qualified contractor, is responsible for installing sufficient internal isolation backflow prevention assemblies and/or methods (i.e., air gap, pressure vacuum breakers, reduced pressure principle backflow prevention assembly, double check valve assembly).

b. The owner, his agent, occupant, or tenant shall be required to obtain a Plumbing permit for installation of the required cross connection control assembly.

c. In the event that a City of Ashland Cross Connection Specialist does not have sufficient access to every portion of a private water system (i.e., classified research and development facilities; federal government property) to allow a complete evaluation of the "Degree of Hazard" associated with such auxiliary water systems, an approved reduced pressure principle assembly or approved air gap shall be required as a minimum of protection.

d. No person shall fill special use tanks or tankers containing pesticides, fertilizers, other toxic chemicals or their residues from the public water system except at a location equipped with an air gap or an approved reduced pressure principle backflow prevention assembly properly installed on the public water supply.

F. THERMAL EXPANSION NOTIFICATION

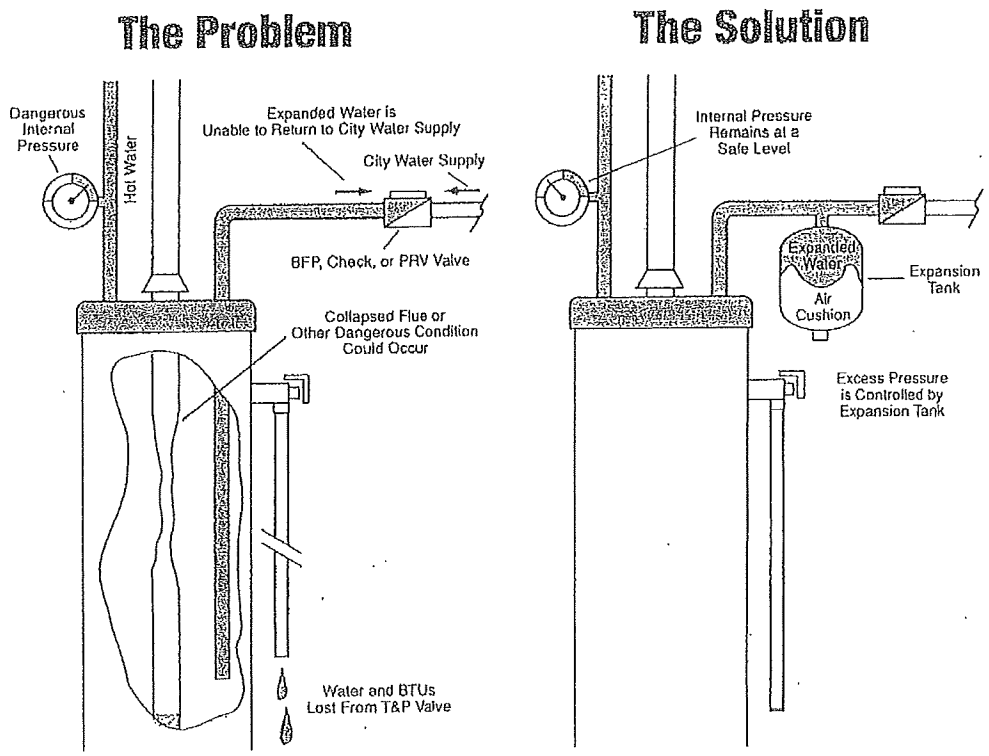
Installation of backflow assemblies is required to eliminate potential cross connections due to possible pollution or contamination problems. Installation of these backflow assemblies can, however cause another potential hazard with the customers hot water heater. Water heaters are installed with a temperature and pressure valve (T&P) which is designed to relieve excessive water temperature or pressure. Also aiding in control of excessive heat and pressure is a condition known as "thermal expansion". Thermal expansion allows extremely hot water to backflow into water main lines, mixing with cold water and dissipating the heat. However, when a backflow prevention assembly is installed on a household water service line, the water cannot go back into the water system. This leaves the T&P valve as the only release route for the overheated water.

If the thermostat in the hot water heater becomes defective and allows the water temperature to increase to more than 212 degrees Fahrenheit, and the T&P valve fails, the

domestic water can become "overheated". Overheated water can cause water heaters to explode or can allow scalding steam to be released from faucets upon personal use.

This condition is rare, because the hot water heater thermostat and the T&P valve must both malfunction simultaneously. However, with the backflow prevention assembly in place, the potential hazard exists.

The City of Ashland shall notify customers installing backflow prevention assemblies of this potential hazard and, also recommends that the T&P valve be inspected periodically. A licensed plumber can inspect, or replace the T&P valve to ensure customer safety and assist with other methods of protection such as thermal expansion chambers and pressure relief toilet ball cock assemblies. The schematic on the left shows what can happen in the water heater if the excess pressure builds up. One solution to the problem is using an expansion tank as shown in the second schematic.



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G. TESTING

All properties that require installation of a backflow assembly shall have said assembly tested annually by a State or Oregon certified tester. It is the responsibility of the property owner to contract with a State certified tester and have the results submitted to the City of Ashland annually. Test results may be submitted either by the certified tester or by the customer. All RPBA, RPDA, DCVA, DCDA, PVBA, and SVB's assemblies are required to be tested as follows:

A) Immediately when installed
B) Annually (based on the anniversary date of installation)
C) When assembly is repaired
D) When assembly is relocated

Backflow assemblies may also be required to be tested more frequently than annually for approved backflow prevention assemblies that repeatedly fail, or are protecting health hazard cross connections, as determined by the water supplier.

H. ENFORCEMENT

1. The owner, manager, supervisor, or person in charge of any installation found not to be in compliance with the provisions of the Water Regulation and Cross Connection Ordinance shall be notified in writing with regard to the corrective action(s) to be taken. The time for compliance shall be in accordance with the "Degree of Hazard" identified.

2. The owner, manager, supervisor, or person in charge of any installation which remains in non-compliance after the time prescribed in the initial notification as outlined in this Policy, shall be considered in violation of the Cross Connection Ordinance. The City of Ashland may discontinue water service to the said property.

3. If, in the judgment of the City of Ashland, any owner, manager, supervisor, or person in charge of any installation found to be in non-compliance with the provisions of the Water Regulation and Cross Connection Ordinance, neglects their responsibility to correct any violation, it may result in discontinuance of water service until compliance is achieved.

4. Failure of a certified backflow prevention assembly tester to submit any record required by the Water Regulation and Cross Connection Ordinance or the submission of falsified reports and/or records may result in the City of Ashland taking the necessary actions to remove said tester from the City of Ashland's list of qualified testers for backflow prevention assemblies within the potable water system for a time period not to exceed one (1) year. If, after one (1) year, the tester wishes to be reinstated as a qualified tester within the City of Ashland, the tester shall submit in writing a request to do so.

Customers who submit falsified reports shall be subject to discontinuance of their water service.

5. Enforcement of this program shall be administered by the City of Ashland Public Works Director or his authorized representative.

6. Requests for extension of time shall be made in writing to the Public Works Director or his authorized representative.

7. In the event that the Public Works Director or his authorized representative denies an extension for any reason, customer may appeal such denial to the City Administrator for review.

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Appendix A

Partial List of Plumbing Hazards

Fixtures with Direct Connections

Description

Air conditioning, air washer
Air conditioning, chilled water
Air conditioning, condenser water
Air line
Aspirator, laboratory
Aspirator, medical
Aspirator, weedicide and fertilizer sprayer
Autoclave and sterilizer
Auxiliary system, industrial
Auxiliary system, surface water
Auxiliary system, unapproved well supply
Boiler system
Chemical feeder, pot-type
Chlorinator
Coffee urn
Cooling system
Dishwasher
Fire standpipe or sprinkler system
Fountain, ornamental
Hydraulic equipment
Laboratory equipment
Lubrication, pump bearings
Photostat equipment
Plumber's friend, pneumatic
Pump, pneumatic ejector
Pump, prime line
Pump, water operated ejector
Sewer, sanitary
Sewer, storm
Swimming pool

Fixtures with Submerged Inlets

Description

Baptismal fount
Bathtub
Bedpan washer, flushing rim
Bidet
Brine tank
Cooling tower
Cuspidor
Drinking fountain
Floor drain, flushing rim
Garbage can washer
Ice maker
Laboratory sink, serrated nozzle
Laundry machine
Lavatory
Lawn sprinkler system
Photo laboratory sink
Sewer flushing manhole
Slop sink, flushing rim
Slop sink, threaded supply
Steam table
Urinal, siphon jet blowout
Vegetable peeler
Water closet, flush tank, ball cock
Water closet, flush valve, siphon jet

Appendix B

Illustrations of Backsiphonage

The following illustrates typical plumbing installations where backsiphonage is possible.

Backsiphonage

Case 1 (Fig. 44)

A. Contact Point: A rubber hose is submerged in a bedpan wash sink.

B. Causes of Reversed Flow: (1) A sterilizer connected to the water supply is allowed to cool without opening the air vent. As it cools, the pressure within the sealed sterilizer drops below atmospheric producing a vacuum which draws the polluted water into the sterilizer contaminating its contents. (2) The flushing of several flush valve toilets on a lower floor which are connected to an undersized water service line reduces the pressure at the water closets to atmospheric producing a reversal of the flow.

C. Suggested Correction: The water connection at the bedpan wash sink and the sterilizer should be provided with properly installed backflow preventers.

Backsiphonage

Case 2 (Fig. 45)

A. Contact Point: A rubber hose is submerged in a laboratory sink.

B. Cause of Reversed Flow: Two opposite multi-story buildings are connected to the same water main, which often lacks adequate pressure. The building on the right has installed a booster pump.

FIGURE 44.
Backsiphonage (Case 1).

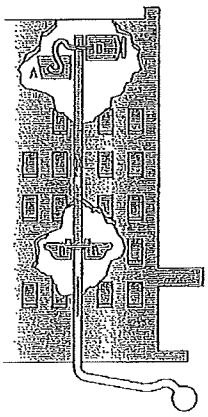
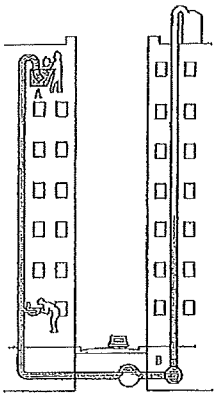


FIGURE 45.
Backsiphonage (Case 2).



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When the pressure is inadequate in the main, the building booster pump starts pumping, producing a negative pressure in the main and causing a reversal of flow in the opposite building.

C. Suggested Correction: The laboratory sink water outlet should be provided with a vacuum breaker. The water service line to the booster pump should be equipped with a device to cut off the pump when pressure approaches a negative head or vacuum.

Backsiphonage

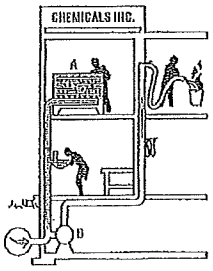
Case 3 (Fig. 46)

A. Contact Point: A chemical tank has a submerged inlet.

B. Cause of Reversed Flow: The plant fire pump draws suction directly from the city water supply line which is insufficient to serve normal plant requirements and a major fire at the same time. During a fire emergency, reversed flow may occur within the plant.

C. Suggested Correction: The water service to the chemical tank should be provided through an air gap.

FIGURE 46.
Backsiphonage (Case 3).



Backsiphonage

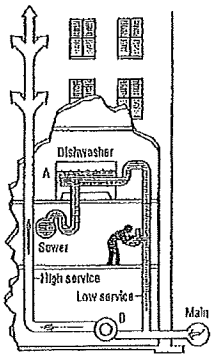
Case 4 (Fig. 47)

A. Contact Point: The water supply to the dishwasher is not protected by a vacuum breaker. Also, the dishwasher has a solid waste connection to the sewer.

B. Cause of Reversed Flow: The undersized main serving the building is subject to reduced pressures, and therefore only the first two floors of the building are supplied directly with city pressure. The upper floors are served from a booster pump drawing suction directly from the water service line. During periods of low city pressure, the booster pump suction creates negative pressures in the low system, thereby reversing the flow.

C. Suggested Correction: The dishwasher hot and cold water should be supplied through an air gap and the waste from the dishwasher should discharge through an indirect waste. The booster pump should be equipped with a low-pressure cutoff device.

FIGURE 47.
Backsiphonage (Case 4).

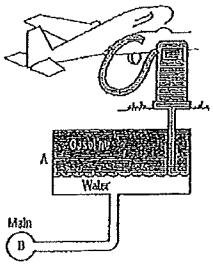


Backsiphonage

Case 5 (Fig. 48)

A. Contact Point: The gasoline storage tank is maintained full and under pressure by means of a direct connection to the city water distribution system.

FIGURE 48.
Backsiphonage (Case 5).



B. Cause of Reversed Flow: Gasoline may enter the distribution system by gravity or by siphonage in the event of a leak or break in the water main.

C. Suggested Correction: A reduced pressure principle backflow preventer should be installed in the line to the gasoline storage tank or a surge tank and pump should be provided in that line.

Backsiphonage

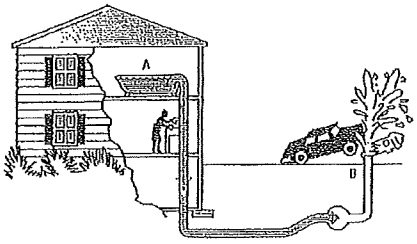
Case 6 (Fig. 49)

A. Contact Point: There is a submerged inlet in the second floor bathtub.

B. Cause of Reversed Flow: An automobile breaks a nearby fire hydrant causing a rush of water and a negative pressure in the service line to the house, sucking dirty water out of the bathtub.

C. Suggested Correction: The hot and cold water inlets to the bathtub should be above the rim of the tub.

FIGURE 49.
Backsiphonage (Case 6).



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Illustrations of Backpressure

The following presents illustrations of typical plumbing installations where backflow resulting from backpressure is possible.

Backflow

Case 1 (Fig. 50)

A. Contact Point: A direct connection from the city supply to the boiler exists as a safety measure and for filling the system. The boiler water system is chemically treated for scale prevention and corrosion control.

B. Cause of Reversed Flow: The boiler water recirculation pump discharge pressure or backpressure from the boiler exceeds the city water pressure and the chemically treated water is pumped into the domestic system through an open or leaky valve.

C. Suggested Correction: As minimum protection two check valves in series should be provided in the makeup waterline to the boiler system. An air gap separation or reduced pressure principle backflow preventer is better.

FIGURE 50.
Backflow (Case 1).

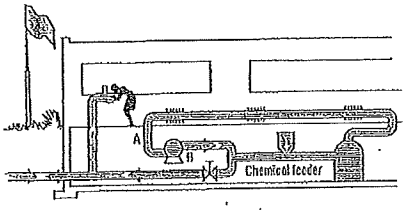
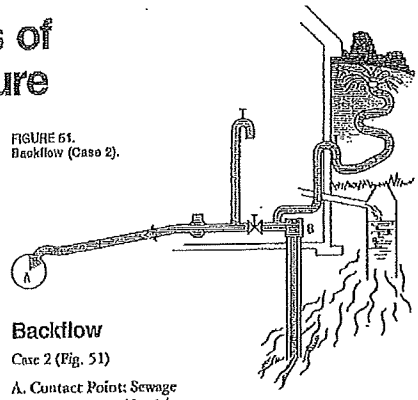


FIGURE 51.
Backflow (Case 2).



Backflow

Case 2 (Fig. 51)

A. Contact Point: Sewage seeping from a residential cesspool pollutes the private well which is used for lawn sprinkling. The domestic water system, which is served from a city main, is connected to the well supply by means of a valve. The purpose of the connection may be to prime the well supply for emergency domestic use.

B. Cause of Reversed Flow: During periods of low city water pressure, possibly when lawn sprinkling is at its peak, the well pump discharge pressure exceeds that of the city main and well water is pumped into the city supply through an open or leaky valve.

C. Suggested Correction: The connection between the well water and city water should be broken

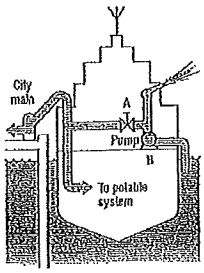
Backflow

Case 3 (Fig. 52)

A. Contact Point: A valve connection exists between the potable and the non potable systems aboard the ship.

B. Cause of Reversed Flow: While the ship is connected to the city water supply system for the purpose of taking on water for the potable system, the valve between the potable and nonpotable systems is opened, permitting contaminated water to be pumped into the municipal supply.

FIGURE 52.
Backflow (Case 3).



C. Suggested Correction: Each pier water outlet should be protected against backflow. The main water service to the pier should also be protected against backflow by an air gap or reduced pressure principle backflow preventer.

Backflow

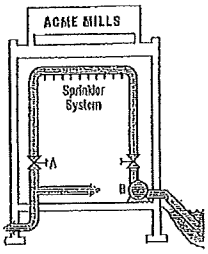
Case 4 (Fig. 53)

A. Contact Point: A single-valved connection exists between the public, potable water supply and the fire-sprinkler system of a mill.

B. Cause of Reversed Flow: The sprinkler system is normally supplied from a nearby lake through a high-pressure pump. About the lake are large numbers of overflowing septic tanks. When the valve is left open, contaminated lake water can be pumped to the public supply.

C. Suggested Correction: The potable water supply to the fire system should be through an air gap or a reduced pressure principle backflow preventer should be used.

FIGURE 53.
Backflow (Case 4).



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