Approved: 2-15-94
Date

MINUTES OF THE SENATE COMMITTEE ON ENERGY AND NATURAL RESOURCES.

The meeting was called to order by Chairperson Don Sallee at 8:00 a.m. on February 7, 1994 in Room 423-S of the Capitol.

All members were present or excused:

Committee staff present: Raney Gilliland, Legislative Research Department
Dennis Hodgins, Legislative Research Department
Don Hayward, Revisor of Statutes
Clarene Wilms, Committee Secretary

Conferees appearing before the committee:
Dennis Schwartz, Kansas Rural Water Association
Charles Jones, Director, Division of Environment
Written testimony submitted by Bruce A. Pfeiffer, Chairman, Kansas-Missouri Chapter of International Association of Plumbing & Mechanical Officials
Written testimony submitted by R. N. Anderson, General Manager, Board of Public Utilities, City of McPherson, KS

Others attending: See attached list

SB-611 - water pollution; concerning lawn irrigation systems

Dennis Schwartz, Kansas Rural Water Association, appeared to present further substantiating documentation requested by committee members dealing with backsiphonage of lawn sprinkler systems. Attachment 1 This information included the following:

1. a letter by Mr. Douglas Crego, Cregor & Lalley, Indianapolis, Indiana, provided to the New York Department of Health

2. an excerpt from the Indiana Court of Appeals Order regarding the application of standards of care

3. a policy statement from the American Water Works Association recognizing the same standard of care, which incidentally is another generally recognized standard of protection

4. a letter signed by Mr. Paul Schwartz, P.E., Chief Engineer for the Foundation for Cross Connection Control and Hydraulic Research, University of Southern California which gives the Foundation's opinion that "lawn sprinkler systems are considered to pose potential health hazards"

5. a letter from USC Foundation for Cross Connection Control advising that most states have regulations which allow water systems to discontinue water service to premises until the health hazard has been eliminated or controlled with the installation of approved backflow prevention assemblies

6. Rainbird, which does not manufacture backflow prevention assemblies and is not connected with any manufacture of backflow prevention assemblies, puts out a backflow prevention handbook with their product noting that "irrigation systems may be subject to contamination from submerged sprinklers"

7. Chapter 3, US Environmental Protection Agency's "Cross Connection Control Manual, June 1989.

Also included in the attachment were plumbing codes from The Uniform Plumbing Code, the BOCA (Building Officials Conference) and the National Plumbing code as assembled by Mr. Cregor.

Mr. Schwartz, Director, Kansas Rural Water Association, encouraged the committee to give serious consideration to the potential legal ramifications that may be created through inconsistencies with nationally known and recognized standards adding this would be the result if SB-611 is approved.

A committee member asked Mr. Schwartz if he could present one documented case where sprinkler systems had caused a real problem due to failure of a backflow device. Mr. Schwartz stated he could not. Mr. Schwartz was asked if it would be safer to outlaw lawn sprinklers. He replied that the appropriate level of protection would make underground lawn sprinkler systems safe. The member stated any device made by man is subject to failure. A question was raised concerning drainage which could cause a break in the vacuum to occur. Mr. Schwartz stated drainage would depend on the device, that a below ground double check valve would not cause such a break but it could happen with some of the other devices.

When asked how many years underground sprinklers had been in use Mr. Schwartz stated he did not know; however, installation numbers were growing. He further stated that there probably are many systems which may have protection no greater than a double check valve installed. Mr. Schwartz concluded he had no documentation on sprinkler systems with or without back-flow prevention devices.

Charles Jones, Director, Division of Environment, KDHE, appeared in opposition to SB-611. Mr. Jones stated that a series of meetings had been held concerning the backflow issue, the last was held in Lawrence, where options were discussed and eventually the parties agreed to disagree. He stated there was agreement that some type of backflow device was needed, the disagreement was on what type would furnish the proper backflow protection. He further noted 780 water systems in the state of Kansas have already adopted more stringent codes in this area.

A member asked Mr. Jones whether regulations currently mandate all sprinkler systems have this device. Mr. Jones stated there currently are no regulations, that they had been working on this issue through guidance. Proposed regulations would state that of the four devices listed on the handout, all but the double check valve would be acceptable. He continued that over a five year period these devices would probably have to be rebuilt and at that time a shift should be made to the preferred device. The member questioned whether there is a requirement that these devices to be replaced every five years and Mr. Jones stated it appeared they needed to be rebuilt during that period of time anyway. Another member requested documentation on the longevity of the devices.

Mr. Jones called attention to the diagrams in Attachment 2, stating the double check valve was the one at issue. Scale or sand could interfere with the seating process thereby allowing backflow. Regarding the statement that there were no known cases of illness due to backflow problems Mr. Jones stated he felt there were failures but probably never at a crucial time. He further stated that the probability of failure is low but still questioned whether the device ia good enough. In answer to comments about cost, Mr. Jones stated the double check valve is possibly not more expensive than other systems but installation costs are higher, also, the double check valve is good but the other devices are better.

In answer to the comment made on Thursday that due to freezing, a large number of rain bird devices failed in Las Vegas, Mr. Jones said he could find no validity from people in Las Vegas. Additionally, the device is used in Michigan and can be used in freezing conditions with proper insulation.

The issues of cost, freezing, vandalism and problems caused by these devices were discussed with Mr. Jones citing various organizations and institutions who were greatly concerned with the quality of water. A committee member stated the legislature deals in facts and when documentation of a problem cannot be presented it was difficult to accept.

A committee member stated they saw their role in the legislature and on the committee as protecting citizens of the state from excessive rules and regulations and this issue was perceived as excessive, also that they were very much opposed to strict regulations without any proof.

Mr. Jones stated that Kansas, without question, has one of the weakest environmental programs in the nation, that Kansas is not excessively regulated.

A member questioned Mr. Jones concerning the difficulties of the double check valve and said they could not understand why the same problem would not occur with the atmospheric breaker and the pressure vacuum breaker since the diagrams presented indicated that regardless of what pressure was bringing about closure of the valve there was always the opportunity for sand or scaling to interfere with proper closure. Mr. Jones referred to Page 15 noting this could happen, however, in combination with the spring that allowed water to flow out or the vacuum breaker system it was believed the devices furnished an extra margin of protection, a mechanical block as well as a system to relieve pressure. Mr. Jones further stated the national institutes that deal with these issues tell them the proposed required systems are better systems.

A member questioned why they are regulating people rather than educating them and asked whether there are state regulations dealing with this issue with Mr. Jones replied there were not. The member questioned whether it was correct that with this bill, the legislature was trying to tell local governments what their regulations could be. Mr. Jones stated that historically they have had a policy in place. Presently about 790 cities and rural water districts have adopted the department's cross connection policy. Concern was expressed that the department was doing things through policy, not regulations. The department is presently formulating regulations.

Mr. Jones stated that if Senate Bill 611 is put into place it will effectively undo the regulations that have been adopted for cross connection programs by more than 790 cities. A member stated that many of these cities had passed the regulations because they believed it was department regulation. Mr. Jones stated this was correct, consequently the department had meetings to give the cities an opportunity to respond.

Due to lack of time the chairperson announced that hearings on SB-611 would be continued on Wednesday, February 9, 1994 at 8:00 a.m. in room 423-S.

Written testimony was submitted in favor of SB-611 by R. N. Anderson, General Manager, Board of Public Utilities, City of McPherson. Attachment 3

Written testimony was submitted in opposition of SB-611 by Bruce A. Pfeiffer, Chairman, Kansas-Missouri Chapter of International Association of Plumbing and Mechanical Officials. Attachment 4

Senator Hardenburger moved approval of the minutes of February 1 and February 3. Senator Lawrence seconded the motion and the motion carried.

The meeting adjourned at 9:05 a.m.

The next meeting is scheduled for February 8, 1994.

GUEST LIST

SENATE COMMITTEE ON ENERGY & NATURAL RESOURCES

DATE February 7, 1994

(PLEASE PRINT) NAME AND ADDRESS	ORGANIZATION
MARK HIRSCHEY	KU/LAWRENCE HOMEOWNER
Blain Bertrand	Lawrence Irrigation Contractors
Glen Westervelt 535 NORTH ST LAWRENCE KS	" " "
Larry D. Shannon	Topeka KSAWWA
RON BAKER	Willowridge Landscape
DARRELL HUFF	TURFMASTERS / LAWRENCE KS.
Richard Woye	Woyes Landscape/Irr. Inc
BRETT BLACKBURN	BLACKBURN NURSERY / TOPEKA SPRINKLER SUPPLY
[illegible] Chaney	Chaney Inc.
Janet Stubbs	Stubbs & Assoc.
Jim DeHoff	Kansas AFL-CIO
Leland E. Rolfs	DWR - KSDA
Dennis F. Schwartz	Ks Rural Water Assoc
Byron N. Johnson	W.D. #1 of Jo Co Ks
TERRY RANDLES	City of Topeka
Bill Anderson	Water Dist #1 of Jo Co
Ed Speer	W.D. No 1 of Johnson County
CHARLES JONES	KDHE
Jerry Grant	KDHE

KANSAS
RURAL
WATER
association
Quality water, quality life

P.O. Box 226 • Seneca, KS 66538 • 913/336-3760 • FAX 913/336-2751

February 7, 1994

TO: SENATE COMMITTEE ON ENERGY AND NATURAL RESOURCES

As requested by this Committee last Friday during the hearing on SB611, I am happy to provide you with substantiating documentation of the attorney's opinion regarding public water suppliers' health hazard/liability caused by backsiphonage through below grade residential lawn irrigation systems.

Senate Bill 611 is an attempt to legislate a reduction in the degree of hazard that underground lawn sprinkler systems pose when connected to public water systems. Similar considerations were given by the New York Department of Health in 1993.

Attached for your review are the following:

1) a letter by Mr. Douglas Cregor, partner of the law firm of Cregor & Lalley, Indianapolis, Indiana, which was provided to the New York Department of Health. Mr. Cregor represents numerous water utilities in Indiana, has taught health requirements and how to limit water utilities' legal liabilities throughout the United States and Canada, and has participated in Kansas Rural Water Association's cross connection and backflow prevention training programs.

2) an excerpt from the Indiana Court of Appeals Order regarding the application of standards of care. This case dealt with a cross connection in the City of Fort Wayne, Indiana, in which 140 cases of typhoid developed in the vicinity of the Anthony Boulevard water main. In this case the city knew or had reason to know of the health hazard and failed to act and the city was held liable;

3) a policy statement from the American Water Works Association recognizing the same standard of care, which incidentally is another generally recognized standard of protection;

4) a letter signed by Mr. Paul Schwartz, P.E., Chief Engineer for the Foundation for Cross Connection Control and Hydraulic Research at the University of Southern California which gives the Foundation's opinion that "*lawn sprinkler systems are considered to pose potential health hazards*". The Foundation says that for the "irrigation systems which do

Senate Energy & Natural Resources
February 7, 1994
Attachment 1

not have the potential for backpressure due to chemical injection or elevation may utilize properly installed vacuum breakers (ABV or PVB) for backflow protection." This letter also references documented case histories where surface water was siphoned through defective operating valves on lawn sprinkler systems into the municipal water supply systems;

5) Another letter from the USC Foundation for Cross Connection Control advising that most states have regulations which allow water systems to discontinue water service to premises until the health hazard has been eliminated or controlled with the installation of approved backflow prevention assemblies;

6) One of the largest manufacturers of residential lawn irrigation systems, Rain Bird, which does not manufacture backflow prevention assemblies and is not connected with any manufacturer of backflow prevention assemblies, puts out a backflow prevention handbook with their product noting that "irrigation systems may be subject to contamination from submerged sprinklers".

7) Chapter 3 of the US Environmental Protection Agency's "CROSS CONNECTION CONTROL MANUAL (June 1989: EPA 570/9-89/007)

Additional evidence of the need for adequate backflow prevention on lawn irrigation systems can be found in every plumbing code. These include: The Uniform Plumbing Code; the BOCA (Building Officials Conference) and the National Plumbing Code. All are nationally accepted plumbing codes. All have specific sections that deal with irrigation systems connected to potable water systems. Every one of these plumbing codes treats lawn irrigation systems as high hazards, which require vacuum breakers (if there is no possibility of back pressure), a reduced pressure backflow prevention assembly if there is any means of creating backpressure. Backpressure on lawn irrigation systems is usually created by elevation above the backflow preventer. It is my understanding that the Uniform Plumbing Code has been adopted by at least the following cities in Kansas: Topeka, Lawrence, Manhattan, Wichita, Lenexa and Olathe.

Mr. Cregor writes in his letter "In the regulated water industry, the strong trend has been to move away from the exposure to liability toward a level of safety that is accomplished through a reasonable standard of care. The courts, the federal government, many state legislatures, state health agencies, recognized experts and water associations all recognize that reasonable standards of care which must be met is one that is consistent with the degree of hazard."

As Mr. Cregor states, " the proposal in New York State proposes to reverse these years of progress, to expose the general public to a known health hazard, to expose the water purveyor to legal liability by creating an invalid presumption and perhaps expose the State of New York to legal liability for a determination that is contrary to the New York Sanitary Code and the recognized standard of care across the United States."

Kansas Rural Water Association encourages you to give serious consideration to the potential legal ramifications that may be created through inconsistencies with nationally known and recognized standards. This will be the result if SB 611 is approved. Kansas Rural Water Association opposes this legislation in the name of public health safety.

Respectfully submitted,

Dennis F. Schwartz
Director, Kansas Rural Water Association

CREGOR & LALLEY
LAWYERS
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July 9, 1993

Mr. John M. Dunn, Chief Design Section
Mr. Michael V. Horan, Principal
Engineering Technician
Bureau of Public Water Supply Protection
New York Department of Health
11 University Place, Room 406
1215 Wester Avenue
Albany, New York 12203-3313

RE: Public Water Supply
Health Hazard/Liability Caused By Backsiphonage
Through Below Grade Residential Lawn Irrigation Systems

Dear Jack and Mike:

I wish to thank you for the courtesy you extended to us in your office conference on June 25th. Further, as the General Counsel to the American Backflow Prevention Association ("ABPA") I wish to thank you for copies of your pertinent statutes, regulations, Public Water Supply Guide, Cross-Connection Control (The New York Manual), policy statements and approved forms. I will personally deliver these to the ABPA's Director of Administrative Affairs for incorporation into the Library of the National Office for use by Members and all forty-nine other state health departments.

Speaking of libraries, I was very impressed by the library the New York State Health Department has by your cubical. The knowledge of cross-connection encased behind those double sliding glass doors represent nationwide accepted standards of protection for the general public. As a lawyer who represents numerous water utilities in Indiana and as special counsel in other jurisdictions, who has taught health requirements and how to limit water utilities' legal liabilities throughout the United States and Canada, and who has reviewed your New York Code, Guide and policy statements, I am completely bewildered by the New York State Health Department decision reinterpreting "PWS 12" to ignore the knowledge which is part of the Health Department's own records and reduce the prescribed standard of care for backsiphonage conditions when the Health Department is fully aware that it is dealing with a known health hazard.

This letter will address five points: (1) backsiphonage as a potential/known threat to the integrity of a Public Water Supply system; (2) the mandated standard of protection is to be "consistent (commensurate) with the degree of hazard"; (3) what is the degree of hazard considered to be under the facts; (4) the continuing duty of the water purveyor to inspect; and (5) liability upon both the State and the water purveyor.

(1)
BACKSIPHONAGE

Backsiphonage has long been a known form/cause of backflow. The theory of backsiphonage is explained in detail in Chapter Three of the United States Environmental Protection Agency's (U.S.E.P.A.) CROSS CONNECTION CONTROL MANUAL (June 1989: EPA 570/9-89/007). A copy of the Federal Government Manual is enclosed and marked as Exhibit "A".

(2)
STANDARD OF PROTECTION

The standard of protection required by 5-1.31 of the New York Sanitary Code is:

"5-1.31 CROSS CONNECTION CONTROL

(a) The supplier of water shall protect the public water system by containing potential contamination within the premises of the user in the following manner:

(1) by requiring an approved air gap, reduced pressure zone device, double check valve assembly or equivalent protective device consistent with the degree of hazard posed by any service connection;" (emphasis added).

This same standard of care has been recognized for decades and appears to have been the result of the Court's opinion in Pennsylvania Railroad Company, et al. v. Lincoln Trust Company, Administrator, 91 Ind.App. 28 at page 36 (1929). (See attached excerpt from the Indiana Court of Appeals Order in said case which is marked as Exhibit "B"). This case dealt with a cross-connection in the City of Fort Wayne (Ind.) in which approximately 140 cases of typhoid developed in the neighborhood served by the Anthony Boulevard water main. The City knew or had reason to know of the health hazard and failed to act. The City was held liable.

This same standard of care is recognized by the American Water Works Association, to wit: "Such action would include the installation of a backflow prevention device, consistent with the degree of hazard, at the service connection or discontinuation of the service." (See AWWA Policy Statement on Cross Connections which is attached hereto and marked Exhibit "C"). This appears to be the standard of protection required by most states (including New York) and territories.

(3)
DETERMINING THE DEGREE OF HAZARD

I am sure that you will agree with me that one of, if not the, leading nationally recognized experts in the field of cross-connection is the University of Southern California's Foundation for Cross-Connection Control and Hydraulic Research. As you are aware (and I note that you have all eight U.S.C. Manuals going back to 1960 in your Library), that the Foundation is completely independent from manufacturers, water purveyors and state health agencies. Frankly, the U.S.C. Manual's dedication simply reads:

> "This MANUAL is prepared for the benefit of the GENERAL PUBLIC who have an implicit faith that the water is always safe to drink." (emphasis added)

In order to determine the degree of hazard and thus the standard of protection, I made a series of inquiries to the U.S.C. Foundation's Chief Engineer, Mr. Paul H. Schwartz, P.E. Again, as you are no doubt aware, the U.S.C.'s Chief Engineer is responsible for all opinion letters and Mr. Schwartz is the proper authority in the Foundation for such questions/answers.

I inquired of the Foundation what is the degree of hazard associated with a lawn irrigation system. The Foundation responded that the degree of hazard is to be considered a health hazard. I then asked the Foundation to further qualify a lawn irrigation system which does not have a point of chemigation (injection). The Foundation again responded that the degree of hazard is to be considered a health hazard due to the entrance (backsiphonage) of contaminants through below-grade sprinkler heads. Here the key is the conditions surrounding the sprinkler heads. As many families spread or broadcast fertilizers by hand on the ground, the fertilizer tends to pool around the below grade sprinkler heads. As such the "pooling" is drawn up through the below grade lawn sprinkler heads each time there is a backsiphonage in the system. (See letter from the Foundation dated June 23, 1993 which is marked as Exhibit "D".

Subsequent to the U.S.C. first letter, I learned from Mr. Peetluk that in the territory served by the Suffolk County Water Authority, many of the residences served by the Water Authority have residential cesspools instead of modern septic systems or municipal sewers. As you are no doubt aware, most states outlaw this type of primitive "dry well" and recognize it as a health hazard. It is inevitable that such a limited capacity device would, as a natural consequence of its size, overflow onto the lawn of the homeowner. (See letter from Johnson Cesspool Service, dated June 21, 1993 which is marked as Exhibit "E").

Based upon this inevitable problem, a second inquiry was made of the U.S.C. Foundation. Simply stated: would the potential for backsiphonage of sewage from overflowing residential cesspools through below-grade lawn sprinkler heads be a hazard and if so what degree of hazard? The Foundation responded that:

> "the situation involving the potential for backsiphonage of sewage from overflowing residential cesspools through below-grade lawn sprinkler heads, <u>the degree of hazard is considered to be a contaminant (i.e. health hazard)</u>." (emphasis added).

Further, when asked what do other states do under similar circumstances, the Foundation responded:

> "Foundation has found that many states recognize that this type of problem can arise and have promulgated regulations or adopted policies to the effect that the water purveyor should (and in some states "shall") shut off water service to the premises until the health hazard has been eliminated or controlled by the installation of an approved backflow prevention assembly." (See letter from the Foundation dated July 6, 1993 which is marked as Exhibit "F".)

In conclusion, when evaluating a lawn irrigation system with below grade sprinkler heads, you are dealing with a known health hazard whether through backpressure (injection) or backsiphonage and the degree of protection must be consistent with the degree of hazard posed.

As a post script, it is interesting to note that one of the largest manufacturers of residential lawn irrigation systems, Rain Bird, which does not manufacture backflow prevention assemblies and is not now connected with any manufacturer of backflow prevention assemblies, puts out a backflow prevention handbook with their product noting that "irrigation systems may be subject to contamination from submerged sprinklers". (See p.2 of Rain Bird Backflow Prevention Handbook which is attached hereto and marked Exhibit "G".

(4)
THE CONTINUING DUTY OF THE
WATER PURVEYOR TO INSPECT

You have told us that the New York State Health Department is in the process of diminishing the prescribed standard of care for residential lawn irrigation systems that are subject to backsiphonage by officially reinterpreting PWS 12, Section 2 by deleting the reference to backsiphonage conditions.

For purposes of argument, a water purveyor under your jurisdiction could then argue that it no longer must inspect residential lawn irrigation systems that are not subject to backpressure (injection) as the New York State Health Department has determined that backsiphonage cannot produce a health hazard unless the "activity or situation" renders the residence equivalent to a commercial user.

Your proposed lessening of the standard of care also creates a presumption, a presumption contrary to the law or regulation in most states, and specifically New York. You presume that the threat of backsiphonage through residential irrigation systems can "not be considered as [a] potential hazard". Yet, you are fully aware that it is a health hazard. You also know that 5-1.31 of the New York Sanitary Code requires (duty) that the water purveyor determine (inspect) the service connection to determine the degree of hazard.

Simply stated, the New York Health Department's proposed reinterpretation of PWS 12 will lull the local water purveyor into a false sense of security, to wit: that the water purveyor can still be in compliance with the State Sanitary Code without meeting its duty to inspect the "service connection" to determine the degree of hazard.

(5)
LIABILITY UPON THE STATE
AND THE WATER PURVEYOR

In the regulated water industry the strong trend has been to move away from the exposure to liability toward a level of safety that is accomplished through a reasonable standard of care. The courts, the federal government, the many state legislatures, the state health agencies, the recognized experts and the watèr associations all recognize that the reasonable standard of care which must be met is one that is consistent with the degree of hazard. Yet, the New York State Health Department is proposing with this reinterpretation of PWS 12 to reverse these years of progress, to expose the general public to a known health hazard, to expose the water purveyor to legal liability by creating an invalid presumption and to expose the State of New York to legal liability for a determination that is contrary to the New York Sanitary Code and the recognized standard of care across these United States.

Gentlemen, please do not finalize this tragically flawed and hastily drawn reinterpretation of PWS 12.

Should you need any additional information, please give me a call.

Very truly yours,

Douglas E. Cregor

DEC/0658D/sk
cc: Morton V. Peetluk
Edward A. Bogdan, Jr.

damage was caused by a defect in the water system of the railroad. The injury complained of in this case is alleged to have been caused by the negligence of the city in allowing the typhoid-infected water to enter into its system and then be distributed to a patron. All of the cases cited by appellant city in support of its contention that the court erred in overruling the city's demurrer are cases where the public utility was delivering a utility, such as electric current or water from its own plant to a customer, and where the injury was caused by a defective fixture or appliance owned by the patron, and, over which, the public utility had no control, and for which it was not responsible. The cases cited are not in point, and are of no controlling influence in the instant case. The city, having permitted the railroad company to connect its water main with the water main of the city, was in duty bound to exercise reasonable care to see that no polluted and impure water, dangerous to health, was allowed to enter into its mains through the water main of the railroad. The quantum of care and vigilance necessary to constitute ordinary prudence has relation to the importance of the subject-matter and is commensurate with the duty to be performed. When a city or other public utility assumes that which is practically an exclusive right, i. e., to provide a community with such a prime necessity of life as water, sound public policy requires that the city faithfully perform its duty by furnishing a supply adequate in quantity and wholesome in quality. From the very nature of things, the consumer must rely on the proffered supply. *Roscoe* v. *City of Everett* (1925), 136 Wash. 295, 239 Pac. 831; *Aronson* v. *City of Everett* (1925), 136 Wash. 312, 239 Pac. 1011; *Workingman's Sav. Bank & Trust Co.* v. *City of Pittsburgh* (1925), 284 Pa. St. 248, 131 Atl. 283; *Hamilton* v. *Madison Water Co.* (1917), 116 Me. 157, 100 Atl. 659; *Hayes* v. *Torrington Water Co.* (1914), 88 Conn. 609, 92 Atl. 406, Ann. Cas.

Exhibit B

1-10

AWWA POLICY STATEMENT ON CROSS CONNECTIONS

CROSS CONNECTIONS

Adopted by the Board of Directors on Jan. 26, 1970, and revised on June 24, 1979 and on Jan. 28, 1990.

AWWA recognizes that the water purveyor has a responsibility to provide its customers with water that is safe under all foreseeable circumstances. Thus, in the exercise of this responsibility, the water purveyor must take reasonable precaution to protect the community distribution system from the hazards originating on the premises of its customers that may degrade the water in the community distribution system.

Cross-connection control and plumbing inspections on premises of water customers are regulatory in nature and should be handled through rules, regulations, and recommendations of the state-or provincial-appointed authority or the plumbing-code enforcement agencies having jurisdiction. The water purveyor, however, should be aware of any situation requiring inspection and reinspection necessary to detect hazardous conditions resulting from cross connections. If in the opinion of the utility, effective measures consistent with the degree of hazard have not been taken by the regulatory agency, the water purveyor should take necessary measures to ensure that the community distribution system is protected from contamination. Such action would include the installation of a backflow prevention device, consistent with the degree of hazard, at the service connection or discontinuance of the service.

In addition, customer use of water from the community distribution system for cooling of other purposes within the customer's system and later returned to the community distribution system is not acceptable and is opposed by AWWA.

Exhibit C

SCHOOL OF ENGINEERING
FOUNDATION FOR CROSS-CONNECTION CONTROL
AND HYDRAULIC RESEARCH
KAP-200 UNIVERSITY PARK MC-2531
(213) 740-2032
FAX: (213) 740-8399

23 June 1993

Cregor & Lalley Lawyers
660 Merchants Bank Building
11 South Meridian Street
Indianapolis, IN 46204

ATTN: Mr. Douglas E. Cregor

re: Lawn Irrigation Systems

Dear Doug,

In response to your telephone inquiry, the degree of hazard associated with a lawn irrigation system is considered to be a health hazard. Section 7.2.3.16 of the Foundation's **Manual of Cross-Connection Control**-*8th Edition*, primarily addresses the need for system protection where there is on site chemigation (i.e., chemicals directly added to irrigation water) taking place. This Section states "*....the installation of facilities for spreading of fertilizers, ... through the irrigation system*", which is interpreted as chemigation.

A lawn irrigation system which does not have a point of chemical/fertilizer injection is still considered a potential health hazard due to the entrance of contaminants through below grade sprinkler heads. The fertilizers which may be broadcast by hand on the ground will tend to collect around the sprinkler heads, posing a potential backflow hazard. The conditions surrounding the sprinkler heads will also greatly effect the potential hazard. The area surrounding the sprinkler heads may become highly contaminated due to animals defecating on the ground, or due to the collection of sewage from overflowing septic tanks. These hazards which may be present must be properly protected against.

For the irrigation systems which do not have the potential for backpressure due to chemical injection or elevation may utilize properly installed vacuum breakers (AVB or PVB) for backflow protection. Most plumbing codes address the use of vacuum breakers for irrigation systems.

The water purveyor who normally has jurisdiction to the point of delivery (i.e., service connection) may accept the internal backflow protection, provided at the point where the irrigation line connects to the property's internal plumbing system, in lieu of protection at the service connection. If the water purveyor is satisfied that there is adequate internal protection, then no additional protection at the service connection may be necessary. This decision is at the discretion of the water purveyor. Several factors may effect this decision, such as the local enforcement of the plumbing code or the regular testing of on site backflow preventers.

As with most cases of backflow, the documentation of incidents is hard to come by. There are several case histories involving irrigation systems in Chapter 11 of the **Manual**, but the undocumented cases of backflow are innumerable. With the degree of hazard which we are dealing with, and the proximity to the consumers' plumbing system, we are surprised that more incidents of illness are

Exhibit D

UNIVERSITY OF SOUTHERN CALIFORNIA, LOS ANGELES, CALIFORNIA 90089-2531

not reported. The consumer would probably not blame the water system unless the taste or odor was easily detected. Some samples of actual case histories include:

1986 April - San Luis Obispo, CA - Surface water was siphoned into the city water due to defective operating valves on a lawn sprinkler system.
1986 April - Withrow, WA - Herbicide was backsiphoned into the community's water system causing residents to go without water for four days.
1985 July - Arpelan, OK - Backsiphonage of chlorine, Malathion, Sevin & Diazanon into the public water system.

Should you need any additional information, please give me a call.

Sincerely,

Paul H. Schwartz, P.E.
Chief Engineer

PHS:p

Exhibit D

SCHOOL OF ENGINEERING
FOUNDATION FOR CROSS-CONNECTION CONTROL
AND HYDRAULIC RESEARCH
KAP-200 UNIVERSITY PARK MC-2531
(213) 740-2032
FAX: (213) 740-8399

6 July 1993

Cregor and Lalley Lawyers
660 Merchants Bank Building
11 South Meridian Street
Indianapolis, IN 46204

ATTN: Mr. Douglas E. Cregor

re: Lawn Irrigation Systems

Dear Doug,

In response to your inquiry concerning the situation involving the potential for backsiphonage of sewage from overflowing residential cesspools through below grade lawn sprinkler heads, the degree of hazard is considered to be a contaminant (i.e., health hazard). Reference Section 4.17 and 4.18 of the Foundation's **Manual of Cross-Connection Control** - *8th Edition*.

In response to your second question: "What action do other states take when there is a known health hazard and the health agency has reason to believe or has been informed that internal protection (*as required by the local plumbing code*) is not being provided for or is not being enforced?" , the Foundation has found that many states recognize that this type of problem can arise and have promulgated regulations or adopted policies to the effect that if a cross-connection poses a potential health hazard then the state agency can require that the water purveyor should (*and in some states "shall"*) shut off water service to the premises until the health hazard has been eliminated or controlled by the installation of an approved backflow prevention assembly.

Under the laws and regulations of most states and territories, the health agency has the primary responsibility of ensuring that the water purveyor operates the public potable water system free of actual or potential sanitary hazards, including unprotected cross-connections. This responsibility is carried out through the enforcing of laws, promulgated regulations and adopted policies.

This letter is supplied to supplement my previous letter dated 23 June 1993. Should you require any additional information, please give me a call.

Sincerely,

Paul H. Schwartz, P.E.
Chief Engineer

Exhibit F

PHS:p

RAIN BIRD®

Backflow Prevention Handbook

Rain Bird Sales, Inc.
145 North Grand Avenue
Glendora, CA 91740
818-963-9311

Exhibit G

1-15

So What's the Big Deal?

Ever since the day man constructed his first aqueducts, his water distribution systems have been plagued by backflow problems. It was (is) inevitable, for the laws of physics are absolute.

Over the years, thousands of people have become ill due to uncontrolled cross connections in piping systems and the backflow which occurs through them. A staff engineer for the U.S. Public Health Service, reported that during a 20 year period, 60,000 people had contacted typhoid fever or dysentery and that 400 persons had died as a result of ingesting water that had been contaminated through cross connections.

It is extremely difficult to document clear-cut cases of illnesses due to uncontrolled cross connections. However, the following cases, reprinted from the U.S. Environmental Protection Agency's Cross Connection Control Manual, will serve to illustrate the problem.

Football Team Stricken

In October 1969, most of the members and coaches of a college varsity football team became ill with infectious hepatitis. The water supply on the practice field was found to be the cause. A drinking fountain and the irrigation system for the field were on the same line. A heavy fire demand in the area had created a negative pressure in the waterlines and caused contaminated surface water around the sprinklers to be siphoned into the potable water lines. Players and coaches drinking from the fountain became ill and the school was forced to cancel the remainder of the football schedule.

Arsenic in Reverse

A California laborer had been using an aspirator, attached to a garden hose, to spray a driveway with weedkiller containing arsenic. Sometime while he was at the job, the water pressure reversed. Taking no notice of the incident, the man disconnected the hose and feeling thirsty, drank from the bib of the hose connection at the house. The arsenic in the waterline killed him.

Just What is a Cross Connection?

A cross connection is defined as any actual or potential connection between the potable water supply and a source of contamination or pollution.

A cross connection is not in itself dangerous. It is only when a contaminated fluid passes through it and into a potable water system, that a health hazard is created. This phenomenon is called "*backflow*."

What Causes Backflow?

Backflow is the unwanted reverse flow of liquids in a piping system.

The term, in this context, means the flow of gas, water or other liquid, mixture or substance into a potable water system, from any source other than that intended.

Backflow may occur when there is an imbalance in the hydraulic forces in a potable water system whereby a nonpotable water can be forced or drawn into the potable water system. Two terms are commonly used in describing this phenomenon: *backpressure* and *back-siphonage*. Backflow due to backpressure will occur when a superior pressure is generated in a nonpotable water system by a pump, a pressure vessel such as a steam boiler or other pressure producing equipment. Or, the superior pressure may be due to a difference in elevation.

Backflow due to back-siphonage is caused by atmospheric pressure which when exerted upon a body of water will force the water into a connected potable water piping system in which there is a vacuum or partial vacuum. In either case, a nonpotable substance can be forced to "backflow" through a cross connection into a potable water system when the hydraulic gradient is favorable. (See Fig. 1)

The principal causes of back-siphonage are:

1. Undersized piping.
2. Line repair or break which is lower than a service point.
3. Lowered main pressure due to high water withdrawal rate such as fire fighting or water main flushing.
4. Reduced supply main pressure on suction side of a booster pump.

The principal causes of backpressure are:

1. Booster pump designed without backflow prevention devices.
2. Potable water connections to boilers and other pressure systems without backflow prevention devices.
3. Interconnection with another system operated at a higher pressure, such as a fertilizer injector system.

Exhibit 6

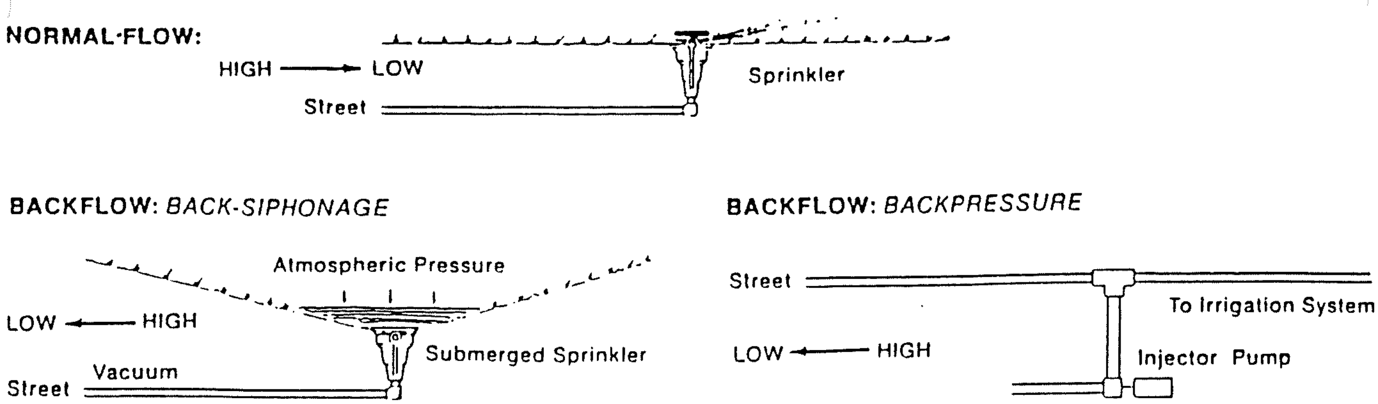


FIG. 1 / Back-siphonage and Backpressure Backflow

What is an Example of a Cross Connection?

Almost every water-using system may be improperly designed, so that a cross connection results. Backflow occurs as a consequence of development of negative pressure in the domestic water supply line. In some instances, for example with injector pumps, positive pressure may be developed within the system and backflow may occur even before negative pressures develop in the domestic water lines.

The following are potentially hazardous water-using equipment: Air-conditioning systems • Aspirators (Including mortuary) • Blueprint machines • Car washing equipment • Chemical and chemical solution lines • Cooling water systems and towers • Display fountains • Fish Ponds • Garbage can washing equipment • Garden spray aspirators • Hose connections • Hospital and laboratory equipment — autoclaves, bedpan washers, instrument sterilizers, pipet washers, and X-ray processing equipment • Hydraulic applicators for fertilizer and other farm chemicals • Industrial process fluid lines, tanks, and vats • Irrigation systems under pressure • Laundry equipment • Mechanical equipment and engines (for cooling) • Plumbing fixtures — flushometer valves on toilets, below-rim inlets to basins and tubs, washing machines, dishwashers, and garbage grinders • Pressure cookers and food-processing equipment • Process water recirculating system • Sewer flush tanks • Slop sinks and utility hoppers • Soda fountains • Steam boilers • Swimming pools • Water using mechanical equipment • Water troughs

Why is an Irrigation System a Cross Connection?

Irrigation systems are cross connections because they may be equipped with pumps, injectors, pressurized tanks or vessels, or other facilities for injecting chemicals into the irrigation system. Also, irrigation systems may be subject to contamination from submerged sprinklers, auxiliary water supplies, ponds, reservoirs, swimming pools, and other sources of contaminated water.

Who is Responsible?

Responsibility for cross connection control rests with (1) the regulatory agencies (which may include The State Health Department, The Local Health Department, The Plumbing Inspection Department, and other local agencies), (2) the local water purveyor, and (3) the water user.

The regulatory agencies enforce appropriate laws, codes, and regulations and see that the necessary action programs are carried on by the water purveyor and water users.

The water purveyor has the responsibility of providing its customers with water that is safe, under all foreseeable circumstances. Thus, the water purveyor must protect the community distribution mains from hazards on customers' premises.

The water user has a dual responsibility. He is responsible for protecting the quality of the water in the community system from contamination originating on his premises. In addition, the water user is also responsible for protecting the water consumers on his own premises. Protection of the public water supply can be accomplished by installation and maintenance of a backflow prevention assembly at the water service connection. However, installed at the service connection or water meter, the backflow preventer will protect only the public water supply; it will not afford any protection to water

Exhibit 6

consumers on the premises. Those using water on the premises (drinking fountains, kitchen equipment, etc.) can be protected only if backflow prevention assemblies are installed at all cross connections on the premises. This means that the water user must maintain an internal cross connection control program (in compliance with local plumbing codes) to isolate and control all cross connections in his own piping system(s) in addition to any protection which may be required at the service connection

Now what do we do?

The answer is simple, eliminate or control the cross connection. A cross connection can be *eliminated* by establishing an air gap separation, or the cross connection can be *controlled* by the installation of a mechanical backflow prevention assembly.

What is an Air Gap?

An air gap is a physical separation between the free-flowing discharge end of a potable water supply pipeline and the top of an open or nonpressure receiving vessel. (See Fig. 2) These vertical separations must be at least twice the diameter of the inlet pipe and never less than one inch. An air gap may be the simplest, least expensive means available for protection against backflow. However, *establishing an air gap is not always possible or practical.*

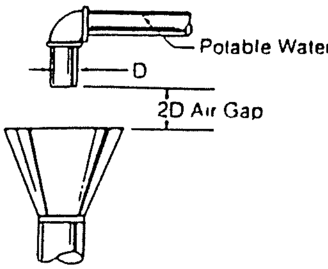


FIG. 2/An Air Gap Separation

What is a Mechanical Backflow Preventer?

A mechanical backflow preventer is a device which allows water to flow in one direction, but does not allow it to flow in the reverse direction.

There are several different types of backflow preventers, namely,

1. Vacuum Breaker
   a) Hose Connection Vacuum Breaker
   b) Atmospheric Vacuum Breaker
   c) Combination Atmospheric Vacuum Breaker and Manual Control Valve
   d) Pressure Vacuum Breaker
2. Double Check Valve Assembly
3. Dual Check Valve
4. Reduced Pressure Principle Backflow Prevention Assembly

Backflow preventers should only be installed in locations where they are readily accessible for maintenance and testing and should not be located where any part of the device can become submerged at any time. Regular testing, inspection and maintenance of these devices is essential to proper protection of the potable water supply.

The choice of backflow preventer to be used will depend on the degree of hazard, the particular piping arrangement involved and local codes.

What is meant by Degree of Hazard?

Probably the best way to explain the concept of the degree of hazard is with the following backflow incident:

A winery in Ohio would flush out the vats, storage tanks, and lines with water supplied by the local purveyor. The flushing was done under a pressure that exceeded the normal line pressure in the system. In 1970, a leaking valve allowed the wine-tinted flush water to backflow into the distribution system. When the residents of the neighborhood opened their faucets for water, they were greeted with wine. Teetotaler or a wine taster — since the only foreign substance was a very dilute wine, no serious harm was done. Such a condition would be considered a *low degree of hazard* (nontoxic), and an approved *double check valve assembly* would have been adequate to prevent the trouble.

If the contaminant had been a substance that could cause death or illness, a *high degree of hazard* (toxic) would have existed. In such a case, installation of a *reduced pressure principle backflow prevention assembly* would be necessary.

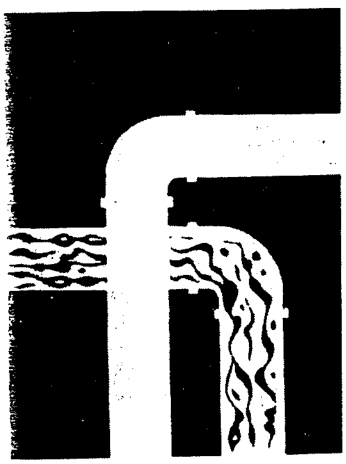
What is a Hose Connection Vacuum Breaker?

A Hose Connection Vacuum Breaker consists of a positive seating check valve and an atmospheric vent, biased to a normally open position. This device is designed specifically for use on hose threaded outlets. (See Fig. 3) Although designed to protect primarily against back-siphonage, it will also protect against low head backpressure backflow.

Exhibit 6

1-78

Theory of Backflow and Backsiphonage



A *cross-connection* [1] is the link or channel connecting a source of pollution with a potable water supply. The polluting substance, in most cases a liquid, tends to enter the potable supply if the net force acting upon the liquid acts in the direction of the potable supply. *Two* factors are therefore essential for backflow. *First*, there must be a *link* between the two systems. *Second*, the resultant *force* must be *toward* the potable supply.

An understanding of the principles of backflow and back-siphonage requires an understanding of the terms frequently used in their discussion. *Force*, unless completely resisted, will produce motion. *Weight* is a type of force resulting from the earth's gravitational attraction. *Pressure (P)* is a force-per-unit area, such as pounds per square inch (psi). *Atmospheric pressure* is the pressure exerted by the weight of the atmosphere above the earth.

Pressure may be referred to using an absolute scale, pounds per square inch absolute (psia), or gage scale, pounds per square inch gage (psig). Absolute pressure and gage pressure are related. Absolute pressure is equal to the gage pressure plus the atmospheric pressure. At sea level the atmospheric pressure is 14.7 psia. Thus,

P absolute = P gage + 14.7 psi
or
P gage = P absolute - 14.7 psi

In essence then, absolute pressure is the total pressure. Gage pressure is simply the pressure read on a gage. If there is no pressure on the gage other than atmospheric, the gage would read zero. Then the absolute pressure would be equal to 14.7 psi which is the atmospheric pressure.

The term *vacuum* indicates that the absolute pressure is less than the atmospheric pressure and that the gage pressure is negative. A complete or total vacuum would mean a pressure of 0 psia or -14.7 psig. Since it is impossible to produce a total vacuum, the term *vacuum*, as used in the text, will mean all degrees of partial vacuum. In a partial vacuum, the pressure would range from slightly less than 14.7 psia (0 psig) to slightly greater than 0 psia (-14.7 psig).

Backsiphonage[1] results in fluid flow in an undesirable or reverse direction. It is caused by atmospheric pressure exerted on a pollutant liquid forcing it toward a potable water supply system that is under a vacuum. *Backflow*, although literally meaning any type of reversed flow, refers to the flow produced by the differential pressure existing between two systems both of which are at pressures greater than atmospheric.

Water Pressure

For an understanding of the nature of pressure and its relationship to water depth, consider the pressure exerted on the base of a cubic foot of water at sea level. (See Fig. 1.) The average weight of a cubic foot of water is 62.4 pounds per square foot gage. The base may be subdivided into 144-square inches with each subdivision being subjected to a pressure of 0.433 psig.

Suppose another cubic foot of water were placed directly on top of the first (See Fig. 2). The pressure on the top surface of the first cube which was originally atmospheric, or 0 psig, would now be 0.433 psig as a result of the superimposed cubic foot of water. The pressure of the base of the first cube would also be inreased by the same amount of 0.866 psig, or two times the original pressure.

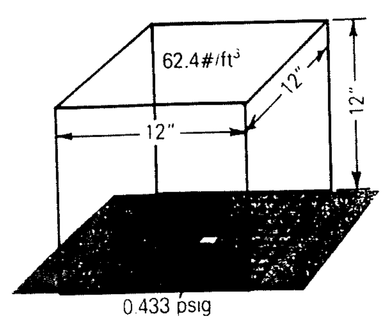


FIGURE 1.
Pressure exerted by 1 foot of water at sea level.

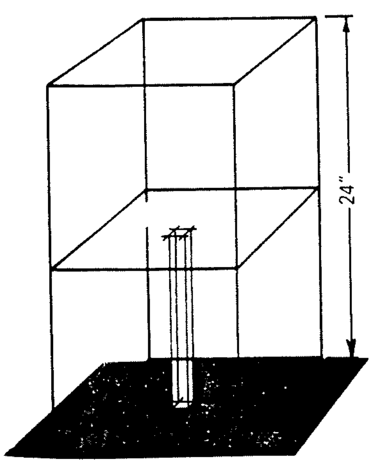
[1] See formal definition in the glossary of the appendix.

1-19

If this process were repeated with a third cubic foot of water, the pressures at the base of each cube would be 1,299 psig, 0.866 psig, and 0.433 psig, respectively. It is evident that pressure varies with depth below a free water surface[1]. in general each foot of elevation change, within a liquid, changes the pressure by an amount equal to the weight-per-unit area of 1 foot of the liquid. The rate of increase for water is 0.433 psi per foot of depth.

Frequently water pressure is referred to using the terms "pressure head" or just "head," and is expressed in units of feet of water. One foot of head would be equivalent to the pressure produced at the base of a column of water 1 foot in depth. One foot of head or 1 foot of water is equal to 0.433 psig. One hundred feet of head are equal to 43.3 psig.

FIGURE 2.
Pressure exerted by 2 feet of water at sea level.

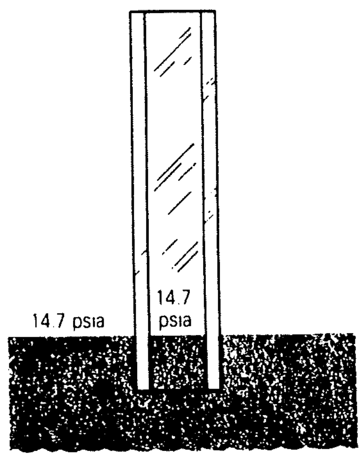


[1]See formal definition in the glossary of the appendix.

Siphon Theory

Figure 3 depicts the atmospheric pressure on a water surface at sea level. An open tube is inserted vertically into the water; atmospheric pressure, which is 14.7 psia, acts equally on the surface of the water within the tube and on the outside of the tube.

FIGURE 3.
Pressure on the free surface of a liquid at sea level.



If, as shown in Figure 4, the tube is slightly capped and a vacuum pump is used to evacuate all the air from the sealed tube, a vacuum with a pressure of 0 psia is created within the tube. Because the pressure at any point in a static fluid is dependent upon the height of that point above a reference line, such as sea level, it follows that the pressure within the tube at sea level must still be 14.7 psia. This is equivalent to the pressure at the base of a column of water 33.9 feet high and with the column open at the base, water would rise to fill the column to a depth of 33.9 feet. In other words, the weight of the atmosphere at sea level exactly balances the weight of a column of water 33.9 feet in height. The absolute pressure within the column of water in Figure 4 at a height of 11.5 feet is equal to 9.7 psia. This is a partial vacuum with an equivalent gage pressure of -5.0 psig.

As a practical example, assume the water pressure at a closed faucet on the top of a 100-foot high building to be 20 psig; the pressure on the ground floor would then be 63.3 psig. If the pressure at the ground were to drop suddenly due to a heavy fire demand in the area to 33.3 psig, the pressure at the top would be reduced to -10 psig. If the building water system were airtight, the water would remain at the level of the faucet because of the partial vacuum created by the drop in pressure. If the faucet were opened, however, the vacuum would be broken and the water level would drop to a height of 77 feet above the ground. Thus, the atmosphere was supporting a column of water 23 feet high.

Figure 4.
Effect of evacuating air from a column.

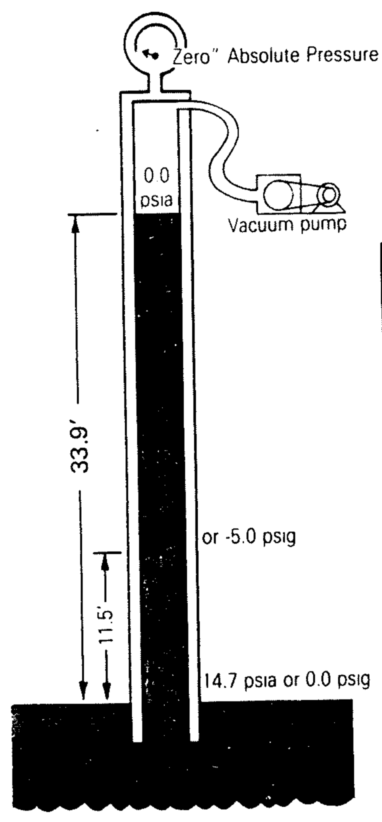
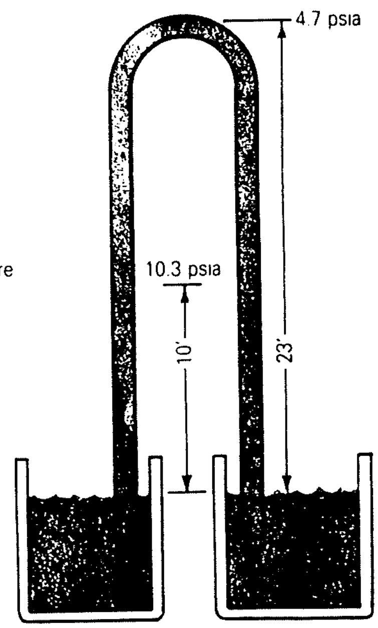


Figure 5 is a diagram of an inverted U-tube that has been filled with water and placed in two open containers at sea level.

If the open containers are placed so that the liquid levels in each container are at the same height, a static state will exist; and the pressure at any specified level in either leg of the U-tube will be the same.

FIGURE 5.
Pressure relationships in a continuous fluid system at the same elevation.



The equilibrium condition is altered by raising one of the containers so that the liquid level in one container is 5 feet above the level of the other. (See Fig. 6.) Since both containers are open to the atmosphere, the pressure on the liquid surfaces in each container will remain at 14.7 psia.

If it is assumed that a static state exists, momentarily, within the system shown in Figure 6, the pressure in the left tube at any height above the free surface in the left container can be calculated. The pressure at the corresponding level in the right tube above the free surface in the right container may also be calculated.

As shown in Figure 6, the pressure at all levels in the left tube would be less than at corresponding levels in the right tube. In this case, a static condition cannot exist because fluid will flow from the higher pressure to the lower pressure; the flow would be from the right tank to the left tank. This arrangement will be recognized as a siphon. The crest of a siphon cannot be higher than 33.9 feet above the upper liquid level, since atmosphere cannot support a column of water greater in height than 33.9 feet.

FIGURE 6.
Pressure relationships in a continuous fluid system at different elevations.

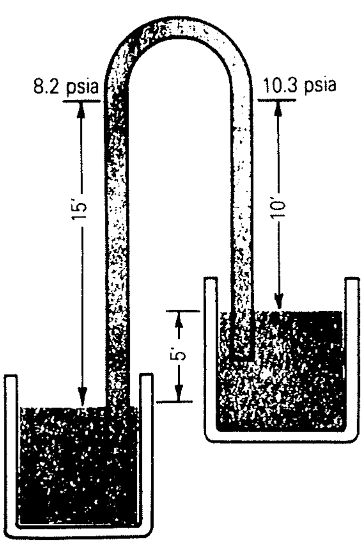


FIGURE 7.
Backsiphonage in a plumbing system.

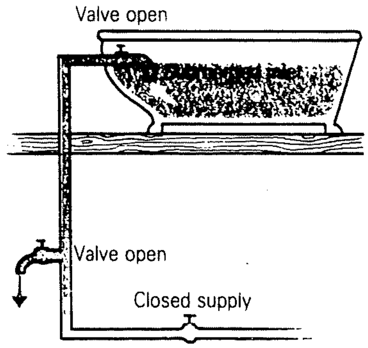


Figure 7 illustrates how this siphon principle can be hazardous in a plumbing system. If the supply valve is closed, the pressure in the line supplying the faucet is less than the pressure in the supply line to the bathtub. Flow will occur, therefore, through siphonage, from the bathtub to the open faucet.

The siphon actions cited have been produced by reduced pressures resulting from a difference in the water levels at two separated points within continuous fluid system.

Reduced pressure may also be created within a fluid system as a result of fluid motion. One of the basic principles of fluid mechanics is the principle of conservation of energy. Based upon this principle, it may be shown that as a fluid accelerates, as shown in Figure 8, the pressure is reduced. As water flows through a constriction such as a converging section of pipe, the velocity of the water increases; as a result, the pressure is reduced. Under such conditions, negative pressures may be developed in a pipe. The simple aspirator is based upon this principle. If this point of reduced pressure is linked to a source of pollution, backsiphonage of the pollutant can occur.

FIGURE 8.
Negative pressure created by constricted flow.

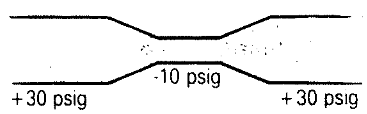
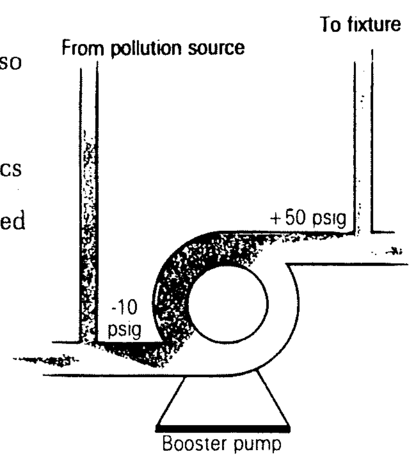


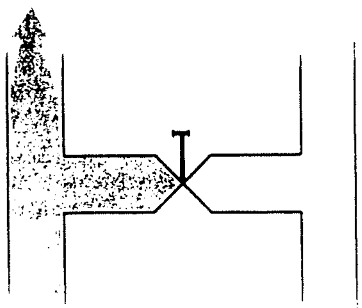
FIGURE 9.
Dynamically reduced pipe pressures.



One of the common occurences of dynamically reduced pipe pressures is found on the suction side of a pump. In many cases similar to the one illustrated in Figure 9, the line supplying the booster pump is undersized or does not have sufficient pressure to deliver water at the rate at which the pump normally operates. The rate of flow in the pipe may be increased by a further reduction in pressure at the pump intake. This often results in the creation of negative pressure at the pump intake. This often results in the creation of negative pressure. This negative pressure may become low enough in some cases to cause vaporization of the water in the line. Actually, in the illustration shown, flow from the source of pollution would occur when pressure on the suction side of the pump is less than pressure of the pollution source; but this is *backflow*, which will be discussed below.

The preceding discussion has described some of the means by which negative pressures may be created and which frequently occur to produce backsiphonage. In addition to the negative pressure or reversed force necessary to cause backsiphonage and backflow, there must also be the cross-connection or connecting link between the potable water supply and the source of pollution. Two basic types of connections may be created in piping systems. These are the *solid pipe* with valved connection and the *submerged inlet*.

FIGURE 10.
Valved connection between potable water and nonpotable fluid.



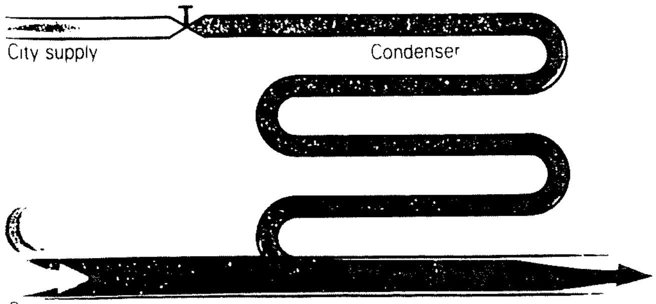
Figures 10 and 11 illustrate solid connections. This type of connection is often installed where it is necessary to supply an auxiliary piping system from a potable source. It is a direct connection of one pipe to another pipe or receptacle.

Solid pipe connections are often made to continuous or intermittent waste lines where it is assumed that the flow will be in one direction only. An example of this would be used cooling water from a water jacket or condenser as shown in Figure 11. This type of connection is usually detectable but creating a concern on the part of the installer about the possibility of reversed flow is often more difficult. Upon questioning, however, many installers will agree that the solid connection was made because the sewer is occasionally subjected to backpressure.

Submerged inlets are found on many common plumbing fixtures and are sometimes necessary features of the fixtures if they are to function properly. Examples of this type of design are siphon-jet urinals or water closets, flushing rim slop sinks, and dental cuspidors. Oldstyle bathtubs and lavatories had supply inlets below the flood level rims, but modern sanitary design has minimized or eliminated this hazard in new fixtures. Chemical and industrial process vats sometimes have submerged inlets where the water pressure is used as an aid in diffusion, dispersion and agitation of the vat contents. Even though the supply pipe may come from the floor above the vat, backsiphonage can occur as it has been shown that the siphon action can raise a liquid such as water almost 34 feet. Some submerged inlets difficult to control are those which are not apparent until a significant change in water level occurs or where a supply may be conveniently extended below the liquid surface by means of a hose or auxiliary piping. A submerged inlet may be created in numerous ways, and its detection in some of these subtle forms may be difficult.

The illustrations included in part B of the appendix are intended to describe typical examples of backsiphonage, showing in each case the nature of the link or cross-connection, and the cause of the negative pressure.

FIGURE 11.
Valved connection between potable water and sanitary sewer.



Backflow

Backflow[1], as described in this manual, refers to reversed flow due to backpressure other than siphonic action. Any interconnected fluid systems in which the pressure of one exceeds the pressure of the other may have flow from one to the other as a result of the pressure differential. The flow will occur from the zone of higher pressure to the zone of lower pressure. This type of backflow is of concern in buildings where two or more piping systems are maintained. The potable water supply is usually under pressure directly from the city water main. Occasionally, a booster pump is used. The auxiliary system is often pressurized by a centrifical pump, although backpressure may be caused by gas or steam pressure from a boiler. A reversal in differential pressure may occur when pressure in the potable system drops, for some reason, to a pressure lower than that in the system to which the potable water is connected.

The most positive method of avoiding this type of backflow is the total or complete separation of the two systems. Other methods used involve the installation of mechanical devices. All methods require routine inspection and maintenance.

Dual piping systems are often installed for extra protection in the event of an emergency or possible mechanical failure of one of the systems. Fire protection systems are an example. Another example is the use of dual water connections to boilers. These installations are sometimes interconnected, thus creating a health hazard.

The illustrations in part C of the appendix depict installations where backflow under pressure can occur, describing the cross-connection and the cause of the reversed flow.

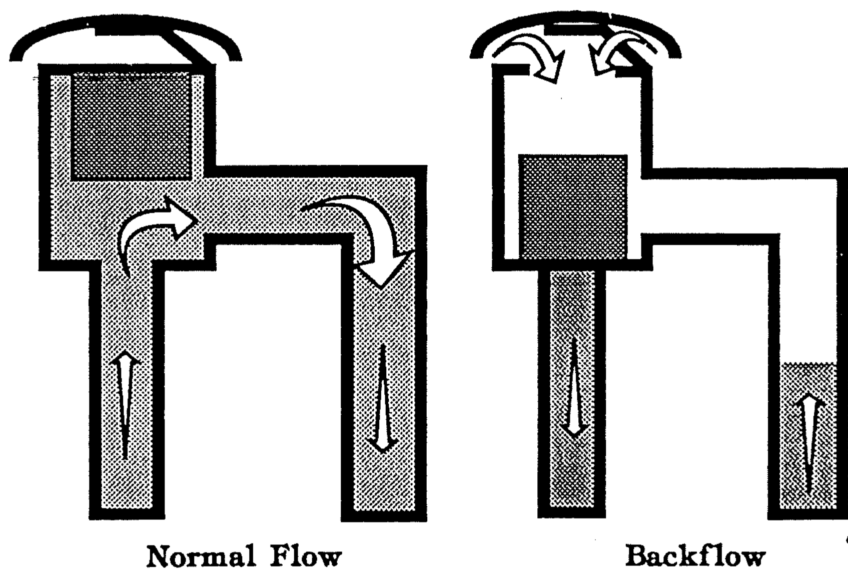
[1] See formal definition in the glossary of the appendix.

Atmospheric (non-pressure) Type Vacuum Breaker {AVB}

The *AVB* is always placed downstream from all shut-off valves. Its air inlet valve closes when the water flows in the normal direction. But, as water ceases to flow the air inlet valve opens, thus interrupting the possible backsiphonage effect. If piping or a hose is attached to this assembly and run to a point of higher elevation, the backpressure will keep the air inlet valve closed because of the pressure created by the elevation of water. Hence, it would not provide the intended protection. Therefore, this type of assembly must always be installed at least six (6) inches above all downstream piping and outlets. Additionally, this assembly may ***not*** have shut-off valves or obstructions downstream. A shut-off valve would keep the assembly under pressure and allow the air inlet valve (or float check) to seal against the air inlet port, thus causing the assembly to act as an elbow, not a backflow preventer. The AVB may not be under continuous pressure for this same reason. An AVB must not be used for more than twelve (12) out of any twenty-four (24) hour period. It may be used to protect against either a pollutant or a contaminant, but may only be used to protect against a backsiphonage condition.

An AVB may be used to protect against a pollutant or a contaminant. However, it may only be subject to a backsiphonage condition. It may be used for twelve of any twenty-four hour period, and may not have shut-off valves or obstructions located downstream.

Atmospheric Vacuum Breaker



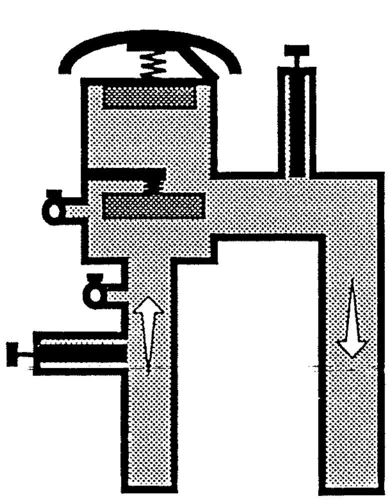
Senate Energy & Natural Rese.
February 7, 1994
Attachment 2

Pressure Vacuum Breaker {PVB}

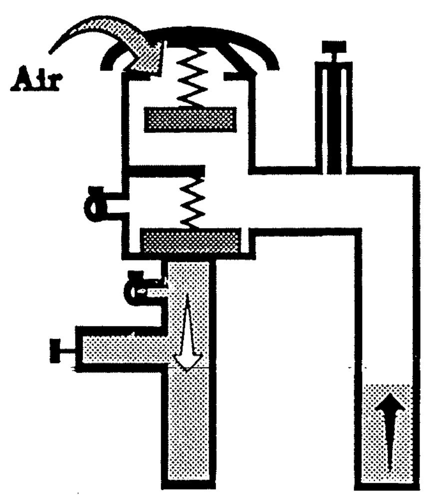
The PVB includes a check valve which is designed to close with the aid of a spring when flow stops. It also has an air inlet valve which is designed to open when the internal pressure is one psi above atmospheric pressure so that no non-potable liquid may be siphoned back into the potable water system. Being spring loaded it does not rely upon gravity as does the atmospheric vacuum breaker. This assembly includes resilient seated shut-off valves and testcocks. The PVB must be installed at least twelve (12) inches above all downstream piping and outlets. The PVB may be used to protect against a pollutant or contaminant, however, it may only be used to protect against backsiphonage. It is not acceptable protection against backpressure.

A PVB may be used to protect against a pollutant or a contaminant under backsiphonage conditions only. It may be used continuously, and have shut-off valves located downstream.

Pressure Vacuum Breaker Assembly



Normal Flow



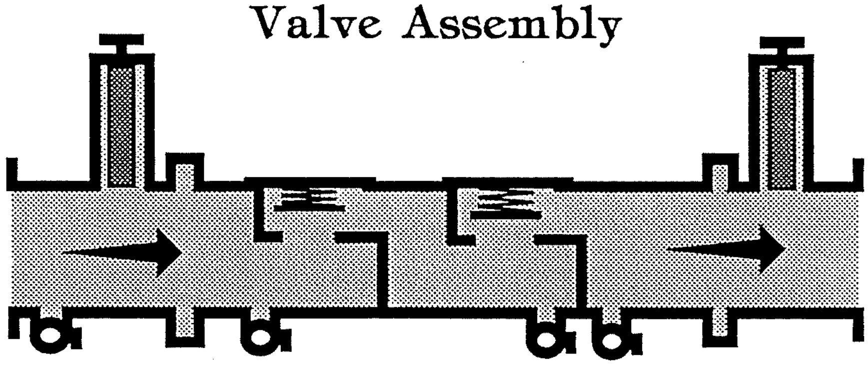
Backsiphonage

Double Check Valve Assembly {DC}

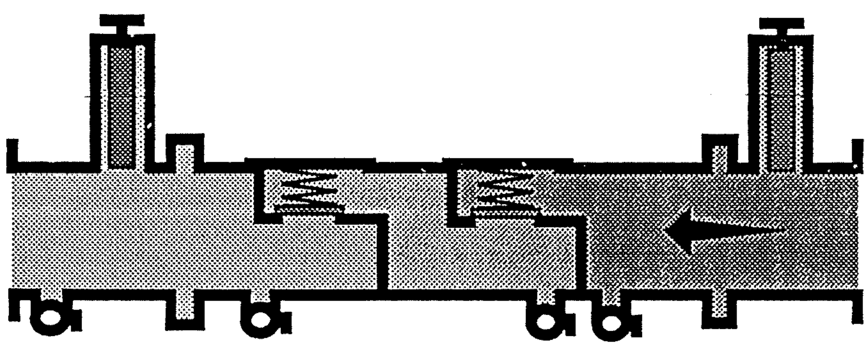
The *Double Check Valve Assembly* consists of two internally loaded, independently operating check valves together with tightly closing resilient seated shut-off valves upstream and downstream of the check valves. Additionally, there are resilient seated testcocks for testing of the assembly. The DC may be used to protect against a pollutant only. However, this assembly is suitable for protection against either backsiphonage or backpressure.

The DC may be used to protect against a pollutant only, under backsiphonage or backpressure conditions.

Double Check
Valve Assembly



Normal Flow

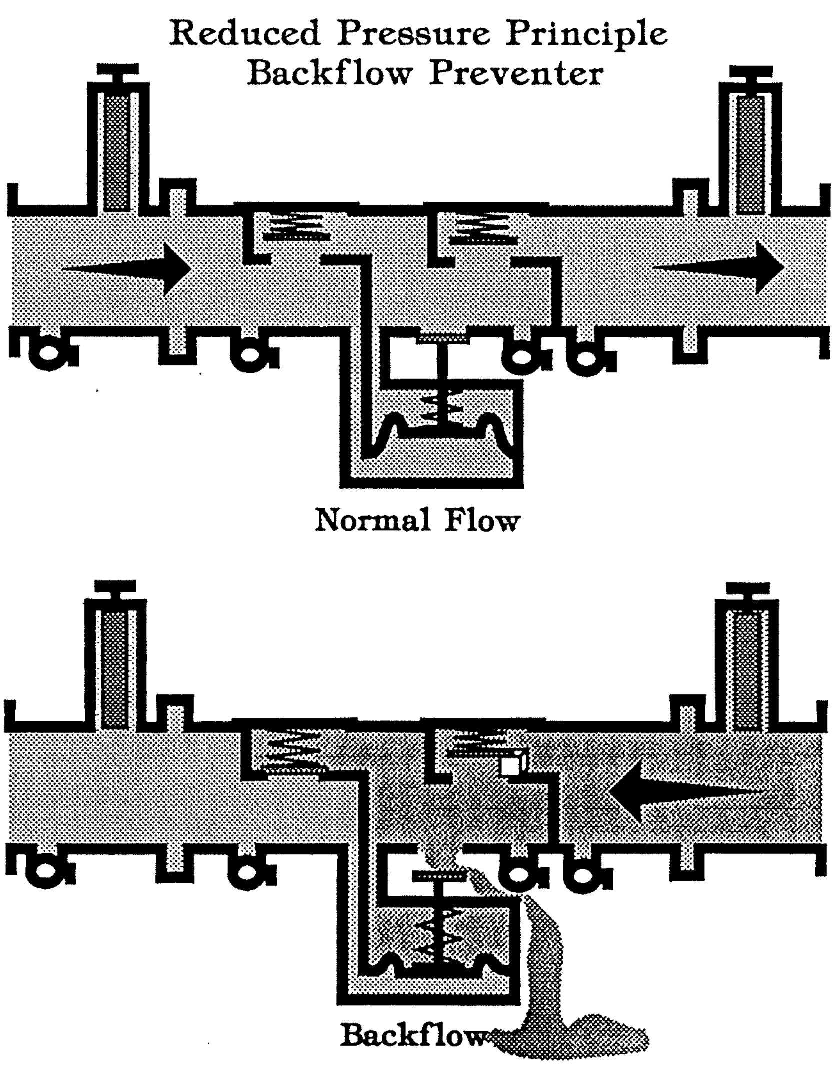


Backflow

Reduced Pressure Principle Assembly {RP}

This assembly consists of two internally loaded independently operating check valves and a mechanically independent, hydraulically dependent relief valve located between the check valves. This relief valve is designed to maintain a zone of reduced pressure between the two check valves at all times. The RP also contains tightly closing, resilient seated shut-off valves upstream and downstream of the check valves along with resilient seated testcocks. This assembly is used for the protection of the potable water supply from either pollutants or contaminants and may be used to protect against either backsiphonage or backpressure.

The RP may be used to protect against either a contaminant or a pollutant under backsiphonage or backpressure conditions.



BOARD OF PUBLIC UTILITIES
CITY OF McPHERSON
P.O. BOX 1008 • McPHERSON, KS 67460 • 316-245-2525

December
14
1993

Senator Don Steffes
1008 Turkey Creek Drive
McPherson, KS 67460

Representative Delbert Crabb
1532 North Walnut
McPherson, KS 67460

Re: Legislative issues of concern to the BPU, scheduled to be heard during the 1994 Legislative Session

Gentlemen:

Cross Connection Regulation

Attached please find a copy of some correspondence from the Kansas Department of Health and Environment concerning a proposed cross connection regulation. The Board of Public Utilities primary concern here is the states attempt to take our home rule capabilities away. This issue is an attempt by KDHE to prevent contamination from one residence "back flowing" into a water distribution system and being transferred over to a neighbor.

If the state is allowed to dictate the "degree of hazard" they will virtually have to take the most conservative approach possible in order to protect themselves. This in turn will create a tremendous amount of undue expense for the industries and residents of Kansas. We feel the responsibility should rest with the water purveyor to asses each issue and make a determination as to how to best handle the situation. This would also put the entire liability on the water purveyor, not the state, should something unfortunate happen.

We feel each community needs to be responsible for its own system and not be regulated into unreasonable mandates that cost everyone unreasonably.

Senate Energy and Natural Resc.
February 7, 1994
Attachment 3

Imminent Domain

Concerning the matter of Imminent Domain. We understand that Representative Carl D. Homes of Liberal, representing the 125th District, intends to oppose the issue of "imminent domain" for municipalities. He apparently is very concerned over the issue of "water rights" and the right of a city to take agricultural water rights for use as a potable water supply. The Board of Public Utilities has always made every effort to avoid the use of "imminent domain", however there are times when this is the only way to resolve a dispute. We ask that you preserve our rights, and assist the municipalities in our efforts to protect the citizen. The adage that says "Government is for the benefit of the multitudes at the detriment of a few" is an appropriate statement here.

We appreciate the opportunity to present these issues to you, presenting our perspective for your consideration.

Yours truly,

BOARD OF PUBLIC UTILITIES

R.N. Anderson

R.N. Anderson, General Manager

RNA/cp

Enclosure

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL C CIALS

KANSAS-MISSOURI CHAPTER
INTERNATIONAL ASSOCIATION OF
PLUMBING AND MECHANICAL OFFICIALS

February 2, 1994

Chairman and Committee
Senate Bill No. 611

As Chairman of the Kansas-Missouri Chapter of IAPMO (International Association of Plumbing and Mechanical Officials), I feel compelled to give my opinion concerning the lawn irrigation act called "Senate Bill No. 611".

Since the conception of laws dealing with the protection of our nations drinking water, IAPMO and other Code Enforcement Agencies, have been striving to ensure, by means of codes and Backflow Prevention Devices, the purity of the water flowing from our taps. These organizations have worked diligently in conjunction with Mechanical Engineers, Manufacturers, and Plumbers to maintain and improve plumbing codes so that this may be achieved.

"Senate Bill No. 611", will be a stride in the wrong direction, and will be detrimental to our goal of supplying safe drinking water to the citizens of Kansas. In the past few months, numerous reports concerning the contamination of our streams and rivers with pesticides and fertilizers have been reported by the media. These reports have caused a great deal of concern as to the safety of the water we are consuming. This same source of contamination exists in our own back yards. Lawns are being sprayed with many of those same chemicals and the danger of contaminating the potable water source is just as real. Should we be any less concerned with the purity of the water in our cities?

The " Double Check Assembly" which is a low hazard backflow device, as well as similar devices, have the capabilities of allowing contaminated groundwater to enter the potable water system by way of backsiphonage. This can be done simply by the fouling of both check valves and the loss of water pressure to the residence, causing a reverse flow of the fluid from the lawn sprinkler system into the drinking water system. For this reason, lawn sprinkler systems should be considered ~~a~~ high hazard, and the appropriate Backflow Devices as recommended by the manufacturers and the Code Enforcement Agencies be installed. These devices include Atmospheric Vacuum Breakers, Pressure Vacuum Breakers, and Reduced Pressure Principal Devices.

My hope, is that your concern for the safety of the people of Kansas, will aid in your decision to help us maintain a clean and safe water source, for this and future generations.

Sincerely,
Bruce A. Pfeiffer

Bruce A. Pfeiffer
Chapter Chairman
Kansas-Missouri Chapter of IAPMO

Senate Energy & Nat'l Resources
February 7, 1994
Attachment 4