TCEQ REGULATORY GUIDANCE
Water Supply Division
RG-477 ● November 2009

A Public Water System Guide to Preparing a Backflow-Incident Emergency-Response Plan

Introduction

Although Texas law requires protection of public water systems (PWSs) from contamination through unprotected cross-connections, occasionally a *backflow incident* will occur in which the distribution system of a public water system becomes contaminated. A backflow incident is a confirmed case where a pollutant or contaminant enters the water supply as a result of back-siphonage or back-pressure. As a best management practice, the TCEQ recommends that public water systems prepare an emergency response plan in order to prepare for a backflow incident. This document contains general information only that is not intended to substitute for the advice of your own operator, engineer, or consultant, nor the rules and regulations established to prevent backflow in the distribution systems of PWSs. Water purveyors, waterworks operators, emergency-management personnel, professional consultants, and licensed backflow-prevention-assembly testers should be aware of these guidelines and understand their roles if an incident occurs. They should also maintain up-to-date knowledge of applicable federal, state, and local public-health statutes, rules, and regulations.

Who Should Read This Guide?

This guide is intended for those who work in a public water system in Texas—for example, a water district, a water-supply corporation, a city, or investor-owned system. In this guide, "you" refers to the PWS and its staff members. The general public, who are the customers of PWSs, will also find answers in this guide to many questions about emergency-response plans for backflow incidents.

Controlling Cross-Connections and Backflow

A *cross-connection* is the point at which a contaminated substance comes in contact with a drinking-water system. However, the potential risks associated with cross-connections can be mitigated by the installation of an appropriate backflow-prevention assembly.

Backflow refers to any unwanted flow of used or non-potable water or other substance from a domestic, industrial, or institutional piping system into a PWS's distribution system. One way to prevent backflow at a cross-connection is to install a backflow-prevention assembly.

The most effective way to prevent backflow is to maintain a rigorous cross-connection-control program within your water system. This will ensure that all cross-connections are protected against backflow. The TCEQ assesses PWSs' cross-connection control programs via surveys conducted by TCEQ personnel concerned with public drinking water and via comprehensive compliance investigations conducted by TCEQ regional investigators. To schedule a survey of your program by personnel from the Public Drinking Water Section, contact the agency's Central Office at 512-239-4691.

What are the potential contamination hazards from cross-connections?

Potential threats to a drinking-water supply include, but are not limited to:

- chemical plants using equipment connected to the public water supply
- hospitals
- mortuaries
- medical, dental, and veterinary clinics
- laboratories
- irrigation and lawn-sprinkler systems
- marinas
- connections with an auxiliary water supply, which could be polluted

How can I determine whether backflow has occurred?

Customer complaints of changes in water quality—such as unusual odor, color, or taste—or physical harm from water contact can indicate backflow. Water-system personnel handling quality complaints should be well-educated about backflow so that they can identify potential incidents. Water operators may note a drop in operating pressure, lowered chlorine residual, a spike in coliform detections, or water meters running in reverse, any of which may indicate that backflow has occurred.

However, it is very difficult to determine whether any of these occurrences are due to backflow. Backflow incidents may not be detected for many reasons, such as:

- Bacterial contamination is usually transient and localized, so sampling may not detect it.

- Chemical and bacterial monitoring is not thorough or frequent enough to identify most backflow incidents.
- Not all contamination can be detected by color, odor or taste, so it passes unreported by customers.
- Water system operators may not report suspected backflow incidents due to concerns about liability and loss of consumer confidence.
- Customers may not report all irregularities in water quality.
- Incidents of reduced pressure in water distribution systems are often transient and difficult to detect by conventional pressure-monitoring equipment, and may be localized. Reduced pressure is often due to routine flushing or line breaks.
- Health effects are difficult to link to backflow incidents, especially chronic effects.
- Contamination may not be widespread enough to draw the attention of public health officials.
- Information that could link an outbreak of illness to a backflow incident is often lacking.

It is important to encourage industrial and residential customers to report backflow incidents to the public water system immediately.

Why should a water supplier prepare an emergency-response plan for backflow incidents?

Texas regulations do not require water suppliers to prepare an emergency-response plan for backflow incidents. However, all PWSs are required to have an operation and maintenance manual that includes protocols to be used during a natural or human-caused event affecting a PWS's water quality. Since it is the water system's primary function to protect public health, the TCEQ recommends adoption of an emergency-response plan as a best management practice. Inadequate preparation for backflow incidents could result in the spread of contamination throughout the water system, endangering the health of the customers.

An Emergency-Response Plan for Backflow Incidents

Designate a Water Utility Emergency-Response Manager

The PWS may elect the utility's manager to be its emergency-response manager, responsible for carrying out the emergency-response plan for backflow incidents. The manager takes charge of backflow incidents as soon as they are known. A backup emergency-response manager should be designated, and should be prepared to assume this lead role if the manager is unavailable.

Organize a Critical Management Team

Establish a team composed of local emergency responders, such as the local TCEQ regional office, law enforcement, public-health agencies, the hazardous-materials (hazmat) team, the local fire department, and your local emergency-response network. Maintain current contact information for all critical-management-team members and establish a mode of communication among them that functions 24 hours a day, seven days a week. Clarify the responsibilities of each team member and delegate tasks appropriately.

Develop contacts with the local news media and determine the most efficient way to disseminate emergency water-quality notices to customers. Keep contact information on site for a variety of local media—newspapers, radio, and television—and be sure that a critical-management-team member is assigned the task of contacting the media.

Develop a Contingency Plan for Alternate Water Supplies

Secure alternate water supplies by establishing mutual aid agreements with neighboring water systems, memorandums of understanding, or inter-municipal agreements to supply water to one another during an emergency. In order to meet TCEQ's water capacity requirements, many public water systems have already established at least one emergency interconnection with a neighboring system.

During a backflow incident, it may be necessary to issue a "do not use water" or "boil water" public health notice to your customers. If the contamination is microbacteriological in nature, then a "boil water" notice could provide adequate public health protection. However, if the contamination is chemical in nature, then a "boil water" notice will not normally provide adequate protection of public health and a "do not use water" notice will be required. If there is any question as to which notice to use, the PWS should issue a "do not use" notice until notified by the TCEQ otherwise. Alternate water sources must be secured in order to maintain critical facilities, such as hospitals and the fire department, that depend on water to function. Be sure to secure enough alternate water to account for extraordinary water demands during a backflow incident, such as fire fighting. An arrangement may be necessary with neighboring fire departments capable of sending tanker trucks to secure an adequate water supply for fire fighting. Alternate sanitation supplies such as portable toilets may be necessary when contaminated water is not to be sent to the wastewater stream.

If a "do not use water" or "boil water" notice is put into effect, bottled water may need to be secured. Establish advance contact with local bottled-water retailers and TCEQ-approved water haulers in order to plan for the distribution of sufficient water to the affected customers.

Maintain Detailed Information about the Water System

Maintain up-to-date information regarding the direction of water flow through the distribution system; the locations of shutoff valves, access points, roads, buildings, and health hazards; and the capacity of the clean-water reservoir. Be familiar with the water system's construction, operation, maintenance, and hydraulics, and the chemicals it uses. It is helpful to keep on hand at the utility office up-to-date laminated maps of the distribution system and the location of all isolation valves. This information will help in determining where and how quickly the contaminated water might spread and how to isolate the affected area, and will hasten the shift to any possible alternate water source in a backflow incident.

Develop a Unidirectional Flushing Plan

Unidirectional flushing is a type of line flushing that isolates pipe sections or loops in an organized, sequential manner, typically from source to periphery. Hydrants should be operated to pull the freshest water into the area being flushed. Flushing programs usually start at the source of contamination and move out through the system.

Unidirectional flushing (UDF) consists of closing specific valves to create one-way flow, and then opening hydrants in consecutively. This increases the speed of the water flow in the pipes to a high enough velocity to remove the contaminated water. **Conventional** line flushing draws water in from all directions and does not increase the speed of water flow through the pipes enough to dislodge deposits. **Unidirectional** flushing allows for a better response to localized water-quality complaints.

The typical requirements to structure a successful unidirectional-flushing program include determining the size and the makeup of discrete flush zones, collecting data, organizing manpower, determining the flushing flow rate, and creating zone maps showing the location of valves, the source of pressure, and the size of the lines. Since a UDF program targets distribution pipes less than 12 inches in diameter, transmission piping is typically not included in a UDF program. Distribution pipes smaller than 12 inches in diameter are divided into zones. This type of flushing is optimized via hydraulic modeling and geographic information systems to pinpoint the best hydrant locations, valve locations, and the velocities that make up a zone in order to determine the sequence in which each pipe within the zone should be flushed.

The PWS must consider the proper disposal of flushed water; such discharges could harm the public health and the environment. Disinfectant residuals in the water may be toxic to aquatic life. In all cases, the flushed water must be handled in accordance with all federal and state regulations.

Train the Public Water System Staff in Backflow and Emergency Management

The utility emergency-response manager may want to ensure that a basic training course on backflow incidents is given to all utility employees so that they are able to identify a backflow incident when it occurs, and are prepared to respond appropriately. Several training courses are available to familiarize water-utility personnel with backflow:

Customer-Service Inspector (CSI) training

- Various CSI courses offered regionally.
- Designed to provide detailed knowledge of backflow and cross-connection control and instruction on customer-service inspections.
- Questions about training providers? Call the TCEQ Operator Licensing Section at 512-239-6135.

Backflow Prevention Assembly Tester course

- Various backflow-training courses offered regionally.
- Designed to provide general knowledge of backflow and detailed instruction on the testing of backflow-prevention assemblies.
- Questions about training providers? Call the TCEQ Operator Licensing Section at 512-239-6135.

Incident Command System training and National Incident Management System training

- NIMS training on standardized incident-management processes, protocols, and procedures that enable water-incident responders to coordinate and conduct response actions.
- Training available through the FEMA Web site at <www.fema.gov/emergency/nims/>.

Establish a Plan of Action

Establish trigger levels based on results being outside the normal baseline ranges for pressure, pH, disinfectant residual and temperature levels. Make a plan for notifying customers about the possible contamination (such as a “boil water,” “do not drink,” or “do not use” notice), flushing the water-distribution system, making available maps that show valves that can be used to isolate and flush distinct parts of the distribution system. The plan should address the worst-case scenario, in which a very hazardous contaminant has entered the water supply and must be remediated by a hazmat team. It should also have a “most likely hazard” scenario that addresses remediation of the hazard most likely to backflow into the water supply (based on the known hazards in the service area). Keep in mind that some contaminants may be discharged into a sanitary sewer, while others require special handling or treatment. Know the state, federal, and local guidelines for disposal of contaminated water. It may also be necessary to quarantine the population that was exposed to the contaminant. Procedures for relocation must be well-planned in advance. The affected population may require immediate and long-term medical attention.

Water Testing

The water utility should assemble an in-house sampling team capable of collecting samples and forwarding them to the appropriate analytical laboratory for baseline monitoring and in response to a reported or discovered backflow incident. Sampling teams responding to potential contamination should be trained and equipped to characterize the site, perform on-site hazard screening using available field-test kits, collect samples, and prepare samples for transport.

If there is evidence or information suggesting contamination at sufficient levels to pose a threat to the life of the utility personnel, the utility should request a trained hazmat emergency-response team. Ideally, the utility emergency-response plan should include pre-established lines of communication with the hazmat response team. However, in most situations, calling 911 will contact the hazmat team.

The water utility should be familiar with the testing capabilities of nearby laboratories. No laboratory can test for all possible contaminants. Most labs specialize in testing certain types of contaminants (for example, chemical or biological). Know the contact information and hours of operation for each laboratory and the types of analyses it performs, as well as the turnaround time and cost of those analyses. A list of laboratories accredited by the State of Texas under the National Environmental Laboratory Accreditation Program can be found at the TCEQ's Web site at: <www.tceq.state.tx.us/assets/public/compliance/compliance_support/qa/txnelap_lab_list.pdf>.

Larger water systems may find it within their means to invest in a portable water-testing kit; however, smaller systems may find that some kits are not within their budget. Many different kinds of portable test kits are on the market; however, their capability to detect abnormalities in the water is limited. Most test kits contain tests for specific chemicals, such as arsenic, but there is no inexpensive test kit that will give a reading of what chemical a sample is contaminated with. Water systems may choose to assemble their own kits by keeping on hand various simple testing apparatus, such as a colorimeter (used to measure chlorine concentration), a pressure gauge, a thermometer, a pH meter, some pesticide-test strips, etc.

Some high-end kits contain a luminometer that will determine the general toxicity of the water. In order to interpret results generated using a luminometer, it is necessary to compare the baseline (normal) water composition to that of the contaminated water. This means that baseline water monitoring using the test-kit luminometer must have been completed before testing for contaminants. The staff must have sufficient training in testing using the luminometer, and must understand basic statistics in order to interpret the results.

Water must be tested throughout all phases of incident response to determine whether the remediation strategy is sufficient, and test results must be reported to the TCEQ in order to lift the public health notice that was issued regarding the water system.

Conduct baseline water quality monitoring during normal times

In a backflow incident, it is necessary to identify the contaminant that has entered the water system. To do so, it is necessary to know what chemicals and organisms are present in the water system during normal times. Conducting baseline water quality monitoring will give you the normal levels of both priority contaminants and standard chemical parameters (chlorine, pH, oxidation-reduction potential, etc.) that can be used to determine what type of contamination has occurred during a backflow incident.

For many priority contaminants, the baseline is expected to be zero or below the detection limit of the corresponding analytical methods. To account for variable water quality within the distribution system, baseline monitoring should involve the collection and analysis of samples from multiple locations in the distribution system. Baseline monitoring should use the same sample-collection and -analysis procedures that would be used in a triggered event. This will eliminate unnecessary suspicion during a triggered event for low-level detections that are regularly seen. Baseline monitoring can also serve as practice for the sampling teams and the utility's network of laboratories, so triggered events will go more smoothly.

Results of baseline monitoring need to be recorded and compared to historical results, if available, for the sample sites. Since there are always some slight variations in a disinfectant residual, etc., the normal upper and lower limits must be determined. It is important to note that some noted results outside of the normal range for disinfectant residual, pH, pressure, and water temperature can vary with the seasons and the increase and decrease of customer water demands or raw-water sources being used. Also, the problem could also be a mechanical failure of the PWS's equipment and not a backflow. These results should be maintained by the PWS and periodically reviewed to track trends.

Establish a procedure for recording backflow incidents

Keep records of the backflow incident such as:

- the type of cross-connection that caused the incident,

- the contaminant,
- the location of the cross-connection and the boundaries of the affected area,
- the remediation efforts employed,
- data identifying the affected population,
- the long- and short-term health effects of the contaminant,
- any treatment given to the affected population, and
- the backflow-prevention method used to eliminate the cross-connection.

Where to Find More Information

Contact the TCEQ—

By phone:

Public Drinking Water Section, 512-239-4691

By mail:

Public Drinking Water Section, MC 155
TCEQ
PO Box 13087
Austin TX 78711-3087

On the Web:

Go to <www.tceq.state.tx.us/goto/publications>. Search for publication number 195 to find *Rules and Regulations for Public Water Systems,* RG-195. Or visit <www.tceq.state.tx.us/rules> and follow the links to 30 TAC Chapter 290, Subchapter D.

Sources of Information about Cross-Connection Control:

American Society of Sanitary Engineering
ASSE International Office
901 Canterbury, Suite A
Westlake, OH 44145
440-835-3040

American Water Works Association
6666 West Quincy Ave.
Denver, CO 80235-3098
800-366-0107

Foundation for Cross-Connection Control and Hydraulic Research
University of Southern California
KAP-200 University Park MC-2531
Los Angeles, CA 90089-2531
866-545-6340

Sources of Information Addressing Responding to Contamination Threats to Drinking-Water Systems

EPA publications on water security

The entire list can be found at:

<cfpub.epa.gov/safewater/watersecurity/publications.cfm?view=all>

Potential Contamination Due to Cross-Connections and Backflow and the Associated Health Risks reviews: (1) causes of contamination through cross-connections; (2) the magnitude of risk associated with cross-connections and backflow; (3) costs of backflow contamination incidents; (4) other problems associated with backflow incidents; (5) suitable measures for preventing and correcting problems caused by cross-connections and backflow; (6) possible indicators of a backflow incident; and (7) research opportunities. This document is available at:

<www.epa.gov/safewater/disinfection/tcr/pdfs/ issuepaper_tcr_crossconnection-backflow.pdf>

A Water Security Handbook: Planning for and Responding to Drinking Water Contamination Threats and Incidents describes how to recognize water contamination incidents, what actions a utility should take in the event of an incident, possible roles of the water utility within the larger Incident Command framework, and how the National Incident Management System is organized. It also describes the utility's actions and decisions during site characterization, laboratory analysis, public-health response, remediation, and recovery. It will also be helpful to utilities that are preparing or updating their emergency response plans. The handbook is available at:

<www.epa.gov/safewater/watersecurity/pubs/ water_security_handbook_rptb.pdf>

Drinking Water Security for Small Systems Serving 3,300 or Fewer Persons presents basic information and steps you can take to improve security and emergency preparedness at small water systems. It is available at:

<www.epa.gov/safewater/watersecurity/pubs/ very_small_systems_guide.pdf>

Emergency Response Plan Guidance for Small and Medium Community Water Systems is intended for use by systems serving a population of 3,301 to 99,999 as they develop or revise their emergency response plans This publication can be found at:

<www.epa.gov/safewater/watersecurity/pubs/ small_medium_ERP_guidance040704.pdf>

Sampling Guidance for Unknown Contaminants in Drinking Water provides comprehensive guidance that integrates recommendations for pathogen, toxin, chemical, and radiochemical sample collection, preservation, and transport procedures to support multiple analytical approaches for the detection and identification of potential contaminants in drinking water. The guidance is intended to support sampling for routine and baseline monitoring to determine background concentrations of naturally occurring pathogens, sampling in response to a triggered event, and sampling in support of remediation or decontamination efforts. This publication can be found at:

<www.epa.gov/safewater/watersecurity/pubs/ guide_watersecurity_samplingforunknown.pdf>

Other EPA resources

Incident Command System (ICS) & National Incident Management System (NIMS) Training for the Water Sector was developed by the EPA Water Security Division to help drinking water and wastewater utilities to better understand the ICS, integrate with other first responders within an expanding ICS structure, and implement NIMS concepts and principles that will help utilities give mutual aid and assistance. Information about NIMS and ICS training is available at:

<www.epa.gov/safewater/watersecurity/pubs/training_nims.pdf>

The EPA's Response Protocol Toolbox, *Planning for and Responding to Contamination Threats to Drinking Water Systems*, assists with emergency-response preparedness and will be of value to drinking-water utilities. This toolbox is available as a series of PDF or Word files at:

<cfpub.epa.gov/safewater/watersecurity/publications.cfm?view=all>

Use of the Drinking Water State Revolving Fund (DWSRF) to Implement Security Measures at Public Water Systems. This fact sheet discusses the types of projects that might be fundable through the DWSRF to help public water systems protect their facilities.

<www.epa.gov/safewater/watersecurity/pubs/security-fs.pdf>