DRAFT for Review May 2026

2026

San Antonio Water System Cross-Connection Control and Backflow Prevention Program

Backflow Prevention Department

San Antonio Water System

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1. Introduction

The San Antonio Water System (SAWS) provides water, recycled water, and wastewater services to over two million customers in the San Antonio area. SAWS is a national leader in water innovation, with one of the country's largest recycled water systems, an underground aquifer storage and recovery facility, and a brackish groundwater desalination plant. SAWS serves over two million customers across Bexar, Medina, and Atascosa counties. The water service area covers most of Bexar County and extends to neighboring municipalities.

Backflow prevention assemblies keep water that has already been piped to commercial and residential customers from “flowing back” into the water system distribution system, preventing accidental contamination of the water supply. Backflow prevention assemblies use mechanical check valves that can fail over time and must be tested. Single check valves are not testable and are not allowed to serve as backflow protection.

All public water systems are required by the Texas Commission on Environmental Quality (TCEQ) to establish and enforce a Cross-Connection Control and Backflow Prevention Program. SAWS is responsible for implementing and enforcing its cross-connection control program, which includes ensuring backflow assemblies are properly installed and tested. SAWS established its program in 1974. SAWS requires customers to install backflow prevention assemblies on their private plumbing systems when a potential hazard is identified. The specific type of assembly is determined by the degree of risk. TCEQ, City of San Antonio code, and SAWS mandate annual testing by a TCEQ licensed Backflow Prevention Assembly Tester (BPAT) for all high-hazard backflow prevention assemblies, and testing of newly installed or repaired assemblies before being placed into service.

a. Reason for the Cross Connection Control and Backflow Prevention Program

Cross-connections pose varying health hazards. Cross-connection control programs help ensure the safety of the public water system. This is achieved by identifying, eliminating, and/or protecting cross-connection points where the potable water supply can come into contact with non-potable water sources, and implementing backflow prevention measures in compliance with federal, state, and local regulations.

A cross-connection is any actual or potential connection or structural arrangement between a public or a consumer’s potable water system and any other source or system through which it is possible to introduce into any part of the potable system any water, industrial fluid, gas, or substance other than the intended potable water with which the system is supplied. Bypass arrangements, jumper connections, removable sections, swivel or change-over devices and

other temporary or permanent devices through which or because of which backflow can occur are considered to be cross-connections.

Cross-Connections can and do happen. There are numerous documented incidents of cross-connections and backflow into the public water system, in San Antonio, other Texas cities and nationwide. The USC Foundation for Cross-Connection Control and Hydraulic Research Foundations Manual of Cross-Connection Control, 10th Edition, documents thousands of incidents across the United States, and many authorities estimate that thousands of cross-connections exist for every one that is discovered.

b. Legal Requirement

In Texas, a cross-connection control program is legally mandated by TCEQ to protect the public water supply from contamination. Public water systems are required to establish and enforce these programs to comply with state and federal regulations.

The Safe Drinking Water Act (SDWA) (1974) is the primary U.S. federal law regulating public drinking water quality, authorizing the Environmental Protection Agency (EPA) to set national health-based standards for tap water to protect against contaminants. This establishes a federal mandate for cross-connection control. The EPA and the SDWA set standards, while the states, including Texas, are responsible for enforcing them.

TCEQ requires public water systems to maintain a cross-connection control program that includes specific components. These rules are outlined in 30 TAC §290.44(h). Failure to comply with these regulations, including non-tested or failing assemblies, gives water suppliers the authority to immediately disconnect service to protect the public water supply. TCEQ rules also require that public water systems adopt local plumbing ordinances, regulations, or service agreements with customers. Texas law clarifies that property owners and water purveyors both have responsibilities to protect the water supply. The property owner is also responsible for protecting their own internal plumbing from contamination.

TCEQ rules place the responsibility for recognizing and evaluating hazards within the PWS's distribution system on the PWS. When a hazard is identified, SAWS must ensure that our customers are protected from contamination by that hazard. SAWS may terminate water service to any connection where an unprotected health hazard is found and only restore service when the health hazard no longer exists or after it has been properly isolated using a backflow prevention assembly.

All hazards must be isolated from the drinking-water supply regardless of when the hazard was first created, or the site was built. Because the effects of a backflow event can be so significant,

there are no grandfather clauses that apply to cross-connection control and backflow prevention in the TCEQ rules on backflow and backsiphonage.

SAWS has implemented a cross-connection control and backflow prevention program that is described in and authorized by Chapter 34, Article VI, Division 8 of the City Code. This program requires the installation, annual inspection and testing of backflow prevention assemblies to prevent the pollution or contamination of the potable water system.

c. Third-party Tracking Services

SAWS began managing this program, including sending notification letters for testing, through a partnership with Backflow Solutions Inc. (BSI) in December 2024. This streamlines the submission and tracking of test results, helps enforce compliance, and reduces administrative work, at no cost to SAWS. BSI charges a fee for receiving and tracking backflow assembly test reports. For questions about submitting test reports, contact BSI Online at 888-966-6050 or support@backflow.com.

d. References

See Appendix B - References

2. Responsibilities

a. General

The responsibility for cross-connection control falls on both property owners and public water suppliers, as stated by TCEQ and SAWS. Property owners must protect against cross-connections by installing and maintaining approved backflow prevention assemblies, and commercial or high-hazard properties may require more stringent measures like air gaps. SAWS is responsible for implementing and enforcing these programs, which includes inspecting systems and ensuring compliance with state and City of San Antonio codes.

Annual testing of backflow prevention assemblies is required by City of San Antonio ordinance and state regulations. Testing ensures the public water supply, as well as water delivered to your home or business, is protected from harmful or even deadly contamination. Failure to have a backflow prevention assembly tested can lead to pollution or contamination of the public water supply and the customer's internal water system.

The implementation of a program for the effective control of cross-connections and backflow prevention requires the full cooperation of all concerned: state and local health agencies, the water purveyor, the City of San Antonio, licensed Backflow Prevention Assembly Testers, and SAWS customers.

b. Roles and Responsibilities Overview

- **Customer/Property owner:** Is responsible for installing, maintaining, and testing their backflow prevention assemblies as required by the local water utility.
- **Licensed Backflow Prevention Assembly Tester (BPAT):** Is licensed by TCEQ to test and repair backflow assemblies. They submit test and maintenance reports directly to the utility or a contracted service.
- **SAWS:** Is responsible for implementing and enforcing a cross-connection control program to protect the public water supply within its service area. The utility must maintain records of all backflow prevention assemblies and ensure they are tested as required.
- **TCEQ**: Sets the minimum regulations and licensing standards for backflow programs across the state.

c. Customer/Property Owner Responsibilities

A customer is the SAWS account owner or person responsible for the backflow assembly. If there is no SAWS open account, the owner, occupant, manager, or other person in control of the property or premises, or the person responsible for the maintenance of the property, shall be considered the customer. The customer's responsibility starts at the point of delivery from SAWS and includes the complete internal water system.

No water may be returned to SAWS potable water distribution system. SAWS may immediately discontinue service to any customer with an unapproved connection or a cross-connection, and service will not be re-established until SAWS determines that the condition is corrected.

Cross-connection hazards are usually classified as either pollution (low or non-health hazard) or contamination (high or health hazard). Pollution in potable water may cause the water to have an objectionable color, taste, or odor, but poses no health hazard. Contamination in potable water may cause illness or death. The terms pollution and low or non-health hazard, and contamination and high or health hazard, are used interchangeably in these guidelines.

The Customer/Property Owner responsibilities include:

- **Customer owned infrastructure**: The customer/property owner is responsible for the portion of any privately owned potable water system lying between the service connection (the terminal end of the connection from the public water system or downstream end of the meter) and the point of use by the customer. This includes but is not limited to all pipes, conduits, tanks, receptacles, fixtures, equipment, and appurtenances used to produce, convey, store, or utilize potable or non-potable water.
- **Installation of backflow prevention assemblies:** Backflow prevention assemblies must be installed by a licensed plumber, or a licensed irrigator on irrigation systems, where a

cross-connection exists or is a potential threat, and must be tested immediately upon installation. TCEQ and SAWS require that all backflow prevention assemblies be approved by the University of Southern California Foundation for Cross-Connection Control and Hydraulic Research. SAWS staff has the final approval authority over backflow prevention assemblies and application, and may require containment backflow protection on designated facilities, when necessary, in the judgment of SAWS staff.

- **Maintenance and repair** of each backflow prevention assembly that is located on the property owner's property, by a licensed BPAT. If a backflow prevention assembly fails a test, the customer must have it repaired, replaced and tested by a licensed tester before returning it to service. The assembly must be tested upon installation and annually thereafter to ensure it remains in working order.
- **Testing:** Backflow prevention assemblies must be tested annually or more frequently, depending on the hazard level (e.g., yearly for high hazard irrigation systems) and repaired or replaced if they are not functioning properly. The licensed tester performing the inspection and testing shall complete a report of each inspection and testing on a TCEQ Test and Maintenance (T&M) form approved by SAWS (Appendix C). The Customer/Property Owner is responsible for hiring a licensed tester to perform an inspection of the backflow assembly. The only exception to this requirement is that backflow assemblies on residential irrigation systems that are considered low hazard (non-health hazard) must be tested every three years.
- **Maintain accurate records:** The customer shall maintain accurate records of tests and repairs to backflow prevention assemblies. T&M reports shall be retained by the owner of the property where the backflow prevention assembly is located for three (3) years after the date of any such test.
- **Submitting the test results to SAWS:** The licensed tester performing the inspection and testing shall complete a report of each inspection and testing on the T&M form approved by SAWS (Appendix C). The tester shall see that the annual report of testing and inspection is submitted to the third-party vendor, BSI Online, within ten (10) days after the completed test.
- **Ensure proper installation:** All assemblies must be installed correctly according to local codes and state regulations, with proper clearances for testing and maintenance.
- **Protect against water damage:** The customer/property owner has the primary responsibility of preventing contaminants from entering his/her potable water system or the public potable water system. The customer/property owner is responsible for any damage caused by water discharge from a backflow assembly.

- **Removal of backflow prevention assemblies:** Customers wishing to remove a backflow prevention assembly must use a TCEQ licensed BPAT tester and follow the steps in Appendix F - Backflow Prevention Assembly Installation and Removal Standards.

d. Costs

All costs associated with the cross-connection and backflow prevention program are to be borne by the customer. This includes the initial purchase of the backflow prevention assembly, its proper installation, testing, and maintenance as long as there is a connection to the SAWS system, whether active or inactive.

e. Licensed BPAT Responsibilities

TCEQ lists BPAT information and licensing requirements at https://www.tceq.texas.gov/licensing/licenses/bpatlic

A Backflow Prevention Assembly Tester (BPAT) is responsible for testing and repairing backflow prevention assemblies to protect the public water supply. Key responsibilities include using calibrated equipment, performing new installation, repair, and annual tests, completing and submitting T&M reports for each assembly, documenting any illegal installations, and keeping up with continuing education requirements to maintain their TCEQ license.

BPATs must register with BSI in order to submit T&M reports for SAWS customers. BPATs are not considered employees, agents, or representatives of the San Antonio Water System.

f. BPAT Scope of Work

BPATs must complete a TCEQ-approved course on cross-connection control and backflow prevention assembly testing, pass an exam administered by the executive director, and hold a current backflow prevention assembly tester license issued by TCEQ. They must comply with all TCEQ rules and regulations relevant to cross-connection control and backflow prevention.

g. SAWS Responsibilities

To protect the public potable water system, the Supervisor of the SAWS Cross Connection Department or their representative will assess hazards in specific situations. If a backflow prevention assembly is required, SAWS will require the customer to install an approved assembly at each service connection or identified hazard point. This assembly must be tested upon installation, annually, and after any repairs are made and before being returned to service. The customer is responsible for all installation, repair, and maintenance costs.

- **Implement programs:** SAWS will implement and enforce a cross-connection control program that complies with state and local regulations.

- **Conduct customer service inspections:** SAWS requires a third-party inspector to conduct Customer Service Inspections (CSI) on private plumbing systems to identify potential cross-connections.
- **Require backflow protection:** SAWS requires the installation of appropriate backflow prevention assemblies.
- **Ensure compliance:** SAWS must ensure that the assemblies are tested to confirm they are working correctly and that all state regulations and local codes have been met before providing permanent water service.
- **Enforce penalties:** SAWS will assess fees for non-compliance, which can also lead to water service suspension.
- **Maintain records of testing:** SAWS maintains records of backflow assembly testing through a partnership with Backflow Solutions Inc (BSI).

The Backflow Prevention Supervisor will enforce the regulations pertaining to cross-connection control by directing thorough inspections of installations of approved backflow prevention assemblies, adhering to the established guidelines for both new and existing facilities. Additionally, the Supervisor will ensure that accurate records are maintained for all approved backflow prevention assembly installations.

Through these rigorous measures, SAWS remains committed to ensuring the safety and integrity of our community's water resources.

h. Inspections by SAWS

San Antonio Water System personnel will perform periodic inspections of backflow prevention assemblies at random locations, as authorized by TCEQ 30 TAC 290, in order to ensure that tests are being performed by a licensed BPAT tester. Additionally, assemblies may be randomly selected and tagged in a manner that will determine if the assembly has been tested as required. Failure to comply could result in the tester's removal from the approved list of testers, and/or litigation. SAWS staff do not test customers' backflow assemblies. This would be a conflict of interest on behalf of SAWS, since SAWS is charged with regulating the program.

3. Administration and Enforcement

a. Backflow Prevention Installation

Backflow preventer installation shall conform to these guidelines (Appendix F). Please direct any questions or comments to the SAWS Cross-Connection Department at 210-233-2910 or email backflow@saws.org.

b. Records and Tests

To ensure the effective operation of backflow prevention assemblies, it is essential to conduct testing in accordance with established performance standards. TCEQ and SAWS follow backflow assembly testing standards as established by the USC Foundation for Cross-Connection Control and Hydraulic Research Foundations Manual of Cross-Connection Control, Tenth or latest edition. Only a TCEQ licensed tester may perform the testing and any necessary repairs. The customer is responsible for initiating the testing and carrying out any required maintenance. Test results must be submitted electronically to the third-party vendor, BSI Online. The licensed tester will complete the original T&M report, TCEQ Form 20700 (Appendix C), and submit it to BSI Online, the vendor for SAWS. Please contact BSI Online at 888-966-6050 or via email at support@backflow.com for more information. The form is intended to be completed on-site while testing is occurring. If the form is completed electronically, the electronic device must also be on-site for proper use of this form.

c. Summary of SAWS and TCEQ Violation Provisions

Criminal and civil penalties are stipulated by City of San Antonio code, Section 34-1081. TCEQ penalties for backflow prevention violations can be substantial, ranging from $50 to $5,000 per violation, per day. Violations frequently involve failing to install, test, or maintain required backflow devices. Enforcement actions can include significant fines, termination of water service, and required corrective actions. Falsifying backflow prevention assembly testing and maintenance (T&M) reports in Texas can lead to severe penalties, including felony charges for tampering with government records and fines up to $25,000 per day per violation from TCEQ, and potential prison time. Falsification violates state environmental regulations and can trigger automatic licensing revocation.

d. Authorization to Enforce

SAWS is granted the authority to take necessary actions against any individual who commits a violation of these regulations within its service area. This provision does not in any way diminish the authority of the Office of the City Attorney, which is empowered to take appropriate actions to enforce the terms of these regulations, prosecute any violations, and defend the legality of these regulations in the event of a challenge.

e. Failure to Provide Proof of Inspection / Non-Compliance

Should the San Antonio Water System (SAWS) not receive the required annual inspection and testing report for a backflow prevention assembly from a property owner, a written notice will be issued to the owner. If the property owner fails to submit the necessary report within ninety (90) days of receiving this notice, SAWS reserves the right to terminate water service to the property in question.

f. Emergency Suspension

The Chief Executive Officer (CEO) of SAWS or their appointed representative may suspend water service to a customer if the CEO determines that contamination or pollution due to backflow presents an imminent threat to the public water system, presents an imminent danger to public health or safety, or threatens to interfere with the operation of the public water system.

A customer notified of the suspension of the person's service by SAWS pursuant to this section shall immediately stop the use of the public water system's water. If the customer fails to immediately suspend use of SAWS' water, SAWS may take the actions it determines are necessary to prevent contamination or pollution, or to minimize damage to the public water system.

g. Access to Property

San Antonio City Code Sec. 34-1080 specifies that a public water system, through its employees or authorized agents, may enter property that receives water service from the public water system to inspect backflow prevention assemblies (Ord. No. 2011-06-23-0575, § 2, 6-23-11). The customer shall make all necessary arrangements, at their expense, to remove security barriers or other obstacles to allow access by public water system personnel without delay. If a customer denies access to a representative for a water use survey or backflow prevention inspection, SAWS will assume the highest risk level and require maximum protection for the customer's service line.

Failure to provide access for the inspection of backflow prevention assemblies shall be considered a violation and may result in disconnection of the customer's water infrastructure from SAWS water system.

h. Fees

If a customer fails to submit the annual report of backflow testing and inspection, SAWS will assess a cost recovery fee to the property owner upon notice of the violation. Failure to pay the cost recovery fee on time may subject the property owner to suspension of service and/or bar the reconnection or resumption of service until the fee is paid as provided in Section 34-78 of

the City Code, for each backflow prevention assembly account for which an annual inspection is required. Fees are added to the customer's regular water bill.

If a customer fails to submit annual report of backflow testing and inspection as set out in section 34-1077(d), SAWS will assess a cost recovery fee to the customer upon notice of the violation. The cost recovery fee shall be assessed as follows:

1—3 Assemblies - $87.00*

4—9 Assemblies - $120.00*

>9 Assemblies - $184.00*

*FY2026 amounts

The San Antonio City Council authorized SAWS to amend the amount of the fee charged to recover the costs related to the cross-connection program. The fee may be waived if the T&M report prepared by the TCEQ licensed BPAT is submitted through BSI.

The fee amount shall be adjusted on January 1st of each year thereafter by the percentage difference (greater than zero) between the Consumer Price Index for All Urban Consumers (CPI-U) as it is calculated by the United States Bureau of Labor Statistics at the end of the month of July prior to the next year and as it was calculated at the end of the month of July one year earlier, and subsequently rounded to the nearest dollar. SAWS will periodically perform a cost-of-service analysis to ensure that the fee charged does not exceed the cost of providing the service.

The authority granted in this section is in addition to the authority granted to SAWS in section 34-1081 of the city code.

i. Wholesale Water Customers and Emergency Connections

Wholesale water customers and customers using an emergency connection must have approved backflow prevention assemblies installed at all SAWS service connections. This includes customers with a master meter serving the property. The backflow assembly must be installed immediately after the meter, or the tap to SAWS water main when premises isolation is required. The customer will be responsible for all related costs of installing, maintaining, and testing the backflow assembly. The selection of an appropriate backflow protection assembly will be based on the degree of hazard involved. SAWS will make the final decision in individual cases.

Note: All customers are required to have a meter for the water delivered. No water will be delivered to a customer which is not metered.

j. Cross-Connection Control and Backflow Prevention Stakeholders

The Backflow Prevention Supervisor may seek advice from stakeholders in the Cross-Connection Control and Backflow Prevention community, including but not limited to personnel from the San Antonio Water System, a representative of the San Antonio Metropolitan Health District, a representative of the Plumbing Inspections Division at Planning and Development Services with the City of San Antonio, the San Antonio Chapter of the American Backflow Prevention Association, a Registered Professional Engineer, a Licensed Irrigator, and a Fire Line System Designer.

4. Customer Service Inspection (CSI)

a. Requirement

TCEQ requires a Customer Service Inspection (CSI) before a water utility can provide continuous water service to new construction and in other specific circumstances. The purpose is to protect the public water supply from potential contamination originating from the customer's plumbing system. Customers are responsible for hiring licensed CSI Inspectors. CSI Inspectors are not considered employees, agents, or representatives of the San Antonio Water System.

A CSI certification must be completed in the following situations, as outlined by Title 30 Texas Administrative Code (30 TAC), Chapter 290.

- **New construction:** Before continuous water service begins for any newly constructed property.
- **Material improvement, correction, or addition:** For any significant modification to the existing private plumbing system, such as remodeling or expanding the system.
- **Contamination suspicion:** When the water provider believes a cross-connection or another potential pollutant or contaminant exists.
- **Recycled water service:** Before a property receives recycled water or if modifications or extensions are made to the customer's recycled water system.

b. Inspections

The required CSI is not a complete plumbing inspection but is limited to verifying specific conditions related to water contamination and lead materials. An inspector must check for the following:

- **Cross-connections:** No direct connections can exist between the public water supply and any potential source of contamination, such as a private well or rainwater harvesting system.
- **Backflow prevention:** Potential contamination sources must be isolated from the public system by an air gap or a backflow prevention assembly, in accordance with state plumbing regulations. This also applies to lawn sprinklers and irrigation systems which require a tested backflow prevention assembly.
- **Lead materials:** The inspection report must state lead regulation compliance as outlined in national plumbing codes and by the Environmental Protection Agency. The inspection certifies that illegal lead pipes, fittings, solder, and flux are not present in the plumbing.
    - **Post-January 4, 2014:** Reduction of Lead in Drinking Water Act mandates that pipes, plumbing fittings, and fixtures must not contain more than a weighted average of 0.25% lead on wetted surfaces. This federal law, amending the Safe

Drinking Water Act, defines "lead-free" and applies to products used in public water systems and residential or non-residential facilities providing potable.
    - **Post-June 19, 1986:** The Safe Drinking Water Act Amendments of 1986 prohibited solder or flux that contained more than 0.2% lead.
- **Industrial use connections:** No connections can exist that would allow water used for industrial, cooling, or condensing processes to return to the public water supply.
- **Plumbing codes:** All plumbing fixtures must comply with Texas state approved plumbing code.

c. Customer Service Inspection Certificate

Customers must obtain a Customer Service Inspection (CSI) certificate from a TCEQ licensed CSI inspector to ensure the private water system is free from cross-connections and contamination before water service is provided. Since water is needed in order to complete construction, SAWS authorizes temporary service for up to 6 months for residential sites and 12 months for commercial sites before requiring that the CSI be submitted.

Customers must submit a Customer Service Inspection that complies with TCEQ requirements to SAWS before an account for continuous water service is permanently established, and as required by section 3.10 of SAWS Utility Service Regulations. SAWS may, at its option, terminate service, require necessary backflow devices, Customer Service Inspections and related testing and take any other measures necessary to comply with state and local requirements for service.

Only individuals with specific licenses are authorized to conduct a customer service inspection in Texas. These include:

- **Plumbing inspectors and water supply protection specialists:** Licensed by the Texas State Board of Plumbing Examiners (TSBPE).
- **Customer service inspectors:** Licensed by the TCEQ after completing a course and passing an exam.

Additionally, if the property is sold without the submission of a CSI, the account will not be transferred to the new property owner until a CSI is submitted. The email address for submission is: CS-TCEQ-CSI@saws.org.

If SAWS finds a serious threat to the integrity of the public water supply, it may terminate water service immediately. Service will only be restored after the hazard has been eliminated or isolated from the public water system.

5. Procedures

a. Procedures Overview

The degree of protection and the type of protection required to prevent cross-connection, backflow and potential pollution or contamination of the San Antonio Water System are outlined in this chapter. The effectiveness of a backflow prevention assembly relies on its type and the quality of its installation, testing, and maintenance.

b. Procedures On Existing Facilities

Annual testing and maintenance

Backflow assemblies use mechanical check valves that can fail over time, so regular testing is required. In the case of an existing service, the following general procedures will be utilized.

- **Mandatory testing:** TCEQ requires that all high hazard backflow assemblies be tested upon installation, after repairs and before being placed back in service, and annually thereafter. SAWS requires that low hazard irrigation backflow assemblies be tested at least every three (3) years.
- **Certified testers:** Tests must be performed by a TCEQ-licensed BPAT. Property owners are responsible for hiring the tester and submitting the test results to BSI at bsionline.com.
- **Enforcement:** Utility providers have the authority to terminate water service if a customer fails to comply with the annual testing and maintenance requirement.

c. Procedures On New Facilities

The requirement for installation of a backflow prevention assembly by a new customer of SAWS shall be issued in conjunction with their request for water service from SAWS Counter Services Division or with their application through the Planning and Development Services Department of Building Inspections for a building permit. In either case, field inspection of the premises and discussion with the owner or their representative may be necessary to determine what the actual or potential health hazards are and determine the assembly requirements.

d. Building Permit

All mechanical layouts or building plans submitted to the City of San Antonio Planning and Development Services Department will be reviewed by a plumbing inspection division representative to ensure compliance with the City's plumbing code. All mechanical layouts or plans will be stamped by the plumbing inspections department to indicate containment backflow protection might be required and contact should be made to the San Antonio Water System Backflow Prevention Section for a determination.

e. Water Service Application

The customer's application for water service shall include a mechanical layout or general provisions as outlined in these guidelines. The SAWS Backflow Prevention department will review the plans and specify the type of backflow assembly, if required. Upon installation and testing of the approved backflow prevention assembly or air gap arrangement, a record of the installation will be made by SAWS.

f. Inspection Procedure – Water Use Survey

After a complete premise inspection by the SAWS Backflow Prevention Inspector, a formal written notice of backflow prevention assembly requirements will be issued to the owner or lessee of an establishment or premise. The notice will contain the following: a list of approved assemblies, a set of backflow prevention assembly installation standards, and a list of licensed testers.

g. Changes to Existing Services

Any customer request for a change on an existing commercial service or on an existing residential service where the change is due to a lawn sprinkler installation or modification will be routed through the SAWS Backflow Prevention Department to ensure compliance with Procedures on New Facilities above.

6. Backflow Protection Methods

a. Selection of a Protection Method

All customers with an actual or potential cross-connection must provide protection via an effective means of backflow prevention at their home or business. The Supervisor of Backflow Prevention may require additional protection if needed.

Backflow protection may be containment of the home or business by installing a backflow prevention assembly immediately after the meter, and/or isolation at certain points within the customer's internal water system.

The type of backflow assembly selected is based on the degree of health hazard. The Backflow Prevention Supervisor will determine when to require this added protection after an individual review of each case. This review may include an on-site inspection of the establishment by his/her representative.

b. Selection of a Backflow Prevention Assembly

Cross-connections vary widely in degree of health hazard. The selection of an appropriate backflow prevention assembly can be determined by answering three questions.

- Is the actual or potential cross-connection subject to backpressure and backsiphonage, or only backpressure? A direct cross-connection is subject to backpressure or backsiphonage, while an indirect cross-connection is only subject to backsiphonage.
- Is there an actual or potential health hazard, or a non-health hazard? A health hazard, or contaminant, may cause death or illness. A non-health hazard, or pollutant, may make the water aesthetically objectionable.
- Is the connection subject to continuous use and pressure? Continuous use will limit the means of backflow prevention that may be used.

The extent to which future additions may be made to the plumbing system may also affect the initial selection of the assembly.

c. Degree of Hazard on Residential Irrigation Systems

Residential properties with irrigation systems and health hazards, or contaminants, require the highest level of protection. These properties are required to have a high hazard backflow assembly installed at the meter for adequate protection against all health hazard conditions. High hazard backflow assemblies on residential irrigation systems with health hazards are required to be tested annually. Residential irrigation systems will be considered to have health hazards if any of the following are on site:

- Alternative Water Sources (Private Wells, Cisterns/Rain Harvesting)
- Aerobic Treatment Systems
- Septic System with Irrigation System
- Irrigation System with Chemical Additives
- Irrigation System with Pools and Autofill or Make-up Line
- Booster Pump

Residential irrigation systems with non-health hazards are required to have their backflow assembly tested every three years.

d. Backflow Prevention Assemblies

Backflow can happen under different hydraulic conditions, from low vacuum to high pressure. The effectiveness of a backflow prevention assembly relies on its type and the quality of its installation, testing, and maintenance. To protect the water supply, SAWS requires customers to install backflow prevention assemblies on their private plumbing systems where an actual or potential cross-connection is identified. The specific type of assembly is determined by the three questions above.

- **Air Gap (A/G):** A physical separation between the free-flowing discharge end of a potable water supply pipeline and an open or unpressurized vessel. An approved air gap shall be at least twice the diameter of the supply pipe and not less than one (1) inch (2.54 cm) above the overflow rim of the receiving vessel.
- **Reduced Pressure Principal Assembly (RP):** An assembly containing two independently acting approved check valves together with a hydraulically operating, mechanically independent pressure differential relief valve located between the check valves and at the same time below the first check valve. The unit shall include properly located resilient seated test cocks and tightly closing resilient seated shutoff valves at each end of the assembly. This assembly is designed to protect against a non-health hazard (i.e., pollutant) or a health hazard (i.e., contaminant). This assembly **shall not** be used for backflow protection on sewage or reclaimed water.
- **Double Check Valve Assembly (DC):** An assembly composed of two independently acting, approved check valves, including tightly closing resilient seated shutoff valves attached at each end of the assembly and fitted with properly located resilient seated test cocks. This assembly shall only be used to protect against a non-health hazard (i.e., pollutant).
- **Pressure Type Vacuum Breaker (PVB):** An assembly containing an independently loaded check valve and an independently operating loaded air inlet valve located on the discharge side of the check valve. The assembly is to be equipped with properly located resilient

seated test cocks and tightly closing resilient seated shutoff valves attached at each end of the assembly. This assembly is designed to protect against a non-health hazard (i.e. pollutant) or a health hazard (i.e. contaminant) under a backsiphonage condition only.

- **Spill/Resistant Vacuum Breaker (SVB):** An assembly containing an independently operating internally loaded check valve and independently operating loaded air inlet valve located on the discharge side of the check valve. The assembly is to be equipped with a properly located resilient seated test cock, a properly located bleed/vent port, and tightly closing resilient seated shutoff valves attached at each end of the assembly. This assembly is designed to protect against a non-health hazard (i.e., pollutant) or a health hazard (i.e., contaminant) under a backsiphonage condition only.
- **Atmospheric Vacuum Breaker (AVB):** An assembly containing an air inlet valve, a check seat and an air inlet port(s). (Also known as the non-pressure type vacuum breaker.) The flow of water into the body causes the air inlet valve to close the air inlet port(s). When the flow of water stops the air inlet valve falls and forms a check valve against backsiphonage. At the same time it opens the air inlet port(s) allowing air to enter and satisfy the vacuum. A shutoff valve immediately upstream may be an integral part of the assembly, but there shall be no shutoff valves or obstructions downstream. The assembly shall not be subjected to operating pressure for more than twelve (12) hours in any twenty-four (24) hour period. An atmospheric vacuum breaker is designed to protect against a non-health hazard (i.e., pollutant) or a health hazard (i.e., contaminant) under a backsiphonage condition only. This type of assembly is not testable.
- **Hose Bib Vacuum Breaker:** This simple and inexpensive device prevents back-siphonage from a garden hose and is required on outdoor faucets.
- **Single Check Valve: S**ingle check valves are not considered to be an approved backflow prevention assembly and is used in limited instances, such as for directional flow control.

e. Type of Business or Establishment – Protection Required

The following table lists many common hazards. It is not an all-inclusive list of the hazards that may be found connected to public water systems. SAWS will review each establishment and business individually for specific requirements.

Premises Isolation: Description of Premises	Assessment of Hazard	Required Assembly
Aircraft and missile plants	Health	RPBA or AG
Animal feedlots	Health	RPBA or AG
Apartments/ Condominiums	Health or Nonhealth†	RPBA or AG
Four Stories or more		
OPTION		
(Containment at the meter or Internal Containment required at each building)		
Automotive plants	Health	RPBA or AG
Beauty Saloon/ Parlors With Foot Spas(Individual Review)	Health	RPBA or AG
Belted Meter Installation	Health	RPBA or AG
(By Individual Review)		
Breweries	Health	RPBA or AG
Canneries, packing houses and rendering plants	Health	RPBA or AG
Cooling Tower,	Health	RPBA or AG
Heat Exchangers, Chillers		
Commercial car wash facilities	Health	RPBA or AG
Commercial laundries	Health	RPBA or AG
Commercial Businesses or Establishments	Health or nonhealth†	RPBA or AG
(By Individual Review)		
Cold storage facilities	Health	RPBA or AG
Connection to sewer pipe	Health	AG
Dairies	Health	RPBA or AG
Docks and dockside facilities	Health	RPBA or AG
Dye works	Health	RPBA or AG
Food and beverage processing plants	Health	RPBA or AG
Gated Community Dedicated Services (By Individual Review)	Health	RPBA or AG
Greenhouse, Landscape and or Grass Farms	Health	RPBA or AG
Hospitals, morgues, mortuaries, medical clinics, dental clinics, veterinary clinics, autopsy	Health	RPBA or AG

facilities, sanitariums, and medical labs		
Jail or prison	Health	RPBA or AG
Laundry and Dry	Health	RPBA or AG
Cleaning Plants-Retail		
(Internal Containment Optional)		
Lease Space	Health	RPBA or AG
(two or More Single Service)		
Containment/Internal Containment Option-Inside City Limits		
Metal manufacturing, cleaning, processing, and fabrication plants	Health	RPBA or AG
Microchip fabrication facilities	Health	RPBA or AG
Paper and paper products plants	Health	RPBA or AG
Petroleum processing or storage facilities	Health	RPBA or AG
Photo and film processing labs	Health	RPBA or AG
Plants using radioactive material	Health	RPBA or AG
Plating or chemical plants	Health	RPBA or AG
Pleasure-boat marinas	Health	RPBA or AG
Power Plant	Health	RPBA or AG
Private/Individual/Unmonitored Wells	Health	RPBA or AG
With SAWS water supply	Health	RPBA or AG
Reclaimed water systems/Rain harvesting	Health	RPBA or AG
Reduction/ Rendering Plant	Health	RPBA or AG
Restricted, classified, military or other closed facilities	Health	RPBA or AG (Located immediately after the tap, outside of the restricted area)
Rubber plants	Health	RPBA or AG
RV Park (by individual review)	Health	RPBA or AG
Sewage lift stations	Health	RPBA or AG
Sewage treatment plants	Health	RPBA or AG
Slaughterhouses	Health	RPBA or AG
Steam plants	Health	RPBA or AG
Stock Yard/Farm & Ranch	Health	RPBA or AG
(By Individual Review)		
Tall buildings or elevation differences where the highest outlet is 80 feet or more above the meter	Health or Nonhealth†	RPBA
Veterinary Clinic	Health	RPBA or AG

(Individual Review)

NOTE: AG = air gap; AVB = atmospheric vacuum breaker; DCVA = double check valve backflow prevention assembly; PVB = pressure vacuum breaker; RPBA = reduced-pressure principle backflow prevention assembly

†Where a greater hazard exists (due to toxicity or other potential health impact) additional area protection with RPBAs is required.

Internal Protection: Description of Cross-Connection	**Assessment of Hazard**	**Required Assembly**
Aspirators	Nonhealth†	AVB
Aspirator (medical)	Health	AVB or PVB
Autoclaves	Health	RPBA
Autopsy and mortuary equipment	Health	RPBA
Bedpan washers	Health	AVB or PVB
Connection to industrial fluid systems	Health	RPBA
Connection to plating tanks	Health	RPBA
Connection to salt-water cooling systems	Health	RPBA
Connection to sewer pipe	Health	AG
Cooling towers with chemical additives	Health	AG
Cuspidors	Health	AVB or PVB
Degreasing equipment	Nonhealth†	RPBA
Domestic space-heating boiler	Nonhealth†	RPBA
Dye vats or machines	Health	RPBA
Fire Line (With Fire Hydrant – see 4.2.4.1) – see Appendix D	Nonhealth	DCDA or AG
Fire Line	Nonhealth	DCVA or AG
(Without Fire Hydrant)		
Fire-fighting system (toxic liquid foam concentrates)	Health	RPBA
Flexible shower heads	Nonhealth†	AVB or PVB
Heating equipment		
Commercial	Nonhealth†	RPBA
Domestic	Nonhealth†	DCVA
Hose bibbs	Nonhealth†	AVB
Irrigation systems		
with chemical additives	Health	RPBA
without chemical additives	Nonhealth†	DCVA, PVB
With OSSF/sanitary sewer	Health	RPBA or AG or PVB or SVB
Kitchen equipment—Commercial	Nonhealth†	AVB
Lab bench equipment	Health or Nonhealth†	AVB or PVB

Laboratory – Chemical or Clinical	Health	RPBA or AG
Ornamental fountains	Health	AVB or PVB
Sewage pump	Health	AG
Sewage ejectors	Health	AG
Shampoo basins	Nonhealth†	AVB
Specimen tanks	Health	AVB or PVB
Steam generators	Nonhealth†	RPBA
Steam tables	Nonhealth†	AVB or RPBA
Sterilizers	Health	RPBA
Swimming pools		
Private	Nonhealth†	PVB or AG or DCVA
Public	Nonhealth†	RPBA or AG
Tank vats or other vessels containing toxic substances	Health	RPBA
Transportation Terminal	Health	RPBA or AG
Trap primers	Health	AG
Vending machines	Nonhealth†	RPBA or PVB
Watering troughs	Health	AG or PVB or RPBA
Wholesale Connections (Planned Unit Develop)	Health	RPBA or AG

NOTE: AG = air gap; AVB = atmospheric vacuum breaker; DCVA = double check valve backflow prevention assembly; PVB = pressure vacuum breaker; RPBA = reduced-pressure principle backflow prevention assembly. AVBs and PVBs may be used to isolate health hazards under certain conditions, that is, back-siphonage situations. Additional area of premises isolation may be required.
†Where a greater hazard exists (due to toxicity or other potential health impact) additional area protection with RPBAs is required.

A field survey may be necessary in many situations. Other types of establishments or businesses may require protection via air gaps or backflow prevention assemblies, depending on the equipment and/or plumbing arrangements utilized. These shall be considered individually, at the discretion of the Supervisor of Backflow Prevention or his/her representative.

Where a private well supply exists in addition to an active San Antonio Water System service, TCEQ rules require that the customer must install an RP at the meter connection or provide an air gap at the meter.

f. Installation

Backflow prevention assemblies and air gap separations shall be installed in accordance with the USC Foundation for Cross-Connection Control and Hydraulic Research Foundations Manual of Cross-Connection Control, Tenth or latest edition. SAWS standards for installation follow the USC standards. If SAWS standards differ from the USC standards, the USC standards take precedence.

g. Size of Assembly

This program does not regulate the size of backflow preventers. However, the containment backflow prevention assemblies required will generally be the same size as the meter requirement stipulated by the San Antonio Water System Development Services Division. Backflow Prevention assemblies must be sized in accordance with local plumbing code requirements. *Exception:* Irrigation systems could exceed the flow capacity of the water service meter. Make sure to size pipe and backflow preventer accordingly.

h. Bypass Policy

If a bypass is installed around the approved backflow prevention assembly, the distribution system must be protected from backflow through this bypass, i.e., it also will include a backflow preventer of the same type and protection as the main service line backflow preventer. Though it need not be of the same size, it must be installed and tested in a similar fashion to the service line assembly to provide the same degree of protection as the main service line.

i. Master Metered Customers

Customers who are billed through one or more master meters, where SAWS is responsible for the water infrastructure, do not need a meter at each tap. If SAWS determines that a backflow assembly is required, it must be installed as close to the meter or tap as reasonably possible.

7. Contact Information

SAWS:

Mark T. Schnur - Backflow Prevention Supervisor
San Antonio Water System
2800 U.S. 281 North
San Antonio, Texas 78212

(210) 233-2910
backflow@SAWS.ORG

BSI Online: For questions about submitting test reports, contact BSI Online at 888-966-6050 or support@backflow.com.

Tester list: A list of companies employing licensed backflow prevention testers is available through BSI Online.

8. Appendices

Appendix A – Definitions

Air Gap Separation is the unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying water to a receiving tank and the flood rim of the tank. An approved air gap separation shall be at least twice the diameter of the supply pipe measured vertically above the overflow rim of the vessel, and in no case shall the gap be less than one inch.

Backflow is the undesirable reversal of flow of water or mixtures of water and other liquids, gases or other substances into the distribution pipes of the potable supply of water from any source or sources. Backflow may occur under either backpressure or backsiphonage conditions.

Backsiphonage is a drop in pressure in the public water system that creates a vacuum effect, which can siphon non-potable water back into the system. This can be caused by events like a water main break or the use of a nearby fire hydrant. Backsiphonage occurs when the pressure in the public water system becomes less than that of the customer's system due to a vacuum or partial vacuum in the public system.

Backpressure: Pressure on a customer's property is greater than the pressure in the public water system, forcing water from the private system back into the public supply. This can occur with systems like boilers, fire suppression systems, or lawn irrigation systems.

Backflow prevention assembly means an assembly that, when properly installed between the public water supply system and the terminus or point of ultimate use, will prevent backflow. Examples of such assemblies include, but are not limited to, reduced-pressure backflow assemblies, double-check valve assemblies, pressure vacuum breakers, and spill-resistant vacuum breakers.

Bypass is a connection from the San Antonio Water System's side of an approved assembly to the customer side of the assembly for the purpose of diverting the water around the backflow preventer while it is being repaired, replaced or tested. All bypasses on backflow prevention assemblies must be the same level of protection.

The **Board** is the San Antonio Water System Board of Trustees created by City Ordinance No. 75686, adopted April 30, 1992.

BPAT means a professional who is licensed by TCEQ to test and repair backflow prevention assemblies.

City or COSA means the City of San Antonio, a Texas home rule municipality.

Cross-connection: Any actual or potential connection or structural arrangement between a public or a consumer's potable water system and any other source or system through which it is possible to introduce into any part of the potable system any used water, industrial fluid, gas, or substance other than the intended potable water with which the system is supplied. A direct cross-connection is subject to both backsiphonage and backpressure. An indirect cross-connection is subject to backsiphonage only.

Customer means the SAWS account owner or person responsible for the backflow assembly. If there is no SAWS open account, the owner, occupant, manager, or other person in control of the property or premises or the person responsible for the maintenance of the property, determined to be the source of a violation of this division, shall be considered the customer.

Customer Service Inspection (CSI): Means an inspection of a customer's private plumbing to ensure there are no cross-connections or lead in the customer's plumbing system.

Double Check Detector Assembly (DCDA): The term "double check-detector backflow prevention assembly" means a specifically designed assembly composed of an approved double check valve assembly with a bypass containing a water meter and an approved double check valve assembly. The meter will register accurately for only very low rates of flow up to three gallons per minute and show a registration of all rates of flow. This assembly shall only be used to protect against a non-health hazard (i.e., pollutant).

The DCDA is primarily used on fire sprinkler systems. The entire assembly must meet the design and performance specifications and full approval, lab and field, of a recognized and approved testing agency for backflow prevention assemblies, e.g., University of Southern California's Cross-Connection Control or American Water Works Association.

Double Check Valve Assembly (DC) is an assembly composed of two single, independently acting, approved check valves, including resilient seating shut-off valves located at each end of the assembly and suitable connections for testing the water tightness of each check valve. The entire assembly shall meet the design and performance specifications and full approval, lab and field, of a recognized and approved testing agency for backflow prevention assemblies, e.g., University of Southern California's Cross-Connection Control or American Water Works Association.

Health hazard Is a cross-connection that involves contaminants; substances that could cause death, injury, illness, or the spread of disease if introduced into the water supply. A **non-health hazard** involve pollutants; an impairment of the water quality which does not create a health hazard to the public but which does adversely affect the aesthetic qualities of the water such as color, taste and odor. Health hazards are commonly called high hazards, and non-health hazards

are commonly called low hazards. The terms are used interchangeable throughout this document.

Pressure Type Vacuum Breaker is an assembly containing a single-loaded check valve and an air inlet valve which shall admit air whenever the pressure within the body of the assembly is reduced so that there is a tendency toward backsiphonage. The body of the assembly must be equipped with two tight closing shut off valves, one immediately upstream from the body and one immediately downstream of the body, and two properly located test cocks. It is designed to operate under constant pressure for long periods of time without failure, making it possible to isolate a lawn sprinkler line from the potable system. It must be installed so as to never be subject to backpressure. The entire assembly shall meet the design and performance specifications and full approval, lab and field, of a recognized and approved testing agency for backflow prevention assemblies, e.g., University of Southern California's Cross-Connection Control or American Water Works Association.

Reduced Pressure Backflow Prevention (RP) assembly is an assembly of two independently operating approved check valves with an automatically operating differential relief valve between the two check valves, resilient seating shut-off valves on either side of the assembly, plus four properly located test-cocks for the testing of the check and relief valves. The entire assembly shall meet the design and performance specifications and full approval, lab and field, of a recognized and approved testing agency for backflow prevention assemblies, e.g., University of Southern California's Cross-Connection Control or American Water Works Association.

Spill Resistant Pressure Type Vacuum Breaker is an assembly containing a single-loaded check valve and an air inlet valve, which shall admit air whenever the pressure within the body of the assembly is reduced so that there is a tendency toward back siphonage. The body of the assembly must be equipped with two tight-closing shut-off valves, one immediately upstream from the body and one immediately downstream of the body and one properly located test cock and vent valve. It is designed to operate under pressure for long periods of time without failure, making it possible to isolate a lawn sprinkler line from the potable system. It must be installed such that it could never be subject to backpressure. The entire assembly shall meet the design and performance specifications and full approval, lab and field, of a recognized and approved testing agency for backflow prevention assemblies, e.g., University of Southern California's Cross-Connection Control or American Water Works Association.

Public water system means SAWS as defined in Title 30 of the Texas Administrative Code, Section 290.38.

SAWS is the San Antonio Water System, a public water system and an agency of the city, created by City Ordinance No. 75686, adopted April 30, 1992.

Appendix B – References

U.S. Environmental Protection Agency - Cross-Connection Control Manual (February 2003 Edition) (EPA 816-R-03-002)

TCEQ RG 195 (2019 edition Texas Commission on Environmental Quality (TCEQ) Rules and USR

TCEQ RG 478 Establishing an Effective Cross-Connection Control Program

TCEQ Regulations for Public Water Supply Systems, Sec. 290.44 (h) (1) Backflow, Siphonage

San Antonio City Code, Article IX, Sec. 10-81 – Adoption of International Plumbing Code (2024)

San Antonio City Code, Chapter 34, Article VI, Division 8. Backflow Prevention - Section 34-1075 through Section 34-1081

San Antonio City Code, Section 34-40 - Cross connections with water mains prohibited

San Antonio City Code, Section 34-41 - Disconnection for noncompliance

San Antonio Plumbing Code, Chapter 6, Section 608.1; Protection of Potable Water Supply

USC Foundation for Cross-Connection Control and Hydraulic Research Foundations Manual of Cross-Connection Control

International Plumbing Code, Chapter 13, Nonportable Water Systems

Appendix C - SAWS T&M Form

Texas Commission on Environmental Quality
BACKFLOW PREVENTION ASSEMBLY TEST AND MAINTENANCE REPORT

The following form must be completed for each assembly tested.
A signed and dated original must be submitted to the public water supplier for recordkeeping *purposes:

San Antonio Water System

PWS ID #:
PWS Mailing Address:
PWS Contact Person:
Address Of Service:

The backflow prevention assembly detailed below has been tested and maintained as required by commission regulations and is certified to be operating within acceptable parameters.

TYPE OF BACKFLOW PREVENTION ASSEMBLY (BPA):

- ◯ Reduced Pressure Principle (RPBA)
- ◯ Double Check Valve (DCVA)
- ◯ Pressure Vacuum Breaker (PVB)
- ◯ Spill-Resistant Pressure Vacuum Breaker (SVB)
- ◯ Reduced Pressure Principle-Detector (RPBA-D)
- ◯ Reduced Pressure Principle-Detector (RPBA-D) Type II
- ◯ Double Check-Detector (DCVA-D)
- ◯ Double Check-Detector (DCVA-D) Type II

Manufacturer: Main: **Bypass:**
Size: Main: **Bypass:**
Model Number: Main: **Bypass:**
Serial Number: Main: **Bypass:**
BPA Location:
BPA Serves:

Reason For Test

New ◯ Existing ◯ Replaced ◯ **Old Model/Serial Number:**

Is the assembly installed in accordance with manufacturer recommendations and/or local codes? ◯ Yes ◯ No

Is the assembly installed on a non-potable water supply (auxiliary)? ◯ Yes ◯ No

Initial Test Date: Time:	**Held/Opened at** ☐ ☐ **Did it fully open?** ☐	**Held/Opened at** ☐ ☐ **Did it fully open?** ☐	**Held/Opened at** ☐ ☐ **Did it fully open?** ☐	**Held/Opened at** ☐ ☐ **Did it fully open?** ☐
Final Test Date: Time:	**Held/Opened at** ☐ ☐ **Did it fully open?** ☐	**Held/Opened at** ☐ ☐ **Did it fully open?** ☐	**Held/Opened at** ☐ ☐ **Did it fully open?** ☐	**Held/Opened at** ☐ ☐ **Did it fully open?** ☐

*** 2nd check: numeric reading required for DCVA only.

Repairs And Materials Used**
Main:
Bypass:

Differential pressure gauge used: Potable: ◯ Non-Potable: ◯
Make/Model: SN: Date Tested for accuracy:

Remarks:

Company Name:
Company Address:
Company Phone:
Licensed Tester Name
Signature:
BPAT Licese Number:
License Expiration Date:

The above is certified to be true at the time of testing.
* TEST RECORDS MUST BE KEPT FOR AT LEAST THREE YEARS [30 TAC §290.46(B)]
** USE ONLY MANUFACTURER'S REPLACEMENT PARTS

Based on TCEQ-20700 (Revision 04-04-2019)

Appendix D - Fire Lines

Backflow Protection for Fire Lines

Backflow protection for fire lines requires backflow assemblies to be installed according to state and local codes, tested annually by a licensed tester, and properly maintained. Best practices include proper placement and access for testing, ensuring components are corrosion-resistant, and performing hydrostatic tests before system completion. The best practices for fire line backflow protection in Texas are guided by state and City of San Antonio codes, with oversight from the Texas Commission on Environmental Quality (TCEQ) and the State Fire Marshal's Office. The specific assembly and installation requirements depend on the contamination risk posed by the fire suppression system.

In the interest of protecting the public's potable water supply from possible contamination, effective March 15, 1992, SAWS began requiring backflow protection on all new fire-line installations. As in other situations encountered in cross-connection control, the degree of backflow protection necessary for a particular fire protection system will depend on specific conditions present.

During the engineering process of determining types of water service, consideration should be given to the critical need of water to the site. This could relate to fire protection or potable water, thus requiring the possible duplication of services so water can be maintained to the site at all times.

Regulatory Framework and References

- **TCEQ Chapter 290:** Title 30 of the Texas Administrative Code (TAC), Chapter 290, governs public water systems and cross-connection control. These rules establish the general backflow prevention requirements for protecting potable water.
- **Texas Department of Insurance (TDI):** The State Fire Marshal's Office, under the Texas Insurance Code, sets licensing rules for fire sprinkler contractors and testing personnel.
- **NFPA Standards:** Fire line installations must comply with National Fire Protection Association (NFPA) standards adopted by the Texas Department of Insurance, such as NFPA 13 (Installation of Sprinkler Systems) and NFPA 25 (Inspection, Testing, and Maintenance).
- **City of San Antonio code:** City code has additional requirements beyond state standards, such as specific testing procedures and approved tester lists.

Backflow Assembly Selection

The type of backflow prevention assembly required is determined by the potential hazard classification of the fire suppression system.

- **Double Check Valve Assembly (DCVA)** is an assembly composed of two single, independently acting, approved check valves, including resilient seating shut-off valves located at each end of the assembly and suitable connections for testing the water tightness of each check valve. This assembly is used for fire lines that pose a low or moderate contamination risk, which is typical for standard fire sprinkler systems.
- **Double Check Detector Assembly (DCDA):** It is functionally the same as a DCVA and includes a bypass assembly with a water meter to detect leaks and unauthorized water use.
- **Reduced Pressure Backflow Prevention (RP)** assembly is an assembly of two independently operating approved check valves with an automatically operating differential relief valve between the two check valves, resilient seating shut-off valves on either side of the assembly, plus four properly located test-cocks for the testing of the check and relief valves. This is required for fire sprinkler systems that present a high health hazard, such as systems that use chemical additives, antifreeze, or are connected to a non-potable water source.
- **Reduced Pressure Detector Assembly (RPDA):** It is functionally the same as an RP and includes a bypass assembly with a water meter to detect leaks and unauthorized water use.

Installation Requirements

Pressure losses across backflow prevention assemblies must be considered in the design or redesign of the fire protection system if it is to function properly. This factor is particularly important when redesigning existing fire protection systems.

Best practices for installation ensure backflow assemblies function correctly and can be properly maintained and include:

- **Proper location:** Backflow assemblies should be installed in an easily accessible location.
    - **Outdoor:** SAWS requires backflow protection assemblies to be installed immediately after the water main. Reduced Pressure (RP) assemblies are not allowed to be installed in below-grade vaults or in areas without adequate drainage.
    - **Indoor:** If inside a building, an assembly must be located at least 12 inches above the floor and have at least 24 inches of clearance on all sides to allow for testing and maintenance.
- **Protection:** Assemblies must be protected from freezing, vandalism, and other environmental damage. Indoor installations should consider potential relief valve spillage from RP assemblies and locate them over a floor drain.

- **Metered bypass:** SAWS may require a metered bypass for fire lines to monitor for leaks and unauthorized usage.
- **Certified materials:** Backflow assemblies in fire protection systems must be listed by accredited agencies like Underwriters Laboratories (UL) or FM Approvals to ensure they meet stringent, fire-safe performance standards. These devices must also appear on the USC Foundation for Cross-Connection Control approved list.

Testing and Maintenance

- **Initial testing**: All new or repaired backflow assemblies must be tested upon installation by a licensed backflow prevention assembly tester (BPAT).
- **Annual testing**: Fire line assemblies must be tested annually to ensure they are working properly.
- **Licensed personnel**: Under Texas law and SAWS requirements, testing and maintenance on fire line assemblies must be performed by a BPAT who is a full-time employee of a fire sprinkler contractor and is licensed by the State Fire Marshal's Office.
- **Reporting:** A signed and dated T&M report must be submitted to SAWS through BSI Online.

Requirements for Backflow Protection on Fire Lines

TYPE OF FIRELINE	REQUIRED PROTECTION
Fireline with no chemical - less than 100' No chemical additive and no additional water supply - less than 100' total linear pipe footage to the most remote head	No Requirement
Fireline with no chemical - greater than 100' No chemical additive and no additional water supply - greater than 100' total linear pipe footage of a fire system to the most remote head*	Double Check Valve Assembly
Fireline with fire hydrant no chemical additive and no additional Water supply- greater than 100' total linear pipe footage of a fire system to the most remote head	Double Check Detector Assembly
Fireline with fire hydrant - no chemical	Detector Check Valve SAWS

additive and no additional water supply-Less than 100' total linear pipe footage to the fire hydrant	
Fire protection system - utilizing chemical additives**	Air Gap Separation or Reduced Pressure Principal assembly
Fire protection system with access to an auxiliary water supply **	Air Gap Separation or Reduced Pressure Principal assembly

Notes:

On a project that reflects ingress/egress, it will be looked at as right of way when determining the 100' stagnant water rule on fire line placement. The line of demarcation will be determined upon individual review.

*Systems over 50% or more renovations and those systems installing booster pumps shall include provisions to protect the potable water supply from stagnant water.

**Systems with chemical loops and/or foam injection shall require a reduced pressure principal backflow prevention assembly at the loop or foam injection point. However, an expansion chamber or relief valve will have to be installed to compensate for thermal expansion in accordance with the fire codes. The installation of reduced pressure principal assemblies for containment backflow protection on fire lines should be avoided and installed only in situations where chemical injection occurs prior to any taps or tees.

***Existing chemical loops and systems with access to an auxiliary water supply shall be retrofitted with approved backflow protection.

Appendix E - Recycled Water Systems

The recycled water customer's responsibility for preventing contamination of the potable water system begins at the customer's potable water service connection. When it is determined by SAWS that a backflow prevention assembly is required for the protection of the public potable water system, the customer will install onsite an approved backflow prevention assembly at each service connection and/or at the hazard point, test annually or more often in those instances where successive inspections indicate repeated failure, and repair and maintain such assemblies as required by these guidelines, International Plumbing Code (IPC) Chapter 13, Nonpotable Water Systems, TCEQ 30 TAC Chapters 210 or 290, SAWS Utility Service Regulations, and the latest version of the SAWS Recycled Water Users Handbook.

The Customer further agrees to provide SAWS, before recycled water service is initiated and thereafter upon request by SAWS, information to allow SAWS to determine the degree of hazard to the public potable water system presented by the customer's onsite recycled water system or any other actual or potential contamination hazard that may exist on the customer's site. Such information shall include plumbing, construction, building and irrigation plans and any other information SAWS requires to make the determination.

Storage Tanks and Recycled Water

Nonpotable water storage tanks with makeup water sources must have backflow protection, as established in Internation Plumbing Code 1301.9.4 Makeup water. Where an uninterrupted supply is required for the intended application, potable or reclaimed water shall be provided as a source of makeup water for the storage tank. The makeup water supply shall be protected against backflow in accordance with IPC Section 608. A full-open valve located on the makeup water supply line to the storage tank shall be provided. Inlets to the storage tank shall be controlled by fill valves or other automatic supply valves installed to prevent the tank from overflowing and to prevent the water level from dropping below a predetermined point. Where makeup water is provided, the water level shall not be permitted to drop below the water source inlet or the intake of any attached pump. Where non-potable systems are supplied with makeup water from a potable source, the potable makeup shall be protected by both an air gap and a RP backflow assembly in accordance with Section 608.

Recycled Water System Testing (Dye Test)

Upon final inspection and approval of the system by SAWS, the final testing phase will commence. Multiple tests will be conducted, including but not limited to, Customer Service inspection (CSI) and two-way shut down tests, testing the backflow prevention assembly, cross-connection control, dye testing, and ponding, runoff and over-spraying.

A dye test is a key component of its Cross-Connection Control and Backflow Prevention Program to ensure recycled water and potable water systems remain completely separate.

SAWS requires a dye test for all new installations of recycled water systems to prevent cross-contamination and ensure non-potable water is completely segregated from the public water supply. A dye test is also required for existing potable systems being converted to recycled water. The recycled water customer and/or system installer is responsible for performing the dye test.

Following a compliance dye test, a dye test must be repeated each time a system change is made. Periodic dye tests may also be required by SAWS or regulatory agencies.

SAWS regulations include other measures beyond a dye test to prevent cross-connections between reclaimed and potable water. These include specific requirements for piping, signage, hose bibs, and the physical separation of the two systems. Please see SAWS Utility Service Regulations, and the latest version of the SAWS Recycled Water Users Handbook.

Key Requirements for Recycled Water Dye Tests

A recycled water dye test is used to trace the path of reclaimed water and confirm that it is not mixing with the public or private drinking water supply.

Inspections required: Before a customer can begin using recycled water, SAWS mandates an inspection of the on-site potable water system by a local plumbing inspector or a state-licensed water protection specialist. This inspection is a part of the process to ensure there is no chance of cross-connection with the non-potable recycled water lines.

Recurring inspections: Inspections are not a one-time event. Re-inspections must be conducted every four years or as deemed necessary by SAWS or the local plumbing inspection department.

Role of dye testing: As part of the overall inspection process, dye testing is a procedure used to verify that there are no cross-connections. The dye is introduced into the recycled water system to confirm that the recycled water pipes are separate from the potable water infrastructure.

Use of licensed testers: All testing of backflow prevention assemblies on recycled water lines must be performed by a TCEQ licensed backflow prevention assembly tester. The tester must use a gauge specifically designated for recycled water.

Test coordination: The customer is responsible for coordinating the test directly with the licensed tester.

When to test: Dye testing must be conducted when a reclaimed water system is installed and whenever a new connection is added. SAWS also requires annual testing of all backflow prevention assemblies.
Who must perform the test: All backflow prevention assembly testing must be performed by a TCEQ licensed BPAT tester.
How the test is performed: A non-toxic, highly visible, biodegradable dye is introduced into the reclaimed water system. The system is then pressurized, and inspectors observe all plumbing fixtures and connections for signs of the dye.
What the dye test is looking for: The presence of colored dye at any sink, faucet, or toilet connected to the potable water system indicates a dangerous cross-connection. No dye should ever appear in the potable water system.

Letter of Demarcation (LOD)

If an annual shut-down/dye test/pressure test(s) cannot be performed on-site of the recycled water customer's facility, the recycled water customer will need to furnish a Letter of Demarcation (LOD) to SAWS indicating there are no cross-connections on the site. This LOD will need to be signed and sealed by a Professional Engineer licensed in the State of Texas.

Recycled/Reclaimed Water System Abandonment

If the owner of an on-site non-potable water reuse system or rainwater collection and conveyance system elects to cease use of, or fails to properly maintain such system, the system shall be abandoned and shall comply with the following:

1. All system piping connecting to a utility-provided water system shall be removed or disabled.

2. The distribution piping system shall be replaced with an approved potable water supply piping system. Where an existing potable pipe system is already in place, the fixtures shall be connected to the existing system.

3. The storage tank shall be secured from accidental access by sealing or locking tank inlets and access points, or filling with sand or equivalent.

For further information , please reference the International Plumbing Code, Section 1301.10.

Where to Find More Information

For the most detailed and current requirements, refer to the following official resources:

- **SAWS Cross-Connection Control and Backflow Prevention Program**: This website has information about annual testing, management by BSI, and links to relevant forms.

- SAWS Recycled Water Users Handbook: This provides information on the rules and regulations for recycled water usage and was developed for customers.
- City of San Antonio Code of Ordinances, Article VIII: This details SAWS' recycled water program, including rules for separation, required inspections, and prohibited uses.

Appendix F - Backflow Prevention Assembly Installation and Removal Standards

Backflow prevention assemblies and air gap separations shall be installed in accordance with the USC Foundation for Cross-Connection Control and Hydraulic Research Foundations Manual of Cross-Connection Control, Tenth or latest edition. SAWS standards for installation follow the USC standards. If SAWS standards differ from the USC standards, the USC standards take precedence.

Any inquiries or requests should be directed to the San Antonio Water System's Backflow Prevention Section at (210) 233-2910.

General Instructions for Assembly Installation Standards

Assemblies will be installed in an accessible location to facilitate maintenance, testing, and repair, and should be located no more than five feet above the floor or grade level. The backflow preventer must be installed between the meter and before the owner's first tap or tee (total containment) unless otherwise approved. In no instance will the assembly be allowed in the same vault with the San Antonio Water System's water meter.

Vault lids will be constructed in such a manner as to permit easy accessibility at all times by an individual. Vaults deeper than five feet shall be provided with a ladder permanently attached to a side wall. It is the contractor and owner's obligation and responsibility to ensure OSHA regulations are adhered to in the construction of all vaults. Additionally, confined space regulations are to be consulted and followed in the testing and maintenance of the backflow prevention assemblies.

Before installing the assembly, pipelines should be thoroughly flushed to remove foreign material.

Test cocks must never be used as supply connections and must be plugged except when testing. Plugs must be non-ferrous, e.g., brass, plastic, etc. Backflow preventers must be installed horizontally and in an upright position, unless approval has been obtained from the University of Southern California Foundation for Cross-Connection Control and Hydraulic Research.

All hot water heating systems should be evaluated before the backflow prevention assembly is installed to ensure that a thermal expansion tank has been properly installed and in working condition.

In order to ensure that backflow prevention assemblies continue to operate satisfactorily, it will be necessary that they be tested at the time of installation and on an annual basis thereafter. Such tests will be conducted in accordance with SAWS performance standards and field test procedures as prescribed by the University of Southern California Foundation for Cross-Connection Control and Hydraulic Research.

The licensed tester performing the inspection and testing shall complete a report of each inspection and testing on the T&M form approved by SAWS (Appendix C). The tester shall see that the annual report of testing and inspection is submitted to the third-party vendor, BSI Online, within ten (10) days after the completed test.

The Backflow Prevention Section will inspect all containment installations, i.e., located between the water meter and before the owner's first tap or tee.

All costs entailed in the subject program are to be borne by the customer. This includes the initial purchase of the backflow preventer, its proper installation, testing and maintenance. Both containment and internal isolation backflow preventers must be maintained in good working condition.

Deactivating and removing a backflow prevention assembly

SAWS must receive documentation to remove a backflow prevention assembly from SAWS and BSI Online records. Backflow prevention assemblies will remain in SAWS and BSI records until the proper documentation is obtained. For a backflow prevention assembly to be removed from SAWS and BSI records a customer must contact a tester to assess the assembly, as well as determine the best way to properly remove it, especially if it was previously damaged.

When customers wish to remove a backflow prevention assembly from their property, the tester must submit a T&M report as official documentation including:

- Backflow information (SN, make, model, size, etc.)
- Physical address/location of the assembly
- Date of removal or visit to property
- Comments stating the assembly is removed
- Tester information (company name, license, etc.)

Testers must submit a photo of the assembly removal or a photo of the removed assembly if already removed, with the serial number clearly shown, a photo of where it was/capped off, and the connections properly plugged.

All documents and pictures should be submitted to BSI Online. BSI Online manages the backflow records for SAWS and must be informed of this change to the property.

Note that failure to submit documentation could result in a non-compliant notice and fee for the customer.

Installation of Reduced-Pressure Principle Backflow Preventers

Reduce pressure principle backflow preventers will be installed above ground.

The unit should be placed at least 12 inches (12”) above the finished grade to allow clearance for repair work, and no higher than sixty inches (60”) above grade to allow for access and safety (Fig. A). A concrete slab at finished grade is recommended. Proper drainage should be provided for the relief valve and may be piped away from the location, provided it is readily visible from above grade and the relief valve is separated from the drain line by a minimum of double the diameter of the supply line. A modified vault installation may be used if constructed with ample side clearances (Fig. B). Freezing can be a problem in this area, and precautions should be taken to protect above-ground installations. Refer to local fire and plumbing codes to find insulating requirements for backflow prevention assemblies.

Fig . A - Example of the placement at least 12 inches (12”) above the finished grade

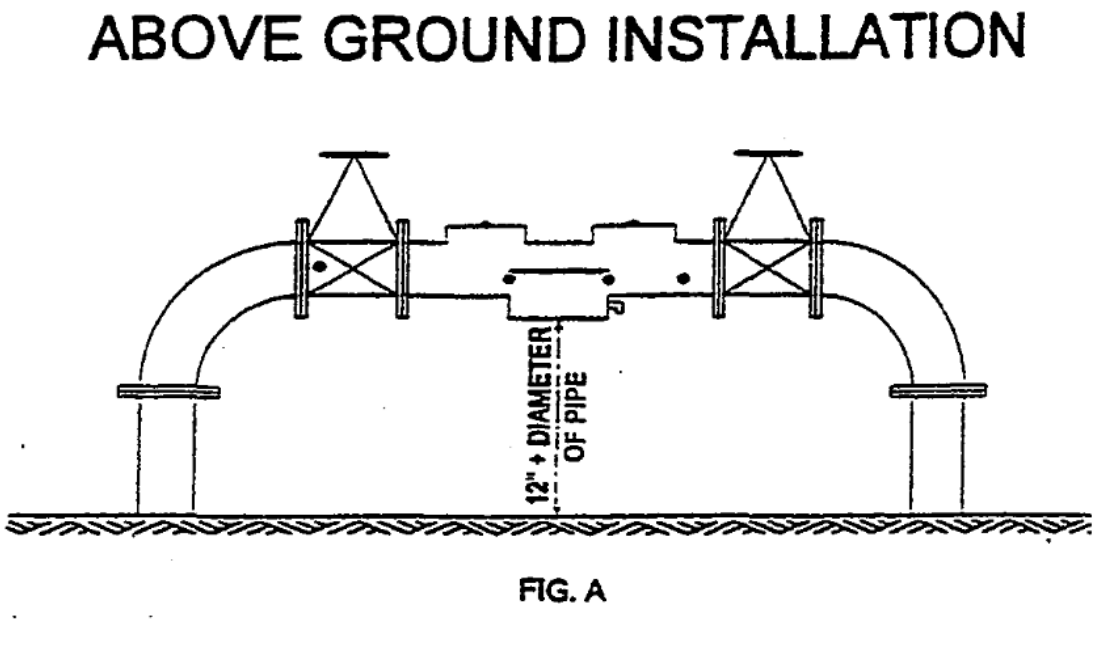


FIG. A

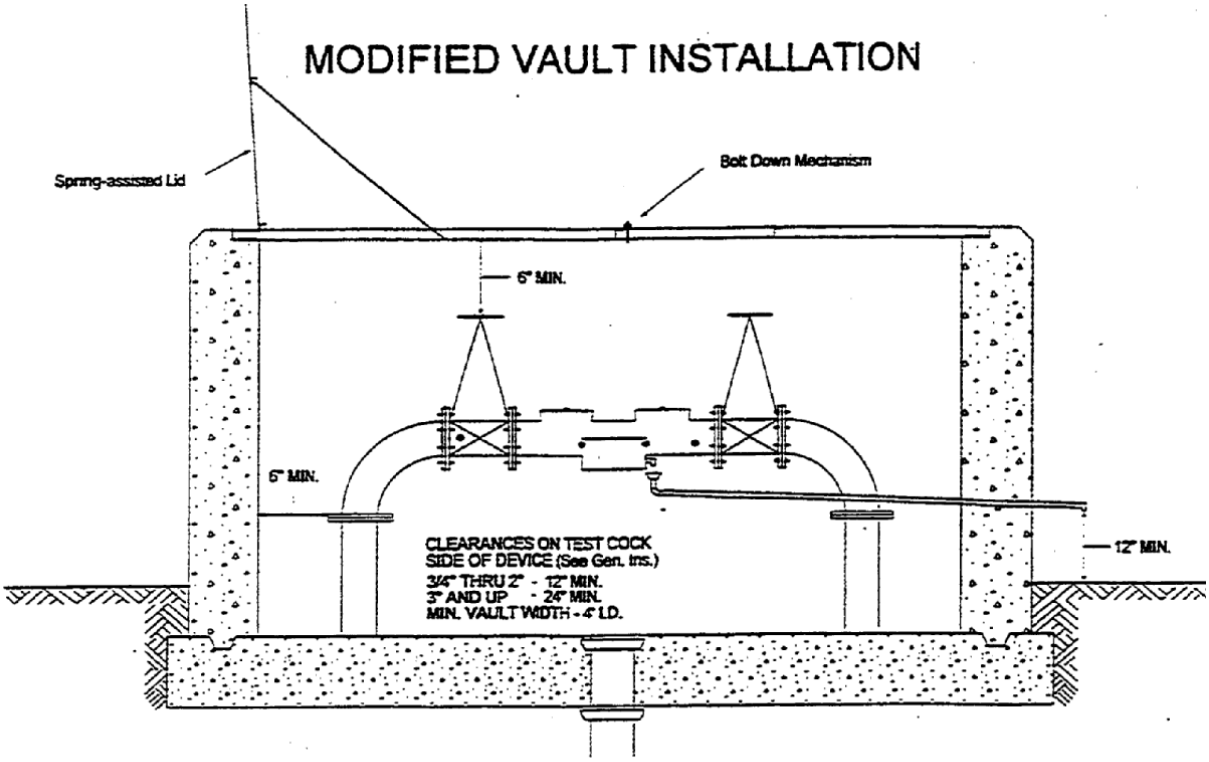


Fig . B - Example of a modified vault installation

Installation of Double Check Valve Assembly Backflow Preventer

Though double check valve assemblies can be installed above ground, these backflow preventers are also readily adaptable for vault installations. Special notice should be given to the side clearances for accessibility to properly test and repair the assembly. Test cocks must be plugged. Plugs must be non-ferrous, e.g., brass, plastic, etc. (Fig. C) .

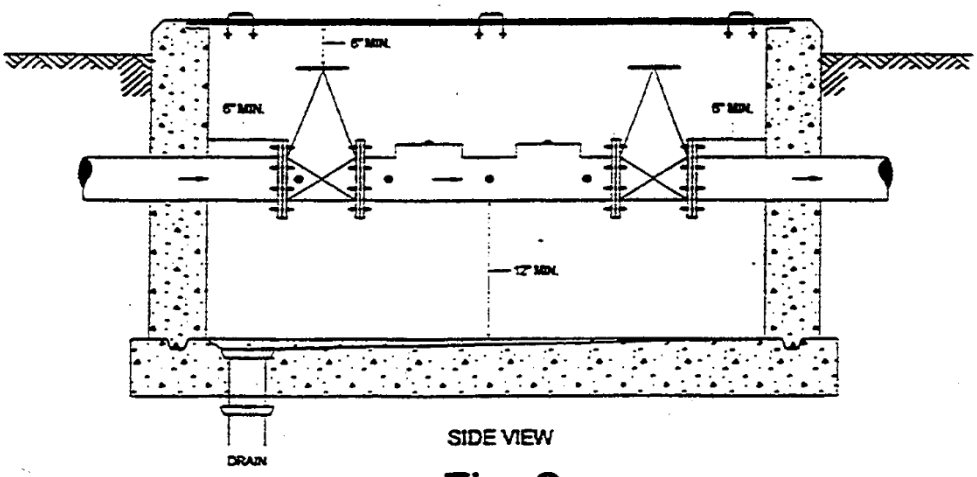


Fig. C

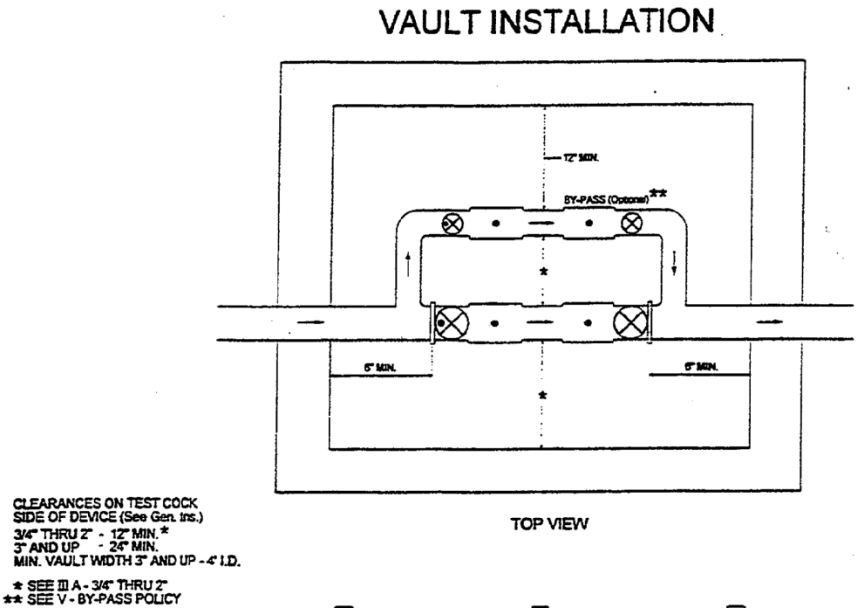


FIG. C -Example of a modified vault installation

Below Grade Vault Installation of Double Check Valve Assemblies

Double check valve assemblies should be installed above grade if possible, but may be installed in below-grade vaults when these vaults are properly constructed in accordance with the following guidelines:

General – Double Check Valve Assemblies – All Sizes

Double check valve assembly backflow preventers, unlike reduced pressure principle assemblies, are designed and readily adaptable for below grade installations, provided they are installed in a vault that is well-drained and of solid construction. Vaults within traffic areas should be constructed accordingly. Assemblies must be installed horizontally and in an upright position. Backflow preventers installed in a vertical position, if approved by the USC Foundation for Cross-Connection Control, will also be allowed.

Indoor Installation of Reduced-Pressure and Double-Check Valve Assemblies

Where it is impractical to install the backflow preventer above ground, the installation may be made in an easily accessible location inside a building. The unit should be placed above the floor and away from the wall at a distance great enough to allow clearance for repair work. If the backflow preventer is positioned against the wall, care should be taken that the test cocks are easily accessible for testing, and the assembly can be repaired. An air gap should be used between the relief valve outlet and the drain line if drainage is to be piped away. The drain should be of adequate size to carry the volume of water the relief valve is capable of discharging. The air gap should be no less than double the diameter of the discharge pipe.

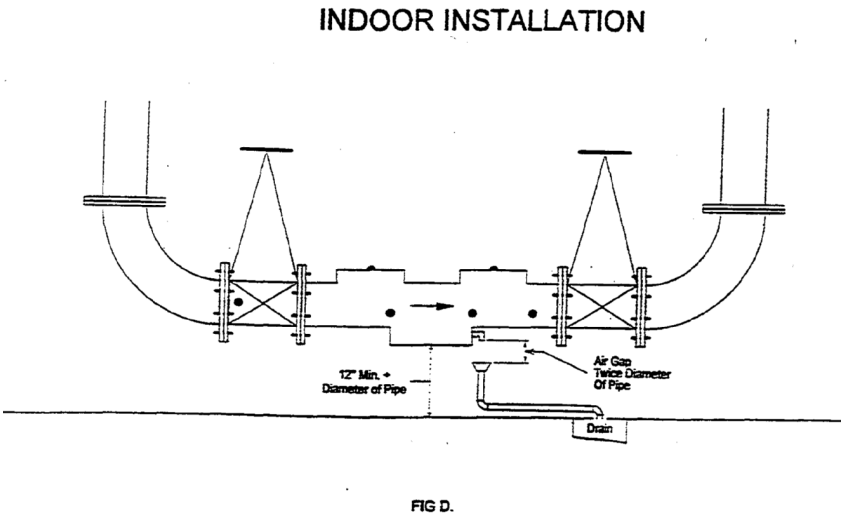


Fig . D - Example of a modified vault installation

By-Pass Policy

Backflow prevention assemblies must be tested upon installation and on an annual basis thereafter. The testing procedure requires the water to be turned off. If continuous water service is a necessity, provisions should be made for a bypass around the mainline backflow preventer. A bypass installed around an approved backflow prevention assembly must be protected from backflow through this bypass, i.e., it also will include a backflow preventer of the same level of protection as the main service line backflow preventer. Though it need not be of the same size, it must be installed in a similar fashion to the service line assemblies.

Air-Gap Separation (A/G)

An air gap separation means the unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying water to a tank or plumbing fixture and the flood level or overflow rim of the receptacle. An approved air gap separation shall be at least double the diameter of the supply pipe measured vertically above the overflow rim of the vessel and in no case shall the gap be less than 1". The tank should be installed as close to the property line as practical. The piping between the water meter and the air gap separation should be entirely visible to ensure that no connections or tees are made in that area. To eliminate possible entrance of vermin, screened protection over the entire (A/G) set up is encouraged. See Fig. E.

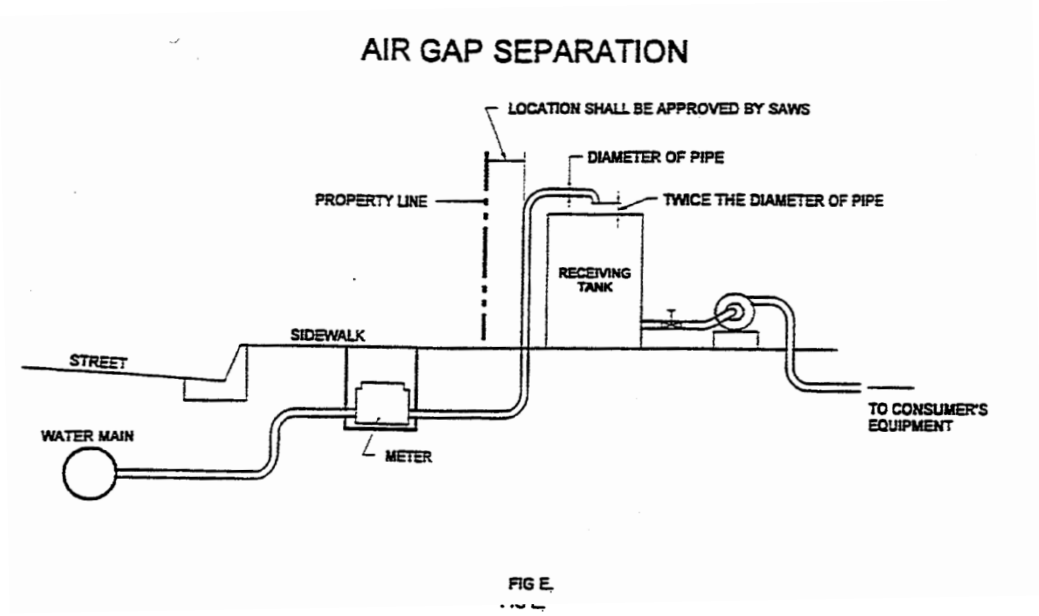


FIG E.

II.

Lawn Sprinkler Installation Using a Pressure Type Vacuum Breaker (PVB) as a Backflow Preventer

A PVB is not designed to protect against backpressure, which is a condition where pressure on the lawn system is greater than the pressure in the supply line. It is suitable only for protection against backsiphonage, which is when a sudden pressure drop in the main water line "siphons" water backward. Pressure-type vacuum breakers may be installed without regard to downstream valves, making it possible to isolate an entire lawn sprinkler system with a single unit when properly located.

Installation and placement (Figure F)

- **PVB must be above ground:** Place the PVB at least 12 inches above the highest downstream sprinkler head.
- **PVB is susceptible to freezing:** They must be protected from freezing by installing it in an approved hot box or with heat tape, which requires a separate electrical permit.
- **Locate close to the water source:** The assembly should be installed within five feet of the connection to the main water supply.
- **PVB** should be installed where it will be accessible for periodic testing and where water spillage is acceptable.
- **Ensure proper drainage:** If the PVB is in a box, the box must have drain holes.

When a PVB may not be sufficient

- Chemical injection: A Reduced Pressure (RP) backflow assembly is required if your system includes a chemical injection system.
- Other approved assemblies: In some cases, a Double Check Valve Assembly (DCVA) may be used, particularly because it can be installed below grade.

Testing and maintenance

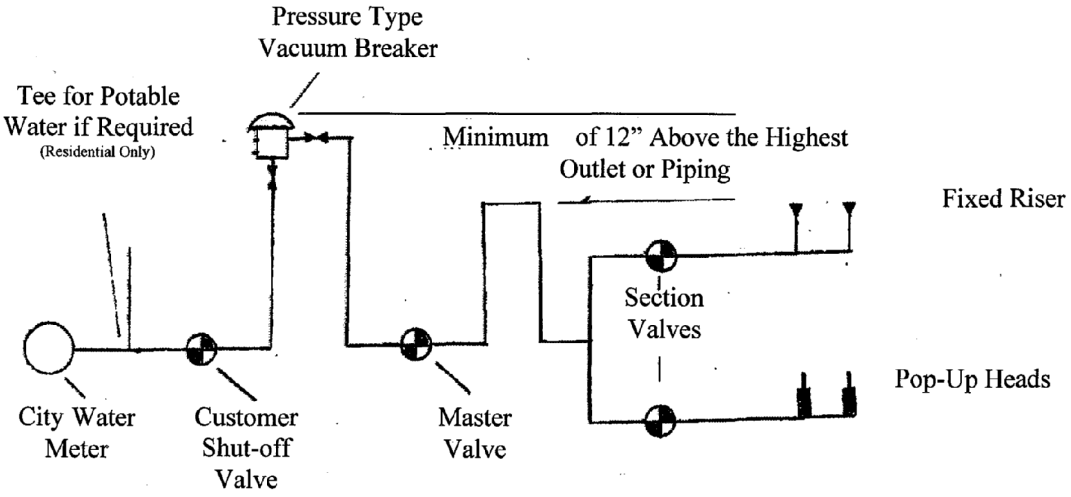
- Professional installation: Backflow prevention assemblies require testing by a licensed BPAT upon installation, immediately after any repair, annually for high hazard applications and every three years for low hazard applications.
- Follow local codes: Always check with your local city or county for their specific backflow prevention requirements and codes, which may exceed state mandates.

Other requirements

- Rain sensors: Local codes often require irrigation systems to have sensors or technology that interrupt operation during rain or freezing conditions.

- Sprinkler head placement: Sprinkler heads must be located on private property and oriented to avoid spraying public roads, sidewalks, and walls.
- If chemical additives are to be used, an air gap separation or reduced-pressure principle assembly will be required.

Fig. F - Lawn Sprinkler Installation Using a Pressure Type Vacuum Breaker as a Backflow Preventer. (Residential only)



Appendix G - Backflow Protection for Water Hauling

Overview

The following information is provided in the interest of protecting the potable water system from actual or potential contamination through cross-connections by ensuring backflow prevention. All water hauling equipment and/or potable water mixing tanks using water from fire hydrants or any other type of outlet must use one of the backflow prevention methods described in this section to adequately protect the potable water system.

For water hauling when drawing water from the SAWS system, backflow prevention is required to prevent contamination of the public water supply. The specific requirements depend on where the water is loaded and the potential risk of contamination. The Texas Commission on Environmental Quality (TCEQ) oversees these regulations, which mandate either an air gap or a mechanical backflow prevention assembly.

General Requirements

The customer must contact the SAWS Cross Connection Department at (210) 233-2910 prior to water usage to request an inspection of the on-site backflow protection installed. Requests made between 8 a.m. and 11 a.m. should normally result in same-day inspections; otherwise, the inspections will be made the following business day, consistent with operational requirements.

Customers electing to permanently install an air gap separation on water transporting vehicle(s) must have the air gap separation inspected and approved by the Backflow Prevention Section.

Customers electing to install a reduced pressure principle backflow assembly will be required to have the assembly tested by a licensed backflow prevention assembly tester upon installation and annually thereafter.

Backflow Prevention Methods

The customer shall provide one of the approved methods for backflow protection described below. The customer shall also comply with these installation guidelines.

Air gap separation provided by a metallic pipe permanently installed on the water transporting vehicle will serve as a fill line and also include a hose connection to the potable water outlet. An air gap provides the highest level of protection by creating a physical separation between the water supply outlet and the receiving tank.

Requirements:

For bulk water dispensing stations, an air gap must be provided between the filling outlet and the receiving tank.

For an air gap to be effective, the separation distance must be at least twice the diameter of the water supply outlet, but never less than 1 inch.

If an air gap is not feasible, a certified mechanical backflow prevention assembly is required.

Requirements for RPs and DCVAs:

Reduced Pressure Principle Assembly (RP): This is required for high-hazard situations where there is a risk of harmful contaminants entering the water supply. An RP assembly must be installed, tested, and certified upon installation by a TCEQ licensed tester and annually thereafter.

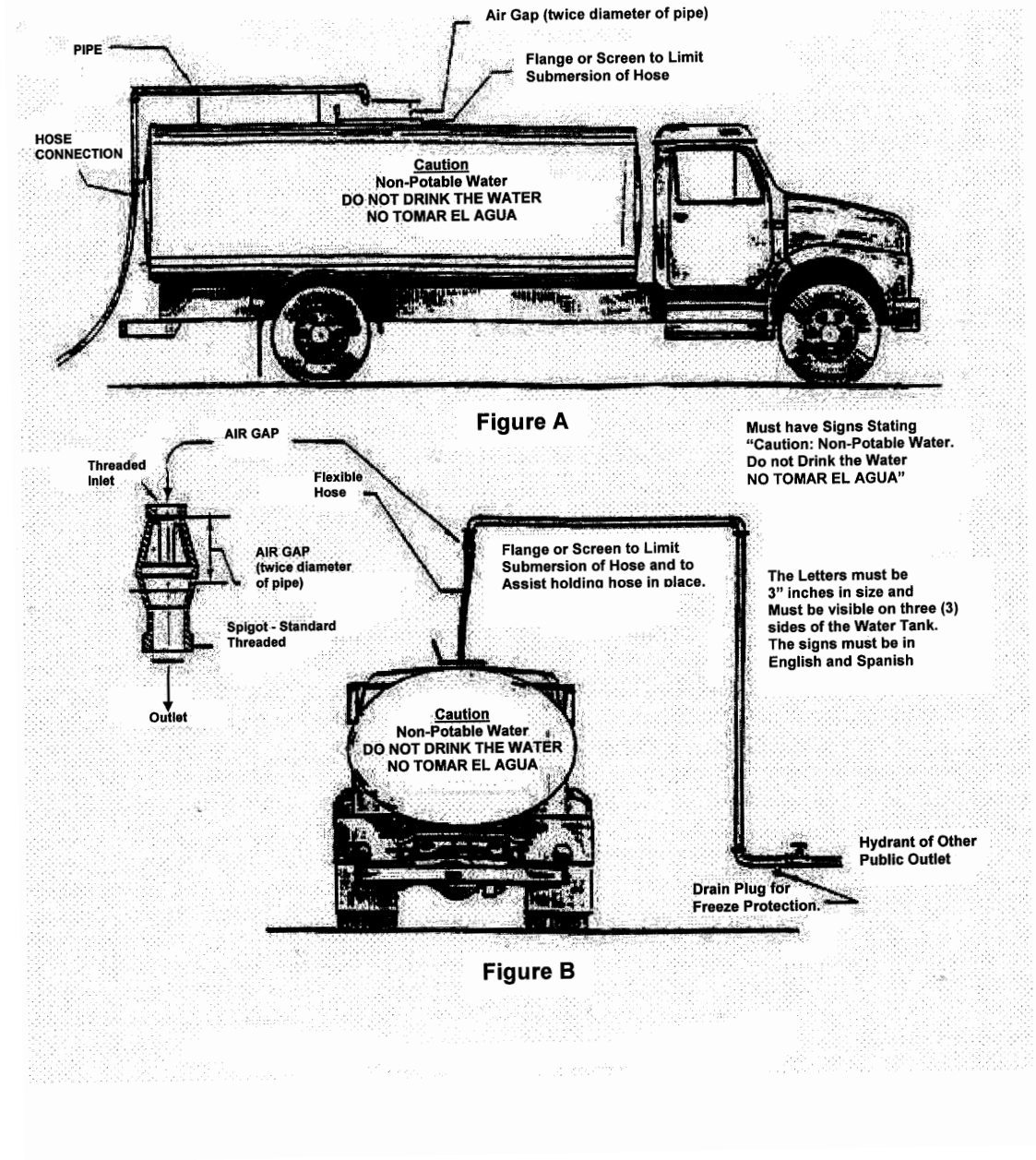
Double Check Valve Assembly (DCVA): This is used for non-health hazard conditions. SAWS reserves the right to determine the level of protection required.

Specific Rules for Water Haulers

Water haulers that operate as public water systems are regulated under the Texas Administrative Code, Title 30, Chapter 290.

- **Backflow protection:** Tank trucks must have an air gap separation or an approved backflow prevention assembly at the filling point.
- **Approved source:** The water must be obtained from a TCEQ-approved source.
- **Equipment:** The tank and all transfer equipment, including hoses, must be used exclusively for potable water and be properly maintained and disinfected.

See Figures A through D.



Figures A and B: Air gap used for backflow prevention on a water hauler truck.

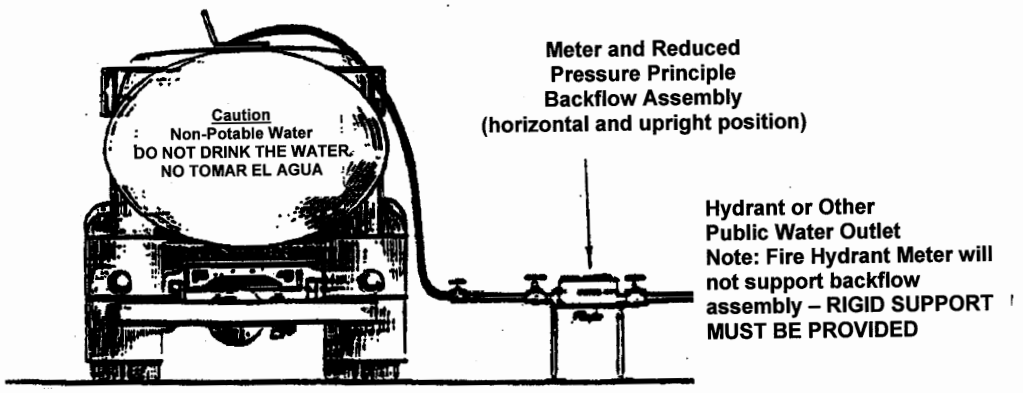


Figure C

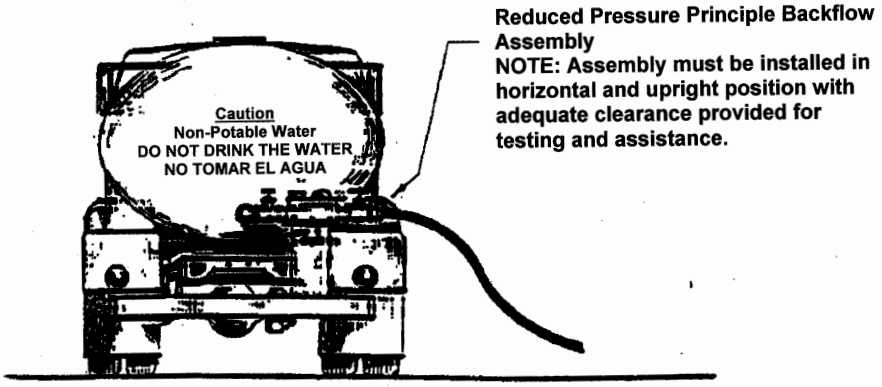


Figure D

Backflow Prevention Method-Reduced Pressure Principle Assembly

Figure C: Reduced Pressure Principle (R/P) backflow prevention assembly installed at the fire hydrant meter.

Figure D provides a pictorial description of Reduced Pressure Principle (R/P) backflow prevention assembly permanently installed on the water-transporting vehicle.