

State of Ohio Class A Drinking Water Operator Certification Program



Session One: Supplemental Materials

This course includes content developed by the Ohio Environmental Protection Agency, the Pennsylvania Department of Environmental Protection, the Indiana Department of Environmental Management, the California State University at Sacramento, and 360water, Inc.

Project funded by the USEPA.



SESSION ONE: SUPPLEMENTAL MATERIALS

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1. License to Operate

A license to operate a public water system is issued to the owner of the system. The complexity of the treatment and size of the plant reflects the classification issued by the regulatory agency. As the size and complexity of the system increases, the skills and experiences of a good operator will need to be increased as well to ensure the delivery of safe potable water to consumers.



The Ohio Administrative Code describes the rules for public water system licensure.

3745-84-01 Public water system licenses.

- A. Except as otherwise noted, the definitions in rule 3745-81-01 of the Administrative Code shall apply to this chapter.
 - 1. "Number of wells supplying system" means those wells that are physically connected to the plumbing system serving the public water system.
 - 2. "Population served" means the total number of individuals receiving water from the public water system during a twenty-four hour period averaged over at least sixty days during any calendar year.
 - 3. "Service connection" means the active or inactive pipes, goosenecks, pigtails, and any other fittings connecting a water main to any building outlet.
 - 4. "Church" means a fellowship of believers, congregation, society, corporation, convention, or association that is formed primarily or exclusively for religious purposes and is not formed or operated for the private profit of any person.
 - 5. "School" means any public or non-public school that meets the minimum standards of the state board of education.
- B. Application for a license to operate or maintain a public water system.
 - 1. Except as provided in paragraphs (B)(6) and (B)(7) of this rule, no person shall operate or maintain a public water system in the state of Ohio without a public water system license issued by the director.
 - a. Any person who operates or maintains a public water system shall obtain an initial public water system license.
 - b. A completed application for an initial public water system license shall be filed with the director not later than thirty days prior to the operation of the public water system, and shall be accompanied by the appropriate fee as set forth in paragraph (E) of this rule.
 - 2. Application for an initial public water system license shall be on a form provided by the director, and the following information shall be provided by the applicant:
 - a. Public water system identification number;
 - b. Name, address, and telephone number of the public water system;
 - c. Owner name, address and telephone number;

- d. Population served (if applicable);
 - e. Number of service connections (if applicable);
 - f. Source(s) of water;
 - g. Number of wells supplying the public water system (if applicable); and
 - h. Additional data which may be required by the director.
- 3. Not later than thirty days after receiving a completed application and the appropriate fee, the director shall issue the initial public water system license.
 - 4. A public water system license or license renewal, issued pursuant to section 6109.21 of the Revised Code and in accordance with this chapter, shall expire on the thirtieth day of January in the year following its issuance.
 - 5. A person proposing to operate or maintain a new public water system shall submit a completed application to the director for an initial public water system license in accordance with this rule not less than thirty days prior to operation of the public water system.
 - 6. Paragraph (B) of this rule does not apply to a church that operates or maintains a public water system solely to provide water for that church or for a campground that is owned by the church and operated primarily or exclusively for members of the church and their families.
 - 7. Paragraph (B) this rule does not apply to any public or non-public school that operates or maintains a public water system solely to provide water for that school.
- C. Renewal of license to operate or maintain a public water system.
- 1. Except as provided in paragraph (C)(6) of this rule, a person holding a public water system license or a public water system license renewal issued by the director under section 6109.21 of the Revised Code, who is proposing to continue operating the public water system, shall submit a completed application for license renewal to the director not less than thirty days prior to the expiration date of the license or license renewal.
 - 2. The application for a public water system license renewal shall be submitted on a form provided by the director and shall be accompanied by the appropriate fee as set forth in this rule.
 - 3. The application for a public water system license renewal shall include the information required in paragraph (B) of this rule reflecting the current conditions of the public water system.
 - 4. Within thirty days of receipt of both a completed application for a public water system license renewal under this rule and the applicable fees, the director shall act on the application by:
 - a. Issuing the license renewal, or
 - b. Issuing the license renewal subject to terms and conditions which the director determines are necessary to ensure compliance with Chapter 6109. of the Revised Code and the administrative rules adopted thereunder, or
 - c. Acting to deny the license renewal upon a finding that the public water system was not operated in substantial compliance with Chapter 6109. of the Revised Code and the administrative rules adopted thereunder.
 - 5. A public water system license renewal to operate or maintain a public water system issued by the director pursuant to section 6109.21 of the Revised Code and this chapter shall expire on the thirtieth of January in the year following its issuance.

6. This rule does not apply to a church that has previously obtained a license under paragraph (B) of this rule.
- D. Display of license to operate or maintain a public water system.
 1. A public water system license or license renewal issued by the director pursuant to this chapter is the property of the state of Ohio.
 2. License or license renewal shall be prominently displayed at the office of the public water system.
 3. License or license renewal shall be surrendered to the director upon revocation.
- E. Fees for operating or maintaining a public water system.

**3745-84-014**

1. Pursuant to section 3745.11 of the Revised Code, a person applying for a public water system license or a public water system license renewal to operate or maintain a public water system under section 6109.21 of the Revised Code and this chapter shall pay the appropriate fee according to the schedule set forth in section 3745.11(M) of the Revised Code at the time of submission of the application to the director.
 2. Failure to pay the appropriate fee required by section 3745.11(M) of the Revised Code at the time of submission of application for a public water system license or a public water system license renewal, shall require payment of an additional amount equal to ten per cent of the appropriate fee.
 3. Failure to pay the fee required by section 3745.11(M) of the Revised Code shall render an application for a public water system license or a public water system license renewal incomplete.
 4. Payment of fees required by section 3745.11(M) of the Revised Code shall be made by tendering a certified check payable to the treasurer of the state of Ohio. The director shall transmit all fees collected under this rule to the treasurer of the state for deposit into the drinking water protection fund created in section 6109.30 of the Revised Code.
 5. For public water systems that are community water systems as defined rule 3745-81-01 of the Administrative Code, the fees for initial license and license renewal, required under this chapter shall be as set forth in section 3745.11(M)(1) of the Revised Code. The public water system may determine its means for obtaining fees, including the assessment of additional user fees which may be assessed on a volumetric basis.
 6. For public water systems that are nontransient noncommunity water systems as defined in rule 3745-81-01 of the Administrative Code, the fees for initial license and license renewal required by this chapter shall be as set forth in section 3745.11(M)(2) of the Revised Code.
 7. For public water systems that are transient noncommunity water systems as defined in rule 3745-81-01 of the Administrative Code, the fees for initial license and license renewal required by this chapter shall be as set forth in section 3745.11(M)(3) of the Revised Code.
- F. Suspension and revocation of a license to operate or maintain a public water system. Upon a finding by the director that a person holding a license to operate a public water system issued by the director pursuant to section 6109.21 of the Revised Code and this chapter, has failed to operate or maintain a public water system in substantial compliance with Chapter 6109. of the Revised Code and the

administrative rules adopted thereunder, the director may suspend or revoke the license. In suspending or revoking a license the director shall act in accordance with the provisions of Chapters 119 and 3745 of the Revised Code and this chapter.

Effective: 08/03/2004

R.C. 119.032 review dates: 05/05/2004 and 08/03/2009

Promulgated Under: 119.03

Statutory Authority: RC Section 3745.11, 6109.04 Rule Amplifies:

RC Section 6109.21

Prior Effective Dates: 04/21/01, 12/01/93, 01/01/99

2. Certified Operator

The OEPA requires that certified operators be in responsible charge of class A public water systems. Depending on the facts of each public water system, this regulation explains what is required so that public health is maintained.



The Ohio Administrative Code describes the rules for certified operators.

3745-7-02 Certified operators required.

- (A) (1) Each person owning or operating a public water system, except as allowed in paragraph (B)(1) or (G) of this rule, shall place the direct supervision for the technical operation and maintenance of such a public water system under the responsible charge of a certified operator having valid certification of a class at least equal to that required by that public water system classification.
- (2) Each person owning or operating a wastewater works serving a population over two hundred fifty or a wastewater works having a population equivalent over two hundred fifty shall place the responsibility for the technical operation and maintenance of such a wastewater works under the responsible charge of a certified operator having certification of a class at least equal to that required by the wastewater works classification, except as allowed in paragraph (G) of this rule.
- (B) (1) Transient noncommunity public water systems serving populations of two hundred fifty or fewer are not required to place the operation of such public water system under the responsible charge of a certified operator, unless the director determines that a serious public health or environmental hazard is associated with the operation of any such public water system.
- (2) Wastewater works serving populations of two hundred fifty or fewer are not required to place the operation of such wastewater works under the responsible charge of a certified operator, unless the director places such a requirement in a national pollutant discharge elimination system (NPDES) permit or determines that a serious public health or environmental hazard is associated with the operation of any such wastewater works.
- (C) The certified operator required by paragraphs (A) and (B) of this rule shall be a full-time employee of the person owning or operating a public water system or wastewater works, except as provided in paragraphs (D), (E) and (F) of this rule. The full-time employee required by this rule may be responsible for two or more public water systems, wastewater works, or a combination of such systems in reasonable proximity, provided that the time spent in fulfilling daily responsibilities is appropriately portioned.
- (D) When substantial evidence is presented to the director that the services of a full-time certified operator cannot be obtained, the director may authorize a public water system or wastewater works to place responsibility for the technical operation and maintenance thereof in charge of an appropriately certified operator who is not a full-time employee of the public water system or wastewater works on a temporary basis, upon submission of:

- (1) Information adequately demonstrating that the services of a full-time employee meeting the certification requirements are not available, and
- (2) A plan showing the duties and responsibilities of said certified operator, including hours of attendance, and
- (3) The contract between the certified operator and the public water system or wastewater works, and
- (4) An acceptable schedule for obtaining the services of a full-time employee with the appropriate certification.

Upon approval by the director of the schedule submitted for paragraph (D)(4) of this rule, the public water system or wastewater works shall comply with the compliance schedule(s) issued subsequently by the director.

- (E) Class A or I public water systems may enter into a contract for the services of an appropriately certified operator to inspect, monitor, and supervise the operation thereof provided that:
- (1) The system serves a population fewer than one thousand, and
 - (2) The system uses only purchased water or ground water source(s), and
 - (3) The contract requires that the certified operator be available to respond to emergencies and provide the services necessary to maintain the reliable operation of the system, and
 - (4) The contract is for a term not to exceed three years, but may be renewable, and
 - (5) The contract is submitted to and approved by the director.
- (F) Class I wastewater works may enter into a contract for the services of an appropriately certified operator to inspect, monitor, and supervise the operation thereof provided that:
- (1) The wastewater works serves a population over two hundred fifty but fewer than one thousand, and
 - (2) The wastewater works treats only domestic sewage, and
 - (3) The contract requires that the certified operator be available to respond to emergencies and provide the services necessary to maintain the reliable operation of the wastewater works, and
 - (4) The contract is for a term not to exceed three years, but may be renewable, and
 - (5) The contract is submitted to and approved by the director.
- (G) Class IV public water systems and class IV wastewater works may be approved by the director to temporarily employ a class III operator where a class IV certified operator is required, if the class III operator has applied for and received approval to take a class IV examination.

Effective date: February 12, 2001

R.C. 119.032 review dates: 1/30/01, 1/30/06

Promulgated under: RC Chapter 119

Rule authorized by: RC Sections 6111.46 and 6109.04(C)(1)(b) Rule amplifies: RC Sections 6111.46 and 6109.04(C)(1)(b) Prior effective dates: 2/1/64, 4/17/86, 9/13/93, 1/1/99

3. Plan Approval

Plan approval is a process of reviewing engineered drawings produced by the owner, ensuring they meet the criteria and guidelines. The objective here is to assure that new or substantially modified public water system facilities such as those for mobile home parks, gas stations, restaurants, condominiums, and the like will be capable of producing an adequate supply of potable water in compliance with applicable regulations.



The Ohio Administrative Code describes the rules for plan approval.

3745-91-02 Application for Approval of Plans.

- A. No person shall begin construction or installation of a public water system, or make a substantial change in a public water system, until plans therefore have been approved by the director of environmental protection. An application for approval of plans for such construction, installation, or substantial change in a public water system, as required by section 6109.07 of the Revised Code, shall be submitted to the district office and shall consist of all of the following:
 - 1. Three copies of plan drawings as specified by rule 3745-91-03 of the Administrative Code (two copies if the facility will be owned by a public entity);
 - 2. One copy of specifications as specified by rule 3745-91-04 of the Administrative Code;
 - 3. One copy of a data sheet as specified by rule 3745-91-05 of the Administrative Code;
 - 4. One copy of supporting information as specified by rule 3745-91-06 of the Administrative Code; and
 - 5. A submittal letter as specified by rule 3745-91-07 of the Administrative Code.
- B. A person applying for a plan approval for a public water system under section 6109.07 of the Revised Code shall pay a fee pursuant to Section 3745.11 of the Revised Code. The fee shall be paid at the time the application is submitted by tendering a check payable to the treasurer of the state of Ohio.
- C. General plans containing preliminary information concerning proposed source, treatment, and distribution may be submitted for approval or for comment. General plans submitted for conditional approval shall be submitted in three copies. The director may require submittal of general plans for conditional approval prior to submittal of an application under this rule for projects with a high degree of complexity, non-standard technology, unusual features, phased implementation, compliance schedules or deviations from standards and guidelines used by the agency.

2 Effective date: 01/01/2002

R.C. 119.032 review dates: 06/27/01, 10/04/06

Promulgated under: RC Chapter 119

Rule authorized by: RC Section 6109.04

Rule amplifies: RC Sections 6109.04, 6109.07, 3745.11 Prior effective dates: 11/26/80, 12/01/93, 12/1/99

4. Wells

Drinking Water Sources

There are two main sources of drinking water, Surface Water and Groundwater.

Surface Water sources typically include Rivers, Streams, Lakes, Reservoirs. Groundwater under the direct influence of Surface Water (GWUDI), such as Springs, is another Surface Water source.

Groundwater sources include Aquifers and other sub-surface water, such as Wells.

There are a number of advantages associated with using surface water as the source for your drinking water system.

Groundwater usually requires less treatment than surface water.

Fairly consistent flow, quality, and temperature can make operation of treatment equipment easier.

Additionally, more sites are available for wells than surface water intakes for small, isolated communities.

Of course, there can be a number of disadvantages associated with using groundwater as the source for your drinking water system.

Although not as susceptible as surface water, groundwater can still be subject to contamination by agricultural and domestic chemicals. Once contamination occurs, it may be long-lasting and difficult to remove.

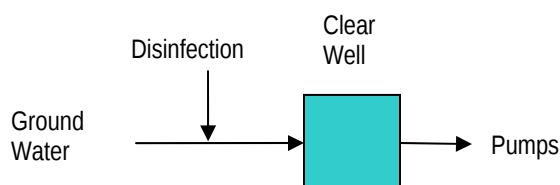
It can also be subject to high levels of hardness and nitrates along with problems from iron and manganese content.

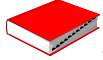
Additionally, multiple wells may be required to supply a community. Property issues such as condemnation, leasing, and location of wells are also concerns.

Wellhead protection zone maintenance can be problematic.

Basic Water Treatment Processes

The following graphic depicts the typical groundwater treatment processes you will encounter.

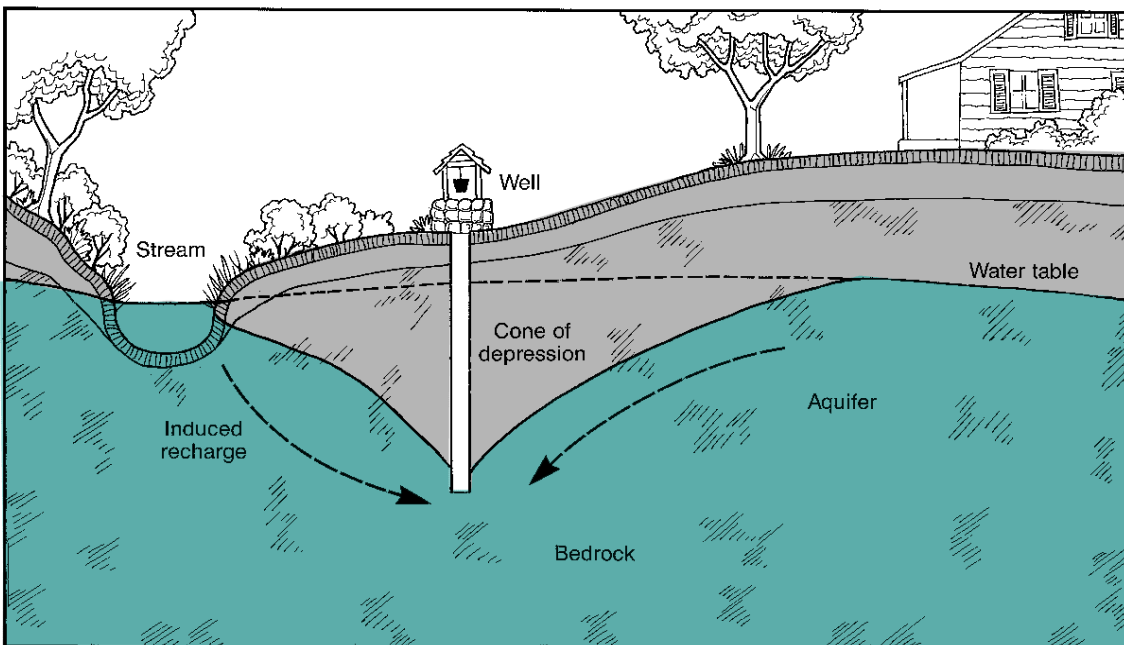




Safe Yield – The amount of water that can be annually withdrawn from a groundwater basin without adverse impacts. This is the long term sustainable pumping rate.

General Well Hydraulics

- When water is pumped from a well, the water table in the vicinity of the well is lowered, creating a cone of depression.
- If cone of depression extends to surface water body, water will flow from the surface water body to the groundwater. This is known as Induced Recharge.
- Image below shows well drawdown.



Well

Disinfection

Sometimes coliform bacteria in a well may result in unsatisfactory sampling results. Disinfecting your well may assist in resolving bacteriological issues.

When to disinfect

- When coliform bacteria are present
- When water taste or odor change
- After casing or pump repairs
- After installing new plumbing fixtures
- After flooding of the well
- During startup of seasonal wells
- As part of annual maintenance

5. Source Water Protection

Delineation

Every public water facility in Ohio is required to have a Source Water (Wellhead) Protection Plan. There are not only requirements for **what** is in the plan but also, **who** is involved in the planning as well as **how** the plan is developed.

Public Water Systems

***The Safe Drinking Water Act defines a public water system as one that serves piped water to at least 25 persons or 15 service connections for at least 60 days per year.**

There are three types of public water systems in Ohio.

- **Community public water systems**, which have at least 15 service connections used by year-round residents of the area or regularly serve 25 year-round residents. Examples of community systems are municipalities, mobile home parks, homeowners associations and nursing homes. Ohio has approximately 1,300 community systems serving over 10 million people.
- **Non-Transient Non-Community (NTNC) public water systems**, which serve at least 25 of the same persons per day for *more than six months* of the year. NTNC systems are typically schools, offices, hospitals, churches and factories. Ohio has approximately 930 non-transient non-community systems serving over 200,000 people.
- **Transient Non-Community (TNC) public water systems**, which serve at least 25 persons per day for *at least 60 days* each year. The TNC systems typically are campgrounds, restaurants, hotels, rest areas, golf courses or large stores. Ohio has almost 3,200 transient non-community systems serving almost 500,000 people.

Ohio Class A System Defined

Class A Public Water System is defined as:

1. Is a community or non-transient non-community public water system which serves a population of no more than 250 or a transient non-community public water system which serves a population of greater than 250
2. Uses only purchased water or ground water sources
3. Does not provide precipitative softening
4. Has no serious public health or environmental hazard associated with the operation of the public water system.
5. Examples: Manufactured Housing Parks and Homeowners Associations, Schools, Places of Employment, Rest Areas and Churches
6. Ohio has about 1,495 Class A systems state-wide.

The Source Water Protection program involves two phases. The first phase is collecting information about the source water, or the "assessment phase". There are three steps to an assessment:

1. Delineating the protection area (drawing a map or describing in words an area encompassing the time it takes ground water to travel five years to the wellhead.)
2. Identifying the potential contaminant sources in that area, such as; Landfills and dumps, Underground tanks, Storm and sewer pipes, agricultural industry, gas stations and septic tanks
3. Determining the susceptibility of the source water to contamination

The second phase is developing and implementing a local drinking water source protection plan. This effort is led by the public water system owner/operator, with assistance from other stakeholders. Also, a part of this phase is management of the plan and updating.

Delineation Updates

- Has the amount of pumping increased or decreased since the date Ohio EPA provided the Drinking Water Source Assessment report?
- Have any wells been added or removed?
- Has a new wellfield been added or are there any plans for a new wellfield?

If the answer to any of the above questions is yes, please contact Ohio EPA's Source Water Assessment and Protection Program staff at your district office, to determine whether the protection area should be re-delineated. Ohio EPA staff can provide this service without charge, or—if preferred—the water supplier may contract with a private consultant.

Potential Contaminant Source Inventory Updates

- Has the surrounding community developed rapidly?
- Have land uses in and around the protection area changed?
- Has management of businesses in the protection area changed?

Ohio EPA recommends re-inventorying the protection area at least every 10 years and encourages updates at shorter intervals, especially where development has been rapid.

Ohio EPA's Source Water Assessment and Protection Program staff can provide assistance, with inventory updates and can also provide an updated map of potential contaminant sources located within and near the protection area.

Protection Plan Update

- Is the list of Protection Team members and contact numbers current?

- Are there new potential contaminant sources that need to be addressed with new potential contaminant source control strategies?
- Should local businesses and residents be reminded about the location of the protection area by redistributing educational materials?
- Are there any updates concerning the size and shape of the protection area that local businesses and residents need to know about?
- Are there any updates to the Drinking Water Shortage/Emergency Response Plan?
- Is there new water quality, potential contaminant source or land use issues that would influence the need to conduct or not to conduct ground water monitoring?

6. Protection Plan

PUBLIC PARTICIPATION AND EDUCATION - THE OVERALL SUCCESS OF A SOURCE WATER PROTECTION PLAN DEPENDS UPON THE COOPERATION OF PEOPLE LIVING AND WORKING WITHIN THE WHP AREA. RESIDENTS AND BUSINESSES NEED TO UNDERSTAND HOW THEIR ACTIONS MAY AFFECT THE QUALITY AND OF THEIR DRINKING WATER, AND WHAT THEY CAN DO TO PREVENT CONTAMINATION FROM OCCURRING.

Source Control Strategies - Describe specific actions or techniques that may be used to reduce the risk of ground water contamination from specific potential pollution sources, such as zoning or other use restrictions.

Ground Water Monitoring - A public water system must assess the need for ground water monitoring. Ground water monitoring can be the early warning to the public water supplier of contamination approaching the wellfield. The community must keep in mind that monitoring is not a preventive measure, and should not be the main focus of a source water protection plan.

Contingency/ Emergency - A public water supplier must have provisions for both a long and short-term alternative source of water due to contamination. The provisions must also take into account spill response, which is usually coordinated with the local emergency planning committee.

Submittal Process

When submitting a Protection Plan for endorsement, **two copies** of the report should be sent to Ohio EPA, one to the central office and one to the appropriate district office. A cover letter from the public water supplier (i.e., municipality or private firm) should accompany each copy. Although consultants are often retained to complete portions of the report, it is important that the report reflect the intentions of the entity responsible for protecting the drinking water source, and it should be submitted by that entity to Ohio EPA. Ohio EPA staff will review the document and respond to the entity within 60 days.

7. Ohio Well Regulations

Sites for new public water supply wells must be thoroughly investigated. Through several protocols, the well site will have to pass certain steps of testing in order to ensure there are no existing sources of contamination to the well site. Steps should be taken to ensure the well site not be in jeopardy of being contaminated throughout its useful life.



The Ohio Administrative Code describes the rules for well regulations.

3745-9-04 Well Siting.

A. A well shall be located in accordance with these requirements.

1. A well, other than a well for the removal of contaminants, shall be located the maximum practical distance from potential or known sources of contamination and only where it can be maintained in a sanitary condition.
2. A well, other than a well for the removal of contaminants, shall be located only where surface and subsurface conditions will not allow contaminants to be conducted into the well.
3. A public water system shall own all the land or obtain an easement or lease of the sanitary isolation radius of a public water system well, and such easement or lease shall be recorded with the county recorder.

[Comment: the director recommends ownership by the public water system of land at least within the sanitary isolation radius.]

4. The sanitary isolation radius is determined from the estimated average daily water demand of the public water system well. Estimated average daily water demand may be determined by the director from the pumping design rate of the well.

Sanitary Isolation Rules	
Estimated Average Daily Water Demand (Q gallons per day)	Sanitary Isolation Radius (feet)
0-2,500	50
2,501-10,000	Square root of Q
10,001-50,000	$50 + Q/200$
Over 50,000	300

5. The director may specify greater sanitary isolation requirements for a public water system well where conditions are determined to exist such that the sanitary isolation radius set forth in paragraph (A)(4) of this rule is insufficient to protect the public health and the public water system from contaminants.
6. Potential sources of contamination shall not be constructed or placed within the sanitary isolation radius of a public water system well.
7. A well, other than a well for the removal of contaminants, shall be located at least ten feet from property boundaries and from easements that are granted to other persons, at least twenty-five feet from the normal driving surface of any public road, and at least five feet from the edge of a driveway or parking lot.

8. A well shall not be located either within ten feet of or within the foundation of any building, except within a pumphouse.
 9. A well shall not be located in a floodway without prior acceptance of the director.
 10. The director may require a hydrogeologic investigation to select the location of a well to ensure that contaminants will not be drawn into the well and that a sufficient quantity of ground water exists for the intended purpose. These investigations may be required where, without limitation, one of these well sitting circumstances exist: potential or known contamination; hydrogeologic setting that may allow transport of contaminants; or initial development of a community well field. The investigation shall be conducted by a hydrogeologist. A hydrogeological investigation is a study of the subsurface and geologic conditions. Information shall be collected, without limitation, about the type and thickness of geologic materials, the occurrence of ground water, how it flows in pore spaces and fractures, and the quantity and quality of the ground water.
- B. A well shall be located so it is accessible for cleaning, treatment, repair, alteration, testing, and such other actions as may be necessary.

Replaces: 3745-9-04

Effective: May 1, 2003

R.C. 119.032 review dates: May 1, 2008

Promulgated Under: 119.03

Statutory Authority: 6109.04, 6111.42 Rule Amplifies: 6109.04(B), 6111.42(E) Prior Effective Dates: February 15, 1975

**3745-9-08 Well disinfection**

- (A) A public water system well shall be disinfected at the time of completion after construction, installation, development, alteration, or repair, and before supplying water for human consumption.
- (B) The standard "AWWA C654-97, Disinfection of Wells," shall be used as a guide except for the topics presented in sections 4.2, 4.5, and 5 that are otherwise specified in paragraphs (C) and (D) of this rule.
- (C) These disinfection procedures shall apply.
 - (1) All loose debris, sediment, mineral encrustation and bacterial slime shall be removed from the well prior to disinfection.
 - (2) Disinfectant shall be slowly poured into the well by wetting the inside casing circumference, drop pipe, and electrical cable.
 - (3) Disinfectant concentration in the water column shall be initially at least one hundred milligrams per liter chlorine. A public water system may use an alternative disinfectant concentration following consultation with the district office staff of the district in which the public water system is located, provided the disinfection procedure will ensure complete disinfection and includes:
 - (a) A mechanical cleaning of the well casing to remove loose debris, sediment, mineral encrustation and bacterial slime before disinfection;
 - (b) Monitoring of the pH and chlorine residual; and
 - (c) Maintaining at least fifty milligrams per liter free chlorine residual throughout the water column.
 - (4) Water in the well shall be agitated or surged to ensure even dispersal of the disinfectant throughout the entire water column.
 - (5) Disinfectant contact time shall be at least eight hours.
 - (6) Disinfectant shall be thoroughly flushed or dissipated from the well before supplying water for human consumption.
 - (7) When calcium hypochlorite is used for disinfection, the tablets or granules shall be completely dissolved in water prior to placement into the well. Sodium hypochlorite solution shall be used within the manufacturer's posted expiration date. Sodium hypochlorite solution with fragrance additives shall not be used for disinfection.
 - (8) With prior consultation with the district office, buffering chemical that has standard ANSI/NSF 60 certification may be used to enhance disinfection efficacy. The director may require submission of chemical disinfection procedures with specifications for the method, equipment, chemicals, and testing for residual chemicals.
 - (9) Disinfectant shall have ANSI/NSF 60 certification.
- (D) After disinfection, a well shall not supply water for human consumption until a least two consecutive total coliform samples that are collected from a well at least twenty-four hours apart are analyzed and demonstrate inactivation

of microbiological contaminants with total coliform-negative results.

- (1) Total coliform samples shall be collected at least forty-eight hours after disinfection and after residual chlorine is completely flushed or dissipated from the well. Total chlorine shall be undetectable before total coliform sampling.
- (2) If total coliform analysis is total coliform-positive, then an additional sample shall be collected and analyzed for total coliform and either fecal coliform or *Escherichia coli* (*E. coli*).
- (3) Microbiological and total chlorine samples shall be analyzed in accordance with Chapter 3745-89 and rule 3745-81-27 of the Administrative Code.

[Comment: "Standard ANSI/NSF 60, Drinking Water Treatment Chemicals - Health Effects, February 9, 2001, Document Number NSF/ANSI 60- 2001." This rule incorporates this standard or specification by reference. At the effective date of this rule, a copy may be obtained from "NSF International, 789 N Dixboro Road, PO Box 130140, Ann Arbor, MI 48113-0140," (734)769-8010, www.nsf.org. This document is available for review at "Ohio EPA, Lazarus Government Center, 122 South Front Street, Columbus, OH, 43215-3425."]

[Comment: "Standard AWWA C654-97, Disinfection of Wells," effective date January 1, 1998, catalog number 43654. This rule incorporates this standard or specification by reference. At the effective date of this rule, a copy may be obtained from "AWWA Bookstore, 6666 W Quincy Avenue, Denver, CO, 80235-3098," (303)795-2114, www.awwa.org. This document is available for review at "Ohio EPA, Lazarus Government Center, 122 South Front Street, Columbus, OH, 43215-3425."]

Replaces: 3745-9-08

Effective: May 1, 2003

R.C. 119.032 review dates: May 1, 2008

Promulgated Under: 119.03

Statutory Authority: 6111.42, 6109.04

Rule Amplifies: 6109.04(B), 6109.04(C)(1)(a), 6111.42(E) Prior Effective Dates:
February 15, 1975

8. Preventive Maintenance

The Role of Maintenance in the Overall Operation

As soon as a facility is built, its buildings and systems start a predictable decline in condition and efficacy. Some elements—such as a roof or building envelope—may have a life cycle of 25 to 30 years before major work is required. Other items—such as pumps and compressors—will need regular service almost immediately after start-up.

The role of maintenance is to identify and remedy potential problems before they impact plant operation. This requires establishment of a set of operating parameters. The design specifications for the equipment help to identify the maintenance parameters. By using a proactive approach (maintaining equipment so that it does not break down as often), we can ensure a level of service that ensures maximum operating efficiency.

Good practice also extends to the actual service and maintenance of the equipment. Injuries to plant personnel result when people work without thinking through the tasks or they accept risks that are not necessary. Common ways to minimize hazards include:

- using lockout-tagout procedures when isolating valves and equipment.
- always replacing guards over moving parts after service.
- following confined space procedures.
- performing good housekeeping procedures.

Poorly maintained equipment can lead to:

- poor water quality that is dangerous to public health.
- hazardous discharges of chemicals to the environment.
- safety hazards to plant personnel.



Standard Operating Procedures, or SOPs, are guidelines developed by management to ensure that the facility's practices conform to internal and external requirements. They establish uniformity and provide information on issues of safety and operation.

Finally, the organizational structure is supported by ready access to operations and maintenance manuals. The service information that these documents supply allows repairs and adjustments to be made in a

scheduled way that helps management to prudently allocate financial, equipment, and labor resources. A set of manuals for all equipment should be kept at the plant.



Maintenance is a support function providing a cohesive process that assists Operations and other departments in fulfilling the mission of the facility. This is achieved by ensuring that all equipment and systems are operated at an expected level of reliability within a specified budget and within the life cycle of the equipment.

Preventive Maintenance as the Key Effort

The heart of any maintenance operation is the preventive maintenance (PM) effort. PM involves regularly checking and servicing equipment so that it is in peak operating condition. Preventive maintenance allows the maintenance department to catch any potential problems before they impact the functioning of the equipment.

Preventive maintenance (PM) is sometimes referred to as “predictive” maintenance. This terminology reinforces the idea that PM is planned and scheduled. We can “predict” when it will be done, what will be done, and how much it will cost in terms of dollars, time, equipment, and personnel. Advanced maintenance techniques, such as vibration analysis, lubrication analysis, and IR scans, may provide clues to help determine when maintenance is required.

There are six major components of a maintenance program.

- Scheduled Preventive Maintenance Tasks
- Unplanned Daily Activities
- Planned Project Work
- Record Keeping
- Inventory Management
- Purchasing

Scheduled Preventive Maintenance Tasks

Typical areas of service include lubrication, calibration, condition assessment and monitoring, and consumable replacement.

Lubrication

Lubrication of moving parts is a fundamental aspect of equipment maintenance. The goal of lubrication is to prevent contact between the moving parts of the bearing surfaces. Choosing and using the proper lubricant is essential. Modern lubricant properties allow a narrower range of products to cover more applications, but it is important to meet the equipment manufacturer's recommendations for lubricant type and usage.

Calibration

Process systems rely heavily on monitoring and automated control. Inaccurate sensors and recorders can cause upset in an entire system. The manufacturer's recommended frequency of calibration should be incorporated into the PM program.

Condition Assessment and Monitoring

Early maintenance programs typically relied on calendar-based scheduling of work tasks. Today, a broad choice of tools helps to pinpoint the optimal maintenance timing. Oil analysis, vibration analysis, and infrared testing are examples of available assessment methods

Record Keeping

Recording and retaining treatment process information is an integral part of the operator's job. However, data gathering and retention is also important in the maintenance operation. It allows:

- Prediction of maintenance efforts.
- Better condition assessments for overhaul and replacement.
- Support for departmental staff and resource requests.

Inventory Management

The key to an effective inventory control system is keeping the minimum number of parts in stock while, at the same time, protecting against emergencies and providing flexibility to carry on daily activities. This is a difficult balance to achieve, and its success depends upon several factors.

- Critical spare parts for key equipment should be on hand at all times.
- Work closely with service providers and contractors to ensure that they have parts which are readily available.
- Partner with providers and contractors to determine which parts will most likely be needed;
- keep these on hand at the plant.

- Plan a manageable inventory while considering the storage space available at the facility.
- Know, and develop a relationship with, vendors and suppliers for replacement parts BEFORE you need them in an emergency.

Pump Performance Issues

Before we review maintenance procedures, it is important to point out some pump performance issues.

To increase the life of a pump:

- It should be allowed to run for the longest period of time possible before being shut off. This helps to reduce the amount of starting torque on the thrust bearings and the pump. Starting also causes high power usage when compared to running the pump more consistently.
- Pump manufacturers always give a maximum amount of times a pump should be started per hour. This recommendation should be recorded in the O&M Manual and followed by the system.

Maintenance on a pump is important to keep the pump running at its optimum performance level. Worn impellers and bearings are just two issues that can cause poor performance.

It is important to note that when you see your pump performance affected, it is not always a problem with the pump itself. For example, suction head and suction lift on the pump can cause an apparent decrease in pump performance. These issues put a load on the pump, but they do not represent a pump maintenance problem.

Shaft Seal Adjustment

Shaft seals will be standard packing or mechanical. Generally, packing material is used to minimize leakage around the pump shaft where it penetrates the volute casing. A number of different kinds of material are available, depending on the application.

Standard Packing Seals

Shaft seals are rings of gasket material that wrap around the shaft of the pump.

Shaft seals are contained within a “Stuffing box.” This is a cylindrical box that surrounds the pump shaft designed to hold the packing rings. The box has packing nuts that can be tightened to maintain seals as the shaft seals wear.

- Proper packing adjustment consists of small, incremental taking up of the packing nuts to maintain proper sealing.
- When gland nuts are fully taken up, another ring of packing should be added. A gland nut is a fitting used to adjust the pressure on the packing to control seal water leakage.

- Periodically, the packing requires replacement.
- All rings need to be replaced, including the rings past the lantern ring (if utilized).

Note: A lantern ring is a perforated hollow ring located near the center of the packing box that receives relatively cool, clean liquid from either the discharge of the pump or from an external source and distributes the liquid uniformly around the shaft to provide lubrication and cooling. The fluid entering the lantern ring can cool the shaft and packing, lubricate the packing, or seal the joint between the shaft and packing against leakage of air into the pump in the event the pump suction pressure is less than that of the atmosphere.

- Over-tightening leads to shaft/sleeve wear.
- Under-tightening leads to excess water leakage, which can cause corrosion of the gland bolts and allow water to infiltrate the bearings.

Note the leaking gland on a small circulating pump in the image below.



Leaking Gland

Mechanical Seals

In some situations, the packing material is not adequate for sealing the pump shaft. A mechanical seal can be used instead. A mechanical seal consists of:

- A rotating element attach to the shaft
- A stationary element attached to the pump casing.
 - Always follow the manufacturer's recommendations carefully.
 - Once installed, periodically check for leaks.
 - Rapid failure is a concern; replace leaking seals immediately.
 - Check flushing lines (if equipped) to make sure they remain clear.

9. Electric Motors

Motor care typically involves the following three categories: cleaning; lubricating; and testing/inspecting.

Cleaning

- Ensure good ventilation.
 - Electric losses in motors create heat, which must be dissipated to avoid exceeding the design limits of the unit.
 - Heat is rejected by passing air internally or externally through or around the unit.
 - In some cases, motors are enclosed and cooled by a heat exchanger.
- Open type motors can draw dirt into the unit.
 - Inspect the motor openings for accumulations of dust and dirt.
 - Motors located outside often use screens to keep out leaves and rodents. Monitor them.
- Totally Enclosed Fan Cooled (TEFC) units rely on an extended exterior surface area to act as a heat sink, since the cooling air cannot flow freely closer to the point where the heat is generated.
 - It is particularly important to keep these clean for maximum heat transfer.
- Some wound rotor and many synchronous units are in service.
 - These older synchronous motors have brushes. Carbon dust from the brushes will be deposited on the brush holders and commutator area.
 - This can leak carbon, causing grounds.

- Clean, dry compression is usually used to blow out dirt.
 - Utilize the lowest possible pressure to prevent damage to insulation.
- In some cases, solvents can be used to remove accumulations of dirt and grease.
 - Make sure the solvent will not damage the insulation.
 - Make sure the solvent does not flow into the bearings.

10. Lubrication

The same considerations follow in motor lubrication as mentioned under pumps. However, it is important not to over-lubricate motors. This situation would allow grease or oil to work past the seals and into the motor windings, which might affect the insulation and promote retention of dirt.

11. Repairs

The heart of any maintenance operation is the preventive maintenance (PM) effort. PM involves regularly checking and servicing equipment so that it is in peak operating condition. Preventive maintenance allows the maintenance department to catch any potential problems before they impact the functioning of the equipment.

Preventive maintenance (PM) is sometimes referred to as “predictive” maintenance. This terminology reinforces the idea that PM is planned and scheduled. We can “predict” when it will be done, what will be done, and how much it will cost in terms of dollars, time, equipment, and personnel. Advanced maintenance techniques, such as vibration analysis, lubrication analysis, and IR scans, may provide clues to help determine when maintenance is required.

Breakdown Maintenance

Breakdown maintenance is often a result of the failure of **preventive maintenance** or **corrective maintenance** functions.

- **Preventive Maintenance**
 - The idea of preventive maintenance, or PM, is to avoid the need for costly repairs due to lack of attention to a system. It is performed on a regular basis and is scheduled in advance.
 - PM was named in the previous section as the heart of any maintenance plan.
- **Corrective Maintenance**
 - Corrective maintenance (CM) has the goal of preventing further damage to equipment that has suffered some ill effect. The maintenance is a result of inspecting the equipment and it addresses a specific problem. Often, a short time period exists between identification of the problem and the need to correct it.

- A quick corrective maintenance can prevent major system failure and prevents the equipment from being removed from service for extended periods without advanced warning.

Breakdown maintenance is also known simply as “repairs”. Repairs are an unscheduled task and are often time-sensitive. The equipment usually must be removed from service for a prolonged period; spare parts may not be on hand; and the cost in labor is extensive. Ordinarily, repairs result from the failure to follow effective preventive maintenance and/or corrective maintenance.

Repairs and maintenance tasks are performed with varying degrees of frequency. The frequency may depend upon manufacturers’ recommendations, amount of wear and tear received, staff time constraints, or plant conditions.

12. Operations and Maintenance (O&M) Manuals

What is an O&M Manual?

Most major pieces of equipment found in a Water Treatment Plant are accompanied by an O&M Manual. The O&M Manual is a scheduling tool for the operation and maintenance of that specific piece of equipment and a major resource for operators. All of the information needed to control, manage, perform service, and maintain proper operation of the equipment can be found in the O&M Manual.

Most Public and Major Community Water Systems are required to maintain O&M Manuals. Non-community water system are not required to maintain O&M manuals, however it is always a good practice to have O&M manuals on the equipment found at any facility.

Typically, the information contained in an O&M Manual can be separated into the eight general categories listed below.

1. General Information

This is information that applies to the specific installation site. It contains the name of the equipment model and what type of auxiliary equipment is typically installed with the system. All bills of materials, packing lists, and the table of contents for the entire manual also can be placed into this category.

2. Equipment Description

A description of how the piece of equipment works and its common applications can regularly be found near the front of the manual. Here, the manual contains:

- a step by step listing of the processes the equipment performs
- an overview of the physical features of the equipment system
- an explanation of the individual components making up the system
- design limits for the equipment (i.e. maximum flow rate)
- typical applications for which the equipment is installed

3. Safety

Depending on the individual manual, there may be an entire portion completely devoted to recommended safety practices, or these tips may be included throughout the text. Regardless, the precautions outlined in the manual should be followed at all times, as they will prevent poor or unsafe operation and personal injury. Common safety concerns are:

- practicing safe operation and maintenance with and around electrical devices
 - knowing when and how to cut power from the equipment
 - lockout/tagout procedures
 - recognizing a problem caused by incorrect or worn wiring
- preventing unsafe conditions around mechanical instruments
- understanding the hazards of particular working conditions
- knowing procedures for handling hazardous materials (i.e. Material Safety Data Sheets)

4. Operation

A complete explanation of how to operate the equipment is provided. While the explanation is a general one that could apply to any installation, it is easily adaptable to a site specific application. Standard operation headings include:

- normal operation
- alternate operation
- emergency operation
- startup
- shutdown
- alarms
- electrical controls (if a computer system can be used to run the equipment, i.e. SCADA)

5. Maintenance

Some form of equipment maintenance instruction is included in the manual. Although it may reference the vendor/manufacture documents (described below) for maintenance on components not provided with the specific piece of equipment, it will generally include the following:

- periodic maintenance schedule
 - the frequency of routine checks and service
 - how to perform the checks and spot indications of problems
- component maintenance procedures
- lubrication procedures
 - types of lubricant required

- procedure and points of application
- frequency requirements

6. Troubleshooting

The troubleshooting included in the manual is a list of common problems that could be encountered with the equipment, along with possible causes and solutions to each problem. Troubleshooting is generally provided in an easy to follow outline format or chart.

7. Vendor/Manufacturer documents

These inserted portions of the manual are supplied by the vendors or manufacturers of auxiliary equipment that is coupled with the entire system. They contain:

- specific information on the supplied item (i.e. motor specs)
- maintenance, lubrication, and troubleshooting for the auxiliary equipment
- warranty and contact information from the vendor/manufacturer of the auxiliary equipment
- detailed drawings of the auxiliary equipment that are not provided in the manual elsewhere

8. Drawings

Engineering drawings can occasionally be found throughout the text, and groups of them can often be found in one place of the manual. These drawings can show where the equipment system is located in the plant or its dimensions. Most commonly, the drawings contained in the manual will show:

- a general view of the equipment
 - profile view
 - overhead view (plan view)
- parts of the equipment that are relevant to operation or maintenance
 - a sectioned view to the working parts of the equipment
 - under removable parts (i.e. safety guards)
 - control panel layouts
- electrical wiring diagrams

13. Confined Space

It is important that you become familiar with the confined spaces and the hazards associated with your facility and that you have been thoroughly trained on the confined space entry procedures at your facility.



Never enter a confined space without following the appropriate procedures.

- A confined space is defined as a space that meets the following three criteria:
 - Is large enough and so configured that a person can bodily enter and perform their assigned work.
 - Has a limited or restricted means for entry or exit.
 - Is not designed for continuous worker occupancy.



Generally if you cannot walk upright into a space and you must duck, crawl, climb, or squeeze into a space, it is considered a confined space.

Characteristics of a Permit-Required Confined Space



A **permit-required confined space** is a confined space that has one or more of the following hazardous characteristics: it contains or has the potential to contain a hazardous atmosphere such as oxygen deficiency, toxicity or flammability; it contains a material that has the potential to engulf an entrant such as water; it has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross section such as a hopper or bin; it contains any other recognized serious safety or health hazard.



A **non-permit required confined space** does not contain or have the potential to contain, any hazard capable of causing death or serious physical harm.

Atmospheric Testing

Potentially hazardous atmospheres present a threat of causing death, injury, illness or incapacitation due to flammable/explosive, toxic or oxygen deficient atmospheres.

The primary atmospheric concerns associated with treatment plants are:

- Oxygen deficiency (less than 19.5% oxygen) from metal corrosion, oxygen scavenging or depletion by another gas.
- Flammability/explosive atmosphere from methane gas, hydrogen sulfide and fuels.
- A toxic atmosphere from hydrogen sulfide, chlorine and other process chemicals.

Monitoring

- It is important to keep in mind that the work you perform within a confined space may create a hazardous atmosphere. Welding, painting, solvent cleaning, pipe grouting or use of power tools with combustion engines can all produce hazardous contaminants that will create a hazardous atmosphere. Therefore, it is imperative that the atmosphere of a confined space that you will be entering is checked using reliable, calibrated direct-reading instruments prior to and during your entry into a confined space.
- The monitoring must be performed by an individual who is knowledgeable about the potential confined space hazards and air monitoring procedures.
 - Atmospheric monitoring should be performed outside of the confined space in the vicinity of the opening or at potential contaminant sources that may pose a problem and, at stratified levels (top, middle, and bottom) within the confined space.
 - Monitoring should be performed in the following order and acceptable results should be within the acceptable concentrations:

<u>Contaminant</u>	<u>Acceptable Concentration</u>
Oxygen	19.5% - 23.5%
Flammable gases/vapors	>10% of the lower flammable/explosive limit

Potential toxic contaminants:

Hydrogen sulfide	<10 ppm
Carbon monoxide	<25 ppm
Chlorine	<0.5 ppm
Other contaminants	< the OSHA PEL or ACGIH TLV or other recognized exposure limit

Ventilation

Air monitoring results that are not within the acceptable concentrations will classify the space as a permit-required confined space and appropriate action must be taken to eliminate or control the hazard. This will involve the following:

- Allowing the space to naturally ventilate.
- Use of forced air ventilation.
- Purge the space with an inert gas or water.

The space should be continuously ventilated using explosion proof, forced air blowers.

- The blowers should be set up to either supply fresh air into the space or to exhaust contaminants out of the space (this is especially useful when activities within the space such as welding or painting create a potential hazardous atmosphere) or, a combination of supply and exhaust ventilation.
- It is important to know the density of the potential contaminants in order to properly position ventilation equipment. Heavier than air gases/vapors will sink to the bottom and lighter than air gases /vapors will tend to accumulate at the top of a space and, therefore, ventilation equipment should be positioned accordingly.

Controls

Prior to entry into a confined space all physical hazards must be considered.

- These may include:
 - Electrical.
 - Hazardous energy sources.
 - Power driven equipment.
 - Material or water flow.
 - Fall hazards.
 - Noise exposure.
- These physical hazards must all be controlled prior to entering a confined space.
- Water supply lines should be disconnected, shut off and locked out or blanked to prevent water flow into the space.
- Electrical and other hazardous energy sources must be de-energized and locked out.
- Appropriate personal protective equipment must be worn.

Confined Space Entry Program

Confined space entries should be performed under a facility specific Confined Space Entry Program that establishes:

- Written entry procedures to be followed.
- The responsibilities of each individual involved in confined space entry (entrants, attendants and supervisors).
- The confined space entry permit system to be used.

Permit-required confined spaces can only be entered under a permit system. A Confined Space Entry Permit is a written document that identifies:

- The space to be entered.
- The work to be done within that space.
- The potential hazards associated with the space.
- The hazard control measures taken.
- Documentation of atmospheric testing results.
- Identification of the workers working within the space (entrants).
- The worker serving as the attendant outside the space.
- The competent person who certifies the permit and authorizes the confined space entry and work.

Work within confined spaces can pose serious safety and health hazards if you are uninformed or untrained in confined space hazards and proper entry procedures. Make sure that your plant's confined spaces have been identified and the hazards associated with each space have been identified and assessed and that appropriate procedures have been established to enter and work within a confined space.

The OSHA Permit-Required Confined Space Standard, 29 CFR 1910.146, establishes the requirements for confined space entry programs, permit systems and entry procedures.

14. Lockout / Tagout



A **tagout device** is a prominent warning, such as a tag, which can be securely fastened to an energy-isolating device to indicate that the energy isolating device and equipment are not to be operated until the tag is removed.

Lockout / Tagout Program

Standard operating procedures should be established for all equipment that has the potential for accidental startup or movement caused by an energy source such as electricity, hydraulics, pneumatic, rotating equipment, gravity, stored energy, pressure and water flow.



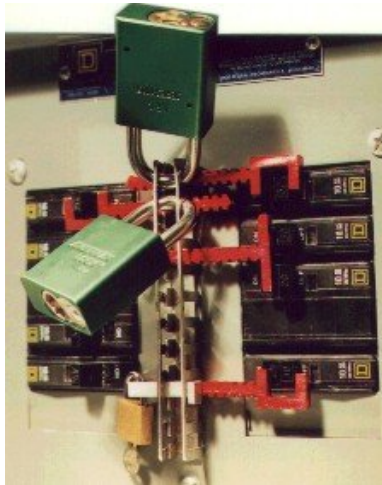
Purpose

These procedures usually are in the form of a lockout/tagout program. The purpose of a lockout/tagout program is to ensure that all personnel follow standardized shutdown and startup procedures to prevent accidental equipment start up, energization or release of stored energy and personal injury or property damage.

OSHA has established requirements for energy isolation, lockout/tagout in the Control of Hazardous Energy Standard, 29 CFR 1910.147 and the Electrical Safety Standard, 29 CFR 1910.333(b).

A lockout/tagout program should include the following basic elements:

- An energy control program that consists of energy control procedures for each piece of equipment, employee training and periodic inspections to ensure that the appropriate procedures and energy isolation is being performed.
- Lockout/tagout must be used to provide full protection for workers when performing maintenance or repair on equipment. If the energy isolating device for a piece of equipment is capable of being locked out then the energy control procedure should use a standardized lockout device similar to those shown in the figures below. A lockout device uses a positive means such as a lock, chain, blank flange, wedge, block or slip blind to prevent the energizing of a machine or equipment.



Lockout Device for Circuit Breakers



Typical Lockout Device

- A standardized tagout system must be used if an energy-isolating device is not capable of being locked out.
- The tags should have appropriate warning language such as: *Do Not Start, Do Not Open, Do Not Close, Do Not Energize, Do Not Operate*. The following two figures are examples of tagout devices.



Warning Tags

A combination of both a lockout device and tagout device is recommended when possible to ensure the most protection.

Energy Control

- Energy control procedures should be developed, documented and used.
- The procedures should state the intended use of the procedure; the steps and responsibility for the placement, removal and transfer of lockout or tagout devices; and the requirement for testing a machine or equipment to ensure that the lockout/tagout devices are effective in controlling the hazardous energy.

Training

- Training should be provided to all employees that will be performing maintenance or may be affected by the maintenance.

The training should include the purpose and function of the energy control program and the procedures for the safe application, use, and removal of the energy controls such as locks or tags.

Sample Lockout/Tagout Procedure

A sample lockout/tagout procedure at your facility might look something like this:

An authorized employee who knows the type and extent of energy a piece of equipment uses and the associated hazards will notify all affected employees that a lockout or tagout system is going to be used and the reason why.

- Shut down the equipment by the normal shut down procedure.
- Operate the switch, valve or other energy-isolating device to ensure that the equipment is isolated from its energy source.
- Ensure that stored energy that may be in springs; elevated equipment parts (gravity); rotating flywheels; hydraulic systems; pneumatic systems; or gas, steam or water pressure is dissipated or controlled by venting, bleeding, blocking or repositioning.
- Apply the lockout or tagout device in accordance with your procedures.
- Perform a final energy isolation test by operating the start button or normal operating controls as a check to make sure that the energy source is isolated. This should only be done after making sure that no personnel are exposed and all tools and equipment are out of the area of operation. After completing the test make sure that all operating controls are reset to the neutral or off position.
- Proceed with the necessary maintenance or repair work.
- Upon completion of the work, remove all tools, reinstall the guards, and clear the area of all personnel.
- Remove the lockout or tagout device and restore energy to the equipment.

14. Record Keeping



The Ohio Administrative Code explains the requirements for record keeping and record maintenance for public water systems.

3745-81-33 Record maintenance.

Any owner or operator of a public water system subject to the provisions of this chapter shall retain on its premises or at a convenient location near its premises the following records:

- A. Records of bacteriological analyses made pursuant to this chapter shall be kept for not less than five years. Records of chemical analyses made pursuant to this chapter shall be kept for not less than ten years. Actual laboratory reports may be kept, or data may be transferred to tabular summaries, provided that the following information is included:
 - 1. The date, place, and time of sampling, and the name of the person who collected the sample;
 - 2. Identification of the sample as to whether it was a routine distribution system sample, check sample, raw or process water sample or other special purpose sample;
 - 3. Date of analysis;
 - 4. Laboratory and person responsible for performing analysis;
 - 5. The analytical technique/method used; and
 - 6. The results of the analysis.
- B. Records of action taken by the system to correct violations of state primary drinking water rules shall be kept for a period not less than three years after the last action taken with respect to the particular violation involved.
- C. Copies of any written reports, summaries or communications relating to sanitary surveys of the system conducted by the system itself, by a private consultant, or by any local, state or federal agency, shall be kept for a period not less than ten years after completion of the sanitary survey involved.
- D. Copies of public notices issued pursuant to rule 3745-81-32 of the Administrative Code and certifications submitted to the director pursuant to paragraph (A)(3) of rule 3745-81-32 of the Administrative Code must be kept for a minimum of three years after issuance.

3745-81-332 Effective: 11/01/2004

R.C. 119.032 review dates: 07/27/2004 and 11/01/2009

Promulgated Under: 119.03

Statutory Authority: RC Section 6109.04 Rule

Amplifies: RC Section 6109.04

Prior Effective Dates: 12/27/1978, 01/01/04

State of Ohio Class A Drinking Water Operator Certification Program



Session Two: Supplemental Materials

This course includes content developed by the Ohio Environmental Protection Agency, the Pennsylvania Department of Environmental Protection, the Indiana Department of Environmental Management, the California State University at Sacramento, and 360water, Inc.

Project funded by the USEPA.



SESSION TWO: SUPPLEMENTAL MATERIALS

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1. Disinfection

Overview of Disinfection

- 1) **Purpose of Disinfection** – The primary purpose is to protect Public Health. All major public water supplies and some major community water supplies are required to disinfect. However not all small community and non-community water systems are required to disinfect.



Disinfection is the process used to kill pathogenic bacteria, in a raw water supply.



Residual Disinfection is the process of maintaining a disinfectant level in the treated or finished water supply throughout a system to assure that re-growth of pathogenic microorganisms will not occur.

- Chemical treatment for well supplies as a minimum requires provision for disinfection.
- For wells that are considered not to be under the influence of surface waters or requiring other forms of treatment, disinfection using chlorine or one of its compounds, followed by 30 minutes of detention time, may be required.
 - An example of detention time would be: You have a tank that holds 150 gallons of water. With the tank empty you fill it at a rate of five gallons per minute. At that rate it will take 30 minutes to fill it. So, if you have a tank that holds 150 gallons of water and you are filling it at 5 gallons per minute you would have a 30 minute detention time.

2) Disinfection Processes and Descriptions

Disinfection Byproducts

Some people believe if a little is good, even more must be better. When it comes to chlorination, over-feeding may cause the formation of additional, harmful, byproducts.

- Some of these reactions between organic compounds and chlorine will form regulated disinfection byproducts including trihalomethanes (THMs) and haloacetic acids (HAAs). It is desirable to remove as much of these organic materials from the water as possible before disinfection with chlorine since the byproducts are carcinogenic.
- All water systems that apply chlorine as a disinfectant must analyze for THMs. The number of samples analyzed and frequency is a function of system size and water source.

Disinfection Demand

Demand is defined as anything in the source water that will react with the disinfectant (chlorine) and make it unavailable for disinfection. This includes iron, hydrogen sulfide, inorganics, and organic material.

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Process Control

Process control refers to controlling the key parameters (chemical feed rates and application points, mixing time, detention time, etc.) to ensure proper water quality.

- Chemical feed of a disinfectant must be continuous and adequate.
- Again, if the dosage of the disinfectant is not sufficient to kill the pathogenic organisms, breakthrough or re-growth may occur in the distribution system.

Time

Time is an important factor. Specifically, contact time is important. Contact time is the amount of time in minutes deemed necessary for the applied chlorine to perform its disinfection function before the water is delivered to the first customer.

Chemical Disinfection

Chlorine Gas

Chlorine gas is a liquid form of pure chlorine. It is stored in cylinder under pressure. When it is withdrawn from the cylinder it comes out in the form of a gas. Large water systems typically use this type of disinfectant.

Hypochlorite – Liquid Chlorination

Hypochlorite generally is a compound of chlorine and either sodium or calcium. Available in solutions from 5% to 15% chlorine.

- **Advantages**
 - Hypochlorite is an effective disinfectant.
 - Hypochlorite is easy to use and apply and does not require special training for handling.
 - It is easy to monitor to determine whether there is a residual disinfectant in the distribution system.
- **Disadvantages**
 - Hypochlorite solution is prone to degrade over time as chlorine vaporizes from solution, reducing its chlorine content, making it less effective and requiring a higher feed rate of the weaker product.
 - It is an aggressive chemical that can corrode many materials it comes in contact with.
 - Hypochlorite can react with organics in either the raw water or finished water to form trihalomethane and haloacetic acids, which are known carcinogenics.
 - It can “off gas” in the feed system, resulting in operational problems.
 - Hypochlorite can form chlorate, which may have adverse health impacts

Disinfection Application

Chlorination Terminology

Demand



Chlorine Demand is the amount of chlorine use by iron, hydrogen sulfide and organic materials found in the raw water. It is the difference between the amount of chlorine applied to the water and the amount of free residual chlorine after a given contact time.

Residual



Free Chlorine residual is the amount of uncombined (free) chlorine remaining in the water after reactions with inorganic and organic material. This residual, plus the combined chlorine from other reactions that have slight disinfection capability, is the total residual available for maintaining the sanitary quality of the water.



Chlorine residual is the total of all compounds with disinfecting properties and any remaining free chlorine.

Chlorine Residual (mg/l) = Combined Chlorine Forms (mg/l) + Free Chlorine (mg/l)

The residual should contain free chlorine since it has the highest disinfecting ability. The presence of measurable chlorine residual indicates that all chemical reactions have been satisfied and that sufficient chlorine is present to kill microorganisms.

Dosage



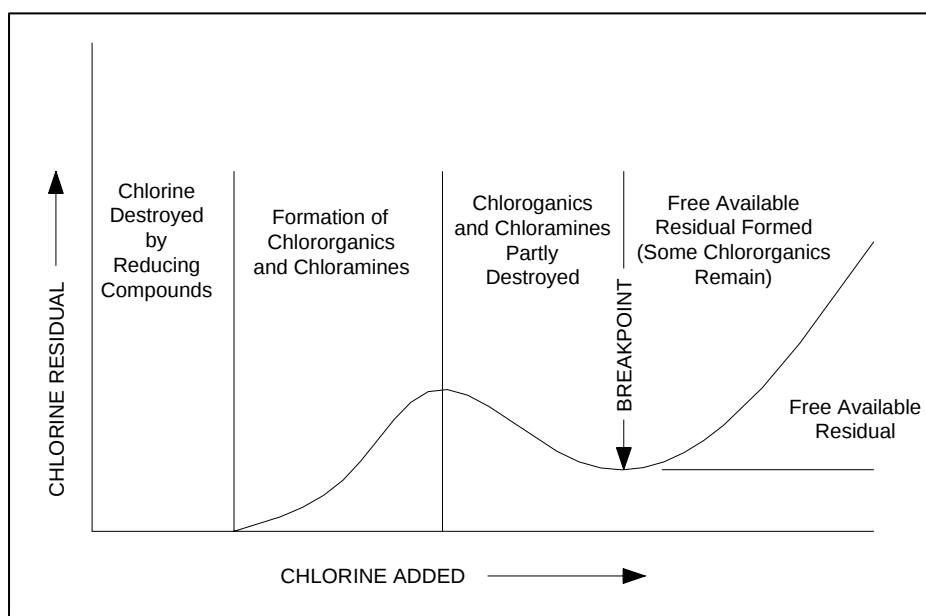
Chlorine dose is the amount of chlorine needed to satisfy the chlorine demand plus the amount of chlorine residual needed for disinfection.

Chlorine Dose (mg/l) = Chlorine Demand (mg/l) + Chlorine Residual (mg/l)

Breakpoint Chlorination



Breakpoint chlorination is the addition of chlorine until all chlorine demand has been satisfied. It is used to determine how much chlorine is required for disinfection.



Breakpoint Chlorination Curve

Breakpoint Chlorination

In determining how much chlorine you will need for disinfection, remember you will be attempting to produce a certain chlorine residual in the form of **FREE AVAILABLE RESIDUAL CHLORINE**. Chlorine in this form has the highest disinfecting ability. **BREAKPOINT CHLORINATION** is the name of this process of adding chlorine to water until the chlorine demand has been satisfied. Further additions of chlorine will result in a chlorine residual that is directly proportional to the amount of chlorine added beyond the breakpoint. Public water supplies are normally chlorinated **PAST THE BREAKPOINT**.

Take a moment here to look at the breakpoint chlorination curve in Figure 7.2. Assume the water being chlorinated contains some manganese, iron, nitrate, organic matter and ammonia. Now add a small amount of chlorine. The chlorine reacts with (oxidizes) the manganese, iron and nitrite. That's all that happens – no disinfection and no chlorine residual (Figure 7.2, points 1 to 2). Add a little more chlorine, enough to react with the organics and ammonia; **CHLORORGANICS** and **CHLORAMINES** will form. The chloramines produce a combined chlorine residual – a chlorine residual combined with other substances so it has lost some of its disinfecting strength. Combined residuals have rather poor disinfecting power and may cause tastes and odors.

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With just a little more chlorine the chloramines and some of the chlororganics are destroyed (points 3 to 4). Adding just one last amount of chlorine we get FREE AVAILABLE RESIDUAL CHLORINE – free in the sense that it has not reacted with anything and available in that it CAN and WILL react if need be. Free available residual chlorine is the best residual for disinfection. It disinfects faster and without the “swimming pool” odor of combined residual chlorine. Free available residual chlorine begins to form at the breakpoint; the process is called BREAKPOINT CHLORINATION. In water treatment plants today it is common practice to go “past the breakpoint”. This means that the treated water will have a low chlorine residual, but the residual will be a very effective disinfectant because it is in the form of FREE AVAILABLE RESIDUAL CHLORINE.

Measurement

The most common method used to measure chlorine residual is the DPD Colorimetric method.

DPD Colorimetric

- This method is a colorimetric used for waters that do not contain iodine-reducing substances. The basic method can be modified to measure monochloramine, dichloramine and free chlorine.

Requirement for a DPD Colorimetric Test Kit

Ohio Administrative Code, Rule 3745-81-27 (C)(1)(a)

“ . . . Residual disinfectant concentrations for free chlorine and combined chlorine may also be measured by using DPD colorimetric test kits. A DPD colorimetric test kit acceptable to the director is one that uses electronic measurement of the color development. It shall also have a digital display of the result. DPD colorimetric test kits with an analog display are not acceptable for use. An acceptable DPD colorimetric test kit shall have a method detection limit of 0.1 mg/l.” Effective Date: 6/28/03

Note: The test kit should have an upper range of 4.0 m./l.

Monitoring

Monitoring is required to assure that compliance is met with regulatory agencies for disinfection. The following table shows the microbial standards that must be adhered to by water suppliers.

Points of Application

Ground Water

Well Pump Discharge

- Well pump discharges that are not subject to influence by surface water, and do not require treatment for other constituents, need only be disinfected.

Clearwell Influent

- In many cases, the clearwell influent may be the filter effluent; however, in some water treatment plants, an intermediate process such as Granular Activated Carbon (GAC) absorption takes place to remove taste and odor and organics that still remain in the filtered water. For these plants, disinfection may not take place until the water leaves these process units and enters the clearwell.

Clearwell Effluent

- Clearwell effluent is monitored for chlorine residual.
- To assure that disinfectant residual is maintained in the transmission/ distribution system at satisfactory levels, additional disinfectant, such as chlorine, may be added at this point. For facilities that practice chlorination, the addition of ammonia may also be provided here.

Plant Effluent

- Plant effluent is subsequently monitored to assure that all water leaving the water treatment facility has adequate levels of disinfectant, either in the form of free chlorine residual or monochloramine.

Feed Pumps

- Feed pumps are used to apply various disinfectants to the water. Typical pumps for this type of service include:
 - Diaphragm pumps, which are generally available in several configurations. Each is a positive displacement type pump where the back and forth motion of a diaphragm in a chamber results in fluid, or chemical flow through the pump. In each pump type, the movement of the diaphragm is initiated differently.
 - Hydraulic pumps, which use hydraulic fluid to generate the back and forth motion of the diaphragm.
 - Peristaltic pumps, which uses a roller to squeeze liquid through a section of flexible tubing.
 - Solenoid pumps, which generates the back and forth motion of the diaphragm.

Typical chemicals used in the disinfectant process that are fed with these pumps include hypochlorite, chlorine dioxide and aqua ammonia.

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System Operation

Normal Operation

Normal operation of the chlorine feed system requires regular observation of the facilities and equipment and a regular preventative maintenance program. Exact operating procedures will depend on the equipment installed, but the general procedure is as follows.

Container Storage Area

- Daily
 - Visually inspect the storage area.
 - Check for leaks.
- Weekly
 - Clean the building or storage area.
- Monthly
 - Exercise all valves.
 - Inspect flexible connectors and replace as necessary.
 - Perform scheduled preventative maintenance.

Chlorine Residuals

Chlorine Procedure

Chlorine Sample Test Procedure (“Hach” Pocket Colorimeter)

This procedure is written for the “Hach” Pocket colorimeter. Other chlorine testers have different procedures. Please consult the manufacturer’s instructions for use.

Instructions marked below with an “ * ” (asterisk) are universal instructions, however.

Free Chlorine

1. *Run the sample tap for 2-5 minutes or longer, to ascertain that chlorine from the main water supply is flowing from the sample tap.
2. *Reduce the flow from the tap.
3. Fill a clean 10 mL test cell to the line with water from the sample tap.
4. Remove the colorimeter’s protective cap.
5. Wipe the sample cell so that it is dry and clean.
6. Place the cell into the well on the colorimeter, making sure that the index mark faces to the front of the colorimeter.
7. Cover the cell with the instruments cap.

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8. Press "ZERO".
9. Wait for the colorimeter to register "0.00" on the LCD display.
10. Remove the cell from the colorimeter.
11. Fill another sample cell with fresh sample to the 10 mL line.
12. Immediately add one free chlorine DPD powder packet to the sample.
13. Cap the cell and shake it for 10 seconds.
14. Immediately place the cell in the colorimeter's well.
15. Cover the cell with the instrument's cap.
16. Press "READ".
17. Wait for the colorimeter to show the free chlorine results in mg/L.
18. Record the results as Free Chlorine in mg/L.

Total Chlorine

1. *Run the sample tap for 2-5 minutes or longer, to ascertain that chlorine from the main water supply is flowing from the sample tap.
2. *Reduce the flow from the tap.
3. Fill a clean 10 mL test cell to the line with water from the sample tap.
4. Remove the colorimeter's protective cap.
5. Wipe the sample cell so that it is dry and clean.
6. Place the cell into the well on the colorimeter, making sure that the index mark faces to the front of the colorimeter.
7. Cover the cell with the instrument's cap.
8. Press "ZERO".
9. Wait for the colorimeter to register "0.00" on the LCD display.
10. Remove the cell from the colorimeter.
11. Fill another sample cell with fresh sample to the 10 mL line.
12. Immediately add one total chlorine DPD powder packet to the sample.
13. Cap the cell and shake it for 10 seconds.
14. On an accurate timer, time for 3-5 minutes
15. After 3-5 minutes place the cell in the colorimeter's well.
16. Cover the cell with the instruments cap.
17. Press "READ".
18. Wait for the colorimeter to show the total chlorine results in mg/L.
19. Record the results as Total Chlorine in mg/L.

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20. Calculate the combined chlorine by subtracting the free chlorine from the total chlorine.
21. Record the calculated value as Combined Chlorine mg/L.

High Levels of Chlorine

When chlorine levels are 2.0 mg/L or greater, when using dry DPD reagents, it is necessary to use a double dose of DPD reagent. This applies to both free and total chlorine. Use either two powder packets (meant for a 10 mL sample) or one powder packet (meant for a 25mL sample) or two doses of an automatic dispenser for each 10 mL of sample. For test instruments that use 25mL or larger samples, double the dose of dry reagent when chlorine levels are 2.0 mg/L or greater. It is also necessary to follow manufacturer's recommendations for high levels of chlorine. Most test kits have switchable ranges and use a well insert with smaller tubes for levels above 2.2 mg/L. With some brands of DPD reagent it may be necessary to double the dose for chlorine levels as low as 1.5 mg/L. You can check this in your laboratory by adding one packet of free chlorine reagent to a sample, test it and immediately add an additional packet. If the chlorine reading rises by 0.2 mg/L then you should use two packets.



Composite sample — A sample collected at a specific site, portions of which are collected at varied time intervals

Samples need to be representative of the water system. You should avoid:

- Fire hydrants
- Yard hydrants
- Mop sinks
- Drinking fountains
- Hose bibs

Be sure to remove:

- Strainers
- Aerators
- Hoses

2. Disinfection Safety

Skin Contact

- Immediately shower with large quantities of water.
- Remove protective clothing and equipment while in shower.
- Flush skin with water for at least 5 minutes.
- Call for medical assistance.
- Keep affected area cool.

Eye Contact

- Immediately shower with large quantities of water while holding eyes open.
- Call a physician immediately.
- Transfer promptly to medical facility.



(image courtesy of AWWA)

Hypochlorite Safety

Hypochlorite does not present the hazards that gaseous chlorine does and therefore is easier to handle. When spills occur, wash with large volumes of water. The solution is messy to handle. Hypochlorite causes damage to your eyes. And skin upon contact. Immediately wash affected areas thoroughly with water. Consult a physician if the area appears burned. Hypochlorite solutions are very corrosive. Hypochlorite compounds are nonflammable; however, they can cause fires when they come in contact with organics or other easily oxidizable substances.

[See, Small Water System Operation and Maintenance, Fourth Edition, p. 324, published by California State University, Sacramento, and the USEPA.].

3. Material Safety Data Sheet

Material Safety Data Sheet (MSDS)

- MSDS sheets are available from the chemical manufacturer/supplier for every chemical.
- The Treatment Plant Operator (TPO) should read and understand the MSDS for each chemical used in the plant. Additionally, the TPO should maintain a personal copy for all hazardous chemicals used.
- The MSDS contains a detailed assessment of chemical characteristics, hazards and other information relative to health, safety and the environment.
- Typical information included in an MSDS includes:
 - Product name and synonyms.
 - CAS number.
 - Manufacturer's address and telephone number.
 - Components and contaminants.
 - Physical data.
 - Fire and Explosion hazard data.
 - Toxicity data.
 - Health hazard data, including exposure limits, effects of exposure and emergency and first aid procedures.
 - Reactivity data, including storage and disposal recommendations and conditions to avoid.
 - Spill or leak procedures.
 - Protective equipment.
 - First aid procedures.

An example of an MSDS is included in the supplemental materials.

4. Aesthetic Contaminants

Iron & Manganese

Common Sources of Iron and Manganese

- Rivers
 - Most iron and manganese is in the particulate form.
 - Levels can vary widely, primarily depending on turbidity levels.
- Reservoirs and Lakes
 - Lower levels of reservoirs and lakes may become anaerobic (depleted of oxygen due to a lack of mixing with the upper layers above the thermocline), which results in solubilization of some of the constituents of the bottom sediments, including iron and manganese.
 - Higher levels of iron and manganese may occur during periods of reservoir/lake turnover (inversion), typically due to the upper portion of the lake/reservoir sinking as the temperature becomes colder, which displaces the lower levels and brings more concentrated levels of iron and manganese closer to the surface.
 - If multiple raw water intake levels are available, it may be valuable to establish a depth water quality sampling program to aid in the decision-making process for what level of withdrawal to use.
- Groundwater
 - Water quality is generally relatively constant in individual wells, but the quality can vary greatly within the same aquifer or well field.
 - Iron and manganese are typically in the soluble state. Deciding which wells to use may depend not only on the quantity that a well can produce, but also on the levels of iron and/or manganese.
- In-plant sources
 - If settled solids in sedimentation basins are not removed frequently, anaerobic conditions may occur, resulting in the release of soluble iron and manganese that downstream filtration may not be able to remove.



Yellow springs, near Yellow Springs, Ohio, formed by iron-precipitating microflora (water from limestone)

Common Treatments

- Compared to the removal of other inorganics, such as calcium and magnesium, iron is not easy to remove from source waters.
- Oxidation and coagulation are effective pretreatment processes for removal of some inorganics prior to filtration.

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- Oxidation involves converting soluble iron (Fe II) and soluble manganese (Mn II) to the precipitated (solid) compounds ferric hydroxide ($\text{Fe}(\text{OH})_3$) and manganese dioxide (MnO_2), respectively. Depending on the source and turbidity level of the raw water, oxidation may be followed by coagulation, flocculation, sedimentation, and filtration.
- Ion exchange, appropriate for groundwater only, is suitable when iron is less than 10 mg/L, and low production volumes are required.
- Sequestration, which is not so much a removal process as it is a stabilization of iron and manganese using polyphosphates (sometimes silicates) to prevent precipitation, is limited to iron levels of 1.0 mg/L or less, and manganese levels of 2.0 mg/L or less, or both combined of 2.0 mg/L or less.

Filtration

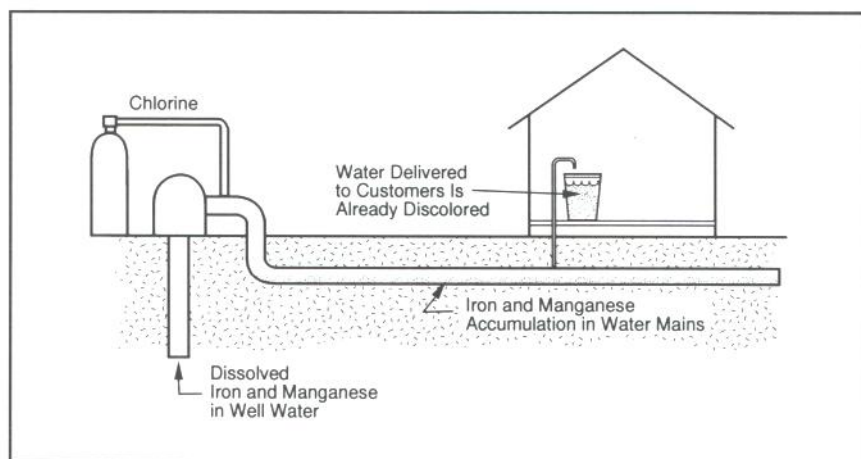
Aeration

- Aeration, such as is accomplished with a tray aerator; the process flow is exposed to a very large amount of air. This process is typically used in conjunction with carbon dioxide removal, and is appropriate for groundwater application only. Because oxygen saturated water is corrosive, using aeration in the oxidation process can prove to be a disadvantage.

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Chlorine

- Chlorine can be in the form of chlorine gas, sodium hypochlorite, and calcium hypochlorite. It is possible that if chlorine is used as the oxidizer before filtration TTHMs can be formed. Another disadvantage to using chlorine as the oxidant is that ferric chloride is formed during the oxidation process. During the greensand filtration process (discussed later in this module) the ferric chloride reacts with the potassium permanganate thus consuming it.



Iron and manganese oxidized by addition of chlorine

Filtration

- Granular media, primarily for filtration of iron and manganese, can be used in pressure filters (tanks).
- Two types of granular media used for iron and manganese removal are presented below: manganese greensand and anthrasand.

Greensand

- Greensand is typically used for groundwater sources containing levels of iron and/or manganese that require treatment.
- Processed from glauconite greensand by saturating the surface with manganous ions, the media utilizes the natural ion exchange properties of greensand.
 - Following saturation, the media is soaked in a strong oxidizing solution that converts the manganous ions to a hard black manganese dioxide coating.
 - The coating makes up about 4 mg per 1000 mg of greensand.
 - It is easy to detect when the media coating is stripped because the underlying greenish color of the glauconite sand will be uncovered.
 - Stripping can be avoided by using the continuous regeneration process. After the oxidation process, potassium permanganate (KMnO_4) is added before it enters the greensand bed. The KMnO_4 will oxidize any trace amounts of soluble iron and manganese and should be added so that a slight excess remains. This slight excess is reduced to a manganese oxide by the

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greensand. These oxides will precipitate on the greensand, maintaining a continuous regeneration. Over dosing of KMnO_4 will produce pink water while under dosing will produce brownish water.

- Greensand filters typically have an anthracite media cap (12 inch to 24 inch depth) that serves to remove iron, thereby reducing fouling and clogging of the greensand.
 - Anthracite has been found to be more effective than sand for iron removal, even when the same size of media is used; anthracite apparently has an adsorption capacity for iron.
 - The maximum hydraulic loading rate for anthracite media is up to 4 times greater than for sand, 8 gpm/sq ft versus 2 gpm/ sq ft.
 - There is a relationship between the loading rate, area of the filter, and the amount of water to be treated for iron and manganese removal.
- Greensand depth typically ranges between 16 inches and 24 inches.
- Greensand capacity is as follows:
 - Capacity for manganese: 5,000 mg per ft^3 of greensand.
 - Capacity for iron: 10,000 mg per ft^3 of greensand.
- Soluble manganese removal primarily occurs by autocatalytic adsorption on the manganese dioxide (MnO_2)-coated media, followed by oxidation of the adsorbed soluble manganese on the media; this process of manganese removal is suitable when iron and manganese levels in the source water are less than 1.0 mg/L.
- Manganese that was previously removed and oxidized on the greensand has an adsorption capacity for soluble manganese, thereby keeping the greensand continuously regenerated
 - Adsorbed soluble manganese is subsequently oxidized by the continuous feeding of an oxidant (preferably chlorine) to form manganese dioxide (MnO_2).
 - Only chlorine is required for oxidation.
- Filter backwash is required when headloss reaches a predetermined endpoint, or when iron and/or manganese begin to break through the filter.
 - The freeboard, the space above the filter media, allows for the media bed expansion during the backwash process.
 - Air wash is important in conjunction with water wash.
 - Insufficient backwashing causes the thickness of the filter media to increase. This can cause problems such as: decreased flow through the filter media, failure to remove additional insoluble iron and manganese, and loss of media during the backwash process.
 - Excessive backwash flow rate can also cause loss of filter media.
 - Backwash waste water can be collected for reuse and the settled precipitates sent to a sanitary sewer or drying bed.
- Advantages to using manganese greensand are plentiful.
 - It has the optimum grain size and shape to retain oxidation and precipitation products of iron and manganese.

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- No on-site batch chemical preparation is required to form a manganese dioxide media coating.
- Media reconditioning is generally not required because the coating is firmly attached to the greensand.
- Manganese dioxide coating is not removed during backwash.
- No detention time is required for oxidation prior to filtration.
- Greensand acts as an oxidation-reduction (redox) buffer, adsorbing a slight overdose of potassium permanganate, and continuing (temporarily) to remove iron and manganese if an underdose of oxidant should occur.
- Greensand is not proprietary.
- Of course, there are some disadvantages to manganese greensand.
 - Minimum pH required is 6.2
 - If prefilter pH adjustment is required, the pH should not be adjusted above 6.8 to 7.0 to prevent the formation of non-filterable iron colloids.
 - The small effective size (ES) of the media grains results in high cleanbed headloss.
 - The media has limited oxidative capacity.
 - Exhausted media must be regenerated with potassium permanganate.
 - High pressure drops, in excess of 8 psi, should be avoided in order to minimize media fracturing.
 - Raw water silica levels of 10 mg/L or more require feeding of sodium aluminate to prevent stripping of the greensand coating.

Other Treatments

Treatment at the Source

- Groundwater treatment involves air injection into the well for oxidation of soluble iron and manganese.

5. Water Quality Analyses

Monitoring the Effectiveness of Oxidation Processes

Iron and Manganese

- Typical sample sources are from raw water and filtered effluent.
 - The purpose of sampling raw water is to determine the dose of oxidant(s) required, based on iron and manganese analyses.
 - The purpose of sampling filtered water is to determine the effectiveness of the oxidation/filtration process, including oxidant dose and particle capture on the filter media.
- Soluble (grab) samples require that the sample be filtered immediately upon collection (before any soluble portion of the metal has a chance to oxidize from exposure to air) through an extremely small porosity filter medium, preferably a membrane ultrafilter, to assure that the metals in the filtered portion are truly in the soluble state and not just colloidal.
- Only the soluble fraction of the total iron and manganese levels creates an oxidant demand.
 - Identifying the soluble concentrations of these metals helps to determine the oxidant dose.
- Both the soluble and total metals samples should be preserved with nitric acid to pH less than 2.

Free Chlorine Residual

- Typical sample sources are filtered influent (or applied) and filtered water.
- A chlorine residual of 0.5 mg/L to 1.0 mg/L should be maintained in the filter effluent to assure complete oxidation of soluble iron and manganese.
 - DPD or amperometric titration can be used for measuring chlorine residuals.
 - DPD is a commonly used reagent/method for measuring chlorine residuals in the field and at small facilities.
 - Amperometric titration is more accurate for measuring chlorine residuals, and is commonly used at larger facilities.
- The sample must be analyzed immediately, as chlorine can off gas from solution.

Analytical Equipment

- Field test kits that might be used include:
 - Portable colorimeter is used for iron and manganese, color, and free chlorine-DPD.
 - Portable spectrophotometers are used for analyzing iron and manganese, color, free chlorine-DPD, and permanganate residual.



6. Hardness

Secondary Contaminants

- MCL's for these contaminants are not enforceable; however, most water treatment plant operators still monitor and record these parameters.
- The secondary contaminants most commonly monitored by the water treatment plant operator include color, corrosivity, aluminum, chlorides, iron, manganese, odor, pH, and total dissolved solids.

Hardness



- Excessively hard water produces scale formation inside water conveyance pipes and pumps, resulting in progressively degraded performance.
- Hot water increases the tendency of water to produce scale, which seriously degrades domestic, commercial, and industrial hot water system performance and lifespan.
- Excessive hardness reduces the effectiveness of soaps and detergents.

7. ION EXCHANGE SOFTENING

Definitions



Hardness, Total – the presence of divalent metallic cations (primarily calcium and magnesium) in water due to the dissolution of minerals in geologic formations by natural waters. Although there is no specific hardness level that defines at what point a water is considered hard, there is a general understanding that a water having a total hardness less than 75 mg/L (as CaCO_3) is considered soft, and above 150 mg/L (as CaCO_3) is considered hard.



Hardness, Calcium – that portion of total hardness due only to calcium.



Hardness, Carbonate – that portion of total hardness which is chemically equivalent to alkalinity; the dissolution by water of calcium and magnesium from minerals containing carbonate and bicarbonate are the predominant source of carbonate hardness.



Hardness, Magnesium – that portion of total hardness due to magnesium ions.



Hardness, Noncarbonate – that portion of total hardness in excess of alkalinity; the dissolution of calcium and magnesium compounds of sulfate and chloride, or silicates in water are the predominant source of noncarbonate hardness. Noncarbonate hardness equals the total hardness minus the carbonate hardness.



Regeneration – chemical process by which a chemically-coated filter media (e.g. ion exchange media) is returned or restored to a productive treatment condition.



Total Dissolved Solids (TDS) – surrogate for ionic strength in water, consisting mainly of dissolved inorganic salts. Since dissolved ions serve as a weak conductor of an electric current, there is a relationship between TDS and conductivity. Although this relationship is site specific, typically it is in the range of 55% to 70% of the conductivity reading.

Common Treatments for Hardness

Ion Exchange Softening

- The Ion exchange process is a common alternative to Lime and Soda Ash for softening water. Water from all natural sources contains dissolved minerals such as calcium and magnesium which cause water hardness.
- The Ion exchange process removes these minerals which softens the water treated by this process.
- The Ion exchange process uses a resin as the medium by which the ions of calcium and magnesium are exchanged for sodium ions.
- The early types of resins used in the ion exchange process were zeolites, which are silica compounds. In the early days the process was called "Zeolite" softening. It is still sometimes called this today.
- The naturally occurring zeolites have an exchange capacity of around 2,800 grains per cubic foot of media. The synthetic resins manufactured today have as much as 35,000 grains per cubic foot removal capacity.

Advantages, disadvantages, and operating points of the ion exchange process

- The ion exchange process has a much lower initial cost and smaller space requirements than those for the lime and soda ash process.
- Ion exchange units can easily be operated by automatic control, thereby requiring a minimal operating staff.
- The only chemical required in most ion exchange applications is salt. This chemical is safe and easy to handle. There is relatively little danger of serious contamination of the water supply through equipment failure or improper operation if salt is used.
- The problem of disposing of the regeneration waste from the ion exchange process is highly variable. In some instances, disposal is very simple at some locations, whereas at other it may be extremely difficult.
- The ion exchange process is not frequently used to treat surface waters. If it is full conventional treatment must be used first to prevent turbidity and algae from fouling the resin.
- The ion exchange process removes all hardness from the water thereby making the water more corrosive. By blending a portion of completely soft water with hard water, a water having any desired hardness can be produced.

Measurements commonly used to express water hardness in the Ion Exchange Process

- One grain per gallon = 17.12 mg/L
- One grain = 0.142 lb per 1,000 gallons
- 7,000 grains = 1 lb per gallon

Ion Exchange Softening Facilities

The ion exchange process requires the following basic components:

- Ion exchange materials (resin)
- Ion exchange units
- Salt storage tanks
- Brine-feeding equipment
- Device for blending hard and soft water

Ion Exchange Resins

- Natural Greensand composed of sodium aluminum silicate commonly called zeolite was once used.
- Today synthetic zeolites and organic polymers, known as polystyrene resins have now replaced natural zeolites.
- Polystyrene resins are most commonly used today because they have three to six times the exchange capacity of other materials.

Ion Exchange Units

- The tanks holding the resin resemble pressure filters.
- The units are normally of the vertical-downflow design.
- The units are provided with the following components:
 - Hard water inlet
 - Soft water outlet
 - Wash-water inlet and collector
 - Brine inlet and distribution system
 - Brine and rinse water outlet
 - Rate of flow controllers
 - Sample taps
 - Underdrain system, which also serves to distribute backwash water
 - Graded gravel support system (supports the resin).

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Salt Storage Tanks

- Sized to hold enough brine for a 24 hour period of operation or three regenerations, whichever is greater.
- Made of salt resistant material, usually fiberglass.
- Rock salt transported in tanker trucks is usually the type of salt stored and used.

Brine Feeding Equipment

- Concentrated brine (about 25 percent) is diluted to approximately 10 per cent in order to be the most effective.
- A metering pump or hydraulic ejector is used to dilute the concentrated brine as it is applied to the resin bed.
- The brine is very corrosive and special plastic or other salt resistant materials must be used for the pumps and piping.

Blending Hard and Soft Water

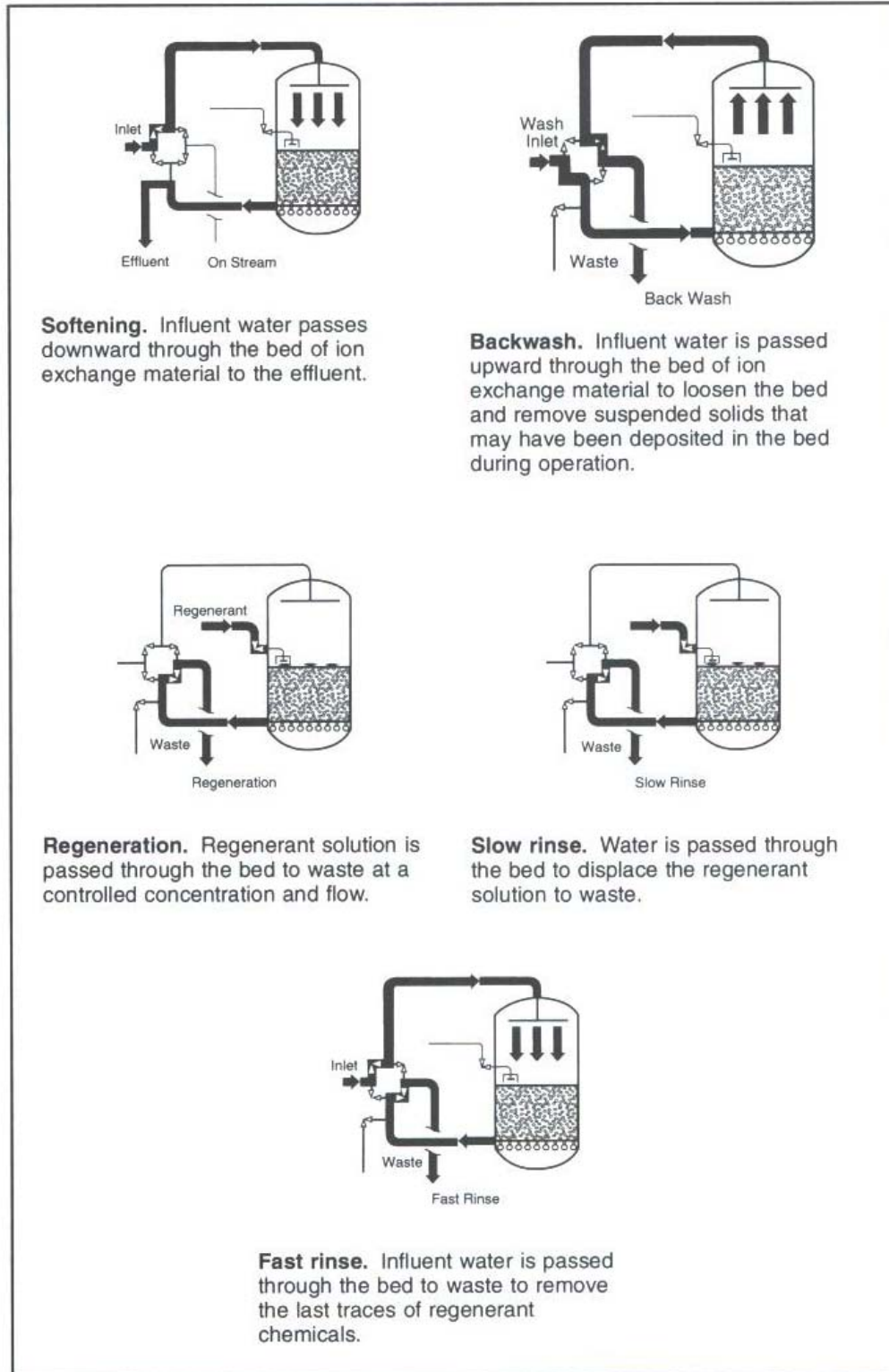
- The normal range for water softening is 80 to 150 mg/L or 4.6 to 8.7 grains per gallon of hardness.
- Zero –hardness water is very corrosive to piping and plumbing systems.
- A by-pass valve or other device is commonly used to blend the soft and hard water at the discharge of the softener.

Operation of the Ion Exchange Process

There are four basic cycles used in the ion exchange process.

- Softening
- Backwash
- Regeneration
- Slow and fast rinse

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Courtesy of Infilco Degremont, Inc., Richmond, Va.

Four cycles in the ion exchange process

8. Disposal of Wastewater

- Discharged wastewater containing spent brine may total from 1.5 to 7 percent of the amount of water softened.
- Discharged wastewater may contain total dissolved solids concentration from 35,000 to 45,000 mg/L.
- Discharge may be sent to an approved wastewater treatment facility or require the issuance of a discharge permit from the governing regulatory authority.

9. Process Control Testing

The ion exchange process is a very simple process and requires a minimal amount of testing.

- Total hardness test
- Sodium test
- pH
- Chloride test (use to periodically check that rinsing after regeneration is adequate).

10. Record Keeping

Tracking of the following information should be performed daily.

- Total hardness and pH
- Daily water treated in gallons per day (gpd) or million gallons per day (mgd).
- Amount of water treated in each softening cycle, in gallons.
- Amount of backwash water, rinse water and brine used each day, in gallons.
- Amount of salt, in pounds or tons, added to the storage tank daily, weekly or monthly whichever applies.

State of Ohio Class A Drinking Water Operator Certification Program



Session Three: Supplemental Materials

This course includes content developed by the Ohio Environmental Protection Agency, the Pennsylvania Department of Environmental Protection, the Indiana Department of Environmental Management, the California State University at Sacramento, and 360water, Inc.

Project funded by the USEPA.



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1. Minimum Pressures

The water system should be designed to operate at minimum of 20 pounds per square inch under normal conditions. This pressure is usually enough to supply an adequate quantity of water to the consumer to operate plumbing fixtures. The higher pressures in the distribution system will minimize the possibility of backflow thereby reducing the possibility of contamination.



The Ohio Administrative Code describes the rules for minimum pressures.

3745-83-01 Operational requirements.

- A. Except as otherwise noted, the definitions in rule 3745-81-01 of the Administrative Code shall apply to this chapter.
- B. Disinfection.
 - 1. For purposes of this rule of the Administrative Code, "major noncommunity public water system" means a noncommunity public water system designated by the director for which he deems it advisable, because of the relatively large number of people who drink or may drink water from the system, that the water be disinfected in the same manner as for a community public water system.
 - 2. Unless exempted under other provisions of this rule, each community public water system and each major noncommunity public water system shall maintain a minimum chlorine residual of at least two-tenths milligram per liter free chlorine, or one milligram per liter combined chlorine measured at representative points throughout the distribution system. The director may by order require higher residuals as necessary to compensate for pH, temperature, or other characteristics of the delivered water. Chlorine concentrations shall be analyzed in accordance with paragraph (C) of rule 3745-81-27 of the Administrative Code.
 - 3. A system is exempt from paragraph (B)(2) of this rule if it meets all the following conditions:
 - a. The system obtains all its water from a ground water source which has, in the judgment of the director, been properly developed, constructed, and adequately protected; or from a system to which paragraph (B)(2) of this rule applies;
 - b. The distribution system serving the water system, in the judgment of the director, has been properly constructed and maintained and is protected by an effective cross-connection program;
 - c. The system, in the judgment of the director, has a satisfactory history of bacteriological monitoring indicating no contamination;
 - d. The director has certified in writing that conditions of paragraphs (B)(3)(a), (B)(3)(b), and (B)(3)(c) of this rule have been met.

4. A system is exempt from paragraph (B)(2) of this rule if, with written approval of the director, it uses chlorine dioxide as a primary or supplementary disinfectant in accordance with the terms of the approval.
5. Each water system subject to paragraph (B)(2) of this rule and not exempt under paragraph (B)(3) of this rule shall install and place in operation equipment capable of meeting disinfection requirements of this rule.
6. Notwithstanding the MRDL for total residual chlorine in paragraph (C) of rule 3745-81-10 of the Administrative Code, at times of actual or threatened outbreak of waterborne disease, each system subject to paragraph (B)(2) of this rule that may be affected by such outbreak shall maintain a minimum chlorine residual of at least one milligram per liter free chlorine, or six milligrams per liter combined chlorine measured at representative points throughout the distribution system, despite possible resulting tastes or odors in the delivered water.
7. Finished water storage facilities, as defined in paragraph (E)(1) of this rule, serving community water systems or major non-community water systems shall be adequately disinfected in accordance with "American Water Works Association Standard C652-02 Disinfection of Water-Storage Facilities (2002)" before being placed in service and before being returned to service after repairs. A reservoir shall be considered adequately disinfected when analyses of at least two consecutive samples taken at twenty-four hour intervals are total coliform-negative. The consecutive samples taken in order to determine compliance with this paragraph shall be analyzed in accordance with paragraph (D) of rule 3745-81-27 of the Administrative Code. The standard sample used shall contain one hundred milliliters.
8. All new, cleaned, or repaired water mains serving community water systems or major noncommunity water systems shall be disinfected in accordance with "American Water Works Association Standard C651-99 Disinfecting Water Mains (1999)." Samples taken in order to determine compliance with this paragraph shall each contain one hundred milliliters and shall be analyzed in accordance with paragraph (D) of rule 3745-81-27 of the Administrative Code.
 - a. A new or cleaned water main shall be considered adequately disinfected when analyses of at least two consecutive samples taken at twenty-four hour intervals are total coliform-negative.
 - b. Repaired water mains shall be considered adequately disinfected when analyses of samples taken in accordance with "American Water Works Association Standard C651-99 Disinfecting Water Mains (1999), Section 4.7.5" are total coliform-negative.
- C. Approval of chemicals. All chemicals, substances, and materials added to or brought in contact with water in or intended to be used in a public water system or used for the purpose of treating, conditioning, altering, or modifying the characteristics of such water shall be shown by either the manufacturer, distributor, or purveyor to be non-toxic and harmless to humans when used in accordance with the formulation and concentration as specified by the manufacturer, and shall conform with the "American National Standards Institute/National Sanitation Foundation" (ANSI/NSF) standard 60 Drinking Water Treatment Chemicals - Health Effects (2001 and previous), or standard 61 Drinking Water System Components - Health Effects (2003 and previous). Any organization certified by the "American National Standards Institute" may certify in writing that a product conforms with these standards.

- D. Minimum pressure. Community water systems shall maintain a minimum pressure of twenty pounds per square inch gage at ground level at all points in the distribution system under all conditions of flow other than conditions caused by line breaks, extreme fire flows, or other extraordinary circumstances.
- E. Finished water storage facilities
 - 1. "Finished water storage facility" means a tank, reservoir, or other facility used to store water that will undergo no further treatment except residual disinfection.
 - 2. A public water system shall provide a cover on all finished storage facilities so they are not open to the atmosphere.
- F. Reports.
 - 1. Community water systems.
 - a. In addition to any other reporting requirement of Chapter 3745-81 of the Administrative Code, the operator of a community water system shall prepare an operation report for each month of operation on forms provided by the director. The director may require that the report include the following:
 - 1) General operation data;
 - 2) A summary of samples analyzed, including distribution system sampling and chlorine residual sampling;
 - 3) Information on daily water treatment and system pumpage;
 - 4) Information on chemical application;
 - 5) Analysis of general parameters relating to the quality of the treated drinking water;
 - 6) Source water levels;
 - 7) Changes in personnel in responsible charge;
 - 8) Such other information as may be necessary or desirable for the director to carry out his duties under Chapter 6109 of the Revised Code.
 - b. The operation report shall be submitted to the district office with jurisdiction no later than the tenth of the month following the month for which the report was prepared.
 - c. The operator shall report significant interruptions of service or of chlorination immediately by telephone to the district office with jurisdiction.
 - 2. Noncommunity water systems.
 - a. The operator of a public water system other than a community public water system shall prepare and file an operation report at a frequency determined in writing by the director. The reports shall be on forms provided by the director and shall contain such information as may be necessary for the director to carry out his duties under Chapter 6109 of the Revised Code.
 - a. The operation report shall be submitted to the district office with jurisdiction no later than the tenth of the month following the end of the period for which the report was prepared.

[Comment: This rule incorporates the American water works association standards C651-99 and C652-02 by reference. Copies may be obtained from the "AWWA Bookstore, 6666 West Quincy Avenue, Denver, CO, 80235, 1-800-9267337, www.awwa.org." These standards are available for review at "Ohio EPA, Lazarus Government Center, 122 South Front Street, Columbus, OH, 43215-3425."]

[Comment: This rule incorporates the ANSI/NSF standards 60 and 61 by reference. Copies may be obtained from "NSF International, 789 North Dixboro Road, P.O. Box 130140, Ann Arbor, MI, 48113-0140, (734)769-8010, www.nsf.org." These standards are available for review at "Ohio EPA, Lazarus Government Center, 122 South Front Street, Columbus, OH, 43215-3425."]

Effective: 08/03/2004

R.C. 119.032 review dates: 05/05/2004 and 08/03/2009

Promulgated Under: 119.03

Statutory Authority: RC Section 6109.01, 6109.03, 6109.04 Rule

Amplifies: RC Section 6109.01, 6109.03, 6109.04

Prior Effective Dates: 11/26/80, 09/13/93, 01/01/99, 04/21/01

2. Security

Public water system security is a major concern for all communities. The USEPA has published guidelines for security for small community systems. Briefly, well heads should be locked and all chemicals should be stored in locked facilities. Small community budget constraints may affect the security procedures employed by drinking water operators.

Selections in the Appendix are taken from the USEPA publication, Drinking Water Security for Small Systems Serving 3,300 or Fewer Persons, from the Office of Water, EPA 817-R-05-001. The complete document can be found at www.epa.gov/safewater.

3. Pump Terms and Definitions



Flow—the volume of water per unit of time that passes through a pump. Typical units of measure for flow include gallons per minute (gpm), cubic feet per second (cfs), and gallons per day (gpd).



Pump Head—the amount of energy input to the water by the pump. Pump head is typically measured in units of feet of water (ft).



Water Horsepower—the amount of power supplied to the water which is needed to pump water to a certain elevation. Water Horsepower is typically measured in units of horsepower (hp).



Brake Horsepower—the amount of power that must be applied to the pump shaft to operate the pump. This is higher than the water horsepower since there are inefficiencies in the pump and motor, where energy is lost to friction and heat. Brake Horsepower is typically measured in units of horsepower (hp).



Pump Efficiency—the percentage of the power input to the shaft, that is actually transferred to the water.

Pumps provide lift to move water from the plant to elevated storage areas.

The majority of the line pressure is not provided by pumps but by storage elevation of the water which creates “head” that provides the pressure. However, many systems use booster pumps to provide additional pressure in areas that need it.

Components

The main components of a Water Distribution System include:

- Pumps
- Storage facilities
- Transmission mains
- Valves and hydrants
- Meters

Storage Facilities can consist of the following:

- Clear wells
- Stand pipes
- Elevated storage tanks.
- Hydro-pneumatic tanks.

Clear wells are large concrete basins for storing treated water at the treatment facility or in the distribution system. A clear well allows the treatment plant to operate at a constant rate, building up reserves during low-use hours and maintaining supply during peak-use hours. It also can allow for additional contact time with disinfectants.

Elevated Storage Tanks have supporting structures to elevate the tank to provide additional head (pressure). They use gravity to pressurize water through the distribution system.

Storage tanks are typically filled in off-peak hours and monitored to maintain sufficient water pressure during high-use periods. An example of a high use period is early morning and mid-evening.

There are different ways that transmission main systems can be designed.

- Branching systems have dead-end lines that can cause taste and odor problems due to stale water in the ends of the lines.
- Branching systems must be flushed out periodically. This is usually completed by releasing water in a systematic way from fire hydrants
- Loop or grid systems eliminate dead ends and provide more water in high-demand situations, such as fire fighting.

Different materials can be used for transmission mains. The following are the most common:

Ductile iron:

- Stronger, more ductile (flexible) and lighter than cast iron
- Often coated with cement mortar to reduce internal corrosion

Plastic (polyvinylchloride or PVC):

- Low initial cost
- Lightweight
- Resistant to corrosion
- Low resistance to flow
- More susceptible to crushing
- Cannot be thawed electrically

Meters are placed throughout the distribution system to measure the flow to main supply lines, pumping stations, connections to other utility systems and individual users.

Meters are used for billing purposes and to identify areas of water loss.

Metered billing will promote lower customer use and encourage conservation.

4. Valves

Purpose of Valves

- The primary purpose of valves is to allow for isolation of mains or sections of main within the network.
- Another important function of valves is to control flow or pressure.

Valve Applications

- **Isolation Valves** are used to isolate mains or sections of mains.
 - Isolation may be necessary when repairing main breaks or leaks or performing other distribution network maintenance activities.
 - The most commonly used isolation valve is the gate valve.



Gate Valve

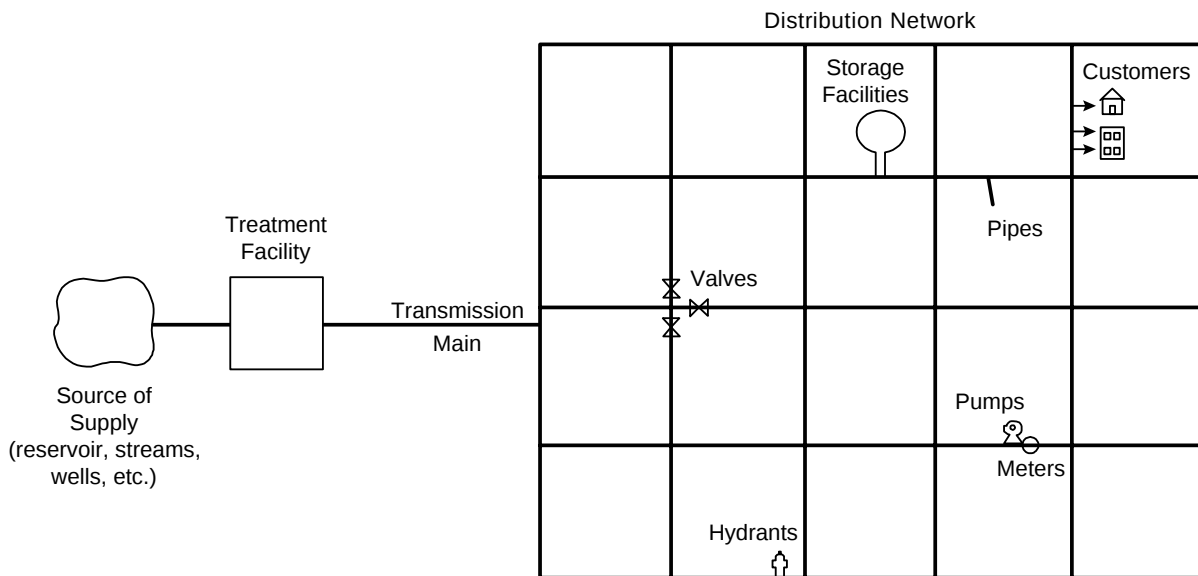
5. Distribution Networks

Purposes of Distribution Networks

- The primary purpose of a distribution network is to deliver adequate volumes of safe drinking water to system customers at adequate pressures.
- Another important purpose of a distribution network is to provide adequate fire flows to areas of the system.

Components of Distribution Networks

- Pipes
- Storage Facilities
- Pumps
- Valves
- Hydrants
- Meters



6. Ohio Regulations



The Ohio Administrative Code, at section 3745-85-01, described the requirements for a drinking water supply emergency contingency plan.

Below is the text of contingency plan requirements.

3745-85-01 Contingency plans.

- A. Except as otherwise noted, the definitions in rule 3745-81-01 of the Administrative Code shall apply to this chapter.
- B. Contingency plan required. Each community water system shall prepare and maintain a written contingency plan for providing safe drinking water to its service area under emergency conditions.
- C. Location of copies.
 - 1. One copy of the contingency plan shall be kept at the water treatment plant, if there is a plant, and another shall be kept in the water system administrator's office.
 - 2. Public water systems serving a population of more than two hundred fifty shall keep three additional copies of the plan at various accessible, secure locations in the service area.
 - 3. A copy of the contingency plan shall be available for inspection by representatives of the director.
 - 4. A copy of the contingency plan for community water systems shall be made available to the county emergency management agency (EMA) upon its request.
- D. Contents of contingency plan.

The contingency plan shall contain:

- 1. A map of the distribution system, detailed locations for each valve in the system, including references that will aid in location of valves, and a map of the well field and surface water intakes as applicable.
- 2. A statement of amounts budgeted for emergency use, along with a statement showing who can authorize expenditures for such purpose, and under what conditions such authorization and expenditure can occur.
- 3. A determination of not less than ten of the most likely emergencies that will affect the water system and a description of the procedures to be followed and actions necessary to

provide service during the emergencies. For systems serving fewer than one thousand five hundred people, the following emergency circumstances shall be included in such outline.

- (a) Short term power failure (time of interruption less than two hours);
 - (b) Extended power failure (two hours or more);
 - (c) Pump or motor failure;
 - (d) Loss of water from a well or other water source;
 - (e) Major water main break;
 - (f) Unplanned absence of operator; and
 - (g) Contamination of source water including, but not limited to, releases of oil and hazardous substances.
- 4. A description of the method that will be used to obtain and transport water from an alternate source should such procedure become necessary (including connecting to another water system), and a description of at least three possible alternate sources of water and the method of disinfection that will be used for each source.
 - 5. A list of water users having critical needs for a continuous supply of water.
 - 6. The methods of notification of users that an emergency exists.
 - 7. If depressurization of the water system has occurred, the procedure that will be used to return the system to normal service.
 - 8. Twenty-four hour telephone numbers for:
 - (a) The Ohio environmental protection agency, division of drinking and ground water;
 - (b) Police;
 - (c) Fire;
 - (d) The county EMA director;
 - (e) All water supply personnel;
 - (f) Municipal administrative personnel;
 - (g) Contractors for line breaks, "first call" and "second call";

- (h) Electric power supplier;
- (i) Electricians, "first call" and "second call";
- (j) Well drilling and pump service contractors, "first call" and "second call";
- (k) Plant mechanical contractors, "first call" and "second call";
- (l) All suppliers of equipment and chemicals normally used;
- (m) Hospital, emergency squad, medical assistance; and
- (n) Critical water users who have requested notification.

E. Revision required.

1. The contingency plan required by this chapter of the administrative code shall be revised and updated as necessary, but at least annually;
2. Copies of the revised pages of the plan shall be promptly distributed to holders of the plan, as described in paragraph (C) of this rule.
3. Community water systems that have identified hazardous chemical contamination as one of their most likely emergencies under paragraph (D) (3) of this rule shall consult with the county EMA regarding participation in a hazardous spill exercise.

Replaces: Part of 3745-85-01, former 3745-85-02, former 3745-85-03, Part of 3745-85-04, former 3745-85-05

Effective: April 21, 2001

RC 119.032 review dates: 03/14/2006 and 03/14/2011

Promulgated under: RC Chapter 119

Rule authorized by: RC Section 6109.01, 6109.03, 6109.04 Rule amplifies: RC Section 6109.01, 6109.03, 6109.04 Prior effective dates: 11/26/80

7. Sample Contingency Planned Approved by OEPA

Below is a sample Contingency Plan approved by the OEPA for use by a mobile home park. This sample plan will show how this small community followed the requirements under OAC 3745-85-01.

SAMPLE PLAN

DRINKING WATER SUPPLY EMERGENCY CONTINGENCY PLAN
MOBILE HOME PARK
FRANKLIN COUNTY, OHIO
PWS NUMBER XXXXXXXX

REVISED SEPTEMBER, 2005

Copies of this plan are at the following locations:

1. WATER TREATMENT PLANT
2. MIKE SMITH (HOME)
3. JOE JONES (HOME)

The following persons are thoroughly familiar with the emergency plan and are authorized to implement all or part of the plan as necessary:

1. JOE JONES	CELL _____	HOME _____
2. MIKE SMITH	_____	_____

Contingency plans must be updated at least yearly and a copy of the revised plan submitted to the:

Ohio EPA, Central District Office
3232 Alum Creek Drive
Columbus, OH 43207-3417

MOBILE HOME PARK FRANKLIN COUNTY

DRINKING WATER SUPPLY
EMERGENCY CONTINGENCY PLAN
(PWS ID NUMBER xxxxxxxx)

REVISED SEPTEMBER, 2005

SESSION THREE: SUPPLEMENTAL MATERIALS

[Site specific telephone numbers have been omitted]

THE OHIO ENVIRONMENTAL PROTECTION AGENCY

Division of Public Drinking Water Central Office

614-644-3020

Central District Office

1-800-282-9378

614-728-3776

FIRE DEPARTMENT AND AMBULANCE SERVICES

Hamilton Township

911

POLICE DEPARTMENT

Columbus Police Department

911

Franklin County Sheriff

Ohio State Highway Patrol

DISASTER SERVICES

Emergency Management Agency of Franklin Co.

WATER COMPANY PERSONNEL

Joe Jones, Water Plant Operator

Mike Smith

MOBILE HOME PARK OWNER

Pioneer, OH 43554

CONTRACTORS FOR MAIN BREAKS

First Call - Excavating- Gerard

Second Call - Excavating

ELECTRIC POWER SUPPLIER

The American Electric Power Co.

GAS COMPANY

Columbia Gas

ELECTRICIAN

First Call - Electric

Second Call - Electric

Third Call - Electric

SESSION THREE: SUPPLEMENTAL MATERIALS

[Site specific telephone numbers have been omitted]

PUMP SERVICES

HD Water Services

Dublin Pump Company

PLANT MECHANICAL CONTRACTORS

First Call- Kel-Par Company

Second Call- J.R. Mason Inc

CHEMICAL SUPPLIERS

KOK Chemical Products Inc.

Bonded Chemical Co.

DISTRIBUTIION SYSTEM SUPPLIES

National Waterworks Co.,Inc.

Midwest Pipe and Supply

WATER HAULERS

H2O on the Go

WATER SOURCES

City of Columbus

LEAK DETECTION SERVICES

Underground Utility Services Gene Rigby

Ohio Leak Locators

LOCAL RADIO STATIONS

WTVN 610 Newsroom	614-481-6397
WBNS AM/FM	614-460-3850

LOCAL TV STATIONS

WBNS Columbus OH	Channel 10	614-460-6950
WTVN Columbus OH	Channel 6	614-461-6666
WCMH Columbus OH	Channel 4	614-263-1512

LOCAL NEWSPAPER

Columbus Dispatch	Newsroom	614-461-5000
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APPENDIX B**CRITICAL USERS LIST****WATER USERS HAVING A NEED FOR CONTINUOUS WATER SUPPLY**

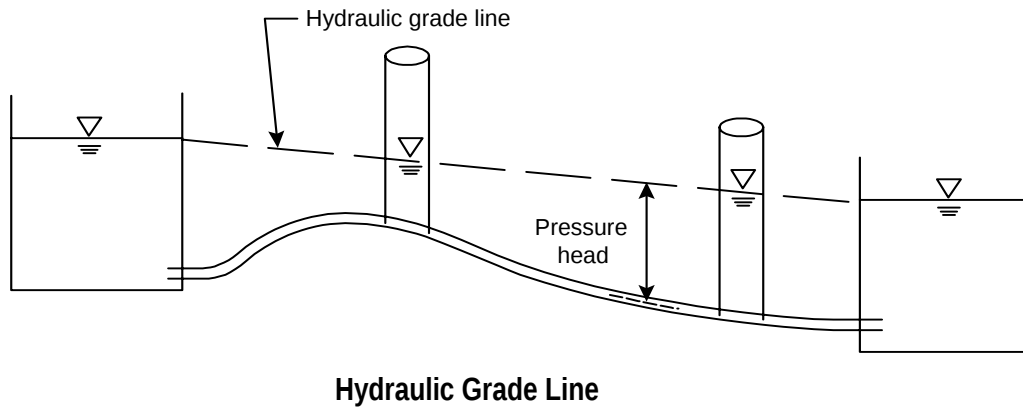
This system has only residential customers with no one being identified as a critical user having a need for a continuous supply of water.

APPENDIX I**SUPPLIERS LIST**

National Waterworks	Distribution Repair Parts
KOK Products	Chlorine
Cargill Salt	Softener Salt
Artesian of Pioneer	

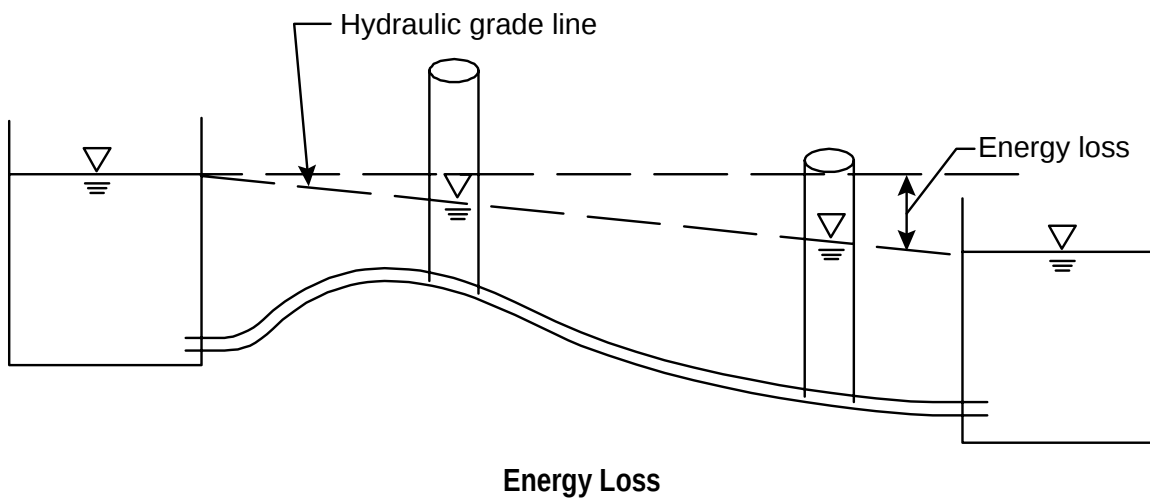
PARTS LIST

No distribution parts are kept on hand at the treatment plant. Parts are purchased locally as needed, when needed, primarily from National Waterworks.



8. Energy Loss

The difference between the Hydraulic grade line at two different points, one up stream the other downstream, equals energy loss. Energy Loss, or headloss, can have a negative impact on system pressures and flows.



Friction Losses

- As water travels through a pipeline, the energy or head of the water is reduced due to friction created by the roughness of the pipe walls. This loss in head will reduce the available pressure in the pipeline. Friction loss is represented by the letter C in hydraulic equations. The lower C values represent smoother inside surfaces of the pipe.
- The pipeline roughness varies based on the age, material, size of the pipeline, and the quality of the water that flows through the pipeline.
- A general rule of thumb to estimate headloss is that it is approximately equal to the flow in a pipeline, squared. Therefore, if the flow in a pipeline is doubled, the headloss will increase by a factor of about 4.

Minor Losses

- Headloss caused by rapid changes in velocity due to:
 - Changes in pipe diameter, shape, or direction, or
 - Meters and valves.

9. Backflow Prevention

Backflow prevention is put in place to prevent an outside source of potential contamination from being introduced into the distribution system. An example of a typical cross connection may be an interconnection between your distribution system and an untreated well which could cause contamination in your system.



The Ohio Administrative Code describes the rules for backflow prevention.

3745-95-04 Where protection is required.

- A. An approved backflow prevention device shall be installed on each service line to a consumer's water system serving premises, where in the judgment of the supplier of water or the director, a pollution system, health or severe health hazard to the public water system exists.
- B. An approved backflow prevention device shall be installed on each service line to a consumer's water system serving premises where any of the following conditions exist:
 1. Premises having an auxiliary water system on the premises, unless such auxiliary system is accepted as an additional source by the supplier of water and the source is approved by the director;

2. Premises on which any substance is handled in such a fashion as to create an actual or potential hazard to a public water system. This shall include premises having sources or systems containing process fluids;
 3. Premises having internal cross-connections that, in the judgment of the supplier of water, are not correctable, or intricate plumbing arrangements which make it impracticable to determine whether or not cross-connections exist;
 4. Premises where, because of security requirements or other prohibitions or restrictions, it is impossible or impractical to make a complete cross-connection survey;
 5. Premises having a repeated history of cross-connections being established or re-established; or
 6. Others specified by the director.
- C. The following requirements apply to premises that have an auxiliary water system on the real property that is owned or under control of the consumer and adjacent to the premises.
1. A physical separation shall be maintained between the public water system or a consumer's water system and the auxiliary water system as required by paragraph (B) of rule 3745-95-02 of the Administrative Code; and
 2. An approved backflow prevention device shall be installed on each service connection serving the consumer's water system, unless the supplier of water does all of the following:
 - a. Determines, on a case-by-case basis, that the installation of an approved backflow prevention device on a service connection is not required in consideration of factors including, but not limited to, the past history of cross connections being established or re-established on the premises, the ease or difficulty of connecting the auxiliary water system with the public water system on the premises, the presence or absence of contaminants on the property or other risk factors;
 - b. Requires the consumer to sign an agreement which specifies the penalties, including those set forth in rule 3745-95-08 of the Administrative Code, for creating a connection between the public water system and the auxiliary water system;
 - c. Conducts or causes to be conducted an inspection at least every twelve months to certify that no connection or means of connection has been created between the public water system and the auxiliary water system;
 - d. Maintains an inventory of each consumer's premises where an auxiliary water system is on or available to the premises, or on the real property adjacent to the premises; and
 - e. Develops and implements an education program to inform all consumers served by the public water system about the dangers of cross-connections and how to eliminate cross-connections.
- D. An approved backflow prevention device shall be installed on each service line to a consumer's water system serving, but not necessarily limited to, the following types of facilities unless the director determines that no severe health, health, system or pollutional hazard to the public water system exists:
1. Hospitals, mortuaries, clinics, nursing homes;
 2. Laboratories;
 3. Piers, docks, waterfront facilities;

4. Sewage treatment plants, sewage pumping stations, or storm water pumping stations;
 5. Food or beverage processing plants;
 6. Chemical plants;
 7. Metal plating industries;
 8. Petroleum processing or storage plants;
 9. Radioactive material processing plants or nuclear reactors;
 10. Car washes; and
 11. Others specified by the director.
- E. An approved backflow prevention device shall be installed at any point of connection that is approved in accordance with paragraph (B) of rule 3745-95-02 of the Administrative Code between a public water system or a consumer's water system and an auxiliary water system, unless such auxiliary system is accepted as an additional source by the supplier of water and the source is approved by the director.

Effective: 05/01/2003

R.C. 119.032 review dates: 12/06/2002 and 05/01/2008

Promulgated Under: 119.03

Statutory Authority: 6109.04

Rule Amplifies: 6109.01, 6109.03, 6109.04, 6109.13 Prior Effective Dates: 7/1/72, 11/26/80

Definitions

Backflow



Backflow is a flow condition, induced by a differential pressure, which causes the flow of water, or mixtures of water and other substances, into the distribution pipes of a potable water supply system from a source other than its intended source.

- Backflow can result from backsiphonage or backpressure. Backsiphonage and backpressure are discussed in more detail later in this unit.

Cross-Connection



A **cross-connection** is an arrangement allowing either a direct or indirect connection through which backflow, including backsiphonage, can occur between a system containing a source or potential source of contamination and the drinking water in a public water system. Simply put, a cross-connection links a source of pollution with a potable water supply.

- Cross-connections allow treated water to be removed from any public water system, used for any purpose or routed through any device or pipes outside the public water system, and returned to the public water system.
- Cross-connections do not include connections to devices totally within the control of one or more public water systems and connections between water mains.
- There are two basic types of cross-connections: direct and indirect.
 - A direct cross-connection is subject to backflow by backpressure. A potable water makeup water line that supplies a boiler is one example of a direct cross-connection.



Direct Cross-Connection

- An indirect cross-connection is not subject to backflow by backpressure. Consequently, backflow can only occur due to backsiphonage. An over-the-rim type inlet, used to fill an open vessel, is an example of an indirect cross-connection.

Common Cross-Connections

Cross-connections can be difficult to identify. Many common situations that appear harmless can be actual or potential cross-connections. Because of the dynamic nature of water systems, with constant expansions and modifications occurring, the ability to identify cross-connections is very important. A connection between a drinking water system and a non-potable water system, such as a fire protection system or process water system is an obvious cross-connection, but others are not so obvious. Cross-connections can occur in complex piping arrangements within buildings and equipment or at a simple connection like a wash sink with a hose attached.

Backsiphonage



Backsiphonage is the backflow of water (or a mixture of water and other substances) from a plumbing fixture or other customer source, into a public water supply system due to a temporary negative or sub-atmospheric pressure within the public water supply system.

- Backsiphonage occurs when atmospheric pressure exerted on a pollutant forces it toward a potable water system that is under vacuum.
- The water system main does not have to be under a true vacuum (i.e., zero psi absolute pressure or -14.7 psi gage pressure) for backsiphonage to occur. Only a negative difference in pressure and a full pipe or tube is required to produce backsiphonage.

Potential Causes of Backsiphonage

Negative or sub-atmospheric pressures in the water system, which can lead to backsiphonage, are often caused by high demands or high flow rates. System headloss caused by friction losses and minor losses, as well as demand for flow beyond the supply capacity, can result in negative or sub-atmospheric pressure in the system. The following are several common occurrences that can result in negative or sub-atmospheric pressure and can potentially cause backsiphonage:

- **Hydrant Operation**

Flowing hydrants for fire fighting, hydraulic testing, system flushing and other reasons can result in high flow rates and low systems pressures.

- **Main Break**

Main breaks can result in the discharge of large volumes of water at very high flow rates, causing low system pressures.

- **High Demands**

High demands can result in negative or sub-atmospheric pressures when the hydraulic capacity of the system is exceeded, causing low pressure due to friction and minor losses. Also, when water demands exceed supply capacity, low pressure can develop

- **Booster Pumps**

Operation of booster pumps without a low pressure cutoff switch can result in negative pressures on the suction side of the pumps, causing a potential for backsiphonage.

Backpressure



Backpressure is the backflow of water, or a mixture of water and other substances, from a plumbing fixture or other customer source, into a public water supply system due to a pressure in the fixture or customer source that exceeds the system pressure.

Backpressure can occur for two reasons:

- An increase in pressure in the customer system.
- A decrease in pressure, to below the customer system pressure, in the public water system.

Potential Causes of Backpressure

- Pumps, boilers, and air/steam pressure in the customer system increase pressure and can cause backflow to the water supply system.
- If pressure decreases in the water supply system, the weight of water in high-rise building piping can provide enough pressure to cause backflow.

Purpose of Backflow Prevention

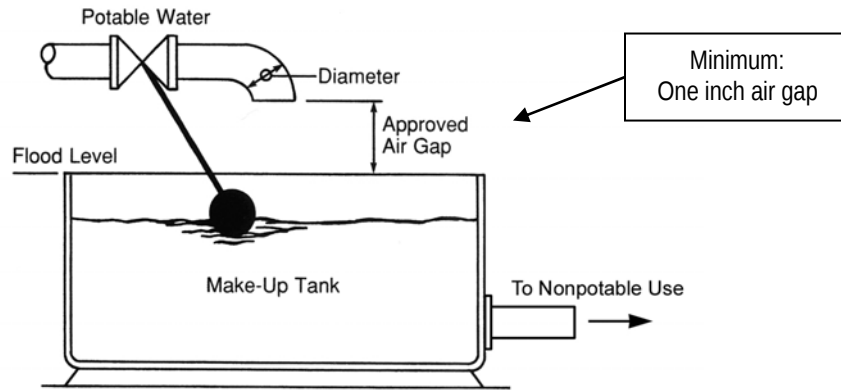
To prevent potential contaminants from being introduced to the distribution network by the reverse flow of water from a source of questionable water quality.

Types of Backflow Prevention Devices

- A physical air gap or separation between the backflow source and the distribution network.
- A reduced pressure device (double-check valve with relief valve as added redundancy).
- A double-check valve assembly.

Types of Backflow Prevention Devices

Air Gap



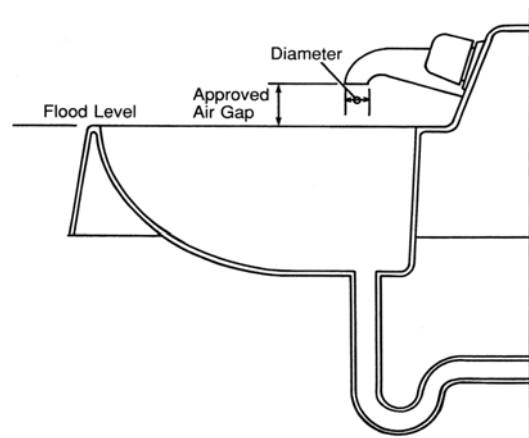
Schematic of Air Gap on a Tank

Operation of an Air Gap

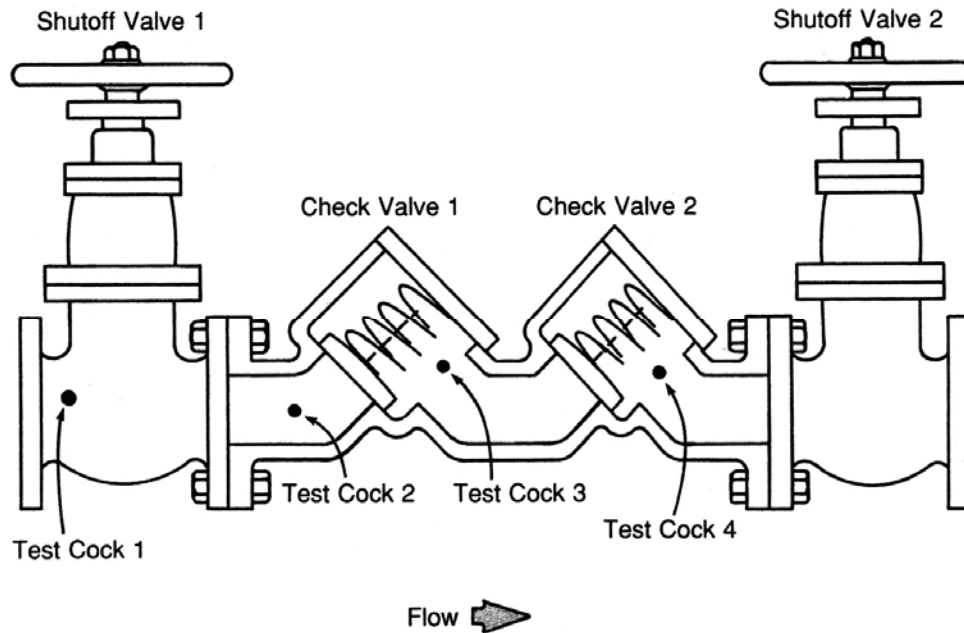


An **air gap** provides a physical separation between the end of a potable water supply line, faucet, plumbing fixture or other device, and the flood level rim of an open or non-pressurized receiving vessel. A minimum of one inch separation is required.

- The air gap is a non-mechanical backflow preventer consisting of an unobstructed vertical distance through free atmosphere between the lowest point of a water supply outlet and the flood level of the fixture being discharged to.
- See diagram on right for air gap on a lavatory.



Double Check Valve Assembly (DCVA)



Schematic of Double Check Valve Assembly

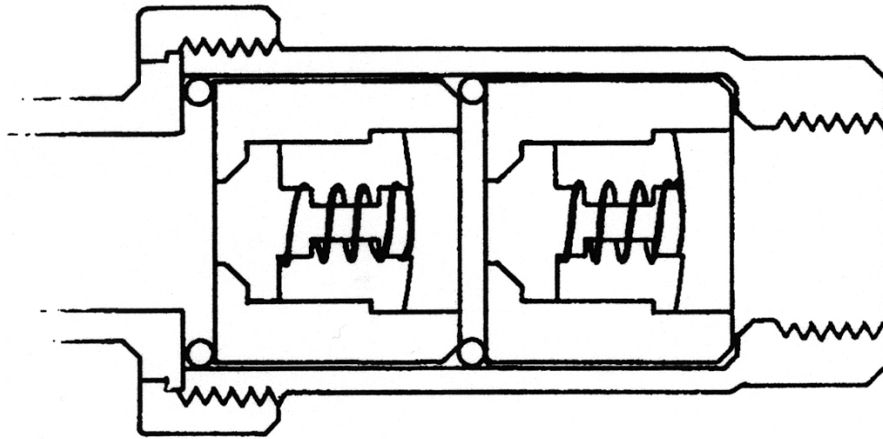
Operation of a Double Check Valve Assembly



The **Double Check Valve Assembly (DCVA)** consists of two ***independently acting***, soft seated, spring-loaded check valves in series within one body, with two tightly closing shutoff valves and four test cocks.

- During normal operation, the check valves open and permit flow from the potable water system to the customer. If backflow conditions occur due to either backpressure or backsiphonage, the check valves will close tightly and prevent potential pollution of the potable water system.

Residential Dual Check Valve (RDCV)



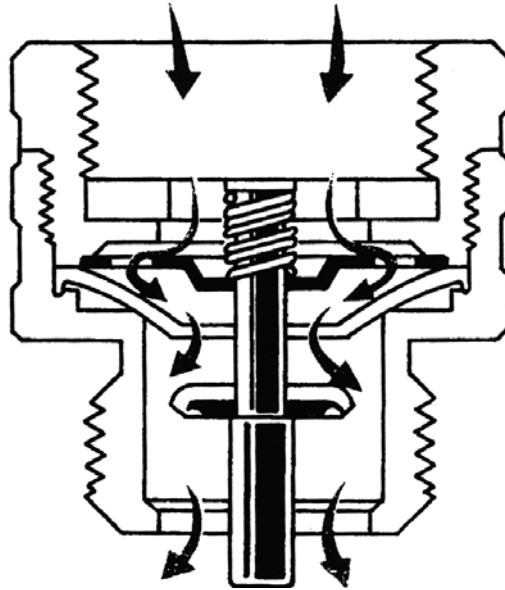
Residential Dual Check Valve Schematic ⁹

Operation of a Residential Dual Check Valve



The **Residential Dual Check Valve (RDCV)**, consists of two spring-loaded, independently acting check valves in a single valve body. The check valves close to prevent backflow by backpressure and/or backsiphonage.

Hose-Bibb Vacuum Breaker (HBVB)



Schematic of Hose-Bibb Vacuum Breaker

Operation of a Hose-Bibb Vacuum Breaker



A **Hose-Bibb Vacuum Breaker (HBVB)** consists of a spring-loaded check valve that seals against an atmospheric outlet when the supply pressure is turned on. When the supply is turned off, the device vents to the atmosphere, providing protection against backsiphonage.

State of Ohio Class A Drinking Water Operator Certification Program



Session Four: Supplemental Materials

This course includes content developed by the Ohio Environmental Protection Agency, the Pennsylvania Department of Environmental Protection, the Indiana Department of Environmental Management, the California State University at Sacramento, and 360water, Inc.

Project funded by the USEPA.



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1. Total Coliform

Water Quality Parameters and Monitoring for Bacteria

Total coliform are monitored for regulatory compliance, as an indicator of the microbiological safety of water and for control (inactivation) of microorganisms, some of which may be pathogenic.

- Class A water systems may be required to collect distribution system samples for chlorine analyses to maintain compliance with the EPA Total Coliform Rule.
- Total coliform is a microbiological indicator used to assure that water delivered to the consumer is bacteriologically safe.
- Monitoring for total coliform will assist in identifying sources of contamination.
- Heterotrophic Plate Count (HPC) is a general indicator of the quantity of all types of bacteria, thereby a general indicator of the bacteriological quality of the water.
- Total Coliform monitoring is a requirement for all public water systems under Ohio Administrative Code 3745-81-21; [Coliform monitoring requirements](#).
- If any routine sample(s) are positive for total coliform, then repeat samples must be taken as follows:
 - Systems that collect more than one sample per month must collect at least four repeat samples within 24 hours for routine each sample that tested positive for total coliform.
 - Systems that collect only one sample per month must collect at least four repeat samples within 24 hours for each routine sample that tested positive for total coliform.
 - Systems must continue to collect repeat samples until all samples are negative or it is determined that the system has violated the MCL.
 - Systems that collect less than five samples per month must collect at least five samples during the month immediately following the positive sample.
 - Any sample that tests positive for total coliform must be analyzed for E. coli or fecal coliform

Analytical Tools

- Free and total chlorine — DPD Colorimetric — see Method 408.E of Standard Methods for the Examination of Water and Wastewater.
- Coliform Bacteria analytical methods include:
 - M-ColiBlue24® for detecting and counting fecal and total coliform within 24 hours

2. Key Monitoring and Reporting Requirements

Microbiological (Coliform)

- Class A systems must monitor monthly or quarterly based on the type of system and population served.
- Samples are taken from the distribution system.
- A system is in acute MCL violation if:
 - Any routine sample is found to be total coliform positive and at least one repeat sample is total coliform positive.
 - Any routine sample is fecal coliform or E. coli positive.
 - Any repeat sample is found to be fecal coliform or E. coli positive.

Inorganic Chemicals

- One sample every three years (groundwater sources) is required, or quarterly samples for at least 4 consecutive quarters if initial sample is over the MCL.
- Samples are taken from each point water enters the distribution system.
- A system is in violation if average of routine and check samples exceeds the MCL for any regulated inorganic chemical contaminant.

Volatile Organic Chemicals and Synthetic Organic Chemicals

- One annual sample is required, or quarterly samples for at least 4 consecutive quarters if initial sample is over the MCL.
- Samples are taken from each point water enters the distribution system.

A system has exceeded the MCL if average of routine and check samples exceeds the MCL.



The Ohio Administrative Code, at section 3745-81-27, describes the total coliform analytical method.

3745-81-27

1. The standard sample volume required for a total coliform analysis is one hundred milliliters. The time from sample collection to initiation of analysis shall not exceed thirty hours. Systems are encouraged but not required to hold samples below ten degrees Celsius during transit.
2. Total coliform analyses shall be conducted in accordance with one of the following methods.
 - a. Membrane filter (MF) technique, as set forth in "Standard Methods" section 9222.
 - b. Enzyme substrate coliform test, as partially described in "Standard Methods" section 9223 and further explained in the twentieth (1998) edition of "Standard Methods" section 9223.
3. Fecal coliform analysis, for cases in which membrane filter analysis gives total coliform-positive results, shall use EC medium. Nutrient EC medium preparation is described on page 9-54 of "Standard Methods".
 - a. The total coliform-positive culture is transferred by one of the following methods:
4. Remove the membrane containing the total coliform colonies from the substrate with a sterile forceps and carefully curl and insert the membrane into a tube of EC medium; or
 - a. Swab the entire membrane filter surface with a sterile swab and transfer the inoculum to EC medium (do not leave the swab in the EC medium).
 - b. Gently shake the inoculated tubes of EC medium to ensure adequate mixing and incubate in a waterbath at 44.5 ± 0.2 degrees Celsius for twenty-four plus or minus two hours. Gas production of any amount in the inner fermentation tube of the EC medium indicates a positive fecal coliform test. Public water systems need only determine the presence or absence of fecal coliforms; a determination of fecal coliform density is not required.
5. *Escherichia coli* (*E. coli*) analysis shall be done by a method identified in paragraph (D)(2)(b) or (D)(2)(c) of this rule. These methods allow simultaneous determination of the presence or absence of total coliforms and *E. coli* when applied to drinking water samples, but they are not approved for determining whether bacteria samples resulting from membrane filter tests contain *E. coli*.

3. Total Coliform References

References: See, www.epa.state.oh.us/ddagw/labcert.html (collection procedure for bacteria from the Laboratory Manual for the Microbiological Analyses of Public Drinking Water 2001).

Bacteria Procedure

In order to properly complete the public water system information and sample information sections of the required microbiological Sample Submission Report form, the sampler should provide the laboratory with the following items:

1. The Ohio EPA **District Office** to receive the results.
2. The name of the **PWS** (public water system) that was sampled.
3. The six or seven digit **PWSID #** assigned to public water system by the Ohio EPA.
4. The mailing **Address** of the PWS that was sampled.
5. The County in which the PWS is located.
6. The Contact **Name** for the person responsible for the PWS.
7. The number of the Contact **Phone** for the contact person.
8. The **Sample Collection Date** must be indicated for sample to be acceptable for analysis.
9. The **Time** that the sample was collected must be indicated for sample to be acceptable for analysis.
10. The full name (not initials) of the person who collected the sample: **Sample Collected By**.
11. The number for the **Collector's Phone**.
12. The **Sample Class** (Routine, Repeat, Special, or Raw).
13. The **Sample Monitoring Point** (usually DS000, or the assigned RSOO# code if for a well).
14. If the sample class is Resample, the sample number of the previous sample with positive results that initiated the collection of the resample: **Repeat for Sample #**.
15. The **Tap Address** where the sample was collected, for example, 28 Main St.
16. The **Sample Tap ID** where the sample was collected for example, sink tap 2 - Jim's Grocery.

Collection of Microbiological Drinking Water Samples: Total Coliform/Fecal Coliform/E.coli

The prescribed procedures must be followed in detail for a valid laboratory analysis

1. Select the sampling tap
 - a. A tap, such as faucet, petcock, or small valve, is preferable. Do not sample from hoses or drinking water fountains.
 - b. Avoid taps with a leak at the stem or taps with a swivel joint.

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- c. Aerated or screened nozzles may harbor bacteria. The aerator or screen must be removed before collection of the sample.
- d. Place all carbon filters, sediment filters and water softeners on bypass unless operated by a public water system.
- e. Sanitize the nozzle of the tap with a chlorine solution
 - i. Use a 5.25% sodium hypochlorite solution, such as Clorox™ liquid bleach. Do not use chlorine solutions with special scents. To prepare a sanitizing solution that will contain about 400 mg/L of available chlorine (as hypochlorite) from the 5.25% sodium hypochlorite, add one ounce of bleach to one gallon of water (or **1** tablespoon per half-gallon. Store the mixed solution in a tightly closed screw capped container. The solution should be discarded and remade six months after preparation. Stronger solutions can be used, however, some faucet discoloration may result.
 - ii. Flush the sample tap to waste for one minute. Close the valve.
 - iii. Apply the sanitizing solution, prepared in step (i) above to the nozzle. This can be accomplished by either using a spray bottle or a plastic bag.
 - (2) Using a spray bottle, saturate the tap opening with sanitizing solution then wait at least two minutes before proceeding, or
 - (3) Place the bag over the nozzle and hold the top of the bag tightly on the tap. Alternately squeeze and release the bag to flush the solution in and out of the tap. Do this for two minutes. A fresh solution and bag must be used to sanitize each tap.
- f. Flush the tap. The sample to be collected is intended to be representative of the water in the main. The tap must be opened fully and the water run to waste for at least 3-5 minutes to allow for adequate flushing of the piping between the tap and water main.
- g. Reduce the flow from the tap. This will allow the samples bottle to be filled without splashing. Thereafter, run CL2 test free & total and then record the results.
- h. Remove the cap from the sample bottle.
 - i. Grasp the bottom of the sample bottle.
 - ii. Remove the cap and hold the exterior of the cap between fingers while filling the sample bottle. Take care not to touch the mouth of the bottle or the inside of the cap with fingers or the sample could become contaminated.
 - iii. The bottle must be open only during the collection of the sample.
- I. Fill the sample bottles
 - i. Do not rinse out the bottle before collecting the sample. Do not remove any 'pills' from the bottle. The bottle contains a small amount of sodium thiosulfate to neutralize the chlorine in the water
 - ii. Do not touch the rim or mouth of the bottle during collection of the sample.
 - iii. Do not overflow. Fill the bottle to within ¼-l" of the top.
- j. Immediately recap the sample bottle tightly.

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- k. If there is any question as to whether a sample or bottle has become contaminated during collection of the sample, the sample must be discarded and a new sample collected in a new sample bottle.
- l. Deliver the sample to the laboratory as soon as possible. The laboratory must receive the sample so that analysis can be completed (incubation initiated) within 30 hours after collection. Allow the laboratory adequate time to analyze the sample. Certified laboratories will not test samples >30 hours old because the results will be invalid and the laboratory risks loss of certification.
- m. Additional information
 - i. A sample identification slip (may use microbiological SSR form) is supplied with each sample bottle. The collection portion of the form is to be filled out in a legible manner using indelible pen, rubber stamp or typewriter. Do not use a fountain pen or other pens having water soluble ink.
 - ii. Samples must be collected in bottles supplied by the certified laboratory performing the analyses. Bottles may be used from other certified laboratories provided the sample bottle supplying laboratory furnishes records of sample bottle sterility tests.
 - iii. Samples must be accompanied by a properly completed sample identification slips. Sample identification slips that have not been properly completed as to name of water supply, address, date and time of collection, and signature of collector must not be accepted for bacteriological examination.

Labs will not analyze samples for the following reasons:

1. Time elapsed since sample collection >30 hours.
2. Leaking or breakage of sample bottles in transit.
3. Free chlorine residual in dechlorinated sample.
4. Incomplete information for completion of SSRs.
5. Samples frozen.
6. Less than 100 ml of sample available.
7. Any other reason that may affect test results.

4. Monitoring, Reporting and Waiver

Monitoring the public water system will show whether or not the chemicals added to the water are effective. Monitoring provides the basis for the analysis which will show whether or not the public water system is working within OEPA regulations.



The Ohio Administrative Code describes the rules for monitoring, reporting and waivers.

3745-83-01 Operational requirements.

- (A) Except as otherwise noted, the definitions in rule 3745-81-01 of the Administrative Code shall apply to this chapter.
- (B) Disinfection.
 - (1) For purposes of this rule of the Administrative Code, "major noncommunity public water system" means a noncommunity public water system designated by the director for which he deems it advisable, because of the relatively large number of people who drink or may drink water from the system, that the water be disinfected in the same manner as for a community public water system.
 - (2) Unless exempted under other provisions of this rule, each community public water system and each major noncommunity public water system shall maintain a minimum chlorine residual of at least two-tenths milligram per liter free chlorine, or one milligram per liter combined chlorine measured at representative points throughout the distribution system. The director may by order require higher residuals as necessary to compensate for pH, temperature, or other characteristics of the delivered water. Chlorine concentrations shall be analyzed in accordance with paragraph (C) of rule 3745-81-27 of the Administrative Code.
 - (3) A system is exempt from paragraph (B)(2) of this rule if it meets all the following conditions:
 - (a) The system obtains all its water from a ground water source which has, in the judgment of the director, been properly developed, constructed, and adequately protected; or from a system to which paragraph (B)(2) of this rule applies;
 - (b) The distribution system serving the water system, in the judgment of the director, has been properly constructed and maintained and is protected by an effective cross-connection program;
 - (c) The system, in the judgment of the director, has a satisfactory history of bacteriological monitoring indicating no contamination;
 - (d) The director has certified in writing that conditions of paragraphs (B)(3)(a), (B)(3)(b), and (B)(3)(c) of this rule have been met.

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- (4) A system is exempt from paragraph (B)(2) of this rule if, with written approval of the director, it uses chlorine dioxide as a primary or supplementary disinfectant in accordance with the terms of the approval.
- (5) Each water system subject to paragraph (B)(2) of this rule and not exempt under paragraph (B)(3) of this rule shall install and place in operation equipment capable of meeting disinfection requirements of this rule.
- (6) Notwithstanding the MRDL for total residual chlorine in paragraph (C) of rule 3745-81-10 of the Administrative Code, at times of actual or threatened outbreak of waterborne disease, each system subject to paragraph (B)(2) of this rule that may be affected by such outbreak shall maintain a minimum chlorine residual of at least one milligram per liter free chlorine, or six milligrams per liter combined chlorine measured at representative points throughout the distribution system, despite possible resulting tastes or odors in the delivered water.
- (7) Finished water storage facilities, as defined in paragraph (E)(1) of this rule, serving community water systems or major non-community water systems shall be adequately disinfected in accordance with "American Water Works Association Standard C652-02 Disinfection of Water-Storage Facilities (2002)" before being placed in service and before being returned to service after repairs. A reservoir shall be considered adequately disinfected when analyses of at least two consecutive samples taken at twenty-four hour intervals are total coliform-negative. The consecutive samples taken in order to determine compliance with this paragraph shall be analyzed in accordance with paragraph (D) of rule 3745-81-27 of the Administrative Code. The standard sample used shall contain one hundred milliliters.
- (8) All new, cleaned, or repaired water mains serving community water systems or major noncommunity water systems shall be disinfected in accordance with "American Water Works Association Standard C651-99 Disinfecting Water Mains (1999)." Samples taken in order to determine compliance with this paragraph shall each contain one hundred milliliters and shall be analyzed in accordance with paragraph (D) of rule 3745-81-27 of the Administrative Code.
 - (a) A new or cleaned water main shall be considered adequately disinfected when analyses of at least two consecutive samples taken at twenty-four hour intervals are total coliform-negative.
 - (b) Repaired water mains shall be considered adequately disinfected when analyses of samples taken in accordance with "American Water Works Association Standard C651-99 Disinfecting Water Mains (1999), Section 4.7.5" are total coliform-negative.
- (C) Approval of chemicals. All chemicals, substances, and materials added to or brought in contact with water in or intended to be used in a public water system or used for the purpose of treating, conditioning, altering, or modifying the characteristics of such water shall be shown by either the manufacturer, distributor, or purveyor to be non-toxic and harmless to humans when used in accordance with the formulation and concentration as specified by the manufacturer, and shall conform with the "American National Standards Institute/National Sanitation Foundation" (ANSI/NSF) standard 60 Drinking Water Treatment Chemicals - Health Effects (2001 and previous), or standard 61 Drinking Water System Components - Health Effects (2003 and previous). Any organization certified by

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the "American National Standards Institute" may certify in writing that a product conforms with these standards.

- (D) **IMPORTANT** - Minimum pressure. Community water systems shall maintain a minimum pressure of twenty pounds per square inch gauge at ground level at all points in the distribution system under all conditions of flow other than conditions caused by line breaks, extreme fire flows, or other extraordinary circumstances.
- (E) Finished water storage facilities
 - (1) "Finished water storage facility" means a tank, reservoir, or other facility used to store water that will undergo no further treatment except residual disinfection.
 - (2) A public water system shall provide a cover on all finished storage facilities so they are not open to the atmosphere.
- (F) Reports.
 - (1) Community water systems.
 - (a) In addition to any other reporting requirement of Chapter 3745-81 of the Administrative Code, the operator of a community water system shall prepare an operation report for each month of operation on forms provided by the director. The director may require that the report include the following:
 - (i) General operation data;
 - (ii) A summary of samples analyzed, including distribution system sampling and chlorine residual sampling;
 - (iii) Information on daily water treatment and system pumpage;
 - (iv) Information on chemical application;
 - (v) Analysis of general parameters relating to the quality of the treated drinking water;
 - (vi) Source water levels;
 - (vii) Changes in personnel in responsible charge;
 - (viii) Such other information as may be necessary or desirable for the director to carry out his duties under Chapter 6109 of the Revised Code.
 - (b) The operation report shall be submitted to the district office with jurisdiction no later than the tenth of the month following the month for which the report was prepared.
 - (c) The operator shall report significant interruptions of service or of chlorination immediately by telephone to the district office with jurisdiction.
 - (2) Noncommunity water systems.
 - (a) The operator of a public water system other than a community public water system shall prepare and file an operation report at a frequency determined in writing by the director. The reports shall be on forms provided by the director and shall

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contain such information as may be necessary for the director to carry out his duties under Chapter 6109 of the Revised Code.

- (b) The operation report shall be submitted to the district office with jurisdiction no later than the tenth of the month following the end of the period for which the report was prepared.

[Comment: This rule incorporates the American water works association standards C651-99 and C652-02 by reference. Copies may be obtained from the "AWWA Bookstore, 6666 West Quincy Avenue, Denver, CO, 80235, 1-800-926-7337, www.awwa.org." These standards are available for review at "Ohio EPA, Lazarus Government Center, 122 South Front Street, Columbus, OH, 43215-3425."]

[Comment: This rule incorporates the ANSI/NSF standards 60 and 61 by reference. Copies may be obtained from "NSF International, 789 North Dixboro Road, P.O. Box 130140, Ann Arbor, MI, 48113-0140, (734)769-8010, www.nsf.org." These standards are available for review at "Ohio EPA, Lazarus Government Center, 122 South Front Street, Columbus, OH, 43215-3425."]

Effective: 08/03/2004

R.C. 119.032 review dates: 05/05/2004 and 08/03/2009

Promulgated Under: 119.03

Statutory Authority: RC Section 6109.01, 6109.03, 6109.04 Rule Amplifies: RC Section 6109.01, 6109.03, 6109.04

Prior Effective Dates: 11/26/80, 09/13/93, 01/01/99, 04/21/01

5. Penalties

If a public water system violates the rules set by OEPA, then the public water system may be assessed penalties. Penalties may take the form of a money penalty, loss of certification of the operator, and may include the loss of the license to operate the public water system.



The Ohio Administrative Code describes the rules for penalties.

3745-81-04 Administrative penalties.

Pursuant to section 6109.23 of the Revised Code, the director may assess and collect administrative penalties from any person who owns or operates a public water system and violates Chapter 6109. of the Revised Code or the administrative rules adopted thereunder. Administrative penalties for a public water system shall be calculated according to this rule in the following manner. Each violation of the public water system shall be assigned a value of one thousand dollars. This amount represents the threat to public health caused by the public water system's failure to comply with the applicable regulations. This value is then multiplied by a number, expressed as a decimal, which represents the public water system's size, in accordance with the following list in order to determine the penalty amount for each day of each violation:

System size (number of people served)	Number
At least 15 service connections or 25 to 3,300	0.25
3,301 to 6,700	0.50
6,701 to 10,000	0.75
10,001 or more	1.00

Effective: 10/17/2003
R.C. 119.032 review dates: 07/22/2003 and 10/17/2008

Promulgated Under: 119.03 Statutory Authority: 6109.23 Rule Amplifies: 6109.23
Prior Effective Dates: 10/1/1999.

6. Regulated Contaminants

Certain contaminants are regulated by the EPA because the contaminants have been proven to cause adverse health issues. Ordinarily, contaminants do not present drinking water health concerns; however, if the level of contaminants rises above the threshold set by OEPA, then your community may be at risk of unsafe drinking water supplies.



The Ohio Administrative Code describes the rules governing contaminants.

3745-81-12 Maximum contaminant levels and best available technologies for organic contaminants.

- A. Total trihalomethanes: the maximum contaminant level for total trihalomethanes of 0.10 milligram per liter applies to community public water systems that treat their water with any combination of chlorine, chloramines, chlorine dioxide and/or ozone. This level applies until January 1, 2002 to surface water systems which serve a population of ten thousand or more persons. This level applies until January 1, 2004 to ground water systems which serve a population of ten thousand or more persons. Compliance with the maximum contaminant level for total trihalomethanes is calculated according to paragraph (A) of rule 3745-81-24 of the Administrative Code.
- B. The following maximum contaminant levels for total trihalomethanes and haloacetic acids (five) apply to community public water systems and nontransient noncommunity public water systems that treat their water with any combination of chlorine, chloramines, chlorine dioxide or ozone. These levels apply beginning January 1, 2002, to surface water systems which serve a population of ten thousand or more persons. These levels apply beginning January 1, 2004, to surface water systems serving fewer than ten thousand persons and ground water systems. Compliance with the maximum contaminant levels for total trihalomethanes and haloacetic acids (five) is calculated according to paragraph (D) of rule 3745-81-24 of the Administrative Code. The director identifies the following as the best available technology (BAT), for achieving compliance with the maximum contaminant levels for organic disinfection byproducts identified in this paragraph:

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Contaminant	MCL (mg/L)	BAT
total trihalomethanes	0.080	enhanced coagulation or enhanced softening or GAC10, with chlorine as the primary and residual disinfectant
haloacetic acids (five)	0.060	enhanced coagulation or enhanced softening or GAC10, with chlorine as the primary and residual disinfectant.

C. A public water system that is installing GAC or membrane technology to comply with the MCLS for TTHM and HAA5 may apply to the director for an extension of up to twenty-four months past January 1, 2002, but not beyond December 31, 2003. In granting this extension, the director shall set a schedule for compliance and may specify any interim measures that the public water system must take. Failure to meet the schedule or interim treatment requirements constitutes a violation of Ohio primary drinking water rules.

D. The following maximum contaminant levels (MCLs) apply to community public water systems and nontransient noncommunity public water systems. The associated best available technologies (BATs), designated as GAC for granular activated carbon and PTA for packed-tower aeration, identify the best technology, treatment techniques, or other means available for achieving compliance with the stated maximum contaminant levels. The director may determine that a public water system shall apply best available technology in order to reduce the level of a contaminant to below its maximum contaminant level.

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Contaminant	CAS number	MCL milligrams per liter	BAT
Vinyl chloride	75-01-4	0.002	PTA
Benzene	71-43-2	0.005	GAC PTA
Carbon tetrachloride	56-23-5	0.005	GAC PTA
p-Dichlorobenzene	106-46-7	0.075	GAC PTA
1,2-Dichloroethane	107-06-2	0.005	GAC PTA
1,1-Dichloroethylene	75-35-4	0.007	GAC PTA
Trichloroethylene	79-01-6	0.005	GAC PTA
1,1,1-Trichloroethane	71-55-6	0.2	GAC PTA
o-Dichlorobenzene	95-50-1	0.6	GAC PTA
cis-1,2-Dichloroethylene	156-59-2	0.07	GAC PTA
trans-1,2-Dichloroethylene	156-60-5	0.1	GAC PTA
1,2-Dichloropropane	78-87-5	0.005	GAC PTA
Dichloromethane	75-09-2	0.005	PTA
Ethylbenzene	100-41-4	0.7	GAC PTA
Monochlorobenzene	108-90-7	0.1	GAC PTA
Styrene	100-42-5	0.1	GAC PTA
Tetrachloroethylene	127-18-4	0.005	GAC PTA
Toluene	108-88-3	1	GAC PTA
1,2,4-Trichlorobenzene	120-82-1	0.07	GAC PTA
1,1,2-Trichloroethane	79-00-5	0.005	GAC PTA
Xylenes (total)	1330-20-7	10	GAC PTA

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- E. The following maximum contaminant levels apply to community public water systems and nontransient noncommunity public water systems. The associated best available technologies (BATs), designated as GAC for granular activated carbon, PTA for packed-tower aeration, and OX for oxidation with chlorine or ozone, identify the best technology, treatment technique, or other means available for achieving compliance with the stated maximum contaminant levels. The director may determine that a public water system shall apply best available technology in order to reduce the level of a contaminant to below its maximum contaminant level.

Contaminant	CAS number	MCL milligrams per liter	BAT
Alachlor	15972-60-8	0.002	GAC
Atrazine	1912-24-9	0.003	GAC
Benzo[a]pyrene	50-32-8	0.0002	GAC
Carbofuran	1563-66-2	0.04	GAC
Chlordane	57-74-9	0.002	GAC
2,4-D	94-75-7	0.07	GAC
Dalapon	75-99-0	0.2	GAC
Dibromochloropropane (DBCP)	96-12-8	0.0002	GAC PTA
Di(2-ethylhexyl) adipate	103-23-1	0.4	GAC
Di(2-ethylhexyl) phthalate	117-81-7	0.006	GAC
Dinoseb	88-85-7	0.007	GAC
Diquat	85-00-7	0.02	GAC
Endothall	145-73-3	0.1	GAC
Endrin	72-20-8	0.002	GAC
Ethylene dibromide (EDB)	106-93-4	0.00005	GAC PTA
Glyphosate	1071-53-6	0.7	OX
Heptachlor	76-44-8	0.0004	GAC
Heptachlor epoxide	1024-57-3	0.0002	GAC
Hexachlorobenzene	118-74-1	0.001	GAC
Hexachlorocyclopentadiene	77-47-4	0.05	GAC PTA
Lindane	58-89-9	0.0002	GAC
Methoxychlor	72-43-5	0.04	GAC
Oxamyl (Vydate)	23135-22-0	0.2	GAC
Picloram	1918-02-1	0.5	GAC
Polychlorinated biphenyls (PCBs)	1336-36-3	0.0005	GAC

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Pentachlorophenol	87-86-5	0.001	GAC
Simazine	122-34-9	0.004	GAC
2,3,7,8-TCDD (Dioxin)	1745-01-6	3x10-8	GAC
Toxaphene	8001-35-2	0.003	GAC
2,4,5-TP (Silvex)	93-72-1	0.05	GAC

Effective: 01/01/2002

RC 119.032 review dates: 6/26/01, 10/04/2006

Promulgated under: RC Chapter 119

Rule authorized by: RC Section 6109.03, 6109.04

Rule amplifies: RC Section 6109.04

Prior effective dates: 12/27/78, 8/24/81, 5/22/89, 9/13/93

7. Nitrates & Nitrites (Monitoring Schedule)



Nitrate in Public Drinking Water

What is nitrate?

Nitrate (NO_3) is an inorganic chemical composed of nitrogen and oxygen. Nitrate contamination of drinking water usually results from runoff of agricultural fertilizers or from human or animal wastes, such as livestock feed lots or faulty septic systems.

How much nitrate is allowed in drinking water?

The maximum contaminant level (MCL) for nitrate in drinking water is 10 milligrams per liter (mg/L). This is the maximum allowable level of nitrate that may be present in drinking water without a high risk of causing health problems.

What are the health effects of nitrate?

Nitrate is essentially harmless to most people, but is considered an acute toxin to infants under six months of age. In infants, it causes a condition known as methemoglobinemia, or “blue-baby syndrome,” which can be fatal. The most obvious symptom is a bluish skin coloring, especially around the eyes and mouth. Other symptoms can include shortness of breath, nausea, vomiting and dizziness. An infant with bluish skin should be taken immediately to a medical facility for treatment.

Blue-baby syndrome is caused when bacteria in the digestive tract of infants change the nitrate into nitrite, a much more harmful substance. The nitrite then enters the bloodstream, where it can lower the blood's ability to carry oxygen to the body, causing a blueness to the skin. Infants under six months of age are at higher risk than others because their digestive tract is not fully developed. By six months of age, the hydrochloric acid in the stomach increases to a level that kills most of the bacteria which change nitrate to nitrite, significantly reducing the risk of methemoglobinemia.

Healthy adults and older children can consume higher levels of nitrate than infants because of their fully-developed digestive systems. It is recommended that women who are pregnant or nursing consult with their physicians about limiting nitrate consumption. People with medical conditions that may make them more susceptible to methemoglobinemia, such as reduced stomach acidity, should also consult their physicians.

What precautions should be taken for someone at risk?

Substitute bottled water for tap water until the nitrate advisory is lifted. Boiling tap water will not get rid of the nitrate; it only concentrates it. It is safe to bathe or shower in tap water with elevated nitrate levels.

How often is monitoring required?

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All public water systems (PWS) are required to monitor their water for the presence of nitrate.

Ground water systems typically monitor once a year. However, if nitrate is detected at 5 mg/L or greater, Ohio EPA requires quarterly monitoring (every three months). This increased monitoring allows Ohio EPA to better protect the public health by keeping a closer watch on water supplies with potential problems.

What happens if the MCL is exceeded?

A public water system may have an MCL violation if a nitrate result is above 10 mg/L. Another nitrate sample should be collected within 24 hours after the PWS is told about the high nitrate result. If the sample cannot be taken within 24 hours, the PWS must issue a public notice and collect the sample as soon as possible, but no later than two weeks after being told of the high nitrate result.

A nitrate MCL violation has an acute or immediate risk to human health. When a nitrate MCL violation is confirmed, public notice must be issued within 24 hours. Ohio EPA provides instructions on how to issue the public notice and a draft public notice. As proof that the public notice was issued, the system is required to complete a verification sheet and send it to Ohio EPA.



Taken from "Fact Sheet", January 2005
State of Ohio Environmental Protection Agency
Division of Drinking and Ground Waters, 122 South Front Street, Columbus, Ohio 43215
(614) 644-2752
www.epa.state.oh.us

8. Violations

If your public water system is in violation of any requirement, including any failure to monitor any parameter or any result exceeding a MCL, then the OEPA will issue a notice of violation.

Public Notices can be either Tier I or Tier II or Tier III.

Tier I Public Notice is described as:

- Acute MCL Violation.
- A violation or situation that may pose an acute risk to human health requires that notice be given to the persons served by the public water system within 24 hours.

Tier II Public Notice is described as:

- Monthly MCL Violation.
- Issue as soon as practicable, but no later than 30 days after notification of the violation.
- If posted, notices must remain in place as long as the violation or situation exists, but at least for 7 days.

Tier III Public Notice is described as:

- Monitoring Violation
- A monitoring violation with no acute health risk.
- Issue as soon as practicable, but no later than 30 days after notification of the violation.
- If posted, notices must remain in place as long as the violation or situation exists, but at least for 7 days.

A **Public Notice** will include the following:

- Subject: Why the public water system is in violation.
- Rule governing the violation: OAC 3745-81-21.
- Monitoring period that was violated.
- Required sampling.
- Sample results submitted.
- Required monitoring period.
- Any actions required as a result of the monitoring violation.

SESSION FOUR: SUPPLEMENTAL MATERIALS

Comply with Rule 3745-81-32	Notify water users via public notice
Method of Notification	Hand deliver or posting in conspicuous area served by the water system within 30 days of this letter
Verification to OEPA	Return to OEPA a copy of the notice as issued, along with the attached verification form, within 10 days after you notify your water users.

SESSION FOUR: SUPPLEMENTAL MATERIALS

Nitrate Levels

- Nitrate level in drinking water is a serious health concern for infants less than six months old.
- Public notices must include the following information within 24 hours:

- **DO NOT GIVE THE WATER TO INFANTS.** *Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue baby syndrome.* Blue baby Syndrome is indicated by blueness of the skin. Symptoms in infants can develop rapidly, with health deteriorating over a period of days. If symptoms occur, seek medical attention immediately.

- Formula for children under six months of age should not be prepared with tap water. Instead, use bottled water or other water low in nitrates when preparing infant formula until further notice.

- **DO NOT BOIL THE WATER.** Boiling, freezing, filtering, or letting water stand does not reduce the nitrate level. Excessive boiling can make the nitrates more concentrated, because nitrates remain behind when the water evaporates.

- Adults and children older than six months can drink the tap water (nitrate is a concern for infants because they can't process nitrates in the same way adults can). However, if you are pregnant, nursing or have specific health concerns, you may wish to consult your doctor.

9. Sample Public Notice of a Violation

April 26, 2006

Joe's Restaurant
Main Street
Small Town, OH 43678

Re: Joe's Restaurant
Shelby County
Transient Water System
PWSID No. 1234567

SUBJECT: Notice of Violation -- Failure to Sample Drinking Water for Total Coliform Bacteria

Your public water system is in violation of Rule 3745-81-21 of the Ohio Administrative Code for failure to comply with the coliform bacteria sampling requirements:

Monitoring Period:	January - March 2006
Required Coliform Sampling:	at least one routine sample
Sample Results Submitted:	NONE
Required Monitoring Periods:	Jan-Mar; Apr-June; July-Sept; Oct-Dec each year

Actions required as a result of the above monitoring violation:

1. Comply with Rule 3745-81 -32: Notify water users (public notice; example enclosed).
2. Method of Notification: Hand delivery or posting conspicuously in area served by water system, within 30 days of this letter.
3. Verification to OEPA: Return to us a copy of your notice as issued, along with the attached verification form, within 10 days after you notify your water users.

Please mark your calendar to sample in future monitoring periods. Continued failure to monitor may subject you to legal action. If you have any questions, please contact me at (937) 285-6417.

Sincerely,

John Smith

Division of Drinking and Ground Waters

Enclosures

cc: County Health Department
Toni Buchanan, DDAGW/CO

SAMPLE

DRINKING WATER WARNING

[System] water is contaminated with [fecal coliform] or [E. coli]

BOIL YOUR WATER BEFORE USING OR USE BOTTLED WATER

Fecal coliform [or E. coli] bacteria were found in the water supply on [date]. These bacteria can make you sick, and are a particular concern for people with weakened immune systems.

What should I do?

- ◆ DO NOT DRINK THE WATER WITHOUT BOILING IT FIRST. Bring all water to a boil, let it boil for at least one minute, and let it cool before using, or use bottled water. Boiled or bottled water should be used for drinking, making ice, brushing teeth, washing dishes, and food preparation until further notice. Boiling kills bacteria and other organisms in the water.
- ◆ Fecal coliforms and E. coli are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Microbes in these wastes can cause short-term effects such as diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a special health risk for infants, young children, some of the elderly, and people with severely compromised immune systems.
- ◆ The symptoms above are not caused only by organisms in drinking water. If you experience any of these symptoms and they persist, you may want to seek medical advice. People at increased risk should seek advice about drinking water from their health care providers.

What happened? What is being done?

Bacterial contamination can occur when increased run-off enters the drinking water source (for example, following heavy rains). It also can happen due to a break in the distribution system (pipes) or a failure in the water treatment process. We are investigating and taking the necessary steps to correct the problem as soon as possible.

For more information, please contact _____ at _____ or _____
name of contact phone number mailing address

General guidelines on ways to lessen the risk of infection by microbes are available from the EPA Safe Drinking Water Hotline at 1(800) 426-4791.

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

PWSID#: _____ Date distributed: _____

Draft Contingency Plan Template
August 2003

Joe's Restaurant
Water has high levels of nitrate

DO NOT GIVE THE WATER TO
INFANTS UNDER 6 MONTHS OLD
OR USE IT TO MAKE INFANT FORMULA OR JUICE

Results from water samples collected on June 5, 2006 showed nitrate levels of 13.74 mg/L. This is above the nitrate standard, or maximum contaminant level (MCL), of 10 mg/L. Nitrate in drinking water is a serious health concern for infants less than six months old.

What should I do?

- **DO NOT GIVE THE WATER TO INFANTS.** *Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue baby syndrome.* Blue baby syndrome is indicated by blueness of the skin. Symptoms in infants can develop rapidly, with health deteriorating over a period of days. If symptoms occur, seek medical attention immediately.
- Formula for children under six months of age should not be prepared with tap water. Instead, use bottled water or other water low in nitrates when preparing infant formula until further notice.
- **DO NOT BOIL THE WATER.** Boiling, freezing, filtering, or letting water stand does not reduce the nitrate level. Excessive boiling can make the nitrates more concentrated, because nitrates remain behind when the water evaporates.
- Adults and children older than six months can drink the tap water (nitrate is a concern for infants because they can't process nitrates in the same way adults can). However, if you are pregnant, nursing or have specific health concerns, you may wish to consult your doctor.

What happened? What is being done?

Nitrate in drinking water can come from natural, industrial, or agricultural sources (including septic systems and run-off). Levels of nitrate in drinking water can vary throughout the year. We are investigating and taking the necessary steps to correct the problem as soon as possible.

For more information, please contact _____ at _____ or _____
name of contact phone number mailing address

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

PWSID#: _____ Date distributed: _____

SESSION FOUR: SUPPLEMENTAL MATERIALS

Tier 1: Total Coliform Notice

April 26, 2006

May 1, 2006
Joe's Restaurant
Main Street
Small Town, OH 43678

Re: Joe's Restaurant
Shelby County
Transient Water System
PWSID No. 1234567

SUBJECT: Notice of Violation -- Failure to Sample Drinking Water for Total Coliform Bacteria

Your public water system is in violation of Rule 3745-81-21 of the Ohio Administrative Code for failure to comply with the coliform bacteria sampling requirements:

Monitoring Period:	January - March 2006
Required Coliform Sampling:	at least one routine sample
Sample Results Submitted:	NONE
Required Monitoring Periods:	Jan-Mar; Apr-June; July-Sept; Oct-Dec each year

Actions required as a result of the above monitoring violation:

1. Comply with Rule 3745-81 -32: Notify water users (public notice; example enclosed).
2. Method of Notification: Hand delivery or posting conspicuously in area served by water system, within 30 days of this letter.
3. Verification to OEPA: Return to us a copy of your notice as issued, along with the attached verification form, within 10 days after you notify your water users.

Please mark your calendar to sample in future monitoring periods. Continued failure to monitor may subject you to legal action. If you have any questions, please contact me at (937) 285-6417.

Sincerely,

John Smith
Environmental Specialist
Division of Drinking and Ground Waters

Enclosures

cc: County Health Department

10. Lead & Copper

- Samples for lead and copper must be taken every six months, unless the system is below the action levels for lead and copper for two consecutive six month periods or has optimized corrosion control. In that case samples must be taken annually.
- Small or medium sized systems (less than 10,000 persons served) that are below the action levels for lead and copper for three consecutive years may reduce sampling to once every three years.
- Samples are collected at a number of locations throughout the distribution system. The number of distribution samples that must be taken depends upon the number of persons served.
- A system has exceeded the MCL if the 90th percentile value of the samples collected in any monitoring period exceeds the action levels for lead or copper. The 90th percentile value is the value of the sample in the 90 percent position of the total numbers of sample collected.
- The action levels for lead and copper are 0.015 mg/L and 1.3 mg/L.

Lead and Copper Rule

This rule became effective in 1991 with revisions that became effective April 11, 2000. OEPA has primacy for enforcement. This rule deals mainly with lead and copper levels in water at the customers' tap. Major provisions of this rule include:

- Requires monitoring of lead and copper levels at customer taps. Monitoring requirements vary, depending upon the size of the system.
 - Monitoring requirements are broken down by systems serving more than 50,000 persons, systems serving 3,301 to 50,000 persons, and systems serving 3,300 or fewer persons.
 - Transient non-community water systems are excluded from this rule.
- Systems where lead and copper levels at the customer tap exceed action levels (0.015 mg/L for lead and 1.3 mg/L for copper) must institute corrosion control practices. This usually involves additional chemical treatment at the water treatment plant to raise pH and make the water more stable and less corrosive.
- Follow-up monitoring is required to verify corrosion control practices are working.

Water systems must provide educational information to their customers outlining the causes of elevated lead and copper levels, the health effects of lead and copper, and actions the customers can take on their own to reduce their risk of exposure.

SESSION FOUR: SUPPLEMENTAL MATERIALS

SAMPLE

Lead Tap Monitoring Report

Submit with form EPA 5105

Page 1 of 1 pages

PWS Name Anytown Mobile Home Park	PWS I.D.1234567	County Pickaway
Dates samples were collected: 05/02/06		

- (1) List this monitoring period's samples in order from the lowest lead concentration to the highest lead concentration. .
- (2) Number the first column of each line used, starting with the number 1.
- (3) Calculate the 90th percentile he number(s) according to the instructions and circle that number(s) and the lead concentration(s) for that sample(s).

Line Number	Sample Date <u>and</u> Laboratory Sample Number	Address <u>and</u> Tap type	Structure Type SFR MFR or BLDG	Interior Plumbing Material Pb CuPb>82 CuPb<83 CuLF or other	Service Line Material Pb Cu or other	Tier 1 2 3 or other	Lead Concn. [Cu] ug/L	
1	05/02/06 82573	123 S. A St. Anytown	R	SFR	CuPb>82	Cu	1	<5.0
2	05/02/06 82574	103 S. A St. Anytown	R	SFR	CuPb>82	Cu	1	<5.0
3	05/02/06 82575	08 N. Main St. Anytown	R	SFR	CuPb>82	Cu	1	<5.0
4	05/02/06 82576	20 N. Main St. Anytown	R	SFR	CuPb>82	Cu	1	<5.0
5	05/02/06 82577	19 Front St. Anytown	R	SFR	CuPb>82	Cu	1	<5.0

Tap type codes B- Bathroom sink cold water tap; D- drinking fountain; K - kitchen sink cold water tap; R - rest room cold water tap; O - other tap (with prior Ohio EPA approval)

This report Is required under Revised Code sections 6109.04 and 6109.12. Noncompliance may result in civil. EPA 5108 12.97 NOTICE: penalties up to a maximum of 825,000 per violation under sections 6109.31 and 6109.33.

Calculation: This report shows no detectable amounts in the sample.

SESSION FOUR: SUPPLEMENTAL MATERIALS

SAMPLE

Copper Tap Monitoring Report

Submit with form EPA 5105

Page 1 of 1 pages

PWS Name Anytown Mobile Home Park	PWS I.D. 1234567	County Pickaway
Dates samples were collected 05/02/06		

- (1) List this monitoring period's samples in order from the lowest lead concentration to the highest lead concentration. .
- (2) Number the first column of each line used, starting with the number 1.
- (3) Calculate the 90th percentile he number(s) according to the instructions and circle that number(s) and the lead concentration(s) for that sample(s).

Line Number	Sample Date and Laboratory Sample Number	Address and Tap type	Structure Type SFR MFR or BLDG	Interior Plumbing Material Pb CuPb>82 CuPb<83 CuLF or other	Service Line Material Pb Cu or other	Tier 1 2 3 or other	Copper Conc. [Cu] ug/L
1	05/02/06 82573	123 S. A St. Anytown	R SFR	CuPb>82	Cu	1	928
2	05/02/06 82574	103 S. A St. Anytown	R SFR	CuPb>82	Cu	1	1030
3	05/02/06 82575	08 N. Main St. Anytown	R SFR	CuPb>82	Cu	1	1050
4	05/02/06 82576	20 N. Main St. Anytown	R SFR	CuPb>82	Cu	1	1249
5	05/02/06 82577	19 Front St. Anytown	R SFR	CuPb>82	Cu	1	1449

Tap type codes B- Bathroom sink cold water tap; D- drinking fountain; K - kitchen sink cold water tap; R - rest room cold water tap; O - other tap (with prior Ohio EPA approval)

This report Is required under Revised Code sections 6109.04 and 6109.12. Noncompliance may result in civil. EPA 5108 12.97 NOTICE: penalties up to a maximum of 825,000 per violation under sections 6109.31 and 6109.33.

Calculation:

Add 4th and 5th lines together and divide by 2: (1249 + 1449) divided by 2 = 1349. The violation is 1350.

11. CORROSION CONTROL

Protecting Public Health

Corrosive water can leach toxic metals from the distribution and household plumbing systems. Two metals that are most likely to cause concern because they are commonly found in household plumbing systems are:

- Lead
- Copper

Corrosion of older cast iron water mains can cause the formation of iron deposits called tubercles. These deposits can protect bacteria and other microorganisms from chlorine allowing them to grow creating a public health hazard.

Improving Water Quality

Corrosive water can attack metal piping causing taste, odor, and color problems in a water system. Red-water can occur when iron is dissolved from cast-iron water mains by corrosive water. Corrosive water can also affect lead and copper piping. Corrosive water can affect water quality in the following ways:

- Stains plumbing fixtures and laundry
- Aesthetically unappealing for drinking and bathing
- Provide food for harmful microorganisms
- Cause public health concerns from leaching of lead and copper into the water supply

Extending the Life of Plumbing Equipment

Corrosive water can result in significant costs to water systems and customers by:

- Significantly reducing the life of valves, unprotected metals and pipes
- Shortens the service life of plumbing fixtures
- Shortening the useful life of a hot water heater

Meeting Federal and State Regulations

In 1991 the US Environmental Protection Agency (USEPA) enacted the Lead and Copper Rule. All water systems are required to check if their water is corrosive enough to cause lead and copper corrosion products to appear in the customer's water at levels exceeding the new action levels. The new action levels are as follows:

- Lead – 0.015 mg/L or 15.5 ug/L (ug = microliter) at the 90th percentile of the number of samples tested.
- Copper – 1.3 mg/L or 1,350 ug/L (ug = microliter) at the 90th percentile of the number of samples tested.

If the action level is exceeded, the water system is required to take action to reduce the corrosivity of the water.

Water System Corrosion

Corrosion can be broadly defined as the wearing away or deterioration of a metal due to chemical reactions with its environment. The most familiar example is the formation of rust (oxidized iron) when an iron or steel surface is exposed to moisture.

Water that promotes corrosion is known as corrosive or aggressive water. In water treatment operations, corrosion can occur to some extent with almost any metal that is exposed to water. How extensive the corrosion will be depends on several factors.

Factors Affecting Corrosion

The rate of corrosion depends on many site-specific conditions, such as the characteristics of the water and the type of pipe material. Chemical reactions play a critical role in determining the rate of corrosion. The following factors affect the corrosion rate:

- Dissolved Oxygen – as the concentration of DO increase so does the rate of corrosion.
- Total Dissolved Solids – as the TDS increases water becomes a better conductor, which in turn increase the rate of corrosion.
- Alkalinity and pH – Generally as alkalinity and pH increase, the rate of corrosion decreases.
- Temperature – because chemical reactions occur more quickly at higher temperatures, an increase in water temperature generally increases the corrosion rate.
- Type of metal – metals that easily give up electrons will corrode easily.

Types of Corrosion

Corrosion in water systems can be divided into two broad classes:

- Localized – the most common type found in water systems, attacks the metal surfaces unevenly.
- Uniform – corrosion takes place at an equal rate over the entire surface.

Corrosion Control Methods

The basic methods used for stabilizing water to protect against the problems of corrosion are:

- Adjustment of alkalinity and pH
- Formation of a calcium carbonate coating
- Use of corrosion inhibitors and sequestering agents

Adjustment of alkalinity and pH

Generally soft waters that have a pH of less than 7 and are slightly buffered (low alkalinity) will be corrosive to lead and copper. Water that has too much alkalinity can also be quite corrosive. In, general a moderate increase in pH and alkalinity levels can reduce corrosion. The following are some chemicals commonly used to adjust alkalinity and pH:

- Lime – used to adjust both pH and alkalinity, it is less expensive than other chemicals having the same effect.
- Soda Ash – can be added with lime to further increase a waters alkalinity.
- Sodium Bicarbonate – used sometimes instead of Soda ash, because it will increase alkalinity without as much of an increase in pH.
- Caustic Soda – when used with soda ash or sodium bicarbonate will increase pH and alkalinity.

Formation of a Calcium Carbonate Coating

A common protective-coating technique is to adjust the pH of the water to a level just above the saturation point of calcium carbonate. When this level is maintained, calcium carbonate will precipitate and form a protective coating on the inside of the pipe walls. The same chemicals use to adjust pH and alkalinity can be used to develop the protective coating of calcium carbonate.

Use of Corrosion Inhibitors and Sequestering Agents

Some waters do not have enough calcium or alkalinity to make the formation of a calcium carbonate coating economical. Therefore the addition of corrosion inhibitors and sequestering agents are used to control corrosion. The most common compounds used are:

- Polyphosphates
- Silicates

The chemical reactions by which these compounds combine with corrosion products to form a protective layer are not completely understood; however, the chemicals have proven successful in many water systems.

Some polyphosphates also sequester iron, whether it is dissolved in water from the source or from corrosion of the system.

12. Consumer Confidence Reports

(CCR Information taken from Small Water System Operation and Maintenance, 4th Edition, at page 497, published by California State University, Sacramento and the USEPA, Office of Drinking Water)

EPA has developed regulations requiring every public water system to prepare and distribute an annual Consumer Confidence Report. The reports are an opportunity for positive communication with consumers and a means to convince consumers of the importance of paying for good quality water.

Consumer Confidence Reports are an effective way for a water utility to communicate with consumers that their water is safe to drink. These reports also provide an opportunity to inform rate payers of the need for sufficient funds to properly operate and maintain the water supply, treatment, and distribution systems. If higher rates are necessary to fund a capital improvement program, the reports can explain the importance of having sufficient water with adequate pressure and high quality.

Items that should be covered in Consumer Confidence Reports include:

1. Information on source of drinking water supply,
2. Brief definition of terms, List of contaminants detected including level detected, MCL (maximum contaminant level), and MCLG (maximum contaminant level goal),
3. For MCLs violated, information on health effects, and
4. Information on any unregulated contaminants.

Some utility agencies try to have an article published in the local newspaper explaining the report before it is made available to consumers. This advance information helps the consumers understand the report.

CCR's should be a short, concise letter report of one or two pages that can be mailed directly to consumers or mailed in the envelope with the utility bill.

All utility staff should be familiar with the contents of the report because consumers who know individual staff members frequently will ask questions about the report.

Water utilities should emphasize the good job they are doing as guardians of health in these Consumer Confidence reports.

Sample Drinking Water Consumer Confidence Report

The following is a representation of a drinking water consumer confidence report.

**The Easy Rest Motel and Apartments
Drinking Water Consumer Confidence Report
For 2005**

The Easy Rest Motel and Apartments has prepared the following report to provide information to you, the consumer, on the quality of our drinking water. Included within this report is general health information, water quality test results, how to participate in decisions concerning your drinking water and water system contacts.

The Easy Rest Motel and Apartments supplies water to its customers from two drilled wells located on the property. Water from the wells is pumped to three hydro pneumatic pressure tanks, and then to a cartridge filter, the water is then split through three ion-exchange softeners before distribution. The aquifer that supplies drinking water to Easy Rest Motel and Apartments has a high susceptibility to contamination, due to the sensitive nature of the aquifer in which the drinking water wells are located and the existing potential contaminant sources identified. This does not mean that this well field will become contaminated, only that conditions are such that the groundwater could be impacted by potential contaminant sources. Future contamination may be avoided by implementing protective measures.

The sources of drinking water both tap water and bottled water includes rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity.

Contaminants that may be present in source water include: (A) Microbial contaminants, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations and wildlife; (B) Inorganic contaminants, such as salts and metals, which can be naturally-occurring or result from urban storm water runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming; (C) Pesticides and herbicides, which may come from a variety of sources such as agriculture, urban storm water runoff, and residential uses; (D) Organic chemical contaminants, including synthetic and volatile organic chemicals, which are by-products of industrial processes and petroleum production, and can also come from gas stations, urban storm water runoff, and septic systems; (E) radioactive contaminants, which can be naturally-occurring or be the result of oil and gas production and mining activities.

In order to ensure that tap water is safe to drink, USEPA prescribes regulations which limit the amount of certain contaminants in water provided by public water systems. FDA regulations establish limits for contaminants in bottled water, which must provide the same protection for public health.

Drinking water, including bottled water, may reasonably be expected to contain at least The EPA requires regular sampling to ensure drinking water safety. The Easy Rest Motel and Apartments conducted sampling for the following contaminants during 2001-2005. Samples were collected for a total of 28 different contaminants most of which were not detected in the Easy Rest Motel and Apartments water supply. The Ohio EPA requires us to monitor for some contaminants less than once per year because the concentrations of these contaminants do not change frequently. Some of our data, though accurate, are more than one year old.

During the month of December 2005, Easy Rest Motel and Apartments failed to Monitor and report Synthetic organic compounds (SOC's). These samples were collected on February 4, 2006, which indicated that all levels are below the Environmental Protection Agency allowable limit.

Steps have been taken to ensure that all sampling will be conducted as required by enacting a more comprehensive management plan. This plan assigns responsibilities for sampling and contains contingency measure if the assigned staff is absent.

Listed below is information on those contaminants that were found in the Easy Rest Motel and Apartments drinking water.

SESSION FOUR: SUPPLEMENTAL MATERIALS

Contaminants (Units) MCLG		MCL	Level	Range of		Sample	Typical Source of Contaminants
		Violation	Found	Detections		Year	
Inorganic Contaminants							
Fluoride (ppm)	4	4	0.94	NA	No	2002	Erosion of natural deposits; Water additive promoting strong teeth; Discharge from fertilizer and aluminum factories.
Copper (ppb)	1.3	AL=1.3	796	263-937	No	2005	Corrosion of household plumbing.
Lead (ppb)	0	AL=15	<5.0	<5.0-<5.0	No	2005	Corrosion of household plumbing systems.
Arsenic*	50	10	17.9	0-17.9	No	2005	Erosion of natural deposits

*"Some people who drink water containing arsenic in excess of the MCL over many years could experience skin damage or problems with their circulatory system, and may have an increased risk of getting cancer." The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline (1-800-426-4791).

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infection. These people should seek advice about drinking water from their health care providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by Cryptosporidium and other microbial contaminants are available from the Safe Drinking Water Hotline (1-800-426-4791).

For more information on your drinking water contact the Easy Rest Motel and Apartments manager's office at (555) 555-1234.

Definitions of some terms contained within this report.

Maximum Contaminant Level Goal (MCLG): The level of a contaminant in drinking water below, which there is no known or expected risk to health. MCLGs allow for a margin of safety.

Maximum Contaminant level (MCL): The highest level of contaminant that is allowed in drinking water. MCLs are set as close to the MCLG's as feasible using the best available treatment technology.

Parts per Million (ppm) or Milligrams per Liter (mg/L) are units of measure for concentration of a contaminant. A part per million corresponds to one second in a little over 11.5 days.

Parts per Billion (ppb) or Micrograms per Liter (g/L) are units of measure for concentration of a contaminant. A part per billion corresponds to one second in 31.7 years.

Maximum Residual Disinfectant Level Goal (MRDLG): The level of drinking water disinfectant below which there is no known or expected risk to health. MRDLG's do not reflect the benefits of the use of disinfectants to control microbial contaminants.

Maximum Residual Disinfectant Level (MRDL): The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.

Maximum Residual Disinfectant Level (MRDL): The highest residual disinfectant level allowed.

Maximum Residual Disinfectant Level Goal (MRDLG): The level of residual disinfectant below which there is no known or expected risk to health.