



Small Distribution System Best Practices

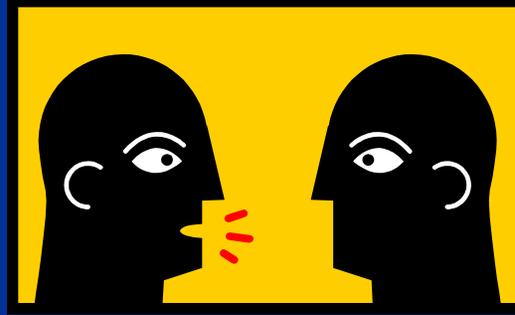
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CT DPH

Operators



- 💧 Treatment plant, Distribution System and Small Water Systems Operators have the responsibility for operational activities which directly impact the quality and/or quantity of drinking water provided to consumers.
- 💧 Certified Operators are required for the operation of Community and Non-Transient Non-Community Public Water Systems.

Agenda:



1. CT Distribution Systems – discussion
2. DWS Guidance Documents: Water Main & Storage Tank Design & Construction Guidelines
3. Distribution System Sanitary Elements and Sanitary Deficiencies (EPA & DWS)

1. CT Distribution Systems

Components of a Water System

- 💧 Source Water
- 💧 Treatment
- 💧 Storage
- 💧 **Distribution System**



1. CT Distribution Systems



💧 **Ref.** RCSA Section 25-32-7a

💧 (i) "Distribution system" means any combination of pipes, tanks, pumps, etc. which delivers water from the source(s) and/or treatment facility or facilities to the consumer.

Ref. EPA, Distribution Systems: A Best Practice Guide

💧 Distribution systems usually consist of: piping & fittings, pump & pump stations, meters, storage tanks, backflow prevention devices, hydrants and valves





1. CT Distribution Systems Discussion

cont.

Community Non-Transient Non-Community PWSs

💧 **625 Classified Small Water Systems (SWS)**

- 💧 Serve population from 25 to 999 persons
- 💧 SWSs in total serve 95,583 persons
- 💧 363 of 625 SWSs serve population <100 persons
- 💧 42 of 625 serve population >500 persons

💧 **54 Class I Distribution Systems (DS I)**

- 💧 Serve population from 1,000 to 5,000 persons
- 💧 DS I in total serve 100,877 persons



1. CT Distribution Systems Discussion cont.

Community Non-Transient Non-Community PWSs

💧 **42 Class II Distribution Systems (DS 2)**

- 💧 Serve population from 5,001 to 50,000 persons
- 💧 DS 2 in total serve 714,991 persons

💧 **11 Class III Distribution Systems (DS 3)**

- 💧 Serve population greater than 50,000 persons
- 💧 DS 3 in total serve 1,780,714 persons



2. References: Water Main Design & Construction Guidelines (WMD&CG 10/1/06)

STATE OF CONNECTICUT DEPARTMENT OF PUBLIC HEALTH
DRINKING WATER SECTION
WATER MAIN DESIGN AND CONSTRUCTION GUIDELINES

Effective Date: October 1, 2006

The following guidance is provided in the interest of facilitating the approval process for federally or state funded projects such as Drinking Water State Revolving Fund and STEAP grant projects that may include water main replacements or installations. Discretion in the application of these guidelines is allowable except as required by regulation. For routine distribution water main installations that do not require approval from the Department prior to construction, it is recommended that the following guidelines be utilized during design and construction except as required by regulation.

Sizing and Layout

(1) Section 19-13-B102(p) of the Regulations of Connecticut State Agencies (RCSA) requires transmission facilities to be sized to provide flows in excess of the maximum flows experienced in the community water system or service area. In addition, Section 19-13-B102(f)(1) of the RCSA requires that all service connections have a minimum water pressure at the main of 25 psi under normal operating conditions which in these guidelines includes normal peak demands but excludes fire flow demands. Whenever feasible, it is recommended that the minimum water pressure be 35 psi. Positive pressure (20 psi minimum recommended) should be maintained under all flow conditions, including fire flows if fire protection is provided, at all points in the distribution system. Pressure reducing devices should be installed where static pressures will exceed 100 psi. Pressure reducing devices conforming to section 604.7 of the current State of Connecticut Plumbing Code should be installed on individual service lines where static pressures entering the building are greater than 80 psi. If fire protection is to be provided, the system design should be such that fire flows, minimum fire flow pressures, hydrant spacing, etc. are in accordance with the requirements of the local fire protection regulatory authority.

(2) Water mains should be sized, whenever possible, to achieve a balance between hydraulic requirements and water quality maintenance. Excessive retention time (less than 5 to 7 days of retention time recommended) may result in low flow areas which may lead to water quality deterioration during normal operating conditions. If excess capacity is required for fire flow or future demands, flushing devices or equivalent should be installed in low flow areas and an operational plan should be implemented to routinely flush low flow areas. The use of smaller diameter parallel water mains in lieu of single larger mains should be considered whenever possible.

(3) Water mains should be looped and dead-end water mains avoided whenever possible. If dead-end mains are unavoidable, flushing devices should be installed at the termini of the dead-end water mains and an operational plan should be implemented to routinely flush the dead-end mains. If water mains will be separated by a closed valve thereby creating static conditions (as in the case of pressure zone boundaries for example), flushing devices should be installed on both sides of the closed valve.

Materials

(1) Pipes, fittings, valves, meters, fire hydrants, and other appurtenances should, at a minimum, conform to the most current applicable AWWA standards if available. In the absence of applicable

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sewer.

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STATE OF CONNECTICUT DEPARTMENT OF PUBLIC HEALTH
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standards, water pipe should be installed in accordance with manufacturer's instructions. In the absence of applicable AWWA standards, water pipe should be installed in accordance with the more stringent of manufacturer's instructions or other applicable recognized industry standards if available. At a minimum, continuous uniform and stable support, free of unsuitable materials, should be provided such that the water pipe is fully and firmly supported along its entire length. Proper embedment and backfill, free of unsuitable materials, should be provided and sufficiently compacted to ensure that the water pipe is adequately supported, stabilized, and protected. Special care should be taken when making pipe joints to ensure water tightness.

(2) All materials should be kept as clean as possible during construction. The use of plugs or equivalent on the open ends of the pipe is recommended to prevent contamination of pipe at the job site. Joints should be cleaned of any grit and other foreign material which may promote leakage.

(3) All buried water pipe should be placed at such a depth below finished ground level, four feet minimum, that will prevent freezing during the coldest weather experienced. Service connections that will not be used during freezing weather and will be drained during such time may be exempt from this recommendation. In special situations, excluding ledge, where it may not be feasible to bury the water pipe below the frost line, the use of adequate insulation or equal may be permissible to prevent freezing of the water pipe. Consideration should also be made for insulating water pipe that is installed four feet or greater below finished ground level but passes above or below a structure that may be a cold air source such as a culvert.

(4) Thrust blocks and/or restrained joints should be used on all tees, bends, caps, plugs, reducers, valves, hydrants, etc. to prevent joint separation. If a combined thrust block/restrained joint system is used, either the thrust block or restrained joint system should be designed to provide full thrust restraint independent of the other system.

(5) The water main should be adequately protected by the use of flexible joints, preferably ball and socket joints, or equivalent in critical areas of water main stress such as piping through rigid walls or structures and/or where differential settlement may occur.

(6) Separating Distances from Sources of Pollution:

(A) Parallel installations: water mains should be laid at least 10 feet horizontally, measured edge to edge, from any existing or proposed sewer (sanitary, building/house, and storm) whenever possible. If the 10-foot horizontal separating distance cannot be physically achieved, the water main may be installed closer provided that is located in a separate trench or on an undisturbed shelf and at least 12 inches horizontally (18 inches recommended), measured edge to edge, and 18 inches above the top of the sewer, measured from crown to invert. There should be no reduction in the 10-foot horizontal separating distance for a sanitary sewer force main. No water main should come in contact with any part of a sewer manhole.

(B) Crossings: at sewer crossings, a minimum vertical clearance of 18 inches, measured from the crown to invert, should be maintained between the water main and sewer with the preferred location

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2. WMD&CG

cont.

Guideline Sections

- 🔹 Size & Layout
- 🔹 Materials
- 🔹 Appurtenances
- 🔹 Service Connections
- 🔹 Installation
- 🔹 Cross Connections
- 🔹 Hydrostatic Testing & Disinfection

2. STD&CG

cont.

- Storage tank technical guidelines were developed to assist water system personnel, operators, consultants, etc. during design and construction of new tanks as well as to assess existing tanks.
- The guidelines are best engineering type practices based on industry standards (AWWA, Ten States Standards, etc.) and what we've seen during sanitary surveys and project reviews.
- Except where specifically noted as being regulatory requirements, the guidelines themselves are not enforceable.
- Guidelines can be located at DPH website.



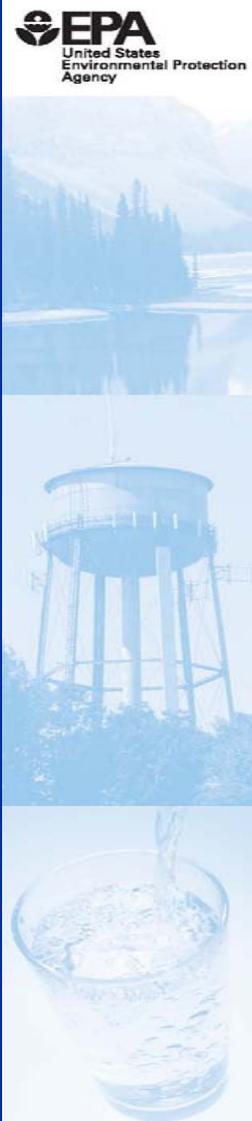
2. STD&CG

cont.

Guideline Sections

- 💧 Definition
- 💧 Location
- 💧 Sizing
- 💧 General Design and Construction Considerations
- 💧 Water Quality Maintenance
- 💧 Materials
- 💧 Coating & Cathodic Protection
- 💧 Appurtenances
- 💧 Yard Piping
- 💧 Disinfection & Water Quality Testing

2. References: Distribution Systems A Best Practice Guide



Distribution Systems: A Best Practices Guide

Introduction

<i>Purpose</i>	This Guide discusses the importance of maintaining your distribution system.
<i>Target Audience</i>	This Guide is intended for owners and operators of all public water systems serving fewer than 10,000 persons.

Distribution Systems

Distribution Systems usually consist of:

- ♦ Piping and fittings
- ♦ Pumps and pump stations
- ♦ Meters
- ♦ Storage tanks
- ♦ Backflow prevention devices
- ♦ Hydrants and valves

Importance of Maintaining Your Distribution System

A properly maintained distribution system is important for ensuring that you can: provide high quality water to your customers, continue operating in the event of an emergency, help minimize property damage as a result of responding to an emergency, and help prevent contamination events. A properly maintained distribution system can also extend equipment life-cycles and minimize problems related to minor or major equipment failures.

Distribution System Routine and Preventative Maintenance Tasks

The following table provides suggested frequencies of routine and preventative maintenance tasks for systems under normal operation. However, any time a system experiences water quality issues, the appropriate tasks should be performed as frequently as needed. Contact your state for more information.

<i>Task</i>	<i>Benefits</i>	<i>Suggested Frequency</i>
Valve exercising	<ul style="list-style-type: none"> ♦ Improves reliability. ♦ Familiarizes crews with valve location. ♦ Identifies inoperable valves. ♦ Locates obstructed valve boxes. ♦ Ensures isolation of distribution system sections when necessary. 	Annually.
Flushing pipelines	<ul style="list-style-type: none"> ♦ Removes aged water from the pipeline. ♦ Reduces buildup of biofilms and sediments. ♦ Restores disinfectant residual. 	Annually for all piping. More often in areas with water quality issues (e.g., dead ends).
Storage tank inspections	<ul style="list-style-type: none"> ♦ Detects vandalism. ♦ Identifies defects. ♦ Ensures that access hatches are locked. ♦ Ensures that vents, overflows, and drains are screened. 	Daily or weekly for vandalism. Annually for other items.



3. Sanitary Deficiencies for Distribution Systems (EPA)

Chapter 7

- 💧 Piping Materials – 7 items
- 💧 Material Standards - 8 items
- 💧 Water Quality - 13 items
- 💧 Maps, Drawing & Planning – 4 items
- 💧 Distribution System Monitoring - 10 items
- 💧 System Operation & Maintenance - 11 items
- 💧 Safety Considerations - 8 items
- 💧 Disinfection Procedures - 3 items
- 💧 Design Operational Constraints on WQ - 3 items
- 💧 Design Operational Constraints on Reliability – 4 items

💧 Ref. EPA - How to Conduct Sanitary Survey of Small Water System Pages 4-13

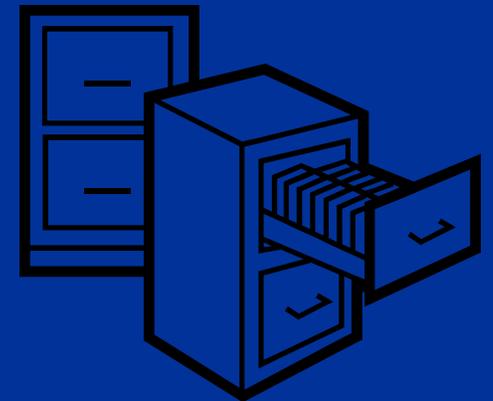


3. DWS Sanitary Survey Distribution System Elements

- Does the PWS have a sampling site plan with sampling points representative of water delivered to all customers?
- Does the PWS have an annual flushing program?
- Does the PWS maintain a minimum of 25 psi under normal conditions to all service connections? (i.e. are positive pressures maintained in the distribution system under normal operating conditions?)
- Does the PWS have a program to reduce the amount of unaccounted for water (i.e. leak survey, calibration of meters, etc.)?

3. DWS Sanitary Survey Monitoring, Reporting, and Data Verification Elements

- 💧 Review of the water quality testing schedule to check for any:
 - 💧 Monitoring/reporting violations
 - 💧 Outstanding public notification requirements
 - 💧 Inventory of water system facilities
 - 💧 Inventory of sampling locations
 - 💧 Contact updates
- 💧 Record keeping requirements
 - 💧 Maps
 - 💧 Water quality results
 - 💧 Public notice documents
 - 💧 Water meter readings
 - 💧 Treatment effluent logs
 - 💧 Customer complaints
 - 💧 Records of actions taken to correct violations



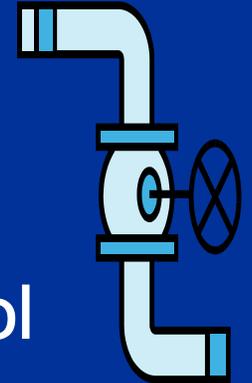


3. Record Keeping Requirements

RCSA Section 19-13-B102(I)

Item to maintain on record	Time frame
Total coliform bacteria test results	Five years
Chemical test results	Ten years
Actions taken to correct violations	Three years
Sanitary survey reports and responses to such	Ten years
Records concerning a variance granted to the water system	Five years
Maps and records showing location of mains, hydrants and other facilities (community water systems)	Integrated map to be filed and updated every five years
Complaint log (community water systems)	Three years following resolution
Lead and copper records	Twelve years
Cross-connection control records	Five years
Consumer confidence reports (community water systems)	Five years
Filter turbidity measurements (surface water treatment plants)	Three years
Public notices issued and certification forms	Three years
Meter readings (community water systems)	Readings taken weekly from each source of supply

3. DWS Sanitary Survey Distribution System Elements



- Does the PWS have a cross connection control program?
 - Have all categories of concerns been identified?
 - Have all cross connection violations been corrected?
 - Have all backflow prevention devices been tested?
 - Has the cross connection report been submitted to DPH?
- Ref. RCOSA Section 19-13-B102 (f)**

Visit the DWS website!



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Haitian Relief Effort

Department of Public Health
410 Capitol Avenue
Hartford, CT 06134

Phone:
(860) 509-8000

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Drinking Water Section

Welcome to the Drinking Water Section (DWS) website. The DWS is responsible for the administration of state and federal drinking water regulations and is dedicated to assuring the quality and adequacy of our State's public drinking water sources. We provide technical assistance, education and regulatory enforcement to over 2,600 public drinking water systems, which provide drinking water to approximately 2.7 million persons on a daily basis. We maintain a continuing commitment to drinking water treatment and monitoring, drinking water source protection, and consumer education in order to assure and maintain the high standard of drinking water Connecticut's citizens have come to expect and enjoy.



For the latest information on upcoming events, topics of interest and essential updates check our [What's New](#) section frequently.

CT RECOVERY For Information on the American Recovery and Reinvestment Act of 2009 public drinking water infrastructure projects [click here](#)

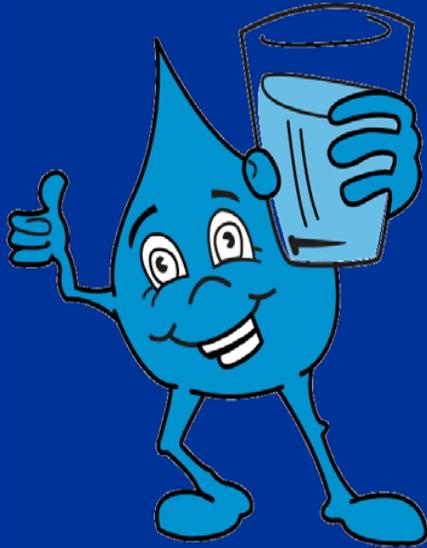
Ground Water Rule Public water systems using groundwater sources will be required to comply with the provisions of the Ground Water Rule on **December 1, 2009**. For updated information on the Ground Water Rule [click here](#)

- [Public Water Systems](#)
- [Certified Operators](#)

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ater](http://www.ct.gov/dph/publicdrinkingwater)



Thank you!



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WMD&CG: Water Main Size & Layout specifications

- “transmission facilities to be sized to provide flows in excess of the maximum flows experienced in the community water system or service area”
- “all service connections have a minimum water pressure at the main of 25 psi under normal operating conditions which in these guidelines includes normal peak demands but excludes fire flow demands”
- “pressure reducing devices should be installed where static pressures will exceed 100 psi.”
- “water mains should be sized, whenever possible, to achieve a balance between hydraulic requirements and water quality maintenance. Excessive retention time (less than 5 to 7 days of retention time recommended)etc.”



WMD&CG: Materials specifications

- 💧 “Pipes, fittings, valves, meters, fire hydrants, and other appurtenances should, at a minimum, conform to the most current applicable AWWA standards”
 - 💧 “All pipe materials and products including, but not limited to, paints, linings, coatings, adhesives, and lubricants in direct contact with potable water should be certified to NSF/ANSI Standard 61”
 - 💧 “Metallic materials should be protected against internal and external corrosion”
 - 💧 “The use of non-metallic buried water pipe should include a tracer wire, underground utility detection tape, or equivalent means for pipe location”
-etc.



WMD&CG: Appurtenances specifications

- ☉ “Shut-off valves should be installed at intervals and locations as determined by the public water system (PWS) to minimize interruptions of service to customers during repairs or maintenance”
- ☉ “Air release valves should be located and installed to prevent the entry of rainwater and vermin and under no circumstance should they be subject to being submerged”
- ☉ “Blow-offs or equivalent appurtenances should be installed at low points of the water main installation, depending on flow rate and pipe profile, where sediment may accumulate”
- ☉ “Flushing devices should be capable of providing a minimum flushing velocity of 2.5 feet per second”

....etc.

WMD&CG: Service Connections specifications

- “Domestic service pipes should have a minimum diameter of $\frac{3}{4}$ inch”
 - “Domestic service pipes should be connected to a single-service corporation stop at the water main and should be installed with a shut-off valve and curb box”
 - “Domestic service connections should be individually metered”
 - “Means should be provided to flush dedicated fire service lines to remove stagnant water”
-etc.



WMD&CG: Cross Connection specifications

- 💧 “Section 19-13-B37 of the RCSEA requires that no physical connection be made between the distribution system of a PWS and any customer with a private well or existing PWS well unless such well is physically disconnected from the customer’s plumbing”
 - 💧 “In addition, if the well is known to be contaminated, the customer shall also install a reduced pressure principle backflow prevention device (RPD) on the service line from the PWS”
-etc.



STD&CG: Location specifications

- ☉ Section 19-13-B102(d)(1) of the RCSA requires storage tanks to be located above the level of the 100-year flood elevation.
- ☉ Section 19-13-B102(f)(5)(B) of the RCSA requires in-ground finished water storage tanks to be located at least 50 feet from any part of a subsurface sewage disposal system or sanitary sewer and at least 25 feet from the nearest watercourse, storm drain, or other source of pollution.
- ☉ Section 19-13-B102(f)(5)(B) of the RCSA allows the 50-foot separating distance requirement for sanitary sewers to be reduced to 25 feet if the sanitary sewer is constructed in accordance with Section 19-13-B103d of the RCSA (Technical Standards for Subsurface Sewage Disposal Systems).

....etc.



STD&CG: Sizing specifications

- 💧 “Section 19-13-B102(p) of the RCSA requires storage tanks to be sized to provide flows in excess of the maximum flows experienced in the water system or service zone served by the storage tanks”
 - 💧 “The minimum usable storage capacity for atmospheric storage tanks not providing fire protection should be equal to the average daily demand (ADD) of the PWS or service area served by the storage tank”
 - 💧 “Storage tanks should be sized to achieve a balance between hydraulic requirements and water quality maintenance”
-etc.



STD&CG: General Design and Construction Considerations specifications

- ☉ Storage tank materials, fabrication, installation / construction, and testing should be in accordance with the most current applicable American Water Works Association (AWWA) standards if available.
- ☉ Bladder tanks should be certified to NSF/ANSI Standard 61.
- ☉ Section 19-13-B102(f)(5)(A) of the RCSEA requires that all finished water storage tanks be properly constructed in a sanitary manner and located to prevent storm water and precipitation from entering the tank and contaminating the water. In addition, all tanks should be constructed to protect the stored water from contamination by birds, animals, insects, and excessive dust.

...etc.

STD&CG: Water Quality Maintenance specifications

- “Storage tanks should be designed and operated to facilitate adequate turnover and mixing/circulation of stored water to prevent water quality deterioration due to excessive water age (stagnation) and dead spots within the storage tank”
- “Complete turnover is recommended every 3-5 days, however, specific turnover rate should be established based on the stored water quality and/or hydraulic modeling”
- “Whenever possible, separate inlets and outlets should be provide”
- ...etc.

STD&CG: Coating & Cathodic Protection specifications

- ☹ “Interior and exterior coatings should be able to withstand conditions to which they may be subjected to while in service”
 - ☹ “Interior coatings should be properly applied and cured in accordance with applicable standards or manufacturer’s recommendations to prevent leaching of substances into the stored water”
 - ☹ “When feasible, interior coatings should be used in conjunction with a cathodic protection system for maximum corrosion protection”
 - ☹ “Cathodic protection access plates should be sealed watertight”
-etc.