

SECTION 4

WATER DISTRIBUTION SYSTEM

4.1 **DESIGN CRITERIA**

4.1.1 **SUBMISSIONS:**

1. Water Distribution system Public Improvements Plans: The public improvement plans shall describe the proposed water distribution system in adequate detail so as to serve as construction drawings as well as satisfying the requirements of this section.
2. Water Distribution system Report: A water distribution system report shall be submitted with the final plat describing the basis for the design of the water distribution system and shall include but is not limited to :
 - a. Soil conditions with resistivity resistivity test results along the proposed water line location.
 - b. Anticipated water consumption requirements including peak daily demand.
 - c. Fire flow requirements according to Insurance Services Office requirements.
 - d. Anticipated residual pressure within the subdivision on peak hour demand.

4.1.2. METHOD: The design of the water distribution system shall be based on standard design practices and design criteria contained in this section.

4.1.3 CRITERIA: The design of the water distribution system shall be based on the following:

1. Flow: Design peak daily residential per capita demand shall be 400 gallons per day. Peak daily industrial demand must be approved by the Town Engineer. Peak minute residential demand shall be taken to be 15 gpm. Residential areas require 1500 gpm for fire flow. In industrial and commercial areas, a fire flow of 3500 gpm shall be made available for the area.
All pipes shall be designed to have a maximum velocity of 10 feet per second.
2. Pressure: all areas shall be designed to have a maximum static head of 250 feet (108 psi) and a minimum static head of 100 feet (43 psi). distribution systems shall also be designed to maintain a 20 psi residual pressure during required fire flow and a 30 psi residential residual during peak residential flows. Pressure zones shall conform to existing town of Lyons zones as approved by the Town Engineer.
3. Pipe size: The minimum pipe size shall be determined as follows:
 - a. Minimum pipe size for residential shall be six (6) inch diameter, except where smaller diameter pipe is approved for areas of low demand.

- b. Minimum pipe size for commercial and multiple family areas (higher density than duplex) shall be eight (8) inch diameter.
- 4. Distribution system layout:
 - a. Dead ends shall be minimized by looping all mains, when possible.
 - b. Water lines shall be located in the streets as shown in Figure 4-1. Other utilities shall not be installed within ten feet of any existing town water line.
 - c. Water lines into cul-de-sacs shall extend so that the maximum distance from the water line to the curb at the closed end of the cul-de-sac shall not exceed ten (10) feet.
 - d. Water mains shall be located 10 feet to the north or east of the street center-line. See figure 4-1.
- 5. Valves will be located as follows:
 - a. At all street intersections so that each block may be isolated.
 - b. At each entrance into a cul-de-sac.
 - c. For each fire hydrant.
 - d. In all cases the line valves shall not have more than a 600-foot separation.
- 6. Fire Hydrants: Fire hydrant locations shall be as follows:
 - a. Fire hydrants shall be connected to looped water lines, whenever possible.
 - b. Fire hydrants shall be connected to six (6) inch diameter lines and larger.
 - c. Single family and duplex residential developments shall have fire hydrants spaced so that no structure shall be more than 300 feet from the hydrant as measured via the street. Hydrants shall not be more than 600 feet apart.
 - d. Fire hydrants in cul de sacs over 300 feet in length shall be on an eight (8) inch minimum water main.
 - e. Multiple family (higher density than duplex) developments shall have fire hydrants spaced so that no structure shall be more than 200 feet from a fire hydrant as measured via the street. Hydrants shall not be more than 400 feet apart.
 - f. Commercial and Industrial developments shall have fire hydrants spaced so that no structure shall be more than 175 feet from a hydrant as measured via the street. Fire hydrants shall not be more than 350 feet apart.
 - g. Fire Hydrants shall be located at intersections as far as practicable as shown in Figure 4-2.
- 7. Air Relief Valves: On mains larger than ten (10) inch diameter, air relief valves shall be provided at all high points. The air relief valve shall be placed in a vault with easy access and sufficient working space. (See figure 4-3 for valve and vault specifications.)

8. Surface Water Crossings: Prior to preparations of construction drawings, surface water crossings shall be discussed with town Engineer. In general, the following requirements shall be met:
 - a. Above Water Crossings: The pipe shall be adequately supported, protected from damage from freezing and accessible for repair or replacement.
 - b. Under Water Crossings: The pipe shall be bedded in $\frac{3}{4}$ inch washed rock six (6) inches or more surrounding the main with a six (6) inch thick concrete cap on top. (See Figure 4-4 for details.)
9. Cover: All distribution mains shall have a minimum of 4 $\frac{1}{2}$ feet and a maximum of six (6) feet of cover from finished grade to the top of the pipe. Prior to the installation of any water main, the street shall be at subgrade elevation.
10. Service Connections: Water service lines shall be located so as to take the shortest, most direct path (preferably perpendicular to the water main) from the water main to the house. When possible, the water service lines shall be located five (5) feet from the lot center linecenterline, on the high side of the lot, and a minimum of ten (10) feet on the horizontal plane from the sanitary sewer service line. The point where the water service line crosses under the curb shall be marked. This point shall be indicated by chiseling a symbol "V" on the curb. All water service lines shall have a minimum of 4 $\frac{1}{2}$ feet of cover to finished grade. Water service lines are not allowed to cross property other than the property Service lines shall not be located under driveways. No meter pits will be allowed in a driveway, parking area or sidewalk.

4.2 SPECIFICATIONS

4.2.1 SCOPE: The work covered by these specifications concerns the furnishing of all labor, equipment and materials and performing all operations for the construction of the water distribution system including water lines, valves, air vacs, fire hydrants and other fittings and appurtenances in accordance with these specifications and the Standard Design Drawings in Paragraph 4.5.

4.2.2 GENERAL REQUIREMENTS: The water distribution system shall be constructed in accordance with engineered construction plans for the work, prepared under the direction of a professional engineer and approved by the Town Engineer.

1. Water Line Piping: all materials to be installed shall be free of defects. No defective materials shall be permitted to be installed or remain on the job site.

- a. Cast Iron Pipe (CIP): All CIP pipe shall be Class 150 push-on joint, cement mortar lined, cast iron pipe and shall conform to American Standard A 21.8 (AWWA C1!*)¹, American Standard A 21.4 (AWWA C104) thickness class 22 CIP shall be bituminous coated with a minimum 1 mil thickness. Pipe is to be furnished in 18 or 20 foot laying lengths.
- b. Ductile Iron Pipe (DIP): all DIP shall be manufactured and tested in accordance with ANSI A21.51-1976 (AWWA C151-76). DIP shall have a bituminous coating on the outside of 1 mil thickness minimum and cement mortar lined to conform to ANSI A21.4 (AWWA C104). Thickness class and thickness design shall be as in ANSI. 50 (AWWA C150) and shall be a minimum thickness of 50. Pipe is to be furnished in 18 or 20 foot laying lengths.
- c. Polyvinyl Chloride Pressure Pipe (PVC): All PVC pressure pipe shall be AWWA C900 Johns Manville Blue Brute or approved equal. Pipe shall have outside dimensions (OD) construction. The standard dimension ratio (SDR) shall be 18 or 14, Class 150 or 200 pipe. Pipe is to be furnished in 20 foot laying lengths. Any PVC pipe damaged by tapping operations shall be replaced without expense to the Town of Lyons.
- d. Steel Pipe:
 - 1. Pipe is to be fabricated in accordance with AWWA Standard Specification C-200-75 from steel sheets conforming to ASTM A570 Grade C. Minimum wall thickness of steel shall be 3/16".
 - 2. Pipe is to be cement mortar lined inside in accordance with AWWA Standard Specification C-205 and coal tar enamel coated and wrapped outside with fibrous glass mat, 15# asbestos felt and kraft in accordance with AWWA Standard Specification C-203. Cement mortar lined pipe shall have an I.D. after lining not less than the specified nominal size.
 - 3. Pipe is to be furnished principally in 40 foot net laying lengths with special lengths as required by plan and profile for location of fittings. Pipe is to be furnished with O-ring joints unless otherwise noted on plan. Pipe fabricator shall prepare a pipe laying diagram or laying schedule showing the location of each piece by mark number. O-ring joint shall consist of a flared bell end and a grooved spigot and designed to retain the "O-ring" rubber gasket. The spigot end groove may be rolled in or bar type provided that there is no reduction in the cross sectional area of the pipe at the joint. Bell and spigot ends shall be sized by forcing over a sizing die or by expanding to stretch the steel beyond its elastic limit so that the clearance between outside of spigot and inside of bell at normal engagement does not 1/16" measured on the circumference. The O-ring gasket shall have sufficient volume to approximately fill the area of the groove and shall conform to AWWA C-301 Section 3.4. The joint shall be suitable for a safe working pressure equal to the class of pipe

furnished (not to exceed 250 psi) and shall operate satisfactorily with a deflection, the tangent of which is not to exceed .75" /D, where D is the outside diameter of the pipe in inches. Steel pipe shall be furnished from the manufacturer with an integral cadweld known for securing bonding wire to pipe. Field coating material shall consist of two wraps of 6" wide Protecto-Wrap #200 w/#1170 primer and shall be furnished by pipe fabricator. Shop applied outside coating shall be continuous to the end of pipe on the bell end and shall be cut back on spigot end so that **coating extends at least 1/2"** inside the bell end at normal engagement. Shop applied inside lining shall be continuous to the end of pipe on the spigot end and shall be cut back on the bell end to the point of maximum engagement or further as shown on plans. The inside surface of the bell and the outside surface of the spigot shall be painted one shop coat of quick dry chlorinated rubber compound per AWWA C-203 Section 2.1, type A or B.

2. Pipe Fittings: All fittings shall be cast iron cement mortar lined mechanical joint fittings Class 250 conforming to ANSI A21.10 (AWWA C101-67) and ANSI A21.11 (AWWA C111-72).
3. Valves:
 - a. Gate Valves: All gate valves to conform to AWWA C500, Mueller or approved equal with cast or ductile iron bodies, bronze mounted, non rising stem with O-ring valve seals. Valves shall be double disc, parallel seats and operating pressure of 150 psi for sizes over 12", 200 psi for sizes under 12". Valves shall have 2" square operating nut and turn left to open.
 - b. Butterfly Valves: butterfly valves shall be used for water mains 12" in diameter and larger. Valves shall conform to AWWA C504, Dresser type or approved equal with cast or ductile iron bodies, Class 125 including flanges. Valves shall have a 2" square operating nut and turn left to open.
 - c. Main control Valves: The main valve shall be hydraulically operated an diaphragm actuated, glove or angle patterned. The main valve shall have a single removal seat, plus a resilient, synthetic rubber disc retainer assembly, combining to insure a drip tight closure of the main valve when the cover chamber is pressurized.
The diaphragm assembly of the main valve shall be fully guided both top and bottom by a bearing in the main valve cover and a integral bearing in the valve seat. No pistons or external packing glands are permitted or required as the diaphragm assembly shall travel within its guides virtually unrestricted.
The main valve shall be similar in all respects to the Clayton 100-01 Hytrol Valve as manufactured by Cla-Val Co., or approved equal,

and shall be fully equipped to received a full range of compatible pilot systems designed for specific service applications.

d. Pressure Reducing Valve: This valve shall maintain a constant downstream delivery pressure regardless of varying inlet pressure. The valve system shall include a Clayton 100-01 Hytrol equipped wit a pilot control system consisting of (1) a pilot system strainer, 2) a fixed orifice in the control system, and 3) a pressure reducing pilot control which shall be a direct-acting, adjustable, spring-loaded, normally open, diaphragm valve, designed to permit flow through the main valve when controlling pressure is less than the spring setting of the pilot control. This valve system shall be similar in all respects to a Claton 90-21 Pressure reducing valve as manufactured by Cl-Val Co., or approved equal.

4. Fire Hydrants: Fire hydrants shall meet or exceed AWWA Standard C502-54 as follows: cast-iron body; fully bronze mounted; 150 psi working pressure; minimum five foot trench depth (four and one-half foot cover); six inch mechanical joint inlet; compression type main valve which closes with pressure; minimum five and one-quarter inch (5 1/4") main valve opening; two, two and one-half inch (2 1/2") hose nozzles and one, five and one-half inch (5 1/2") pumper nozzle; nozzle threads in conformance with National Standard ASA B26, (hydrant supplier shall confirm nozzle threads with Lyons Fire Protection district); nozzles shall be easily replaceable in the field with normal Water Department tools and equipment; operating and cap nuts shall be one and one-half inch #17 national Standard hex; main valve shall open right (clock-wise); direction of opening shall be shown by arrow cast on stamped on the top of the hydrant,. Fire hydrants shall have easily replaceable, "breakable sections" which permit a clean break at or near ground level in the event of collision, without loss of water or injury to major parts of the hydrant. Working parts shall be removable for maintenance or repair without excavation. Operating mechanism shall be non-wetting, oil-reservoir lubricated, with O-ring seals. Barrel drain shall be bronze mounted with at least two outlets and shall operate automatically with the main valve. Fire hydrants supplied by the Contractor shall be pre-qualified in strict accordance with this specification.

4.3 CONSTRUCTION

4.3.1 GENERAL REQUIREMENTS: Section 7, General specifications shall be followed except as modified in Paragraph 4.3.2.

4.3.2 SPECIFIC REQUIREMENTS: The following specific requirements shall apply in the construction of the water distribution system:

1. Trench Depth: The trench shall be of sufficient depth to provide a **minimum of 4 ½ feet from subgrade and a maximum of six (6) feet from finished grade of cover over the top of the pipe.** Street to be at subgrade elevation prior to the installation of any water lines. The excavation of the trench shall not advance more than 200 feet of the pipe laying operation, except where permitted by the Town Inspector for drainage or other purposes.
2. Pipe Installation: During laying operations, no debris, tools, clothing, gravel or other materials shall be placed in the pipe. All joints will be made according to the pipe manufacturer's recommendations. Laid pipe shall be brought to correct line and grade. The pipe shall be secured in place by installation of the bedding material tamped under and along the pipe up to the spring linespringline of the pipe. At times, when pipe laying is not in progress, the open ends of pipe shall be closed by means of a water tight plug. The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or lining and so as to leave a smooth end at right angles to the axis of the pipe. Pipe ends shall be smoothed and beveled with a file or other tools according to pipe manufacturer's recommendations. The town Inspector shall be notified at least twenty-four hours in advance of when pipe is to be laid in any trench. No pipes shall be covered until they have been inspected by the Town Inspector.
3. PVC Pressure Pipe Installation: An insulated copper wire shall be placed and secured to the top of the pipe. The wire installation shall conform to the following:
 - a. The wire shall be insulated No. 14 gauge single strand, direct bury electrical wire or heavier, but not more than a single strand.
 - b. The splice used shall be a compression type splice.
 - c. The wire shall extend up the inside of each valve box and be of sufficient length to be easily accessible.

All valves and fittings on PVC installations shall be securely fastened and tied back to the main with all-thread rod to prevent any lateral movement. All valves and fittings shall have thrust blocks and be wrapped in 4 mil or heavier polyethylene plastic sheeting.
4. Thrust Blocks: all plugs, caps, tees, bends and hydrants shall be provided with cast-in-place concrete thrust blocking as shown on the Standard Design drawings in paragraph 4.5. The blocking shall be so placed that the pipe and fitting joints will be accessible for repair and separated from the concrete with a 8 mil of plastic sheeting. Bends in the vertical plane shall also be anchored with all-thread connections and fittings. All thread connectors and fittings shall be coated with Protecto Wrap #1200 mastic prior to concrete placements.

5. Valve and Hydrant Setting: Immediately prior to the installation of a valve or hydrant, the following operations shall be performed: The valve or hydrants shall be carefully inspected. The interior shall be thoroughly cleaned, the to determine that all parts are in proper working order, with valves seating properly and the hydrants shall be operated as many times as necessary to determine that all parts are in proper working order, with valves seating properly and the hydrant drain valve operating properly. Valves and hydrants shall be set plumb and securely braced into place.

Hydrants shall be set as shown in the Standard Design Drawings in paragraph 4.5. Lateral piping to the hydrant shall be connected to a 6 inch gate valve with box, which has been all thread connected directly to a tee in the main. Hydrants shall be set with the bury line at the established finished grade and with hose nozzles parallel to the curb, with the pumper nozzle facing the curb and at least six inches behind the curb or sidewalk.

Valves shall be provided with valve boxes centered and plumb over the operating nut of the valve. The boxes shall be supported to prevent any shock or stress in this position during back-filling.backfilling. Valve box covers shall be set to finished grade but may be first left just below subgrade level to prevent damage during street construction and later adjusted to grade at the time of paving. Hydrants shall be provided with a drainage pit with nine square feet of surface area and two feet of depth below the bottom of the pipe. Pits shall be back-filledbackfilled with **1 ½ inch washed crushed rock to a level six inches above the barrel draining hole**. Concrete reaction blocking shall be so placed so as not to obstruct the barrel draining hole.

6. Plugging and Marking Extremities: Standard plugs or caps shall be installed and thrust blocked against undisturbed soil at all extremities, unless provided with a blow-off or inline fire hydrant. Where blow-offs or fire hydrants are not called for, in addition to thrust blocking the end, a #9 wire shall be firmly attached to the plug or cap and connected to a 2" x 4" x 2' (redwood) board, buried above the end of the line and 1 foot below finish grade.
7. Filling and Venting the Line: All valves shall be operated by the Town maintenance personnel. The line shall be slowly filled with water and all air expelled from the pipe. Care shall be taken that all available hydrants (including hydrant gate valves), air valves an other vents are open during the filling of the line, the contractor shall make whatever taps are required for venting purposes. The rate of filling the line shall not exceed the venting capacity.
8. Disinfection and Flushing of Mains: Disinfection shall be done as follows: Chlorine dosage shall be at least 50 parts per million and shall

be retained in the line at least 24 hours. The chlorine residual at the pipe extremities and other representative points shall be at least ten parts per million. If the test is not satisfactory, the disinfection shall be repeated until a ten parts per million chlorine residual is obtained. Following chlorination, the main shall be thoroughly flushed throughout its extremities until the water runs sweet and clear with no chlorine residual in excess of that carried with the existing system. The Contractor shall take all necessary precautions to prevent the flow of strong chlorine solution into existing water facilities and will assume responsibility for damages done by heavily chlorinated water due to negligence on his part. No water mains shall be placed in service or tapped until a written release is obtained from the Town Administrator.

9. Restoration and Cleanup: Where construction is done in streets, the street shall be graded immediately after back-filling/backfilling to provide drainage away from the trench. The Contractor shall restore or replace all removed or damaged paving, curbing, sidewalks, gutters, sod, shrubbery, fences, irrigation ditches, pipe or other structures or surfaces to a condition equal to that before the work began and to the satisfaction of the Town Inspector. The construction site shall be left clean and orderly.
10. Water Services: Water service shall be continuous length, without joints or connections, Type K copper, with flared connections from the water main to the curb stop. The diameter shall be that called for on the drawings.
 - a. Corporation Stops: Mueller #H-15000, Fort F-600 or Hays 4201 will be furnished in place on the line by the Contractor. The Contractor shall make the tap after the line has been chlorinated, pressure tested and flushed.
 - b. Curb Stops: Mueller #H15200 or Fort Type B-44-333 and Mueller H-10350 curb boxes or approved equals shall be installed as shown on Standard Drawing.
 - c. Water Meters: Water meters of greater than 1 inch in six shall be installed in accordance with Figure 4-9.
 - 1) Specifications for Water Meter Settings - Inside Set:
 - a. Meter CANNOT be placed in crawlspace, even if it is near crawlspace entrance.
 - b. Meter must be tied into water system before water pipes branch off of outside spigots and other parts of the building or underground sprinkling systems.
 - c. Meter must be easily accessible and not be put in a cramped space or near the ceiling.
 - d. Conduit must extend six (6) inches from meter all the way to the bottom of remote readout.
 - 2) Specifications for Water Meter Settings - Outside Set:

- a. Meter pit must have a row of bricks at its base for a foundation.
- b. All fittings MUST be flared fittings, not sweated or compression fittings.
- c. The top of the meter yoke must be seven (7) inches below the top of the fiber board pit.
- d. The meter pit lid may not be covered before or after the inspection.
- e. The wire and conduit for a remote readout must be buried two (2) feet deep.
- f. Conduit must extend from inside the meter pit all the way to the bottom of the remote readout.
- g. The center of the meter pit lid should be approximately fifteen (15) inches from the outside water shut-off curb stop box.

3) Specifications for Water Meter Settings - Inside and Outside Sets:

- a. **Conduit for a remote readout should be $\frac{1}{2}$ inch PVC.**
- b. Ninety degree (90') bends in conduit must be sweeping 90's.
- c. The remote readout must be 60 inches above ground level.
- d. Remote readouts must be in front of the building. Readouts may be on either side of the building but not more than five (5) feet from the front corner.

4.4 TESTING

4.4.1 COMPACTION TEST: Compaction tests to verify specified trench compaction shall be performed as required in Section 7 of this manual.

4.4.2 PRESSURE TEST: Pressure tests shall be conducted by the Contractor according to the applicable sections of AWWA C600 or AWWA C603 to a minimum pressure of 150 pounds per square inch at low point of section being tested. All joints and connections are to be water tight within tolerances allowed by the above specifications. Any leakage which is discovered by observation or test shall be located and made water tight by the Contractor. Testing shall be performed in the presence of the Town Inspector.

4.4.3 SOIL RESISTIVITY TEST: Prior to all water main installations, using other than PVC pipe, soil resistivity tests will be made by the Developer along the proposed line and the following protection provided:

<u>Test Reading</u>	<u>Pipeline Material</u>	<u>Protection</u>
Less than 1000 ohms/ be placed	Cast or Ductile Iron	Plastic sleeve shall
Cubic centimeter pipeline and		over entire length of

1000 to 2000 ohms/ shall be cubic centimeters sand	Cast or Ductile Iron	bedded in six (6) inches of sand in any direction.
Greater than 2000 ohms	Cast or Ductile Iron	Pipe shall be bedded in existing fillbackfill material per back- specifications

4.5 STANDARD DESIGN DRAWINGS

FIGURE 4-1 Main Locations in Through Streets and Cul-de-Cul de sacs
4.2 Location of Fire Hydrants and Valves
4.3 Air Relief Valve Details
4.4 Watercourse Crossing Details
4.5 Water Tap Differentiation and Meter Location
4.6 Thrust Blocks
4.7 Fire Hydrant Assembly
4.8 Gate Valve And Valve Box Details
4.9 Meter Settings for tapes 1-1/2" and larger
4.10 Bore Crossing Details
4.11 Maximum Joint Openings for Steel and Rubber Pipe Joints