

CHAPTER 5

**WATER SYSTEM DESIGN
STANDARDS**

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CHAPTER 5

WATER SYSTEM DESIGN STANDARDS

5.00 Objective

Permanent water distribution facilities shall be provided to all properties (legal lots of record) created by partitioning or subdivision of land within the City per these Standards.

These standards have the objective of developing a water distribution system that will:

- a. be consistent with the adopted water system master plan;
- b. provide sufficient capacity to maintain minimum pressure during periods of maximum use and to provide sufficient volumes of water at adequate pressures to provide the expected average daily consumption plus fire flows at a minimum energy loss;
- c. be of materials strong enough to resist all expected loads, both internal and external, and able to preserve the potability of the water supply; and
- d. be economical and safe to build and maintain.

5.01 Additional Referenced Standards

Design of water system and related improvements in the City of Keizer shall conform to these Design Standards, City of Keizer Standard Construction Specifications, and certain sections (as required by the City Engineer) of the current edition of the following referenced standards, publications, or documents:

- a. Oregon Department of Human Services - Health Division - Drinking Water Program
- b. American Water Works Association (AWWA) Standards
- c. Ductile Iron Pipe Research Association (DIPRA) Publications
- d. Oregon Plumbing Specialty Code
International Association of Plumbing and Mechanical Officials (IAPMO)
- e. Uniform Fire Code
- f. City of Keizer Water System Master Plan

5.02 Special Design Problems

The design of the following are considered special problems and are not covered in detail in these Standards:

- a. Pump Stations
- b. Reservoirs
- c. Treatment Plants
- d. Relining of Existing Water Mains
- e. Pressure Regulating Devices
- f. Flow Measurement Devices
- g. Combination Air and Vacuum Valves

Review and approval of the above special design problems by the City shall be required. When requested by the City, full design calculations shall be submitted for review prior to approval. Items a, b, and c also require approval by the Department of Human Services - Health Division - Drinking Water Program.

5.03 Water System Design Considerations

The system shall have sufficient capacity to maintain 40 psi at the building entrance for one and two-family dwellings. For other development provide minimum pressure of 35 PSI at the building side of the meter during periods of maximum use, and to provide sufficient volumes of water at adequate pressures to satisfy the expected daily consumption plus fire flows. Normal working pressure in the distribution system ranges from 60 to 75 PSI.

In general, water distribution systems should be designed to care for maximum development of the service area recognizing possible urban renewal, industrial expansion, etc.

As a condition of water service, all developments will be required to provide public water mains of sufficient size to serve adjacent parcels and to provide for future looping. This shall include the extension of water mains in easements across the property to adjoining properties and across the street frontage of the property to adjoining properties when the main is located in the street right-of-way.

Head loss shall be determined by the Hazen-Williams equation. Design shall be based on the following Hazen-Williams "C" Values:

Pipe Diameter	"C"
8" and Less	100
10" to 12"	110
Greater than 12"	120

Velocities in public water mains shall normally range from three to six feet per second for average demand to a maximum velocity of 10 feet per second for

combined average demand plus fire flow.

A 20-PSI residual pressure under fire flow conditions shall be maintained in the distribution system. In general, a maximum velocity of 10 feet per second will govern for sizing mains at all other locations of the service level.

Note: Private water systems shall limit velocities as required by the Oregon Plumbing Specialty Code, Installation Standards.

5.04 Water System Capacity

Design capacities shall be determined by consideration of the following factors and assumptions:

- a. Area to be served, both immediate and overall service area.
- b. Current and projected population within the areas to be served.
- c. Current and projected land use within the areas to be served.
- d. Commercial, industrial, or institutional users to be served.
- e. Changes in any of the above factors that are likely to occur within a foreseeable time period.

In the absence of consumption data or other reliable information, the following factors are assumptions:

- a. Peak hour demands
0.75 gallons per minute (gpm) per person for Single Family Residential
0.25 gpm per person for Multiple Family Residential
5,000 gallons per acre per day for Commercial areas
10,000 gallons per acre per day for Industrial areas
- b. Demand for unique commercial installations, industrial users, PUD's, multiple, and institutional concerns will be calculated on an individual basis.
- c. Fire flows shall be provided in accordance with Uniform Fire Code requirements as interpreted by the Fire Marshal.

5.05 Water Main Classification

a. Transmission Mains (Supply Mains)

Mains that are used for transporting water from the source of supply and storage reservoirs to the centralized point of distribution and distribution reservoirs. Transmission mains are generally 10" in diameter or greater.

b. Feeder Mains

Mains that transport water from centralized points of distribution and distribution reservoirs to the various points of interconnection with the grid system of mains and centralized points of consumption. There are two types of feeder mains:

1. **Primary**

Those feeder mains not supplying individual consumers, but their sole purpose being to transport water from centralized points of distribution to various points of interconnection with the grid system and centralized points of consumption.

2. **Secondary**

Those feeder mains that serve the same purpose as any other feeder mains except that individual consumers are served by this group, due either to the fact that no other main is available or that the required supply to the consumer demands a large main.

c. Distribution Mains

Mains used for supplying the individual consumer. As a general rule these are the small mains in the water supply system. Distribution mains are generally 8" in diameter or less.

5.06 Water System Construction Plans

a. **Cover Sheet**

The Cover Sheet shall be prepared in accordance with the requirements of Chapter 1 of these Design Standards.

b. **Water System Plans & Profiles**

Plan view of water system lines shall be to a scale of not greater than 1" = 50' and shall contain the following information:

1. Location of water mains, service lines, meter boxes, thrust blocks, and appurtenances with each fitting and branch line stationed to facilitate coordination in locating appurtenances. A detail is required at all locations where 3 or more fittings are used.

2. Stationing shall be tied to property corners or street monuments with the relationship of each valve and fitting shown to the property corners in two directions. Each line with a separate designation shall be stationed from 0+00 at a connection point 0+00 at its point of connection to another line and each service line stationed.
2. Size, length, service level, type of material, and class of pipe between fittings. All private water lines and wells shall be shown and so designated as private on the plans.
3. Location of water courses, stream and railroad crossings, gas mains, culverts, sanitary and storm drains, underground power and other utilities, that either cross the alignment within 250 feet of the terminus of the proposed extension or are adjacent to the proposed extension within the right-of-way or within 10 feet of the easement line, and existing hydrants within 500 feet of the proposed extension. The intent is to prevent grade conflicts of all future extensions and fire hydrant requirements. All watercourse crossings must delineate the 100-year floodplain and 100 year floodway.

Water System Profiles

Profiles for the individual water lines shall be to the same horizontal scale on the same sheet and drawn immediately below the corresponding plan view reading from 0+00 left to right, and shall be required in the following instances:

1. Railroad and culvert crossings and ditch or stream crossings (with elevations of the ditch or streambed and the 100-year flood elevation) showing profile and casing details. Horizontal scale 1"=20', vertical scale 1"=2'.
2. Utility crossings that conflict with the proposed water line installation. Same horizontal and vertical scale as (1) above.
3. Mains installed in easements across private property. Horizontal scale 1"=50', vertical scale 1"=5'.

SPECIAL NOTE: The design engineer shall field locate and verify the alignment, depth, and inverts of all existing facilities shown on the plans that will be crossed by proposed facilities and shall certify them with a note on the plans. City as-builts are only to be used as an aid to the design engineer when field verifying the existing facilities.

5.07 Water System Appurtenances

Detailed drawings shall be included for all water system appurtenances including fire hydrants, thrust blocks, valve boxes, blow offs, service installations, etc. Appropriate references to City's Standard Details may be used in lieu of details actually shown on the plans.

5.08 Water System Requirements

Subsections 5.09 through 5.17 contain the physical design requirements for public water systems in the city. These design requirements may be used for private systems, provided a registered professional civil engineer designs the system.

5.09 Pipe Materials

All water mains and services shall be designed for a cold-water test pressure of 150 PSI (refer to AWWA C150 and DIPRA Technical Bulletin "Designing for Ductile Iron Pipe.") Fittings and valves shall have a working pressure of 250-PSI.

Three inch through 24-inch pipe shall be ductile iron pipe conforming to AWWA C151, pressure class 350. Ductile iron pipe shall be cement lined conforming to AWWA C110. Pipe joints shall be rubber gasket of the push-on type conforming to AWWA C111. Fitting joints shall be rubber gasket of the mechanical joint type conforming to AWWA C111.

Note: A higher thickness class of Ductile Iron Pipe may be required if the cover on the main is less than required in City of Keizer Standard Construction Specifications.

5.10 Water Main Sizing

This section shall be used to size public water mains, as opposed to water services, that will serve more than one dwelling unit.

a. **Grid System Design**

The distribution system mains shall be looped at all possible locations to create a "grid" that will provide for high water quality. The installation of permanent dead-end mains upon which fire protection depends and areas of large demands on single mains will not be permitted.

b. **Allowable Pipe Sizes**

Pipe Size	Designated Use
4"	May only be used on dead-end streets with service to no more than 12 residences and have no fire flow requirements.
6"	Minimum size residential subdivision distribution water main for the grid (looped) system shall not exceed an unlooped length of 600 feet and shall not be permanently dead-ended. Looping of the distribution grid shall be at least every 600 feet, unless otherwise required by fire flow calculations.
8"	Minimum size for permanently dead-ended mains supplying fire hydrants with a fire flow less than 2,000-gpm and for secondary feeder mains in residential subdivisions.
10" & larger	Required for primary feeder mains and mains in industrial subdivisions.

All water system extensions on private access easements shall be reviewed on a case-by-case basis.

All dead-end mains shall terminate with a blowoff assembly. Mains that can conceivably be extended at some later date shall have a blowoff assembly with as per Standard Detail Number W-22. Permanent dead-ends shall have a blow-off assembly as per Standard Detail Number W-23. Where curbs exist, the preferred location of the blowoff is in the sidewalk. If the blowoff is required to be located in the street it shall be a minimum of 5 feet from the curb face.

5.11 Minimum Depth

Normal cover required over buried water mains within the street right-of-way except the paved area shall be 36 inches from finish grade referenced from the existing top of curb or proposed top of curb elevation. The paved area of the street right-of-way shall have a minimum cover of 30 inches.

Normal cover for mains in easements across private property shall be 36 inches; granular backfill will be required.

Finish grade shall normally mean the existing or proposed top of curb elevation. Where the main is located in the cut or fill side slope or where mains are located in easements, finish grade shall mean at the water main alignment. The intent is to provide a minimum cover over the pipe of 30 inches in the street right-of-way and 36 inches in easements.

5.12 Location

a. **Relation to Sewer Lines and Other Utilities**

Water lines shall be separated from other utilities in accordance with OAR 333.

b. **Water Mains Within Street Right-of-Way**

The standard location for water mains within public right-of-way shall be as shown on Standard Detail Number ST-13 and preferably on the south and west sides of the street. Exceptions to these requirements may be made in order to avoid conflicts with other existing underground facilities, and to permit sanitary sewers to be installed on the low sides of streets. Granular backfill will be required within the Street Right-of-Way.

Mains shall not be installed in alleys. As nearly as practical, mains shall be installed on a particular street with the distance from the curb line of the street varied as little as possible. On curved streets, mains may be laid on a curve concentric with the street centerline with deflections no greater than the manufacturer's specifications, or mains may be laid in straight lines along the tangent between selected angle points to avoid conflicts with other utilities. The angle point and tangent section shall not be less than three (3) feet in front of the curb face.

c. **Within Easements**

Mains laid in easements along property line, with the easements centered on property line, shall be offset 18 inches from the property line. The installation of mains within easements across privately owned property is to be done only when absolutely necessary, such as the avoidance of dead-end conditions. Such easements, when required, shall be exclusive and a minimum of ten (10) feet in width except that the minimum width shall be twenty (20) feet or more for transmission water mains and the conditions of the easement shall be such that the easement shall not be used for any purpose which would interfere with the unrestricted use for water main purposes. Under no circumstances shall a building or structure be placed over a water main or water main easement. This includes overhanging structures with footings located outside the easement. The intent is to provide an unobstructed area above the easement in which to operate or repair equipment.

Easement locations for public mains serving a PUD, apartment complex, manufactured home, or commercial/industrial development shall be in parking lots, private drives, or similar open areas which will permit an unobstructed vehicle access for maintenance by City forces.

Easement widths shall vary from the ten (10) foot minimum by five (5) foot increments, i.e., 10, 15, 20 feet, etc. Easements must be fully executed prior to construction, and recorded prior to final acceptance.

Common placement in the easement of water, sewer, and storm drain line may be allowed under certain conditions.

Common easements will be reviewed on a case-by-case basis. Separation of utilities must meet Oregon Department of Environmental Quality and Department of Human Services - Health Division - Drinking Water Program requirements.

All easements must be furnished to the City for review and approval prior to recording.

5.13 Surface Water Crossing

Surface water crossings of mains shall be in accordance with OAR 333 and the following.

- a. Mains crossing stream or drainage channels shall be designed to cross as nearly perpendicular to the channel as possible.
- b. The following water surface crossings will be treated on a case-by-case basis:
 1. Stream or drainage channel crossings.
 2. Bridge crossings.
 3. River or creek crossings requiring special approval from the Division of State Lands.
- c. The minimum cover from the bottom of the streambed or drainage channel to the top of pipe shall be 36 inches.
- d. A scour pad centered on the water line will be required for mains less than 12 inch inside diameter when the cover from the top of the pipe to the bottom of the stream bed or drainage channel is 30 inches or less. The scour pad shall be 6 inches thick and 6 feet wide reinforced with number four bars 12 inches on center both ways and shall extend to a point where a one-to-one slope, that begins at the top of the bank and slopes down from the bank away from channel center line intersects the top of the pipe.

5.14 Water Valves

a. **Sizes**

Valves shall be the same size as the mains in which they are installed.

Valve types and materials shall conform to Chapter 5 of the Standard Construction Specifications.

b. **Location**

Distribution system valves shall be located at the tee or cross fitting as nearly as possible. Wherever a conflict exists with curbs, etc., the valve shall be located at the intersection of the main with a property line. There shall be a sufficient number of valves so located that not more than 4 and preferably 3 valves must be operated to achieve any one particular shutdown. The spacing of valves shall be such that the length of any one shutdown in high value areas shall not exceed 500-feet nor 800-feet in other areas.

In general, a tee-intersection shall be valved on two branches and a cross-intersection shall be valved on three branches. Transmission water mains shall have valves at not more than 1,000-foot spacing. Hazardous crossings, such as creek, railroad, and freeway crossings, shall be valved on each side. Creek under crossings shall have a sampling tap on each side.

c. **Phased Construction**

Water mains installed by phased construction that will be extended in the future shall terminate with a valve and blow off in accordance with the City of Keizer Standard Detail “Standard Blowoff with in-Line Valve.”

A “Standard Blowoff with Plugged End” may be used if the main is less than 120 feet in length and service taps are not provided to the properties fronting the line. Future service connections will not be allowed until a valve is installed or a main is extended.

All developments will be required to extend mains across existing or proposed streets for future extensions by the City or other developments. All terminations shall be planned and located such that new or existing pavement will not have to be cut in the future when the main is extended.

5.15 Backflow Prevention

a. **General**

An approved backflow prevention assembly(s), which may require an approved metering system, shall be required for each use in the following instances:

1. On all services larger than 1”
2. When a private line must be looped between 2 or more City mains in order to obtain the required flow and the resultant loop will not benefit the City grid system.
3. When pipe materials other than those approved for potable water are installed on private fire services.

4. On all private fire lines attached to the City's distribution system.
5. On all private water lines or distribution systems attached to the public water system at the master meter on the detector check assembly.
6. When private well exists on the property being served.
7. As determined by the City Cross-connection Control Inspector.

Note: The assembly must meet the City-approved assembly standards that are taken from the current approved list of assemblies obtained from the Department of Human Services - Health Division - Drinking Water Program.

b. **Location**

The approved backflow prevention assembly shall be installed on the property being served in a place accessible for City inspection and testing and located as follows:

1. Before any branch, immediately downstream of the meter; or
2. If no meter, at the property line; or
3. If in the building, before the first branch or hazard being controlled or as determined by the City Cross-connection Control Inspector; or
4. If installed outside the building being served, it shall be placed adjacent to the property line entirely on private property in an approved vault or structure.
 - Double check assemblies up to two inches may be installed, in standard meter boxes, Utility Vault Company, Series 66 or equal.
 - Reduced pressure and double check assemblies larger than 2" must be installed in vaults.
 - Vaults design shall be submitted, reviewed, and approved on a case-by-case basis by the City.
 - Vaults must have a minimum 18" sump, shall be water tight, and shall be provided with a positive drainage outlet.

NOTE: *While any of the above methods are acceptable, the City's preferred method is to have the backflow assembly installed in a building mechanical room.*

5.16 Fire Hydrants

a. **Coverage**

Distribution of hydrants shall be based upon the required fire flow and the average area served as required by the Insurance Services Office (ISO) and the Fire District having jurisdiction.

b. **Location**

No fire hydrant shall be installed on a main of less than eight inch inside diameter unless it is in a looped system of 6-inch mains. The hydrant lead shall be a minimum 6-inch inside diameter.

Hydrants shall be located as nearly as possible to the corner of street intersections in locations approved by the City of Keizer and the Fire District having jurisdiction.

No hydrant shall be installed less than 5 feet from an existing utility pole or guy wire nor shall a utility pole or guy wire be placed less than 5 feet from an existing hydrant.

Approved hydrant types and installation shall conform to City of Keizer Standard Construction Specifications.

See applicable sections of these Water System Design Standards for Mobile Home Parks and Planned Unit Developments for locations under special conditions.

c. **Hydrant Valves**

Each “on line” fire hydrant (see Standard Detail Number W-25) shall have a hydrant valve and valve box at the main line tee. “Off line” fire hydrants (see Standard Detail Number W-24) shall have hydrant valves and valve boxes at the hydrant. Hydrant valves will permit repair of the hydrant without shutting down the main supplying the hydrant. Hydrant valves shall be resilient wedge gate valves conforming to Chapter 5 of the Standard Construction Specifications.

5.17 Water Service Lines

The term “service line” is defined as the water line extending from the distribution main to the meter.

a. **Sizes**

The sizes of service lines that may be used are ¾”, 1”, 1 ½”, 2”, 3”, 4”, 6”, 8”, 10”, and 12”. Service lines will be reviewed for effects on the distribution system and shall not be greater in size than the main.

Service piping shall be equal to or greater than the meter size, however, 3-inch meters require a 4-inch tap and 4 inch minimum piping and fittings.

For 3-inch and greater services, a design drawing must be submitted showing the vault and fitting requirements, with the expected flow requirements and proposed usage.

b. **Location**

The service lines shall normally extend from the main to behind the curb or sidewalk with the curb stop and meter and meter box being located at the termination of the service connection (Standard Detail Numbers W-11, W-12, W-13, W15, & W16). In general, individual service connections shall terminate in front of the property to be served and shall be located eighteen (18) inches each side of a common side property line Standard Detail Number W-14. The domestic service shall not be connected to fire protection service. A backflow prevention assembly shall be placed on domestic service lines as required by Section 5.15.

5.18 Fire Service Lines

The fire service line shall normally extend from the public main to the property line and terminate at a property line valve.

“Long side” fire services shall have valves and valve boxes at the main line tee and at the property line. “Short side” fire services shall have valves and valve boxes at the property line. Valves will permit repair of the fire service line without shutting down the main. Valves shall be resilient wedge gate valves conforming to Chapter 5 of the Standard Construction Specifications.

A double detector check backflow prevention assembly shall be placed on all fire service lines in accordance with Section 5.15 of these Design Standards. Exceptions for residential flow through potable systems will be reviewed on a case-by-case basis. **The preferred location of backflow prevention assemblies is in a building mechanical room.**

Plans for fire service lines shall meet the requirements of sections 1.07, 1.09, 1.10, 1.11, 5.05, and 5.06. The plans must be stamped by a Civil Engineer.

Plans for fire service lines shall include a vicinity map, adjoining street name, width, curb and property line, location of existing water line referenced to property line, existing hydrant locations, and the distance to property pins where the service crosses the property line.

SPECIAL NOTES:

1. *Private customer lines are under the jurisdiction of the City, who currently contracts with the Marion County Building Department; and*
2. *A pump shall not be used on a service line to provide adequate pressure to a subdivision lot or property located above the pressure level of the supply main.*

5.19 Water and Fire Service Line Materials

Pipe materials shall be designated on the plans and shall conform to Chapter 5 of the Standard Construction Specifications.

Galvanized pipe is not an approved material for underground service.

5.20 Meters

All water meters scheduled for services inside the City will be furnished and installed by City forces at the request and expense of the customer.

Note: The service line and meter box must be placed with water mains installed by the developer to City of Keizer Standard Construction Specifications.

a. **Meter Boxes and Vaults**

Unless otherwise approved, all meter boxes and vaults must be as shown:

5/8" x 3/4"	Standard Detail Number W-11
1"	Standard Detail Number W-12
1-1/2"	Standard Detail Number W-13
2"	Standard Detail Number W-13
3"	Standard Detail Number W-15
4"	Standard Detail Number W-16

b. **Location**

Meters shall not be located in the same vault as the backflow prevention device.

Meters shall be located at the termination of the water service line.

1. 5/8" through 2" Meters

Installed in the right-of-way in a location that allows for easy reading and maintenance consistent with City of Keizer Standard Construction Specifications.

2. 3" and larger Meters

Installed outside the public right-of-way in a public utility easement to allow easy reading and maintenance. It must be accessible with a crane truck to within 10-feet of the installation with a 10-foot vertical clearance.

The meter, vault, and piping are to be protected from freezing, vandals, and vehicles. The area around the vault must be sloped in such a manner to prevent storm water from ponding over or running into the vault.

A minimum 3-foot clear space must be provided around the vault to provide ample working space for maintenance.

5.21 Water System Requirements for Private Developments

All private developments (Manufactured Dwelling Parks, Multi-family Residential Developments, Commercial and Industrial Developments) shall have public water mains. The review of plans and the inspection of public water mains in manufactured home parks are under the jurisdiction of the City.

Private distribution systems shall be designed in accordance with the Oregon Plumbing Specialty Code. Presently, the City of Keizer contracts with the Marion County Building Department for plans review and inspection of private water systems.

All public water mains within private developments shall be in public right-of-ways or exclusive easements to the City and shall conform to these Design Standards.

5.22 Water System Requirements for Planned Unit Developments (PUD's)

General design consideration shall conform to requirements set forth by the Department of Human Services - Health Division - Drinking Water Program, the Oregon Plumbing Specialty Code, and these design standards.

Previously introduced requirements for capacity, materials, grids, valves, fire protection, service lines, and meters shall also be applicable to PUD's.