

PART 2: SPECIFICATION FOR WATER DISTRIBUTION SYSTEM DESIGN STANDARDS  
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CITY OF COLUMBIA REGULATIONS  
PART 2  
WATER DISTRIBUTION SYSTEM DESIGN STANDARDS

- 2.1 GENERAL – The following water supply planning standards are based on Federal, State and local health requirements and engineering design criteria. “Ten States Standards” shall apply where applicable. All installations, whether public or privately owned, are to deliver water to the consumer which meet the bacteriological and chemical quality standards of the S.C. Department of Health and Environmental Control. If a building is to be constructed, a building permit must be issued by the governing authority. If power is required, the electrical inspector must approve the wiring prior to requesting electrical service from the utility company.
- 2.1.1 Water mains should not be located in contaminated areas. If a water main must run through a contaminated site, the pipe material must protect the water system from contamination. This includes water mains that are designed within 10’ of a septic tank or tile field
- 2.1.2 Water Services and Plumbing – Water services and plumbing shall conform to relevant plumbing codes.
- 2.1.3 Water Pressure in System – The system shall be designed to maintain a minimum pressure of 20 pounds per square inch at all points in the distribution system under all conditions of flow.
- 2.1.4 Disinfection of Water Mains – (See Part 16, Section, 4.0 Testing and Sterilizing). The specifications shall include detailed procedures for the adequate flushing, disinfection, and bacteriological testing of all water mains.
- 2.1.5 Metering – Each service connection shall be metered in accordance with Chapter 23, Art III Sec 23-69, Code of Ordinances, City of Columbia.
- 2.1.6 These criteria are applicable to all developments including but not limited to residential, commercial and industrial developments, subdivisions and/or parks requiring water service from the City of Columbia.
- 2.2 SYSTEM DESIGN CRITERIA – Distribution mains shall be a minimum 6-inch diameter and arranged so that they are interconnected at intervals such that no loop exceeds 2,400’ of 6” C=100 pipe. Hydraulic equivalent lengths of any pipe size are acceptable.

EXAMPLE: The C=100 6” diameter pipe loop is 2,400 feet in circumference (around the block). The maximum equivalent length across this loop equals 332.0 feet. No combination of pipe length and diameter in a loop shall exceed this equivalent length. Thus, the maximum length around an 8” loop will be approximately 9,600 L.F. Distance between fire hydrants will be measured along the traveled way. All water distribution systems shall be designed using C=100 to provide fire protection with minimum requirements as follows

$$EL=L_1[1+(L_1 \div L_2)^{0.54}]^{-1.85}$$

- 2.2.1 Valves shall be located at the intersection with other water mains. Minimum requirements will be two valves for a tee intersection and three for a cross intersection. Valve spacing shall not exceed 1,000 feet in any case.
- 2.2.2 Hydrants and Flows
- 2.2.2.1 Low density residential: (4 units or less per acre)
- 2.2.2.1.1 Fire hydrants shall be located at each intersection and hydrants shall be spaced no greater than 1,000 feet.
- 2.2.2.1.2 The minimum calculated fire hydrant flow shall be 750 gpm plus 75% of peak demand of the development, 20 psi minimum residual pressure is required at 75% of peak demand. In no case will the residual pressure on the highest building site be less than 35 psi during peak demand.
- 2.2.2.2 High density residential: (5 units and over per acre)
- 2.2.2.2.1 For areas of single family homes or duplexes, hydrants shall not be over 600 feet apart and have a calculated minimum flow of 750 gpm plus 75% peak demand of the development, 20 psi residual pressure is required at 75% of peak demand. In no case will the residual pressure on the highest building site be less than 35 psi during peak demand.
- 2.2.2.2.2 For areas, consisting of triplexes, apartments, dormitories, condominiums etc., hydrants shall not be over 500 feet apart and have a calculated minimum flow of 1,000 gpm plus 75% peak demand of the development, 25 psi residual pressure is required at 75% of peak demand. In no case will the residual pressure on the highest building site be less than 35 psi during peak demand.
- 2.2.2.3 Commercial areas:
- 2.2.2.3.1 For small, isolated commercial districts, the water system shall be designed the same as apartments and dormitories.
- 2.2.2.3.2 For large shopping centers and high-density downtown areas, the maximum hydrant spacing shall be 500 feet and have a minimum flow of 1,000 gpm with 30-psi residual pressure. In no case will the residual pressure on the highest building site be less than 35 psi during peak demand.
- 2.2.2.4 Industrial areas:
- 2.2.2.4.1 For isolated industrial sites, the maximum hydrant spacing shall be 500 feet and have a minimum flow of 1,500 gpm with 40-psi residual pressure.
- 2.2.2.4.2 For concentrated industrial sites, the primary water system shall be designed the same as for isolated industrial sites. Additional industrial fire requirements shall be the responsibility of the industry.
- 2.2.3 Minimum Design Criteria:
- 2.2.3.1 Flow Requirements:

- 2.2.3.1.1 Average demand – 135 gallons per capita per day.
- 2.2.3.1.2 Ratio of maximum day to average day = 2.38.
- 2.2.3.1.3 Ratio of maximum hourly demand to average demand = 4.2.
- 2.2.3.1.4 Reserve fire storage in accordance with National Board of Fire Underwriters
- 2.2.3.1.5 Maximum storage for “balancing” or make up water – 25% of maximum day for first construction, accepted practice thereafter.
- 2.2.3.1.6 Coincident demand – 1.79 times average daily demand.
- 2.2.3.1.7 Design residual pressure is the expected residual pressure at the connection point taking the new connection demand into account.
- 2.2.3.1.8 Coincident demand plus fire flow or peak demand, whichever is greater, shall be used to size subdivision piping.
- 2.2.3.2 Pipe:
  - 2.2.3.2.1 Pipe three (3) inches in diameter and smaller shall be schedule 80 PVC. Pipe four (4) inches through eight (8) inches in diameter may be PVC C-900 or ductile iron pipe. Pipe twelve (12) inches in diameter or larger shall be ductile iron pipe or reinforced concrete pipe. Waterline proposed along a side property line shall be ductile iron pipe. All pipe used shall meet all specifications listed herein.
  - 2.2.3.2.2 In no case will water main piping be less than six-inch diameter except four (4) inch diameter may be used, when properly sized, for court and cul-de-sac streets that do not require a fire hydrant or extensions to adjacent properties. Approval of 4” pipe shall be at the discretion of the City.
  - 2.2.3.2.3 All pipe used must have working pressure rating at least two times the expected static pressure. When static pressure is 75 psi or greater, DIP shall be used.
  - 2.2.3.2.4 The City of Columbia does not accept 1”, 1.25”, 2”, 2.5”, 3” 10”, 14” and 20” pipe for use in its water distribution system.
  - 2.2.3.2.5 Asbestos – Cement pipe is not approved for water distribution system design.
  - 2.2.3.3 The “Equivalent Initial Flow” method may be used for determining the design residual pressure to be used at the delivery point for water to a new subdivision or service. This data will be furnished by the City Engineer’s office at a charge of \$175.00 per test. One week advance notice is required to provide this data.
    - 2.2.3.3.1 Deviation and description of this method is available from the City Engineer.
    - 2.2.3.3.2 Any other “accepted practice” method may be used; however, minimum pipe sizing will be checked by the City Engineer’s office using this method and subdivision piping must meet minimum requirements indicated by this method.

- 2.2.4 Interim Design Standards for proposed connections to existing water distribution systems newly acquired by the City of Columbia:
- 2.2.4.1 Proposed connections to any newly acquired existing system must meet standards established by South Carolina Department of Health and Environmental Control and State Primary Drinking Water Regulations, with regard to fire flows, until such time as the existing system can be brought into conformance with City Standards.
- 2.2.4.2 Fire flow, as described in DHEC Regulations, shall be provided.
- 2.2.4.3 With the exception of the hydraulic analysis for fire flows, all other requirements of City Regulations and Specifications shall apply.
- 2.2.4.4 Once any newly acquired existing system has been brought into compliance with City standards, proposed connections must comply with normal design standards.
- 2.2.4.5 Cover – All distribution mains shall be provided with sufficient earth or other suitable cover. Minimum cover depth will be as follows:
- 2.2.4.6 Minor subdivision piping, 8 inch diameter and less, 30 inch minimum cover. *If conditions prevent a minimum of 30 inches of cover, then pipe material shall be steel, DIP, or other approved material and if exposed shall be insulated to prevent freezing. Thermal plastic pipe shall not be used above grade.*
- 2.2.4.7 12 inch diameter, 36-inch minimum cover.
- 2.2.4.8 16 inch diameter and larger, 48 inch minimum cover.
- 2.2.4.9 Piping 12” or larger to be located outside a dedicated easement (inside dedicated right-of-way) shall have a 48 inch minimum cover. Piping less than 12” to be located outside a dedicated easement shall have a 36” minimum cover. This depth shall be measured from the low point of the cross section of the existing road right-of-way. The road right-of-way shall include embankments, ditches and other such appurtenances adjacent to the road. The Contractor shall be required to coordinate this work with the Engineer/Inspector.
- 2.2.4.10 The Contractor shall be required to have all road crossings tested by an approved laboratory that will certify that the backfill material has been compacted to 95% maximum density as determined by AASHTO-00 procedures.
- 2.2.4.11 Special conditions other than those listed shall be approved in writing by the City Engineer.
- 2.2.5 Easement Requirements – Water mains shall be installed in private easements which must be dedicated to the exclusive use of the City of Columbia. These easements must be granted prior to the date the final plat for the property being developed is recorded and must be shown on the final plat.
- 2.2.5.1 Additionally, easements must be reserved at approximately 600 feet intervals along the boundary of the property under development to allow future

connections to the water system being proposed by the developer. The exact location of these additional easements will be determined by the City Engineer when the proposed water plans are submitted for review and approval prior to construction.

2.2.5.2 Refer to Detail Easement Acquisition at the end of Part 2 to determine width of required easements.

2.2.6 Materials – Pipe selected shall have been manufactured in conformity with City of Columbia specifications for water main construction.

### 2.3 SYSTEM DESIGN:

2.3.1 Dead ends shall be minimized by looping of all mains.

2.3.1.1 *Post hydrants* shall be installed on all dead end mains greater than 200 feet in length. All post hydrants must meet current City Regulations (Part 16, Standard Detail). Where dead-end mains 8” or larger occur, they should be provided with a hydrant for flushing purposes.

2.3.1.2 Permanent post hydrants shall be installed in locations that will prevent potential drainage problems. The runoff shall not be allowed to drain into existing or future yards. If possible, the post hydrant shall be located in an area which allows the flow to be directed into drainage structures (catch basins, etc.). *Post hydrants shall not be directed towards creeks but over ground where possible.* The City Engineer reserves the right to disapprove post hydrant locations based on potential drainage problems.

2.3.1.3 No flushing device shall be directly connected to any sewer.

2.3.1.4 Readily accessible means of flushing all water mains at a minimum velocity of 2.5 feet per second shall be provided.

2.3.1.5 A minimum residual pressure of 20 psi must be maintain while providing flushing flow plus maximum peak hourly flow.

2.3.1.6 Blow-offs (or other flushing devises) shall be required where changing pipe size, unless the engineer can demonstrate there is adequate pressure to flush the lines. Plans shall indicate size of blow-off.

### 2.4 SEPARATION OF WATER MAINS AND SEWERS:

2.4.1 General – The following factors should be considered in providing adequate separation:

2.4.1.1 Materials and type of joints for water and sewer pipes.

2.4.1.2 Soil conditions.

2.4.1.3 Service and branch connections into the water main and sewer line.

2.4.1.4 Compensating variations in the horizontal and vertical separations.

- 2.4.1.5 Space for repair and alterations of water and sewer pipes.
- 2.4.1.6 Off-setting of pipes around manholes.
- 2.4.2 Parallel installation:
  - 2.4.2.1 Normal conditions – Water mains shall be laid at least 10 feet horizontally from any sanitary sewer, storm sewer or sewer manhole, whenever possible; the distance shall be measured edge-to-edge.
  - 2.4.2.2 It is laid in a separate trench.
  - 2.4.2.3 Unusual conditions – When local conditions prevent a horizontal separation of 10 feet, a water main may be laid closer to a storm or sanitary sewer provided that; the bottom of the water main is at least 18” above the top of the sewer.
  - 2.4.2.4 In cases where it is not practical to maintain a ten foot separation, the City and DHEC may allow deviation on a case by case basis, if supported by data from the design engineer. Such deviation may allow installation of the water main closer to a sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 18” above the top of the sewer.
  - 2.4.2.5 When it is impossible to obtain the distances specified in this section, the City and DHEC may allow an alternate design. Any alternate design shall allow enough distance to make repairs to one of the lines without damaging the other.
- 2.4.3 Vertical Separation – Whenever sewers must cross under water mains, the sewer shall be laid at such an elevation that the top of the sewer is at least 18 inches below the bottom of the water main. When the elevation of the sewer cannot be buried to meet the above requirements, the water main shall be relocated to provide this separation or reconstructed with slip-on mechanical joint or prestressed concrete cylinder pipe for a distance of ten feet on each side of the sewer. One full length of water main should be centered over the sewer so that both joints will be as far from the sewer as possible.
  - 2.4.3.1 Where this vertical separation cannot be obtained, the sewer shall be constructed of materials and with joints that are equivalent to water main standards of construction and shall be pressure tested to assure watertightness prior to backfilling.
- 2.4.4 Water mains shall not be laid less than 25’ horizontally from any portion of a wastewater tile field or spray field or it will otherwise be protected by an acceptable method approved by SCDHEC.
- 2.4.5 Crossings:
  - 2.4.5.1 Normal conditions – Water mains crossing house sewers, storm sewers or sanitary sewer shall be laid to provide a separation of at least 18 inches between the bottom of the water main and the top of the sewer, whenever possible.

- 2.4.5.2 Unusual conditions – When local conditions prevent a vertical separation as previously described the following construction shall be used:
- 2.4.5.3 Water mains passing over or under sewer mains should be constructed of the materials described in 4.3 of this section.
- 2.4.5.4 Water mains passing under sewers shall, in addition, be protected by providing:
  - 2.4.5.4.1 A vertical separation of at least 18 inches between the bottom of the sewer and the top of the water main.
  - 2.4.5.4.2 Adequate structural support for the sewers or storm drain to prevent excessive deflection of joints and settling on and breaking the water mains.
  - 2.4.5.4.3 That the length of water pipe be centered at the point of crossing so that the joints will be equidistant and as far as possible from the sewer.
  - 2.4.5.4.4 Sewer manholes – No water pipe shall pass through or come into contact with any part of a sewer or sewer manhole.
  - 2.4.5.4.5 Storm drain manholes – No water pipe shall pass through or come into contact with any part of a storm drain pipe or storm drain manhole/structure.
- 2.5 VALVE, AIR RELIEF, METER AND BLOW-OFF CHAMBERS:
  - 2.5.1 Chambers or pits containing valves, blow-offs, meters or other such appurtenances to a distribution system, shall not be connected directly to any storm drain or sanitary sewer, nor shall blow-offs or air-relief valves be connected directly to any sanitary sewer.
  - 2.5.2 Such chambers or pits shall be drained to the surface of the ground where they are not subject to flooding by surface water, or to absorption pits underground.
- 2.6 HYDRANTS:
  - 2.6.1 Hydrant drains shall drain to the ground surface or to dry wells, provided exclusively for that purpose. (See construction specification details).
  - 2.6.2 Hydrant drains shall not be connected to or located within ten feet of sanitary sewers or storm drains.
  - 2.6.3 Where post-type hydrants are proposed, they must meet the requirements of blow-offs. Post hydrants shall not be used on water lines smaller than 3” in diameter.
- 2.7 SURFACE WATER CROSSINGS – Surface water crossings, both over and under water, present special problems which should be discussed with the reviewing authority before final plans are prepared.
  - 2.7.1 Above-water crossings – The pipe shall be:
    - 2.7.1.1 Adequately supported.

- 2.7.1.2 Protected from damage and freezing.
- 2.7.1.3 Accessible for repair or replacement.
- 2.7.2 Underwater crossings –
  - 2.7.2.1 A minimum pipe cover of 2’ will be provided for all underground stream crossings. If the crossing is greater than 15’ in width a blow off must be provided on the side opposite the supply service.
  - 2.7.2.2 The pipe shall be of special construction having flexible watertight joints. DIP shall be used with any mechanical joints being installed in lock.
  - 2.7.2.3 Valves shall be provided at both ends of water crossings so that the section can be isolated for test or repair; the valves shall be easily accessible and not subject to flooding.
  - 2.7.2.4 Sampling taps shall be available at each end of the crossing.
  - 2.7.2.5 Permanent taps shall be made for testing and locating leaks.
- 2.8 CROSS CONNECTIONS:
  - 2.8.1 There shall be no physical connection between the distribution system and any pipes, pumps, hydrants, or tanks whereby unsafe water or other contaminating material may be discharged or drawn into the system.
  - 2.8.2 The approval of the reviewing authority shall be obtained for interconnections between potable water supplies.
  - 2.8.3 Neither steam condensate nor cooling water from engine jackets or other heat exchange devices shall be returned to the potable water supply.
  - 2.8.4 Water Loading Stations – To prevent contamination of the public water supply, the following criteria must be met:
    - 2.8.4.1 Air Gap – A device must be installed on the fill line to provide an air break and prevent a submerged discharge line.
    - 2.8.4.2 Hose Length – The fill line hose and cross connection control device must be constructed so that when hanging freely it will terminate at least 2 feet above the ground surface.
    - 2.8.4.3 Fill Line Terminus – The discharge of the fill line must be unthreaded and constructed to prevent the attachment of additional hose, piping or other appurtenances.
  - 2.8.5 No bypasses shall be allowed unless the bypass is also equipped with an equal, approved back-flow prevention device.
  - 2.8.6 High hazard category cross connections shall require an air gap separation or an approved reduced pressure backflow preventer.

- 2.8.7 Reduced pressure principal backflow prevention assemblies shall not be installed in any area location subject to possible flooding. This includes pits or vaults which are not provided with a gravity drain to the ground's surface that is capable of exceeding the discharge rate of the relief valve. Generally, if installed in a pit, the drain line shall be two times the size of the line entering the backflow prevention device. The drain cannot empty into any type of ditch, storm drain, or sewer, which could flood water back into the pit.
- 2.8.8 All piping up to the inlet of the backflow prevention device must be suitable for potable water. The pipe must be a AWWA or NSF approved. Black steel pipe cannot be used on the inlet side of the device.
- 2.8.9 Fire line sprinkler systems and dedicated fire lines, except those in the high hazard category shall be protected by an approved double check valve assembly.
- 2.9 PUMPING FACILITIES PLANNING STANDARDS:
- 2.9.1 General – Pumping facilities shall be designed to maintain the sanitary quality of pumped water. Subsurface pits or pump rooms and inaccessible installations should be avoided. No pumping station shall be subject to flooding. (See Columbia Drainage Ordinance & Richland County Drainage Regulations).
- 2.9.2 Location – The pumping station shall be so located that the proposed site will meet the requirements of the sanitary protection of the water quality, hydraulics of the system and be protected against interruption of service by fire, flood or any other hazard.
- 2.9.3 Site Protection – The station shall be:
- 2.9.3.1 Elevated to the minimum of two feet above the 100 year return frequency flood elevation, or protected to such elevation.
- 2.9.3.1.1 No station shall be located in the regulatory floodway as determined by Corps of Engineers maps, etc.
- 2.9.3.2 Accessible at all times.
- 2.9.3.3 Graded around station so as to lead surface drainage away from the station.
- 2.9.3.4 Protected to prevent vandalism and entrance by unauthorized persons or animals.
- 2.9.4 Surface Water Facilities – Pump stations normally associated with the distribution system shall:
- 2.9.4.1 Have adequate space for the installation of additional units if needed, and for the safe servicing of all equipment;
- 2.9.4.2 Be of durable character, fire and weather resistant and with outward opening doors.
- 2.9.4.3 Have floor elevation of at least six inches above finished grade.

- 2.9.4.4 Have underground structure water-proofed.
- 2.9.4.5 Have all floors drained without impairing the quality of water being handled and if equipment is contained on the floor, the floor shall slope at least three inches in every ten feet to the point of drainage.
- 2.9.4.6 Provide suitable outlet for drainage from pump glands without discharging onto the floor.
- 2.9.5 Suction Well – Suction wells shall:
  - 2.9.5.1 Be watertight.
  - 2.9.5.2 Have floors sloped to permit complete removal of water.
  - 2.9.5.3 Be covered or otherwise protected against contamination, including pump lubricants.
- 2.9.6 Equipment Servicing – Pump stations shall be provided with:
  - 2.9.6.1 Crane-ways, hoist beams, eyebolts, or other adequate facilities for servicing or removal of pumps, motors, or other heavy equipment.
  - 2.9.6.2 Openings in floors, roofs, fences or wherever else needed for removal of heavy or bulky equipment.
- 2.9.7 Stairways and Ladders – Stairways or ladders shall:
  - 2.9.7.1 Be provided between all floors, in pits or compartments which must be entered in accordance with OSHA rules and regulations.
  - 2.9.7.2 Have handrails on both sides, and treads of nonslip materials in accordance with OSHA rules and regulations.
  - 2.9.7.3 Stairs are preferred in areas where there is frequent traffic or where supplies are transported by hand. They shall have risers not exceeding nine inches and treads wide enough for safety.
- 2.9.8 Heating – Provision shall be made for adequate heating for:
  - 2.9.8.1 The comfort of the operator.
  - 2.9.8.2 The safe and efficient operation of the equipment.
  - 2.9.8.3 In pump houses not occupied by personnel, only enough heat need be provided to prevent freezing of equipment or treatment process.
- 2.9.9 Ventilation – Ventilation shall conform to the building code. Adequate ventilation shall be provided for all pumping stations. Forced ventilation of at least six changes of air per hour shall be provided for:
  - 2.9.9.1 All rooms, compartments, pits and other enclosures below grade floor.

- 2.9.9.2 Any area where unsafe atmosphere may develop or where excessive heat may be built up.
- 2.9.10 Dehumidification – In areas where excess moisture could cause hazards to safety or damage to equipment, means for Dehumidification shall be provided.
- 2.9.11 Lighting – Pump stations shall be adequately lighted throughout. All electrical work shall conform to the requirements of the City Electrical Code.
- 2.9.12 Sanitary and Other Connections – Except in the cases of small automatic stations or where such facilities are otherwise available, all pumping stations shall be provided with potable water, lavatory and toilet facilities. Plumbing must be so installed as to prevent contamination of the public water supply. Wastes shall be discharged in accordance with the rules, regulations and requirements of the City or County having jurisdiction over the site.
- 2.9.13 Pumps – At least two pumping units shall be provided. If only two units are provided, each shall be capable of carrying the peak demand. If more than two units are installed, they shall have sufficient capacity so that any one pump can be taken out of service and the remaining pumps are capable of carrying the peak demand. The pumping units shall:
- 2.9.13.1 Have ample capacity to supply the peak demand without dangerous overloading.
- 2.9.13.2 Be driven by a prime mover able to operate against the maximum head and air temperature which may be encountered.
- 2.9.13.3 Have spare parts and tools readily available.
- 2.9.14 Suction Lift – Suction lift shall:
- 2.9.14.1 Be avoided, if possible.
- 2.9.14.2 Be within allowable limits, preferably less than 15 feet.
- 2.9.14.3 If suction lift is necessary, provision shall be made for priming the pumps.
- 2.9.15 Priming – Prime water must not be of lesser sanitary quality than that of the water being pumped. Means shall be provided to prevent backsiphonage in accordance with “Ten States Standards.” When an air-operated ejector is used, the screened intake shall draw clean air from a point at least 10 feet above the ground or other source of contamination, unless the air is filtered by apparatus approved by the reviewing authority. Vacuum priming may be used.
- 2.9.16 Booster pumps – Booster pumps shall be located or controlled so that:
- 2.9.16.1 They will not produce negative pressure in their suction line.
- 2.9.16.2 The intake pressure shall be at least 20 psi when pump is in normal operation.
- 2.9.16.3 Automatic cutoff pressure shall be at least 20 psi in the suction line.

- 2.9.16.4 Automatic or remote control devices shall have a range between the start and cutoff pressure which will prevent excessive cycling.
- 2.9.16.5 Inline Booster Pumps – In addition to the other requirements of this section, inline booster pumps shall be accessible for servicing and repairs.
- 2.9.17 Automatic and Remote Controlled Stations – All automatic stations should be provided with automatic signaling apparatus which will report when the station is out of service. All remote controlled stations shall be electronically operated and controlled and shall have signaling apparatus of proven performance. Installation of electrical equipment shall conform with the National Electrical Code and the City of Columbia Electrical Code.
- 2.9.18 Appurtenances:
- 2.9.18.1 Valves – Pumps shall be adequately valved to permit satisfactory operation, maintenance and repair of the equipment. If foot valves are necessary they shall have a net valve area of at least two and one half times the area of the suction pipe and they shall be screened. Each pump shall have a positive acting check valve on the discharge side between the pump and shutoff valve.
- 2.9.18.2 Piping – In general piping shall:
- 2.9.18.2.1 Be designed so that the friction head will be low.
- 2.9.18.2.2 Not be subject to contamination.
- 2.9.18.2.3 Be sloped in one direction to drain.
- 2.9.18.2.4 Have adequate cleanouts.
- 2.9.18.2.5 Have watertight joints.
- 2.9.18.2.6 Be protected against surge or water hammer.
- 2.9.18.2.7 Be such that each pump has an individual suction line or the lines shall be so manifold that they will insure similar hydraulic and operation conditions.
- 2.9.19 Have a standard pressure gauge on its discharge line.
- 2.9.19.1 Have a compound gauge on its suction line.
- 2.9.19.2 Have recording gauges in the larger stations.
- 2.9.19.3 Have a direct reading meter in gallons with accumulator.
- 2.9.20 Water Seals – Water seals shall not be supplied with water of a lesser sanitary quality than that of the water being pumped. Where pumps are sealed with potable water and are pumping water of lesser sanitary quality the seal shall:
- 2.9.20.1 Be provided with a break tank open to atmospheric pressure.

- 2.9.20.2 Have an air gap between feeder line and split line of the tank, at least six inches or two pipe diameters, whichever is greater.
- 2.9.21 Controls – Pumps, their prime movers and accessories, shall be controlled in such a manner that they will operate at rated capacity without dangerous overload. Electrical controls should be located above grade.
- 2.9.22 Power – When power failure would result in cessation of minimum essential service, power supply shall be provided from at least two independent sources or standby or auxiliary source shall be provided.
- 2.9.22.1 Auxiliary Power Supply – When automatic pre-lubrication of pump bearings is necessary, and an auxiliary power supply is provided, the pre-lubrication line shall be provided with a valved by-pass around the automatic control.