

SECTION 8

WATER SYSTEMS

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SECTION 8

WATER SYSTEMS

8-1 INTRODUCTION

These Improvement Standards shall apply to water supply and distribution facilities to be maintained by a CSA Service Area (CSA) providing extended water services. These Standards are minimum criteria. The County Engineer may permit modifications or may require higher standards where unusual conditions are encountered. These Standards shall also apply to any privately owned and maintained system serving 4 or more residential units or any commercial or industrial uses. Where water supply and distribution facilities are to be maintained by a Community Service District or a City, the standards of the District or City shall govern the design and construction of water supply and distribution facilities.

8-2 INTENT OF WATER SYSTEM IMPROVEMENT STANDARDS

The intent of these water system improvement standards is to provide water systems that reliably and safely convey water at a reasonable capital cost and with minimum operation and maintenance costs.

8-3 DEFINITIONS

When the following terms or titles are used in these water system improvement standards, or in any document or instrument where these standards govern, the intent and meaning shall be as herein defined:

- AWWA - American Water Works Association.
- Raw Water – Untreated, non-potable water for irrigation use only.
- Recycled Water – Reclaimed treated wastewater, non-potable water for irrigation use only.
- Water System - Refers to potable, raw water, and recycled (reclaimed) water systems.

8-4 APPLICABLE STANDARDS

The most current requirements of the following agencies, regulations and standards shall apply to the design of water systems. In case of conflict between the requirements of these water system improvement standards and the agencies and documents listed below, the more stringent requirement shall govern.

- United States Environmental Protection Agency (EPA) Drinking Water Regulations.
- Laws, regulations, codes, and standards of the State of California relating to domestic water.
- Title 17, Chapter 5, California Code of Regulations, regarding cross-connections and backflow prevention.
- Title 22, Division 4, Chapter 16, California Code of Regulations, regarding California Waterworks Standards
- Permit and regulatory requirements of the State of California Department of Health Services.
- Yolo County Code Title 6, Chapter 8, Water Quality.
- Rules and regulations of Yolo County Health Department.
- General Order No. 103 of the California Public Utilities Commission.
- Uniform Fire Code.
- Latest Edition of the American Water Works Association (AWWA) standards.

8-5 WATER SYSTEM MASTER PLAN

The Developer shall provide a Water System Master Plan for the approval of the County Engineer that addresses water supply and reliability issues, and demonstrates how adequate daily service and fire protection will be provided for the project.

The Master Plan shall include, at a minimum:

1. A copy of the water assessment prepared for the project in accordance with the California Water Code Section 10910, et. seq.
2. The anticipated growth of the water system over a projected period of at least ten years in terms of the population and number and type of residential, commercial, and industrial service connections to be served by the water system.
3. Estimates of the amount of water needed to meet the total annual demand over the projected ten-year growth period (projected system demand). Methods, assumptions, and calculations used to estimate the projected system demand shall be included.
4. A map and description of the entire existing and proposed service area, showing:
 - a. The location of each water source, including wells that are abandoned, out-of-service, destroyed, standby, or inactive;
 - b. Any valid water rights owned by the system for surface water sources, including information on any limitations or restrictions of those rights;
 - c. For a groundwater aquifer, the groundwater levels and drawdown patterns;
 - d. Permits or approvals for groundwater extraction if pumping from an adjudicated groundwater basin;
 - e. Existing and planned source pumping capability and distribution storage capacity for the system
 - f. The calculated sustained well yields of existing wells if groundwater sources are used; as a whole and for each pressure zone;
 - g. Permits, if required, for any waters proposed for use to offset potable water demand; and
 - h. A Source Water Assessment for each potable water source.
5. Distribution system piping, pressure zones, hydro-pneumatic tanks, and reservoirs;
6. Valves, sample taps, flow meters, unmetered service connections, and other system appurtenances;
7. Conveyance facilities;
8. Provisions for backup power to operate facilities during extended power outages common in rural areas;
9. Any flood plains in the projected service area; and
10. The 100 year flood or highest recorded flood level, whichever is higher.

8-6 IMPROVEMENT PLAN SUBMITTAL

Improvement plans shall meet the requirements of these Improvement Standards, to the satisfaction of the County Engineer.

8-7 APPROVAL OF IMPROVEMENT PLANS

The County Engineer will approve water system improvements concurrently with any street, sewer, storm drainage or other improvements shown on the Improvement Plans. The following must occur before the plans can be approved:

- The local Fire District must approve the improvement plans as to fire flow pressure, fire hydrant spacing, and fire hydrant valve outlet configuration and sizes.

- The location of all wells in use and all abandoned wells must be shown on the improvement plans. Wells must be properly abandoned in accordance with permits issued by the Yolo County Health Department. Copies of well abandonment permits for all abandoned wells must be provided to the County Engineer prior to final acceptance of any public improvements.

8-8 IMPROVEMENT PLAN REVISION

All plan revisions that affect a water system to be maintained and operated by the County shall be approved and signed by the County Engineer prior to construction.

8-9 CONNECTION PERMITS AND FEES

A water connection and/or encroachment permit shall be obtained for each new connection to the water system. Contact Yolo County Department of Planning and Public Works for information concerning fees.

8-10 WATER QUALITY

The quality of the potable water supplied or delivered into any portions of a public water system shall conform to the applicable federal standards and State Department of Health Services Drinking Water Standards.

8-11 WATER PRESSURE

Water distribution systems shall be designed so that normal operating pressures at service connections to the distribution system are not less than 45 pounds per square inch (psi) and not more than 100 psi. During periods of maximum day domestic demand plus fire demand, the pressure shall not be less than 20 psi at the location of the fire flow and no less than 5 psi anywhere in the distribution system.

8-12 WATER DEMAND

Determination of design flow rates required for a specific land use category shall consider maximum day domestic demands occurring in conjunction with an emergency fire flow demand. For design of the water supply and distribution system, the unit demand factors shall be assumed in accordance with Table 8-1 below, in consultation with the County Engineer. Small and/or remote systems may require more stringent standards, as determined by the County Engineer.

To provide for projected growth, the County Engineer may require that distribution mains be upsized in accordance with approved Master Water Plans.

TABLE 8-1 WATER DEMAND FACTORS	
Land Use Category	Average Day Water Demand Factors
Single Family Residential (<6 Dwelling Units/Acre)	728 gpd/dwelling unit
Multi Family (>6 to 12 Dwelling Units/Acre)	521 gpd/dwelling unit
Commercial/Retail	2,598 gpd/ac
Business Professional/Light Industrial	2,598 gpd/ac
Industrial	2,562 gpd/ac
Railroad Yard	109 gpd/ac
Elementary Schools	3,454 gpd/ac
High Schools	4,068 gpd/ac
Public (Fire Station, etc)	1,780 gpd/ac
Park/Recreation	2,988 gpd/ac

The average day demand to maximum day demand peaking factor shall be 2.0. The maximum day demand to peak hour demand peaking factor shall be 1.7 (3.4 average day to peak hour).

8-13 FIRE FLOWS

Required fire flows shall be determined by the California Fire Code, the fire protection district having jurisdiction, and the County of Yolo. Minimum fire flows shall not be less than shown in Table 8-2 following, with a 2-hour duration:

TABLE 8-2 FIRE FLOWS	
Development Category	Fire Flow, Gallons per Minute
Single-Family Residential	1,500
Light Commercial	2,500
Planned Unit and Multiple Dwelling Areas	2,500
Central Business District	3,500
Industrial/Higher Value Buildings	3,500

8-14 WELLS, TREATMENT PLANT AND STORAGE FACILITY DESIGN

Where a CSA is proposed to provide wastewater treatment services, the Developer shall be responsible for all costs to create the CSA, prepare an Engineer's Report to estimate assessments, and provide engineered plans for the wells, treatment plant, and storage facility design. Such plans shall be prepared by an engineering firm retained by the Developer that 1.) has demonstrated expertise and experience designing municipal water supply, treatment, and storage systems, and 2.) is approved by the County Engineer prior to the commencement of design work.

In general, all developments must provide a minimum of two (2) demonstrated sources of water. The water supply and treatment plant shall include, but is not limited to, wells, storage tanks, pumps, hydropneumatic tanks, chemical storage and treatment equipment, backup power with automatic transfer switches, toilet facilities, safety eyewashes, conditioned office space for operations and maintenance personnel and control equipment, lighting, landscaping, landscape irrigation, and security fencing. Automatic backup power systems to operate the water system shall be provided, using natural gas where available, or propane (LPG). Operational systems shall include telemetry and SCADA systems to allow remote monitoring and operations.

Site selection for the above mentioned facilities shall be approved by the County Engineer and meet the requirements of the Yolo County Environmental Health Department and the State Department of Health Services.

8-15 DISTRIBUTION MAIN DESIGN

Sizing of distribution mains shall be such that the normal pressures stated in Section 8-11 and the minimum requirements as stated below for distribution main spacing and sizing are maintained. The Hazen-Williams formula shall be used in the hydraulic study of the system, using a "C" value of 125 for polyvinyl chloride pipe and cement-lined ductile iron pipe.

A Hardy-Cross hydraulic analysis of any proposed distribution system shall be provided to the County Engineer. In design of the system, the maximum assumed delivery from any hydrant shall be assumed to be limited to 1,500 gallons per minute.

- A. Distribution Main Design Plan Requirements:** Plans for the construction of water mains whether in conjunction with other improvements or for a water project only, shall conform to the following standards, as well as other provisions contained in these Improvement Standards.
1. The distribution main shall be shown on the Street Plan and Profile sheets, and for non-street areas on separate plan and profile sheets as required.
 2. Details of distribution mains crossing within 15" of other utilities, or unusual alignments, will be provided if deemed necessary by the County Engineer.
 3. A sand bedding shall be provided around all water mains (6 inches minimum all directions), regardless of pipe material type. If existing soil is too porous to hold sand, a geotextile fabric placed on the trench bottom and covered with 6 inches of sand may be used. Bedding and backfill shall be compacted to 95% relative compaction. Grooves shall be dug in the pipe bedding to accommodate pipe bells, fittings, and joints so that the pipe is continuously supported by the bedding material.
 4. Stationing for all fittings, shut off valves, air release/vacuum valves, and in line blow-off valves shall be called-out in the profile view of the improvement plan sheets. Elevations shall be called-out at all changes in pipe elevation. Horizontal alignment changes shall be called out on the plan view.
 5. Commercial, industrial, and apartment Improvement Plans with a water easement shall have a note that states, "Utilities may not be located within water easement(s) except if the utility crosses the water easement within 20 degrees of perpendicular to the water main."

- B. Distribution Main Location:** All water distribution mains shall be installed within public rights-of-way or easements.
1. In new subdivisions, the centerline of the water main shall be located six feet north or west of street centerlines within minor and primary streets. If a street loops 180 degrees or more it is not necessary for the water main to cross to the other side of the street to meet this requirement.
 2. If it is necessary to install a water distribution main within a private road, the water easement shall be the width of the paving plus one foot each side. Water easements over water distribution mains located on commercial, industrial, or apartment properties shall have a minimum width of 15 feet. The water main shall be centered in the easement.
 3. If it is necessary to install a water distribution main within a landscape corridor, then no trees shall be planted within five feet of the water main. The water distribution main shall be centered within a 15 foot wide water easement. The landscape plans for the corridor shall be submitted prior to approval of the improvement plans.
 4. If a water distribution main is required to be installed between residential homes, the pipe material shall be Class 350 Ductile Iron Pipe, and a 6 inch wide warning tape shall be placed on the backfill. The center of the main shall be centered within a 15 foot wide easement.
 5. Ten (10) feet shall be the minimum horizontal distance between the exterior surfaces of parallel water distribution and sanitary sewer mains or recycled water mains. The water distribution main shall be higher than the sewer main or recycled water main. Separation may be less if it is accordance with California State Department of Health Services requirements and approved by the County Engineer.
 6. On all utility crossings, the water distribution main shall maintain a separation or clearance of at least 12-inches (1 foot) from the utility.
 7. When crossing over a sanitary sewer force main, it shall be specified that the water distribution main be installed a minimum of three (3) feet above the sewer line and be ductile iron.
 8. Water distribution mains to be installed in public right-of-ways or easements not conforming to the items above shall be approved by the County Engineer in consultation with other affected utility providers.
- C. Distribution Main Layout and Sizing:** The distribution system, whenever possible, shall be in grid form so that pressures throughout the system tend to become equalized under varying rates and locations of maximum demand, and to provide system redundancy. The minimum pressures and flows as specified shall govern design of the system. The following conditions are to be considered for the distribution system design:
1. The minimum pipe size shall be eight inches inside diameter.
 2. Where distribution mains are installed in an arterial street, dual mains (one pipeline on each side of the street) may be required.
 3. Mains shall maintain a minimum cover of 36-inches, and when not avoiding other utilities mains shall have a maximum depth of 60-inches, unless otherwise specified by the County Engineer. Both distances shall be measured from finish grade. Mains shall be located a minimum of 24" from the subgrade of the street pavement section.
- D. Distribution Main Pipe Restraint:** Pipes shall be restrained from movement as a result of thrust on the fittings and valves of the water system. Thrust restraint for bends and tees may be accomplished with thrust blocks as shown in Standard Drawing 8-3, or by means of pipe joint restraining devices such as Star Pipe Products, Stargrip® Series 4000, or equivalent. Thrust blocks must be poured against undisturbed soil.

- E. Type of Distribution Main Pipe and Pipe Deflection:** Water mains up to 12" diameter shall be Class 200 AWWA C900 Polyvinyl Chloride. Ductile iron pipe (DIP) for crossings shall be manufactured to conform to ANSI/AWWA C-150/21.50 thickness design of ductile iron pipe and to "Ductile Iron Pipe Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water and Other Liquids" (ANSI/AWWA C-151/A21.51) and shall be cement-mortar lined in accordance with the standard for "Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water" (ANSI/AWWA C-104/A21.4). All DIP shall be encased in clear, 4-mil HDPE sleeves, installed in accordance with these Improvement Standards and the standard for "Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids" (ANSI/AWWA C-105/A21.5).

Pipe curvature induced due to bending PVC pipe shall exceed 140% of the manufacturer's minimum recommended bending radius. Bending of Polyvinyl Chloride pipe shall not exceed the limits described in Standard Drawing 8-9.

- F. Distribution Main Valves:** Valve clusters shall be placed at all pipe intersections with a valve on each leg of the main. Gate valves shall be used on 12" diameter and smaller mains. Butterfly valves shall be used on all larger size mains. Valves shall be placed in between main line intersections at intervals of 500 feet between valves.

8-16 WATER SYSTEM APPURTENANCES

Water system appurtenances include fire hydrants, water service lines, water meters, detector check valves, and back-flow devices.

- A. Fire Hydrants and Blow-off Assemblies:** Fire hydrants and blow-off assemblies shall be located as follows:
1. Fire hydrants shall be connected to distribution mains only.
 2. Fire hydrants shall be placed at street intersections wherever possible, and located to minimize the hazard of damage by traffic. They shall have a maximum normal spacing of 500 feet measured along the street frontage in residential developments, 300 feet in commercial developments, or as otherwise approved by the local Fire District. Hydrants located at intersections shall be installed at the curb return. Within residential areas, all other hydrants shall be located on property lines between lots. See Standard Drawing 8-2 and typical installation details.
 3. The minimum size lateral serving a fire hydrant shall be six inches in diameter provided the distance from the nearest intersecting main to the hydrant shall not be greater than 50 feet if fire flow requirements are 1500 gpm, or 10 feet if fire flow requirements are greater than 1500 gpm. The lateral pipeline connecting the hydrant and the main shall have a gate valve flanged to the main.
 4. A fire hydrant or four (4)-inch blow-off assembly shall be installed on all permanent dead-end runs including cul-de-sacs. If the local Fire District requires a hydrant at the end of a dead-end run, then a 4-inch Blow-off assembly will not be allowed. Two-inch Blow-off valves shall be used if dead-end runs are temporary. Wherever possible, the blow-off assemblies shall be installed in the street right-of-way, a minimum distance of three (3) feet from the lip of gutter, or behind the sidewalk. In no case shall the location be such that there is a possibility of siphoning into the distribution system. See Standard Drawings 8-12, and 8-13 for specifications and typical installation details.

- B. Water Service Lines:** Service lines from the water distribution main to the property line or edge of easement shall always be installed at the time the main is constructed. Services from mains installed in private roads shall extend one foot beyond the edge of the pavement, sidewalk, curb and gutter. Service line criteria shall be as follows:
1. In all new subdivisions, the service line shall be located 5 feet from the side property line, and the meter box assembly shall be located outside of the flowline of any proposed sideyard swales or areas subject to ponding.
 2. The minimum size of a new residential service line and meter shall be one and one-half inches (1-1/2") in diameter. Schools, commercial, industrial, or multiple-family units with higher water demand shall be provided with larger service lines, subject to approval of the County Engineer. All services shall be installed with a corporation stop at the main and valve at the property line. The property line valve shall be the angle meter stop (2" and smaller services) or a gate valve (services larger than 2") at the water meter whenever possible.
 3. The Contractor shall make all water service taps into existing mains upon application for a permit and payment of the required fees. A note to this effect shall be placed on the plan sheet which details the area that requires such tapping. Application should be made to County of Yolo Planning and Public Works Department and the required fees paid at least five (5) days in advance of the time the tap is desired. The Contractor shall perform all work subject to inspection and acceptance by the County Engineer.
 4. All services up to two inches in diameter shall be Type K soft copper. All larger services shall be the same material as the water main. No joints shall be allowed in service lines.
 5. The location of all water services shall be permanently marked with a 2" tall "W" wet-stamped into the face of the concrete curb.
- C. Water Meters:** The developer shall provide meters and a complete automated meter reading system (meters, radio-read transmitters, remote transceivers, software, etc). Water meters shall be installed on all residential, commercial, industrial, multi-family, and irrigation water services. Meter boxes with an idler will be installed by the developer. Meters will be provided by the developer for installation by the builder after building permits are issued. Meter boxes shall be set above the back of walk as required to provide for drainage away from the box and shall be adjusted, as needed, to final grade by the building contractor. Size of water meter shall not be less than the size of the service line unless approved by the County Engineer. See Standard Drawing 8-6 for specifications and typical installation details.
- D. Fire Department Connection:** A backflow prevention device shall be provided for each fire service line into a building, whether residential, commercial or industrial use. See Standard Drawing 8-7 for specifications and typical installation details. The Fire District or Department will review and approve all connection details. Contact the Fire District or Department for requirements based on specific uses, and field testing requirements. Prior to acceptance a copy of the test certification/report from an AWWA certified private Certified Backflow Prevention Assembly Tester shall be required for each device.
- E. Back-Flow Devices:** Back-flow devices are required in accordance with Title 17, Chapter V, and Sections 7583-7622 of the California Code of Regulations. See Standard Drawing 8-8 for specifications and typical installation details. Prior to acceptance a copy of the test certification/report from an AWWA certified private Certified Backflow Prevention Assembly Tester shall be required for each device.

Back-flow devices shall be provided with an insulating blanket and lockable metal enclosure, GuardShack™, or equivalent meeting the following requirements:

1. Manufactured with minimum 1¼" schedule 40 metal pipe (A.S.T.M.-A-53 Gr.A.E.W). All sharp corners on top of the enclosure shall be eliminated by using pipe formed to a 6" radius for 12" wide enclosures and a 9" radius on all 18" wide or wider enclosures.
 2. Expanded metal shall be ½" spacing, #13 gauge flattened diamond pattern steel. Expanded metal shall be "die-formed" for uniformity. There shall be no exposed ends of expanded metal on the outside of the enclosure.
 3. Welding shall be a minimum of ¼" along weld on 4" spacing.
 4. Enclosure shall be powder coated with dark green color, subject to the approval of County Engineer.
- F. Air Release/Vacuum Valve Assemblies:** Air release/vacuum valve assemblies are required at high points in a distribution system as determined by the County Engineer. See Standard Drawing 8-14 for specifications and typical installation details. Air release valve boxes shall be located at least 5 feet away from driveways, and shall be protected with bollards as required by the County Engineer.
- G. Polyethylene Wrapping:**
All valves, fittings, DIP, copper and underground brass shall be wrapped and sealed in an 8-mil minimum thickness polyethylene encasement. Use pipe wrap tape to secure and seal to the polyethylene encasement. Damaged or scratched surfaces on epoxy coated valves and appurtenances may be repaired with an epoxy kit per manufacturer's recommendations and to the satisfaction of the County inspector prior to wrapping. Otherwise, the damaged valve shall be replaced with a new valve.
- H. Tracer wire:** A continuous number 10 AWG, insulated, single strand copper tracing wire shall be attached to all mains, service lines and appurtenances per Standard Detail 8-4 and the following:
1. Tracing wire shall be continuous between mainline valve boxes and fire hydrants. It shall be attached to the top of the pipe with 10-mil polyethylene tape every 10 feet.
 2. Tracing wires through valve boxes shall be brought to the surface by placing outside of riser, but inside the box.
 3. Tracing wire in manholes and vaults shall be attached inside the facility within nine inches of the rim.
 4. Wire splices shall be soldered and located above ground and inside of valve boxes, except for splices necessary for services.
- I. Marking tape:** A 12-inch wide, blue plastic non-detectable water pipe marking tape, marked "Buried Water Main Below," shall be placed in all main line trenches, 12 to 24 inches from the surface. Where a water main and recycled water main intersect, the plastic marking tape shall also be attached to the top of the pipe with nylon tie-wrap banded around the warning tape and the pipe every five feet on center. The warning tape shall extend to the nearest valves located on each side of said intersection.
- J. Markers:** Mains in unpaved areas shall be marked every 150 lineal feet with a blue composite utility marker having a decal stating: "Caution Water Pipeline." Appurtenances (valves, ARV's, test stations, etc.) and angle points shall also be marked. All fire hydrants shall be marked with blue, two-way, retro-reflective markers placed 6" off the street centerline on the side nearest the hydrant.
- K. Water Sampling Stations:** Water sampling stations shall be provided to the satisfaction of the County Engineer.

8-17 RECYCLED WATER AND NON-POTABLE WATER DISTRIBUTION MAINS

Recycled water and non-potable water facilities may be required for use in specified areas as determined by projects conditions of approval or County policy, in consultation with the County Engineer. Design flows and demands for recycled and non-potable water systems shall be determined by the developer's engineer. Design requirements for recycled water and non-potable water distribution mains are similar to potable water; however, there are special provisions described as follows:

1. To avoid cross connection of the potable and non-potable water systems, recycled water and non-potable facilities shall be clearly marked through appropriate coloring of pipe materials and above ground appurtenances. Coloring shall be purple unless otherwise directed.
2. Pipe color shall be purple and embossed or integrally stamped/marked "CAUTION: NONPOTABLE WATER - DO NOT DRINK", or "CAUTION: RECYCLED WATER - DO NOT DRINK". Valve and meter boxes shall be colored purple and have the words "NONPOTABLE WATER" stamped into the face.
3. All above ground facilities shall be marked with signage to caution against drinking water from the recycled water system. All signs shall be made and placed in such a manner as to become a permanent part of the facility or appurtenance. Park sites, large turf areas, and other publicly used areas may require warning signs of the appropriate size as determined by the County Engineer or other regulatory agency.
4. The recycled and non-potable water system shall maintain a minimum pressure of 40 psi.
5. The recycled and non-potable water mains shall be located on the south and east side of a street (or same side as the sanitary sewer). The recycled and non-potable water mains shall be located at a minimum of four feet from the lip of gutter. The recycled and non-potable water mains and valve actuators will be located in the center of traffic lanes or on traffic lane lines. A deviation from these criteria may be allowed if approved by the County Engineer in consultation with other affected utility providers.

8-18 TESTING PROCEDURES

Testing of the water system may proceed only after joint utility crossings are completed, the sewer mains and services have passed pressure test and TV inspection, the recycled water system has passed testing, and subgrade elevations have been met. Road bases to be lime-treated shall be pressure tested before and after the lime treatment process. Testing prior to subgrade placement may be subject to additional pressure tests at the discretion of the County Engineer. The new system shall be filled with potable water through an approved backflow device.

A. Pressure Test:

1. Contractor shall verify that all system valves are open prior to testing.
2. The County inspector shall be present during the duration of the test.
3. Pressure testing shall be conducted for two hours at 150 pounds per square inch or at one-and-one-half times the operating pressure, whichever is higher, as measured from the system high point. The test gauge shall be liquid-filled and capable of testing up to 300 psi.
4. No detectable leakage is allowed.

B. Chlorine Disinfection: Chlorine disinfection shall comply with the AWWA Standard for Disinfection Water Mains (C651-92) and as specified below:

1. Disinfection inspections shall begin only after passing the pressure test.
2. Prior to chlorination, pre-flush water mains and services. Preflushing is not permitted if using the Tablet Method for chlorination.

3. Chlorine shall be drawn through all mains, hydrant runs and services. The County inspector shall verify that a minimum chlorine residual of 50 parts per million (ppm) has been achieved.
 4. After a 24-hour holding period, the County inspector will verify that a minimum chlorine content of 25 ppm remains in the system.
 5. Upon approval by the County inspector, the water system shall be flushed to remove concentrated chlorine. Flushing shall be continued until the remaining water has a chlorine residual below 1 ppm and a turbidity equal to or less than 1 NTU. Chlorinated water shall be neutralized to 1 ppm chlorine residual or less prior to discharge. Discharge location and neutralization methods shall be documented in the SWPPP and coordinated with and approved by the County.
- C. Water Quality Testing:** Water quality samples shall be taken per the following procedure:
1. Once flushing has lowered the chlorine residual below 1 ppm and the turbidity is equal to or less than 1 NTU, the water system shall observe a minimum 24 hour detention time. Water may not be drawn during this time period.
 2. After the 24-hour holding period has elapsed, water quality samples shall be collected by the County inspector for testing.
 3. If the sample lot does not meet the minimum chlorine residual and turbidity criteria, additional flushing shall be required. The procedure shall be repeated until the criteria are met.
 4. A minimum of 2 sets of samples at least 24 hours apart after completion of final flushing as indicated above shall be taken at locations indicated in ANSI/AWWA C651 and will be tested for coliform organisms and heterotrophic plate count. Costs for testing will be the Developer's responsibility. Satisfactory bacteriological results will be:
 - a) absence of total and fecal coliform,
 - b) a heterotrophic plate count less than 100 CFU and
 - c) CL_2 Residual
- D. Continuity Testing:** The Contractor shall test continuity of the tracing wire with standard locating equipment. The County inspector shall witness all testing. Discontinuity in the tracing wire shall be repaired. It is recommended that the Contractor perform continuity testing after subgrade is made, but before asphalt is placed. Final continuity testing will take place after asphalt is placed and all valve boxes are raised.
- E. Corrosion Protection System Testing:** At the completion of the pipe installation, the corrosion engineer shall conduct a test of the corrosion monitoring system in the presence of the County inspector. A report showing the test results shall be submitted to the County for review and approval. The report shall include test station locations as called out on the approved plans, appurtenance tested, test result, and recommendations for future monitoring and maintenance.

8-19 RECORD PLANS

Record Drawings shall be prepared in accordance with Section 2-11 *Record Plans* of these improvement standards and shall also include the following:

1. Each sheet of the improvement plan shall be labeled or stamped "As-Built" or "Record Drawing".
2. Elevations of the top of the end of distribution mains.
3. The type of water distribution main pipe installed shall be clearly marked on each sheet.
4. The type of end fitting and pipe at the end of the distribution mains shall be described.

5. Changes of location of shut-off valves, fittings, air release/vacuum valves, blow-off assemblies, hydrants, and water services which vary from the improvement plans.

Record Drawings shall be approved by the County Engineer prior to acceptance of the project.