

**SECTION 41 - WATER DISTRIBUTION SYSTEMS
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SECTION 41 WATER DISTRIBUTION SYSTEMS

41-1 GENERAL

This section applies to all potable and non-potable water distribution systems.

Refer to Section 41-22, "Recycled Water", of these Specifications for requirements for recycled, reclaimed, and non-potable water distribution systems.

Materials, storage, and installation must comply with the strictest requirements of these Specifications, the Contract Documents, the American Water Works Association (AWWA) Standards, and the manufacturers' recommendations.

Materials must be new, undamaged, and without defects. Loose gaskets and small items must be stored in sealed containers until installation. Pipe, fittings, valves, and appurtenances must be covered during storage to prevent wind-blown dirt and contamination from entering the interiors and to prevent rubber and plastic materials and components from being exposed to UV sunlight. Materials showing evidence of defects, damage, aging, or improper storage, as determined by the Water Utility Inspector, will be rejected and removed from the job site.

All buried metal must be encased with 8 mil polyethylene so that no soil is in contact with metal, in compliance with Section 41-5.03, "Polyethylene Encasement."

The term "Water Utility" is defined as the agency, department, or company responsible for operation and maintenance of the public water distribution system. Where the term "Water Utility" is used in these Specifications or in the Standard Drawings, this definition applies. There are approximately 25 separate water utilities that operate public water distribution systems in Sacramento County. An unofficial, approximate service area map and a phone contact list can be obtained from www.SCWA.net. The Contractor must identify the water utility for the existing and new water pipes, water valves, and water appurtenances within the project area. The Contractor is cautioned that the project area might include existing or new water facilities of more than one water utility. Certain service areas have two different water utilities -- a wholesale water utility and a retail water utility. Projects located on the border of water utility service areas typically have water facilities of both adjacent water utilities.

41-2 WATER PIPE

Water pipe, fittings, and joint restraints must comply with Sections 50-25, "Ductile Iron Pipe (DIP), and Cast Iron and Ductile Iron Fittings", and 50-26, "Polyvinyl Chloride (PVC) Water and Drainage Pipe", of these Specifications. Pipe materials used for water services must comply with Section 50-40, "Water Service Connection Materials", of these Specifications.

Storage of PVC pipe must conform to AWWA C605. Pipe must not be exposed to sunlight for more than 6 months. Pipe showing indications of excessive sunlight exposure will be rejected.

Pipe type and minimum class must comply with the following table. Unless otherwise specified in the Plans, Standard Drawings, or these Specifications, the Contractor may choose the pipe material from the table below subject to the restrictions in Table Notes 1, 2, 3, and 4.

Pipe Type and Minimum Pressure Class	
Size	Type and Minimum Pressure Class
4" – 12"	AWWA C151 Ductile Iron Class 350, or
	AWWA C900 PVC Class 150 (DR 18) (see Notes 1, 2)
Note 1: The Plans might restrict pipe type to ductile iron pipe for all or part of the main. In these areas, only ductile iron pipe can be used and PVC pipe is not allowed.	
Note 2: PVC pipe cannot be used in sections of mains requiring restrained joints, except where the required "restrained-length" is less than one pipe length and is accomplished without PVC-to-PVC pipe joints.	
Note 3: The Plans might specify heavier class pipe for all or part of the piping. In those areas, the minimum pipe class is the heavier class specified in the Plans.	
Note 4: Heavier class ductile iron pipe is required for fabricated flanged pipe.	

41-3 EXCAVATION

Trench excavation for water distribution pipes and water appurtenances must comply with Section 19-1, "Trench Excavation", and these Specifications.

Water mains must be installed to the alignment and elevations shown on the Plans. If the Plans do not specify pipe elevations, water mains must be installed with the following cover:

- Cover for water mains installed within improved streets with curb, gutter, and sidewalk must be between 36 and 54 inches, measured from the flowline of the gutter to the top of the pipe.
- Cover for water mains installed in unimproved areas or in existing streets without curb, gutter and sidewalk must be between 54 and 60 inches, measured from the top of the pipe to the existing ground or pavement surface at the centerline of the pipe.

The width of the trench must comply with Standard Drawing 8-17 and Section 19-1.02, "Trench Width", of these Specifications.

Trenches for water mains must be overexcavated to a depth of at least 6 inches below the outside diameter of the pipe. At locations of joints or couplings the depth of over excavation must be measured from the outside diameter of the pipe joint or couplings.

Unless otherwise specified in the Special Provisions, excavate trenches only as far in advance of pipe laying as permitted by the Agency and in compliance with the requirements of Section 19-1.04, "Maximum Length of Open Trench", of these Specifications.

Cut and abandoned pipes within the area of the trench, including existing water mains, that are not removed in accordance with the Plans or Section 13-2.05, "Abandoned Underground Facilities", must be plugged in accordance with Section 15-1.04, "Abandonment of Pipes, Conduits, and Structures", of these Specifications.

Surface water, groundwater, pipe leakage, or the contents of severed pipe must not be permitted to enter any water pipe that is not abandoned.

41-4 LAYING WATER PIPES

The Contractor must seal shut pipe ends at the end of each workday and whenever the work of laying pipe is discontinued to secure the end of the pipe from animals, trench water intrusion, and windblown dirt. The seal must be watertight. The minimum requirement is to seal the end of the pipe with 8 mil polyethylene secured with metal banding, place plywood against the plastic, and temporarily cover the pipe end with earth. A manufactured pipe end plug approved by the Agency may be used instead of plastic and plywood.

Pipe must be installed in trenches as specified in Section 19, "Trench Excavation, Bedding and Backfill," of these Specifications.

Pipe must not be placed during inclement weather or when the conditions in the trench will interfere with proper jointing of the pipe.

Installation of water pipe, fittings, valves, and water appurtenances must comply with the requirements of these Specifications, the Contract Documents, the American Water Works Association (AWWA) Standards, and the manufacturers' recommendations. Each section of pipe, each fitting, and each valve must be thoroughly cleaned before it is installed. Pipes, valves, fittings, and appurtenances must be lowered into the trench in a manner that prevents damage, particularly to the pipe lining and coating. When required by the Agency, approved slings must be used to lower the pipe. Do not drop pipe, fittings, valves, appurtenances, or accessories into the trench.

The pipe must be laid true and uniform to line and grade, with no visible change in alignment at joints unless a curved alignment is shown on the Plans. The maximum allowable horizontal installation tolerance is 6 inches or as necessary to comply with statutory horizontal separation distances, whichever is less. The maximum allowable vertical installation tolerance is 0.10 foot, as necessary to maintain an unbroken slope direction as indicated on the plans, or as necessary to comply with statutory vertical separation distances, whichever is less. The maximum deflection of ductile iron pipe at joints must not exceed the limits described in Standard Drawing 8-9A. Deflection and bending of polyvinyl chloride pipe must not exceed the limits described in Standard Drawing 8-9B.

Where necessary to properly locate valves and fittings, the pipe must be neatly and squarely cut to length, using methods recommended by the manufacturer.

When field cuts are made in polyvinyl chloride pipe, the cut ends must be cut square and all burrs removed from the pipe interior. The beveling of the pipe ends must be as specified by the manufacturer. Guide marks for jointing the pipe, after cutting, must be made on the pipe in accordance with the manufacturer's specifications.

Except in water systems installed for new subdivisions, no more than 3000 linear feet of water main is to be installed before starting installation of water services and water.

Service line and appurtenance construction must be concurrent with pipe laying. Service line and appurtenance construction must be completed no later than 15 Working Days after the installation of the portion of the water main that they connect to.

41-5 UNDERGROUND WARNING TAPE, LOCATING WIRE, AND POLYETHYLENE ENCASEMENT

41-5.01 Underground Warning Tape

Underground warning tape must be installed above buried water pipes, water service lines, and water appurtenance lines.

Underground warning tape must be 12-inch wide 4 mil minimum thickness low density

polyethylene formulated for extended use underground, minimum tensile strength 4100 MD and 3650 TD in accordance with ASTM D882. Tape elongation must be greater than 550 percent at break point. Unless otherwise directed by the Agency, all lettering must be BLACK on the following background colors:

- Warning tape for potable water pipes must be BLUE and marked “WATER MAIN BURIED BELOW,” or “WATER LINE BURIED BELOW.”
- Warning tape for potable water transmission mains must be BLUE and marked “WATER TRANSMISSION MAIN BURIED BELOW.”
- Warning tape for raw water transmission mains must be GREEN and marked “RAW WATER MAIN BURIED BELOW.”
- Warning tape for recycled, reclaimed, and non-potable water pipes must be PURPLE and marked “RECYCLED/RECLAIMED WATER MAIN BURIED BELOW.”

Underground warning tape must be placed 12 to 18 inches above the top of the water pipe along the length of the pipe. The backfill lift at that height must be compacted prior to placing the warning tape.

41-5.02 Locating Wire

A locating wire must be installed on the center of the top of buried water pipes, water service lines, and water appurtenance lines. The locating wire must be an insulated 10 gauge solid, single strand, soft drawn copper locating wire with 1/16 inch PVC insulation along the entire length of the pipe. Locating wire must extend into each valve box and each service box, and be installed in accordance with Standard Drawings 8-4A and the other water supply Standard Drawings. Locating wire must be continuous and splices are not allowed except at the following locations: tees, crosses, and connections to existing locating wires. Splices must be soldered, then shrink-wrapped or taped in accordance with Standard Drawing 8-4A.

When locating wire runs exceed 600 feet between access points, a locating wire station must be installed midway between the access points in accordance with Standard Drawing 8-4B. The maximum allowable distance from access point to station or from station to station is 600 feet. The spacing must be equidistant between access points and stations when 2 or more stations are required. The locating wire station must be constructed with a traffic-rated valve box. For recycled, reclaimed, and non-potable water locating wire stations, the top surfaces of the box and cover must be coated with a purple coating in accordance with Section 41-22.04, “Purple Identification Coating,” of these Specifications, and the 2-inch PVC riser must be purple PVC.

A continuity test must be performed on each splice prior to backfill. In addition, a continuity test must be performed on all new locating wires after all other utilities are installed prior to paving. Each segment of locating wire between access points must be tested separately. Tests must be performed with a multimeter, set to “ohms,” and set to “x 1” scale. Multimeter probes must be extended with insulated copper wire and soldered copper alligator clips equipped with set-screw tighteners. A reading near zero ohms is a passing test. Repeat for each segment of the locating wire circuit.

41-5.03 Polyethylene Encasement

All buried metal must be encased with 8 mil polyethylene so that no soil is contact with metal. Polyethylene encasement materials and installation must comply with AWWA C105. Pipe must be encased using Method A of Section 4.4 of AWWA C105. Adhesive tape must be used to secure and seal encasement. Tape must be 10 mil PVC tape. Tears, punctures, and damage must be repaired and sealed with tape, or with an 8 mil sheet wrapped around the pipe to cover the damaged area and secured and sealed with tape. Backfill must be performed

without puncturing or stressing the wrapping. Excessive damage to encasement, as determined solely by the Agency, is cause for rejection of the entire section of encasement.

Polyethylene encasement for potable water pipes must be BLACK or CLEAR. Polyethylene encasement for raw water pipes must be GREEN and must be marked "RAW WATER." Polyethylene encasement for recycled, reclaimed, and non-potable water pipes must be PURPLE and must be marked "CAUTION: RECLAIMED/RECYCLED WATER." The warning message must be in minimum 1" tall black letters, repeating every 24 inches along the length, and repeating every 12 inches around the circumference. The encasement must be installed so that the warning message appears along the top of the pipe after installation.

41-6 THRUST BLOCKS AND RESTRAINED JOINTS

Pipes, fittings, and valves must be restrained from movement as a result of thrust on the fittings and valves of the water distribution system. To accomplish this, thrust blocks or pipe-restraining devices must be installed at all valves, tees, crosses, elbows, reducers, dead ends, and pipe deflections greater than 5 degrees.

Thrust blocks must comply with Standard Drawing 8-3A. Thrust blocks must be used for the configurations covered in Standard Drawing 8-3A. Restraint for all other thrust configurations must be accomplished with the use of restrained joints. If a thrust block cannot be poured against undisturbed soil, restrained joints must be used to resist the thrust.

Restrained joints must be provided where specified in the Plans and Standard Drawings and where required to resist thrust. Restrained joints must be used to resist thrust at valves and at fittings in thrust configurations not covered in Standard Drawing 8-3A. Restraining devices must comply with Sections 50-25.03.C and 50-26.05.C of these Specifications.

The Plans or Standard Drawings might require both a thrust block and restrained joints in certain locations, and both must be provided. If the thrust block bearing soil is disturbed in those locations, the soil must be recompact to 90 percent relative compaction before the thrust block is installed.

41-7 SETTING FIRE HYDRANTS

Fire hydrant installations must comply with Standard Drawings 8-2A and 8-2B and Section 50-37, "Fire Hydrants", of these Specifications.

Materials other than ductile iron or polyvinyl chloride pipe must not be used as branch leads that connect fire hydrants to water mains.

Fire hydrants must not be installed within 3 feet of a building or any other structure that would limit access. Fire hydrants must stand plumb with the hex nut for the pumper outlet a minimum of 20 inches above the sidewalk or concrete pad surrounding the hydrant. A 2 by 2 foot by 4-inch thick concrete pad must be installed surrounding the fire hydrant. The top of the pad must be at the elevation of the finished grade.

- In streets where the sidewalk is contiguous with curb and gutter, fire hydrants must be placed behind the sidewalk within the public utility easement.
- In streets where the sidewalk is separated from the curb and gutter by a planter or park strip, or at locations where there are to be curbs and gutters but no sidewalks, fire hydrants must be placed 3 feet behind the curb.
- In streets that are paved but lack curbs, gutters and sidewalks, new and relocated fire hydrants must be placed within 10 feet of the edge of pavement.
- Fire hydrants placed at street intersections must be installed at the beginning or end of curb returns.
- On standard hydrants, the 4-1/2-inch nozzle or outlet must lie on a line perpendicular to the centerline of the street.

- On double pumper hydrants, a line bisecting the angle between the two 4-1/2-inch nozzles or outlets must be perpendicular to the centerline of the street.

Where the Plans indicate that existing fire hydrants are to be removed and salvaged, the salvaged hydrants must be removed intact and delivered undamaged to the Agency Corporation Yard location as directed by the Agency.

41-8 SETTING GATE VALVES

Gate valves must comply with the requirements of Section 50-38.01, “Gate Valves”, of these Specifications.

Gate valves at tees, crosses, reducers, elbows, and other fittings must be provided with flanged joints and bolted directly to the flanged fittings.

41-9 BACKFLOW PREVENTION ASSEMBLIES

Backflow prevention assembly installations must comply with Standard Drawings 8-8A, 8-8B, and 8-8C.

Backflow prevention devices must be located in lawn or planter areas, unless otherwise specified in the Plans. If conflicts occur, the location must be approved by the Water Utility prior to installation.

The Reduced Pressure, Double Check Detector, or Reduced Pressure Detector Assemblies must be tested by a certified backflow prevention assembly tester at the time of installation.

Backflow prevention device installations must include an insulated, UV resistant, protective cover (bag), appropriate for the assembly, and properly placed over the assembly.

41-10 FIRE PROTECTION SERVICE ASSEMBLIES

Fire protection service installations must comply with Standard Drawing 8-7, and must include a double detector check valve assembly with by-pass meter and piping. Fire protection service assembly piping must be flanged ductile iron Class 53 conforming to Section 50-25, “Ductile Iron Pipe (DIP), and Cast Iron Pipe and Ductile Iron Fittings”, of these Specifications.

Buried water valves must be as specified in Section 50-38, “Valves”, of these Specifications. Except for water check valves, all valves must be furnished with flanged ends.

Double detector check valves must be listed by Underwriters Laboratories and approved by Factory Mutual.

By-pass water meters must be 5/8 by 3/4 inch, all copper alloy body conforming to AWWA C700. Bronze check valves must be installed downstream of the by-pass meter. Bronze ball or gate valves must be installed to allow for removal of the by-pass meter without affecting the fire protection system. All piping must be Type “K” copper.

Double detector check valve assemblies must be installed in lawn or planter areas. If conflicts occur, the location must be approved by the Agency prior to installation.

41-11 BLOW-OFFS

Four-inch blow-off assemblies must comply with Standard Drawings 8-13A, 8-13B, and 8-13C. Temporary blow-off assemblies must comply with Standard Drawing 8-12.

41-12 PIPE BEDDING AND BACKFILLING OF TRENCHES

Pipe bedding and backfill for water pipes and appurtenances must comply with Standard Drawing 8-17 and Section 19-2, “Pipe Bedding and Backfilling of Trenches”, of these Specifications.

41-13 REPAVING WATER PIPE TRENCHES

Repaving of trenches for water pipes and appurtenances must comply with Standard Drawing 8-17 and Section 14, “Restoration of Surfaces”, of these Specifications.

41-14 WATER SERVICES

Water services must comply with Standard Drawings 8-1, 8-6A-1, 8-6B, and 8-6C, and with Sections 50-40, “Water Service Connection Materials”, and 50-38, “Valves”, of these Specifications.

Gate valves for water services 3 through 12 inches in diameter must be installed with a box and riser in compliance with Standard Drawing 8-5.

Service saddles must be bronze.

Fitting (tee, ell, etc.) must not be tapped to accommodate a service.

Water services must be 1-1/2 inches in diameter with a 1 inch water meter unless otherwise specified. All buried copper and other metal must be encased with 8 mil polyethylene so that no soil is in contact with metal, in compliance with Section 41-5.03, “Polyethylene Encasement.”

Where the curb and gutter exists, or is to be constructed concurrently with the improvements, the location of each service must be permanently indicated by inscribing the letter "W" in the curb directly above the line when the service is perpendicular to the street centerline. Otherwise, the "W" mark for a skewed or angling service must be placed at a right angle to the end of the service. When water services are installed in a street with existing curb, the curb mark must be placed at the time the services are installed to assure proper location. In new subdivisions when the services are installed before the curb is constructed, the Contractor must establish and mark the exact location of each service and ensure that the "W" is placed in the curb when it is poured. The "W" must not be placed more than 6 inches from the service.

41-15 WATER METERS AND METER BOXES

A water meter is required for all services except fire services.

Water meter installations must comply with Standard Drawings 8-6A, 8-6B, and 8-6C. The size of the meter must be as specified in the Plans. If not specified in the Plans, the size of the meter must be the same size as the service line at the connection to the main.

The water meter box must be located within the parcel being served, unless otherwise specified. Water meter boxes must be located adjacent to the property line or within water or other appropriate public utility easements, and must be located in lawn or planter areas. Meter boxes must not be located in a driveway or traffic area. If conflicts occur, the location must be approved by the Water Utility prior to installation.

The water service line must be thoroughly flushed immediately prior to water meter installation.

41-16 DISINFECTION, FLUSHING, AND BACTERIOLOGICAL TESTING

New water pipes and water appurtenances must be disinfected and protected by use of the following procedures:

- Precautions must be taken to prevent contaminated materials from entering pipe interiors, fittings, and valves during the construction of the water distribution system.
- Water pipes and water appurtenances must be flushed after construction to remove contaminants.
- Water pipes and appurtenances must be disinfected to remove residual contamination.
- Bacteriological water quality tests must be performed by laboratory testing after disinfection.

Newly constructed, modified, or repaired water pipes must not be connected to an existing

water system or placed into service until the Agency has determined that the water pipes have been disinfected in accordance with this section.

Water for filling and flushing pipes must be obtained from the existing public water system. Temporary piping connections to the existing water system must include a reduced pressure backflow prevention assembly that is on the most recent list of approved backflow prevention devices of the Sacramento County Environmental Management Department. The list can be downloaded at www.emd.saccounty.net in the Cross-Connection Control Program section.

41-16.01 Disinfection

All new, modified, and repaired water pipes and water appurtenances must be disinfected in accordance with AWWA C651 “Disinfecting Water Mains.”

The disinfection methods below are allowed by the Agency. Other disinfection methods published in AWWA C651 might be allowed if approved by the Agency.

41-16.01.A Disinfection by the Tablet Method

The Tablet Method must employ the use of a sufficient number of 5 gram calcium hypochlorite tablets as a disinfectant to yield an average chlorine dose of approximately 25 milligrams per liter. The 5 gram calcium hypochlorite tablets must contain at least 65 percent available chlorine by weight. The tablets, 6 to 8 to the ounce, are designed to dissolve slowly in water. These tablets must comply with the requirements of AWWA B-300 standard for hypochlorites.

Because preliminary flushing cannot be performed if tablets are used, cleanliness must be exercised during construction of the water main.

The calcium hypochlorite tablets must be placed at the upstream end of each section of pipeline or branch and at every 500-foot interval along pipelines, in hydrants, hydrant branches, and other appurtenances. They must be attached by an adhesive to the top of the pipe interior. If the tablets are fastened before the pipe section is placed in the trench, their position must be marked on the section to assist in keeping the tablet's position at the top of the pipe.

The adhesive must be Permatex No. 1, or approved equal. There must be no adhesive on the tablet except on the broad side next to the surface to which the tablet is attached. The tablets must be fastened to the pipe to prevent washing to the pipe end.

The minimum number of calcium hypochlorite tablets required for water main disinfection must be as shown in the following Table 41-1:

**TABLE 41-1
REQUIRED 5 GRAM CALCIUM HYPOCHLORITE TABLETS***

Pipe Diameter (inches)	Length of Pipe Section (feet)				
	13 or less	18	20	30	40
4	1	1	1	1	1
6	1	1	1	2	2
8	1	2	2	3	4
10	2	3	3	4	5
12	3	4	4	6	7
16	4	6	7	10	13

* Based on 3.25 grams of available chlorine per tablet. Any portion of tablet rounded to next higher number.

When the installation of the water distribution system has been completed, the pipes must be filled with water at a velocity of less than 1 foot per second. During filling, air must be released from all high points in the line. In addition, as the chlorinated water flows past tees and crosses, related valves, hydrants, and appurtenances must be operated to disinfect the branches and appurtenances.

41-16.01.B Disinfection by the Continuous-Feed Method

The Continuous-Feed Method requires chlorinating the pipe with the injection of sodium hypochlorite solution or calcium hypochlorite solution. The process consists of completely filling the pipe with water, removing air pockets, flushing the pipe to remove particulates, and then filling the pipe with chlorinated water.

The chlorine concentration must be sufficient to yield a free chlorine residual of not less than 10 mg/L measured 24 hours after the pipe is filled.

41-16.01.B.(1) Filling and preliminary flushing:

When the installation of the water distribution system has been completed, the pipes must be filled with water at a velocity of less than 1 foot per second. During filling, air must be released from all high points in the line. Before the pipe is chlorinated, it must be pressure tested and flushed to remove particulates. The flushing velocity in the pipe must be at least 2.5 feet per second and must comply with Section 41-16.02.

41-16.01.B.(2) Chlorination Procedure:

- Water must flow at a constant, measured rate into the new pipe.
- At a point not more than 10 feet downstream from the start of the new pipe, water entering the pipe must receive a dose of chlorine fed at a constant rate to produce a chlorine solution of not less than 25 mg/L free chlorine. The chlorine concentration must be measured and verified at regular intervals in compliance with the procedures in AWWA C651, Appendix A "Drop Dilution Method (DPD)" for chlorine residual testing.
- Unless otherwise approved by the Agency, a chlorine metering pump must be used to

perform the dosing, and the dosing location must be in the temporary jumper piping downstream of the temporary backflow prevention assembly.

- During feeding, end points in the water system must be opened to release the non-chlorinated water and allow the chlorinated water to fill the system.
- As the chlorinated water flows past tees and crosses, related valves, hydrants, and appurtenances must be operated to fill the branches and appurtenances with chlorinated water. The Contractor must verify that all portions of the water system have been filled with the highly chlorinated water.
- The chlorine residual must be checked after 24 hours at locations directed by the Agency to verify that it is at least 10 mg/L free chlorine.

Table 41-2 shows the amount of chlorine required for each 100 feet of pipe for various diameters. Solutions of 1 percent chlorine can be prepared with sodium hypochlorite or calcium hypochlorite. The calcium hypochlorite solution requires 1 pound (454 grams) of calcium hypochlorite in 8 gallons (30.3 liters) of water.

TABLE 41-2 Chlorine Required to Produce 25-mg/L Concentration in 100 ft. of Pipe by Diameter				
Pipe Diameter	100% Chlorine		1% Chlorine Solution	
Inches	Pounds	(Grams)	Gallons	(Liters)
4	0.013	(5.9)	0.16	(0.6)
6	0.030	(13.6)	0.36	(1.4)
8	0.054	(24.5)	0.65	(2.5)
10	0.085	(38.6)	1.02	(3.9)
12	0.120	(54.4)	1.44	(5.4)
16	0.217	(98.4)	2.60	(9.8)

41-16.01.C Holding Period and Final Flushing

The chlorinated water must remain in the pipe for a minimum period of at least 24 hours. At the end of this period the chlorinated water must be flushed from the pipe and water appurtenances in accordance with Section 41-16.02, “Flushing of Water Pipes,” until the chlorine concentration in the water leaving the pipe and appurtenances is no higher than that generally prevailing in the existing distribution system, or less than 1 mg/l total residual chlorine.

41-16.01.D Disinfection of Tie-In’s, Cut-In’s, and Repairs

Disinfection of the final connection to the existing water system must comply with AWWA C651, Section 4.6. The Contractor must perform all procedures listed as “optional” in C651-4.6. Disinfection of Cut-In’s and Repairs must comply with AWWA C651, Section 4.7.

41-16.02 Flushing of Water Pipes

Newly constructed, modified, and repaired water pipes and water appurtenances must be flushed with a minimum flushing velocity in the pipe of not less than 2.5 ft/sec.

Table 41-3 shows the rates of flow required to produce a velocity of 2.5 ft/sec (0.76 m/sec) in the common pipe sizes. Note that flushing must not be a substitute for preventive measures during construction.

TABLE 41-3 Required Flow and Openings to Flush Pipes (40 psi Residual Pressure in Water Main)*					
Pipe Diameter	Flow Required to Produce 2.5 ft/sec (approx.) Velocity in Pipe	Size of Tap			Number of 2.5-inch Hydrant Outlets
		1-inch	1.5-inches	2-inches	
Inches	Gallons per Minute	Number of Taps on Pipe**			
4	100	1	--	--	1
6	200	--	1	--	1
8	400	--	2	1	1
10	600	--	3	2	1
12	900	--	--	2	2
16	1,600	--	--	4	2
<p>* With a 40-psi pressure in the main with the hydrant flowing to atmosphere, a 2.5-inch hydrant outlet will discharge approximately 1,000 gpm; and a 4.5-inch hydrant outlet will discharge approximately 2,500 gpm.</p>					
<p>** Number of taps on pipe based on discharge through 5 feet of galvanized iron pipe with one 90° elbow.</p>					

Water distribution systems must be flushed in a one-direction flow pattern to systematically expel the existing contents out through every end point. The contractor must prepare a step-by-step flushing procedure for the sequential opening and closing of end points and system valves to accomplish the requirements of this Section. The flushing procedure must be designed to prevent the possibility of re-circulating or backwashing existing contents back into the system from branches, appurtenance laterals, and valved off pipe sections. Looped systems require special procedures to ensure that existing contents are expelled in the far portion of the loop with the required velocity. A copy of the flushing procedure must be provided to the Agency prior to flushing.

41-16.03 Bacteriological Testing

After disinfection and final flushing, prior to connecting to the existing water system, new, modified, and repaired water pipes must be sampled for bacteriological water quality in accordance with the most recent edition of AWWA Standard C651, Section 5. Two (2)

consecutive sets of acceptable samples taken at least 24 hours apart must be collected from water pipes at each of the following water sample test points:

- At every 1,200 feet along the water pipe.
- At end points of the water pipe.
- At each branch end.
- At additional sample point locations selected by the Agency.

Sample collection must comply with “Standard Methods for the Examination of Water and Wastewater” authored by AWWA, the American Public Health Association, and the Water Environment Federation. Water samples must be collected in a sterile bottle treated with sodium thiosulfate. The samples must be tested by an independent testing laboratory certified by the California Department of Health Services for:

- The absence of coliform bacteria, and
- A standard heterotrophic plate count (HPC) less than 500 cfu/mL, and
- Chlorine residual.

The water must comply with State and Federal drinking water standards; Title 22 of the California Administrative Code; and the 1986 Amendments to the Safe Drinking Water Act of 1974, as issued by the United States Environmental Protection Agency (EPA).

Water pipes found to have unsatisfactory bacteriological test results must be re-disinfected and tested in accordance with AWWA C651, Section 5.2. The water mains must not be connected to the existing system and placed into service until acceptable water quality test reports are received and approved by the Agency.

41-17 PRESSURE TESTING

All new water pipes and water appurtenances must be pressure tested. Pressure tests must be successfully completed prior to bacteriological testing and prior to making connections to the existing water system.

Permanent pavement must not be placed prior to successful completion of the test. Pressure testing must not be conducted until the water pipes are backfilled, the road subgrade is made and compacted, all other pipe and utility undercrossings are installed including joint utility trenches, and thrust blocks have been in place for at least 36 hours if high-early-strength cement is used or at least 7 Calendar Days if standard cement is utilized.

Water for pressure testing must be obtained from the existing public water system. Temporary piping connections to the existing water system must include a reduced pressure backflow prevention assembly that is on the most recent list of approved backflow prevention devices of the Sacramento County Environmental Management Department. The list can be downloaded at www.emd.saccounty.net in the Cross-Connection Control Program section.

Each section of the pipe to be tested must be slowly filled with water, and all air must be expelled from the pipe. The release of the air can be accomplished by opening fire hydrants and service line cocks at the high points of the system and blow-offs at dead ends. The valve controlling the admission of water into the section of pipe to be tested must be opened wide before shutting the hydrants or blow-offs. After the system has been filled with water and all air expelled, the line must remain in this condition for a period of at least 24 hours.

The pipe must be refilled, if necessary, and a pressure test of 150 psi must be applied and held for a period of 2 hours for each section of the system to be tested. The Contractor must provide the necessary pump and a clean calibrated container for measurement of make-up water required to replace leakage during the 2 hour test.

For acceptance of the water system, each test section must not exceed the allowable make-up water as determined in accordance with the following formula:

$$L = \text{SDT} / 10,876$$

Where:

L = the maximum allowable make-up water in gallons

S = the length of the test section in feet

D = the diameter of the pipe in inches

T = the test time period in hours

No leakage is allowed for welded steel pipe with welded joints.

All defective items discovered during the pressure test must be repaired or replaced. The test must be repeated after any repair until the system meets the above leakage requirement. Even if the leakage is less than the allowable, all observed leaks must be repaired. The test must be witnessed by the Agency.

The Contractor must prevent joints from moving while the pipe lines and their appurtenances are being tested. Damage to pipes, appurtenances, or to any other structures or facilities, resulting from or caused by the tests, must be repaired by the Contractor at the Contractor's expense.

41-18 CONNECTIONS TO EXISTING WATER MAINS

Do not connect newly-constructed water pipes and appurtenances to existing water mains until:

- All new water pipes have been completed except for the tie-in's;
- All water valves and water appurtenances have been completed and are ready for operation;
- Pressure testing and bacteriological testing of all new water pipes and appurtenances have been successfully completed except for the tie-in's; and
- All other items specified in the Contract Documents to be completed prior to water tie-in's have been completed.

Pipe and fittings in the tie-in closure must be disinfected in accordance with Section 41-16.01.D, "Disinfection of Tie-In's, Cut-In's, and Repairs," of these Specifications.

The contractor must not operate valves in the existing public water distribution system. Opening and closing of valves in the existing public water distribution system will be performed by the Water Utility.

In general, shutdowns will be made only at times when there will be the least interference with consumer service. A minimum of 5 Working Days' notice is required for shutdowns except that certain shutdowns involving the shut off of an existing customer or water utility facility that does not have a redundant backup can require longer than 5 Working Days to schedule. Connections are only allowed after complete and satisfactory preparation has been made in order that the shutdown duration is as short as possible. Unless otherwise specified in the Special Provisions, the Agency will notify affected Fire Districts and consumers concerning the interruption of water service.

Hot-taps must be performed by hot-tap specialists employed by or hired by the Contractor and approved by the Agency and the Water Utility. Tapping sleeves for 3 inch and larger connections must be flanged, rated for 150 psi working pressure, with Type 304 stainless steel components, Mueller H-304, Ford FTSS, JCM 432, or equal. Tapping sleeves must be approved by the Water Utility prior to beginning work. An insulating gasket assembly must be installed between the flange of the sleeve and the tapping valve.

41-19 REGULATIONS RELATING TO SANITARY HAZARDS

Water system construction (including recycled, reclaimed, and non-potable water systems) must comply with the regulations for safeguarding the public health, particularly the regulations relating to cross connections and waterworks in the California Code of Regulations, Title 17

Public Health, Chapter 5 Sanitation (Environmental), Sections 7583-7622, and Title 22 Social Security, Division 4 Environmental Health, Chapter 16 Waterworks Standards, and guidance documents issued by the California Department of Health Services. The Contractor must maintain a 10-foot minimum horizontal distance (O.D. to O.D.) between parallel water and sanitary sewer lines and services, and the water main must be installed at least 12 inches (O.D. to O.D.) above the sanitary sewer. The Contractor must maintain a 5-foot minimum horizontal distance (O.D. to O.D.) between parallel water and recycled water lines and services, and the water main must be installed at least 12 inches (O.D. to O.D.) above the recycled water line. When crossing a sanitary sewer force main or hazardous fluid pipeline, the water distribution main must be ductile iron, installed a minimum of 12 inches (O.D. to O.D.) above the pipeline, as close to perpendicular as possible, and with no pipe joints within 8 feet horizontally of the O.D. of the pipeline. Field changes that conflict with these requirements are not allowed without the prior written approval of the Agency.

41-20 SETTING, ADJUSTING AND LOCATING WATER BOXES

Prior to construction, the Contractor must furnish reference points or swing ties to all existing water boxes within the construction area. A copy of the box location measurements must be provided to the Agency prior to construction.

The Contractor must furnish and install water boxes, covers, drop caps, and risers in accordance with the Standard Drawings. Unless otherwise shown in the Plans, in construction areas with existing water boxes involving grade elevation changes or where existing water boxes or risers are disturbed, the Contractor must furnish new replacement water boxes and adjust them to final grade to comply with the requirements of the Standard Drawings. Existing water boxes that comply with the Standard Drawings, that are undamaged, and in good condition may be reused by the Contractor upon approval by the Agency.

Covers must not be interchanged between different make or model boxes.

Water boxes removed for subsequent reinstallation to allow reconstruction of existing streets must be temporarily replaced with a protective metal container such as a 5 gallon bucket or pail. The temporary metal container must cover the riser over the valve and will assist in keeping the location of the valves visible during street reconstruction activities. The risers at each valve must be kept free of debris and the valve operating nut left exposed.

41-21 ADJUSTING AIR RELEASE VALVES

The Contractor must install new air release valve boxes and adjust existing air release valve boxes to comply with the requirement of Standard Drawings 8-14A and 8-14B. Existing air release valves within manhole enclosures must be adjusted to grade using the standard method for adjusting manholes to finish grade, and plugged vent holes in the cover must be cleaned out.

41-22 RECYCLED WATER

The term “recycled water” is defined as reclaimed water or non-potable water. The requirements for recycled water apply whenever the terms “reclaimed water” or “non-potable water” appear in the Contract Documents.

Recycled water systems must comply with the requirements specified for potable water systems except as modified in this Section or the Contract Documents.

This Section specifies modifications to the potable water system requirements and specifies certain requirements that are specific to recycled water systems.

41-22.01 General

Recycled water systems must comply with the requirements of the most recent edition of “Rules and Regulations for Recycled Water Use and Distribution, County of Sacramento,” hereafter referred to as the “Recycled Regulations.

41-22.02 Recycled Water Distribution System

This Section specifies requirements for the recycled water distribution system. The recycled water distribution system is defined as all portions of the recycled water system except the portion downstream of a water meter.

The requirements for the portion of the recycled water system downstream of a water meter are specified in Section 41-22.03, “Onsite Recycled Water System,” of these Specifications.

41-22.02.A Pipes

PVC, polyethylene, and other plastic pipe must be purple, with the words “CAUTION: RECYCLED WATER – DO NOT DRINK” or “CAUTION: RECLAIMED WATER - DO NOT DRINK” embossed or integrally stamped/marked on the pipe. The warning must be stamped on opposite sides of the pipe, repeated every 3 feet.

Ductile iron, copper, and other metal pipe must be encased with eight (8) mil purple polyethylene, in compliance with Section 41-5.03, “Polyethylene Encasement.”

Underground warning tape must be purple, in compliance with Section 41-5.01, “Underground Warning Tape,” of these Specifications.

Valve risers must be 8-inch purple C900 PVC pipe.

If the horizontal separation required in Section 41-19, “Regulations Relating to Sanitary Hazards”, is not possible, written approval for deviations must be obtained from the Agency and the State Department of Health Services prior to commencement of construction. Common trench construction is not permitted.

Recycled water pipes and appurtenances must be disinfected in accordance with Section 41-16, “Disinfection, Flushing, and Bacteriological Testing,” of these Specifications, unless otherwise specified.

41-22.02.B Valve Boxes and Covers

Valve boxes and covers must comply with the requirements of Standard Drawing 8-5, for recycled water. Lids must be labeled “RECYCLED WATER” in cast or bead-welded letters. The top surfaces of the box and cover must be coated with a purple coating in accordance with Section 41-22.04, “Purple Identification Coating,” of these Specifications. Riser must be purple C900 PVC.

41-22.02.C Meter Boxes and Covers

Meter boxes and covers must comply with the requirements of Standard Drawings 8-6A, 8-6B, and 8-6C, for recycled water. Precast concrete boxes must have a purple polyethylene face ring. Covers must be labeled “RECYCLED WATER” in cast or bead-welded letters on the metal portion of the cover. The top surfaces of the cover must be coated with a purple coating in accordance with Section 41-22.04, “Purple Identification Coating,” of these Specifications.

41-22.02.D Blow-Off and ARV Boxes and Covers

Blow-off boxes and covers must comply with the requirements of Standard Drawings 8-12, 8-13A, 8-13B, and 8-13C, for recycled water. Covers must be labeled “RECYCLED WATER” in cast or bead-welded letters. The top surfaces of the blow-off box and cover must be coated with a purple coating in accordance with Section 41-22.04, “Purple Identification Coating,” of these Specifications.

Air release valves must comply with the requirements of Standard Drawings 8-14A and 8-14B, for recycled water.

41-22.03 Onsite Recycled Water System

This Section specifies requirements for the onsite recycled water system. The onsite recycled water system is defined as the portion of the recycled water system downstream of a water meter.

The requirements for the portion of the recycled water system upstream of a water meter are specified in Section 41-22.02, “Recycled Water Distribution System,” of these Specifications.

41-22.03.A Pipes

PVC, polyethylene, and other plastic pipe must be purple, with the words “CAUTION: RECYCLED WATER – DO NOT DRINK” or “CAUTION: RECLAIMED WATER - DO NOT DRINK” embossed or integrally stamped/marked on the pipe. The warning must be stamped on opposite sides of the pipe, repeated every 3 feet. If purple pipe is not available, plastic pipe must be encased in a continuous purple sleeve as specified below for metal pipe.

Ductile iron, copper, and other buried metal pipe must be encased in a continuous purple polyethylene sleeve, with black lettering with the words “CAUTION: RECYCLED WATER – DO NOT DRINK” or “CAUTION: RECLAIMED WATER - DO NOT DRINK,” and “PELIGRO: AGUA IMPURA – NO BEBER.” Each section of sleeve must overlap the next section a minimum of 24 inches and must be secured at the overlap.

Above-ground pipes must be coated with a purple coating in accordance with Section 41-22.04, “Purple Identification Coating,” of these Specifications. Valve risers must be 8 inch purple C900 PVC pipe.

If the site is being supplied with new potable water pipes, the potable water pipes downstream of the water meter must be marked with a continuous blue tape with the words “DRINKING WATER LINE” and “TUBERIA DE AGUA POTABLE.” The tape must be at least 3 inches wide and must be fastened directly to the top of the potable pipe.

If the horizontal separation required in Section 41-19, “Regulations Relating to Sanitary Hazards”, is not possible, written approval for deviations must be obtained from the Agency and the State Department of Health Services prior to commencement of construction. Common trench construction of potable water pipes and recycled water pipes is not permitted.

41-22.03.B Backflow Devices

Backflow devices must not be installed, unless otherwise specified. If a backflow device is required, it must meet the requirements of Section 41-9, “Backflow Prevention Assemblies”, in this Section of these Specifications.

41-22.03.C Valves

Valves must have visible identifying purple tags mechanically attached to the valve body by wire or snap tie or other approved device and have the words “WARNING Reclaimed Water Do Not Drink” and “AVISO AGUA IMPURA NO TOMAR” (T. Christy RC1P2 or equal).

41-22.03.D Recycled Water Boxes and Covers

41-22.03.D.(1) Concrete Boxes and Covers

Traffic concrete boxes and covers must comply with the requirements of the Standard Drawings, for recycled water. Lids must be labeled “RECYCLED WATER” in cast or bead-welded letters. The top surfaces of the box and cover must be coated with a purple coating in accordance with Section 41-22.04, “Purple Identification Coating,” of these Specifications.

Non-traffic concrete boxes and covers must have a purple polyethylene face. The face must be etched, have an ultraviolet inhibitor, and be anchored in the concrete. Concrete box covers must have the words “NONPOTABLE WATER” or “RECLAIMED WATER” or “RECYCLED WATER” stamped into the face. The top surfaces of the cover must be coated with a purple coating in accordance with Section 41-22.04, “Purple Identification Coating,” of these Specifications.

41-22.03.D.(2) Rigid Plastic or Composite Boxes and Covers

Rigid plastic or composite boxes and covers must be purple, and must have the words “NONPOTABLE WATER” or “RECLAIMED WATER” or “RECYCLED WATER” stamped into the cover.

41-22.03.E Hose Bibs

Hose bibs are prohibited in recycled water systems and must not be connected to the recycled water system.

41-22.03.F Quick Coupling Valves

Quick coupling valves must comply with Section 50-43.21, “Quick Coupling Valves”, of these Specifications.

41-22.03.G Sprinklers

Sprinklers must have manufacturer-recommended purple identifiers approved by the Agency.

41-22.03.H Warning Signs

Warning signs must comply with the requirements of Standard Drawing 8-16. Signs must be located in accordance the Recycled Regulations and as directed by the Water Utility.

41-22.03.I Special Cross Connection Test

A special cross connection test is required for sites using recycled water. The cross connection test will be performed by the water purveyor or the Sacramento County Environmental Management Department (EMD) representative after the recycled water, potable water, and fire systems are completely installed and have passed the required pressure testing and disinfection testing. The test must be performed and successfully passed prior to site occupancy. Domestic systems can be shut down for 12 hours and irrigation systems can be shut down for 24 hours during testing.

41-22.04 Purple Identification Coating

The purple identification coating system work must consist of the following:

- Removal of incompatible factory coatings from the surfaces to be coated.
- Surface preparation.
- Two prime coats, 4-8 dry mils each.
- One finish coat, 3-5 dry mils.

Coating work for precast concrete boxes and covers must be performed in a shop prior to installation.

The purple identification coating system must be an industrial coating product of a single manufacturer and must be manufactured by PPG, Tnemec, Sherwin Williams, Devoe, or approved equal. The prime coat material must be a high solids epoxy for immersion service with high abrasion resistance, and must be tintable to the required color. The finish coat material must be a high solids urethane or polyurethane with high weathering resistance, high color retention, good abrasion resistance, and must be tintable to the required color. The coating materials are not required to be approved for contact with potable water. The color of the prime coat material and the finish coat material must be OSHA “Safety Purple,” Pantone 522C, or approved similar color. The color of the prime coat material and the finish coat material are not required to be identical.

Bituminous coatings, asphaltic paint, and other factory coatings that are incompatible with the prime coat material must be removed from the surfaces to be coated prior to surface preparation.

Surface preparation must comply with the following:

- Ferrous Metal: SSPC SP-6 (Commercial Blast Cleaning) or SSPC SP-11 (Power Tool Cleaning to Bare Metal).

- Galvanized Metal and Non-Ferrous Metal: SSPC SP-1 (Solvent Cleaning).
- Precast Concrete: Remove laitance and sealers and lightly roughen surfaces by chemical cleaning or abrasive sandsweeping. Wash off thoroughly with water and allow to completely dry.

The seating surfaces of boxes and covers, and holes for cover retention bolts must not be coated and must be cleaned of coating splatter prior to shipment to the field. Coating application work must comply with the recommendations of the manufacturer's published data sheets and instructions. Coatings on precast boxes and covers must be allowed to cure for a minimum of one week before the boxes and covers are installed in the field.

41-23 FIELD WELDING OF STEEL WATER PIPE

Field welding is required where specified and for connections to existing steel water pipes that do not have an existing connection flange.

Field welding must be in accordance with AWWA C206, and AWS D7.0 "Field Welding of Steel Water Pipe Joints." Field welding must be performed by welder operators qualified in three position welding per AWWA, ASME, or other similar three position-root bend test method of qualification. The welder or welding operator must provide proof upon request by the Agency of having been engaged in similar welding techniques within 6 months of the proposed project welding date. The Agency may request welding sample coupons for testing. The tests results must show weld strength at least equal to the plate strength to be acceptable. Acceptable test costs will be borne by the Agency; unacceptable test costs and weld repairing will be borne by the Contractor. Welding must be done with E6010 S.M.A.W. Welding Process welding rod as in ASME-Boiler and Pressure Vessel Codes; Section IX, Welding Operator Qualification.

Lining and grouting must be applied after welding of joints to preclude formation of welding gas pockets. When internal pipe welding is in progress, the Contractor must provide forced air draft venting of the pipe.

Artificial cooling of the weld area during welding or quenching completed welds is not permitted.

41-24 PAYMENT

Unless otherwise specified in the Special Provisions, payment for the water distribution system will be by lump sum.

The lump sum price paid for water distribution system includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the water distribution system, including cutting, trenching, laying, blocking, making connections, disinfecting, testing, backfilling, as shown or specified in the Contract, in these Specifications, and as directed by the Agency.

The unit price paid for fire hydrants includes excavation, furnishing and placing the tee in the main, the 6-inch lateral to the hydrant, the gate valve, the fittings, and the hydrant, all as detailed on the Plans. Also included in the unit price are blocking, backfill, restoration of street surfaces, and all other labor, equipment and material necessary for installing the fire hydrant in accordance with the Contract.