

**SECTION 12**  
**WATER MAINS**

12-1 General

12-1.01 Scope

This section describes the requirements for furnishing and installing treated water mains, 2-inch and larger, including the materials to be used, methods and requirements for installation, and measurement for payment.

This section does not include installation of appurtenances to water mains such as main line valves, air release valves, blowoff valves, or fire hydrants. This section does not include provisions for testing and disinfecting the water mains. This section does not include the piping within, or to the limits outside of special structures such as pressure reducing or pump stations, and storage tanks; all as shown on the plans. If required, items such as these have been described elsewhere in these specifications.

12-1.02 Description of Work

Work under this section shall include, but not be limited to, controlling dust, excavation of the pipe trench (regardless of surface or subsurface conditions), placing straw bales where required, locating other utilities, drilling and blasting, over excavating the trench bottom where required, dewatering, transporting and stockpiling of material, installing the pipe including storing and handling, laying of the pipe and fittings, installing protective wrap where required; completing joints including application of corrosion protection materials, placing of reaction blocking, installing and testing the locating wire, importing backfill material including permeable backfill material as required and preparing native materials for backfilling, compacting backfill, exporting overburden and unsuitable material, connecting to existing mains, placing and removing temporary erosion control, replacing existing facilities and other utilities, and restoring the pipe alignment including front yard areas, road surfaces and striping, shoulders, and driveway crossings, reshaping and restoring roadside drainage facilities, gutters and sidewalks, removing straw bales from streams, and installing new graveled shoulders along paved roads.

12-1.03 Public Convenience, Preservation of Property and Cleanup

While performing work under this section, the Contractor shall comply with the terms and conditions concerning Public Convenience, Preservation of Property, and Cleanup, as described in the General Conditions of this Contract.

12-1.04 Permits

The Contractor's attention is directed to the Special Conditions of this Contract which requires compliance with encroachment permits, agreements for modification of stream or lake, and all other permits, agreements, and licenses required under these specifications.

12-1.05 Submittals

Submittals supplied by the Contractor shall include: catalog information on pipeline material, fittings, mechanical couplings, restrained joints, and flange insulation kits; samples of gravel, permeable backfill, and sand; load tickets for asphalt paving, gravel, sand, sand-cement slurry, permeable backfill, and ready-mix concrete; and laying diagrams for any sections of water main

that cannot be laid with standard length material. The Contractor's attention is directed to the General Conditions of this Contract under "Submittals".

12-1.06 Inspection

The Contractor shall make all water main materials available for inspection by the District Engineer prior to their installation. The Contractor shall provide the necessary men and equipment to make these materials available. Each phase of work shall pass inspection by the District Engineer before commencing work on the next phase. The phases shall consist of, but not be limited to, pavement cutting, excavation, bedding, pipe laying, application of corrosion protection, including protective wrap of DI pipe, where required, shading around pipe, installing the locating wire, backfilling each layer, testing the locating wire, and trench restoration. Pressure and leak testing, and disinfecting requirements are described elsewhere in these specifications.

12-2 Materials

12-2.01 General

Materials furnished for water mains shall include, but not be limited to, pipeline materials; fittings including bends, tees, wyes, crosses, reducers, caps, couplings, flanges, and other special joints, flange insulating kits, polyethylene encasement, primers and solvents for use with PVC pipe, welding machines for High Density Polyethylene Pipe (HDPE), native and imported backfill, straw bales, concrete for reaction blocking and structure replacement, sand-cement slurry, compactable concrete, water and palliatives for backfill conditioning and dust control, locating wire, and materials used for restoration of the trench and work area.

Requirements for backfill materials, both native and imported, are included with installation procedures contained elsewhere in this section.

12-2.02 Pipeline Material

Pipeline materials shall be either ductile iron pipe (DIP) or polyvinyl chloride pipe (PVC). Special applications may allow the use of HDPE and shall be covered in the Special Conditions of these specifications (Section 10). The type of pipeline material, the nominal size; class, rating, or schedule, shall be as shown on the plans, or as further limited by the Special Conditions of this Contract. For non-surge related applications, in no case shall the system working pressure exceed the maximum working pressure for the pipeline material, size, class, rating, or schedule listed below:

<u>Pipeline Material</u>	<u>Min. Pipe Size (in.)</u>	<u>Max. Pipe Size (in.)</u>	<u>Max. Working Pressure (psi)</u>
DIP (AWWA C151):			
Class 350	4	12	350
All Classes	14	36	*
PVC Pressure Pipe (AWWA C900-07):			
Class 235/DR 18	4	12	150
Class 305/DR 14	4	12	200
PVC Transmission Pipe (AWWA C905):			
Class 235/DR 18	14	24	150
Class 305/DR 14	14	24	200

PVC Schedule Pipe (ASTM D-1785):			
Sch 40	2	3	100
Sch 80	2	3	200
HDPE Pipe (AWWA C906)	-	-	Per Section 10 Special Conditions

\*The maximum allowable working pressure for DIP sizes 14" through 36" shall be based on pressure classes listed in AWWA C151.

For surge-related applications (pumping cycles in pressurized pipe or anticipated cyclic valve closures, i.e.) pipe choice should be made on individual calculations incorporating the surge cycles and static pressure applications for the particular project and would require a more conservative pipe choice than shown in the above table.

The same type of pipeline material and manufacturer shall be used throughout the work unless specific types are listed for specific areas in the Special Conditions of this Contract.

12-2.02-A Ductile Iron Pipe (DIP)

Ductile iron pipe shall conform to AWWA C151, except as modified herein, and shall have a 60,000 psi minimum tensile strength, 42,000 psi minimum yield strength, and 10% minimum elongation. The size and class of pipe shall be as shown on the plans and as designated in the Special Conditions of this Contract. Ductile iron pipe shall have a cement mortar lining with an asphaltic seal coat conforming to AWWA C104 and an asphaltic outside coating conforming to AWWA C151.

Pipe sections shall be nominal 18-foot laying lengths. At least 90% of the pipe shall be furnished as standard 18-foot lengths, except that shorter lengths may be required for horizontal and vertical curves, as described for Installation elsewhere in this section. The remainder may be random lengths, but not less than 16-foot long. The Contractor shall not substitute multiple short lengths of pipe where one or more standard lengths will fit. The Contractor shall make all reasonable efforts to reduce the number of joints in a pipeline facility.

Pipe ends shall be furnished with push-on or mechanical joints, except as noted on the plans, or as specified herein. Push-on and mechanical joints shall conform to AWWA C111. Integrally cast flanges shall conform to AWWA C110. Grooved and shouldered type joints shall conform to AWWA C606. Screwed flanges shall conform to AWWA C115, shall be furnished on minimum Special Class 53 pipe barrels, and shall be limited in use to 200 psi working pressure. Flanges shall be "two holed" wherever required for proper alignment of valves and fittings.

Each section of pipe shall be clearly marked with the nominal pipe size, class, weight, and casting period. The manufacturer's mark, the year the pipe was produced and the lettering "DI" or DUCTILE" shall be cast or stamped on the pipe.

#### 12-2.02-B PVC Pressure Pipe (Polyvinyl Chloride)

PVC Pressure pipe shall conform to AWWA C900, except as modified herein. This pipeline material shall be limited to nominal sizes ranging from 4" to 12" and further restricted to Class 235 and 305, all as shown on the plans and designated in this section and in the Special Conditions of this Contract.

PVC pressure pipe shall be furnished with cast iron equivalent outside diameters.

PVC pipe sections shall be supplied in 20-foot laying lengths. Pipe cut for closures shall be machined or otherwise rendered suitable for inserting into and making a tight joint with the coupling or fitting. At least 90% of pipe furnished shall be standard 20-foot lengths, except that shorter lengths may be required for horizontal and vertical curves, as described for Installation elsewhere in this section. The remainder of pipe sections supplied may be of random lengths, but not less than 18-feet long unless approved by the District. The Contractor shall not substitute multiple short lengths of pipe where one or more standard lengths will fit.

Pipe shall be supplied with one bell end using one elastomeric gasket. Solvent weld joints will not be allowed.

Rubber gaskets shall conform to the requirements of ASTM F477.

Each section of pipe shall be clearly marked with the nominal size and OD base (for example, 8-CI), type of pipe, dimension ratio number (for example, DR18), AWWA Pressure Class (for example, PC235), AWWA Designation Number (AWWA C900), the manufacturer's name or trademark and production record code.

#### 12-2.02-C PVC Transmission Pipe (Polyvinyl Chloride)

PVC transmission pipe shall conform to AWWA C905, except as modified herein. This pipeline material shall be limited to nominal sizes ranging from 14" to 24" and further restricted to pressure class (PC) 235 having a standard dimension ratio (DR) of 18, all as shown on the plans and designated in this section and the Special Conditions of this Contract.

PVC transmission pipe shall be furnished with cast iron equivalent outside diameters.

PVC transmission pipe shall also conform to all other requirements described in this section for PVC pressure pipe.

#### 12-2.02-D PVC Schedule 40 and 80 (Polyvinyl Chloride)

Schedule (Sch) 40 and 80 PVC shall conform to ASTM D-1785, with a cell classification of 12454-A or 12454-B. This pipeline material shall be limited to 2" nominal size for use as small diameter distribution laterals and large diameter service lines, all as shown on the plans and described in this section and in the Special Conditions of this Contract.

Pipe Sections shall be nominal 20-foot lengths (unless approved by the District). 90% of the pipe shall be furnished as standard 20-foot lengths. Standard 20-foot lengths shall be used wherever possible. The Contractor shall not substitute multiple short lengths of pipe where one or more standard lengths will fit.

PVC Schedule pipe shall be furnished with belled ends as solvent-weld socket conforming to ASTM D-2672 or plain ends suitable for use with solvent-weld fittings, as specified in this section. Restrained joints using clamps or other devices will not be allowed.

Each section of pipe shall be marked with the nominal pipe size (2"), the plastic pipe designation code, the schedule, the ASTM designation, the manufacturer's name or trademark, and the laboratory's mark certifying the pipe for use with potable water.

12-2.03 Fittings

Fittings for ductile iron pipe and PVC pressure and transmission pipe shall be either gray or ductile iron, conforming in all respects to AWWA C110, except as allowed herein. Fittings up to 16 inch, which require push-on or mechanical joints only, shall conform in all respects to either AWWA C110 or C153. Fittings up to 16 inch which require one or more flanges may be ductile iron fittings conforming in all respects to AWWA C153, except that the flanges shall have the following minimum thicknesses:

Minimum Flange Thickness (t) (in)

<u>Nominal Dia.</u>	<u>t</u>
3	0.60
4	0.70
6	0.75
8	0.85
10	0.90
12	1.00
14	1.05
16	1.10

All gray and ductile iron fittings shall have a cement mortar lining with an asphaltic seal coat conforming to AWWA C104 and an asphaltic outside coating conforming to AWWA C151.

All gray and ductile iron fittings shall have distinctly cast on the outside of their bodies the pressure rating, nominal diameter of openings, manufacturer's identification, country where cast, the number of degrees of the circle on all bends, the letter "DI" for ductile iron, all as required by AWWA C110 and C153.

Fittings for PVC Schedule 40 and 80 pipe shall be socket type conforming in all respects to ASTM D-2466 and ASTM D-2467 respectively. Except where Schedule 80 fittings require threads, as shown on the plans, they shall conform in all respects to ASTM D-2464. These fittings shall be distinctively marked with the manufacturer's mark, material designation, size, ASTM designation number (D-2464 for Sch 40 and D-2467 for Sch 80), and the seal of NSF.

12-2.04 Joint Configurations

Push-on joints for ductile iron, and PVC pressure and transmission pipe and related fittings may be substituted for mechanical joints where shown on the plans except where restrained joints using mechanical joints are required.

Flanged joints on fittings shall conform in all respects to AWWA C110 except as otherwise allowed in certain instances for specific types of compact fittings described elsewhere in this section. Screwed flanges for ductile iron pipe shall conform to AWWA C115 and shall be furnished on minimum Special Class 53 pipe barrels. The flanges shall be properly aligned wherever required for valves and fittings. Gaskets for all flanges shall be full face 1/8 inch thick fiber reinforced rubber, except for flanged joints requiring insulation kits.

Where angle points in the pipe alignment require two elbow fittings to be flanged and bolted together, the Contractor may substitute a single fitting of proper degree bend to match the required angle. Such substitute elbow fittings shall comply fully with these specifications.

#### 12-2.05 Flange Insulation for Discontinuity

Flanged joints shown on the plans or required by these specifications to be insulated for electrical discontinuity shall use insulating kits conforming to this section. Insulation kits shall consist of one steel washer for each bolt, one phenolic insulating washer for each bolt, one full length polyethylene insulating sleeve for each bolt, one full-face phenolic gasket, and two standard 1/16" full-face service gaskets (install the phenolic gasket between the two standard gaskets). The three gaskets may be replaced by a special duty phenolic gasket, which uses "O" rings to achieve a competent seal. Flange insulating kits shall be as manufactured by Pipeline Seal and Insulator, Inc. (psi), or approved equal.

#### 12-2.06 Restrained Joints

Restrained joints, where indicated on drawings to prevent pipe fittings from separating under pressure, shall be as follows:

##### Ductile Iron Pipe (DIP)

TR FLEX (US Pipe)

TR FLEX GRIPPER (US Pipe)

ROMAC GRIP RING

ROMAC 600 SERIES

ROMAC RFCA

MEGALUG-MJ (EBBA Iron)

MEGALUG RESTRAINT HARNESS SERIES 1700 (EBBA Iron)

MEGAFLANGE SERIES 2100 (EBBA Iron)

FORD/UNI-FLANGE SERIES 1400

FORD/UNI-FLANGE SERIES 1450 WEDGE ACTION RESTRAINER

Polyvinyl Chloride Pipe (PVC)

ROMAC GRIP RING

ROMAC 470 & 600 SERIES

ROMAGRIP FOR PVC PIPE

ROMAC RFCA FOR PVC PIPE

MEGALUG SERIES 2000 PV (EBBA Iron)

EBBA IRON SERIES 1500, 2500 & 2800

MEGAFLANGE SERIES 2100 (EBBA Iron)

FORD/UNI-FLANGE SERIES 1390

FORD/UNI-FLANGE SERIES 900

FORD/UNI-FLANGE SERIES 1500

Other types of joint restraining systems shall not be used unless approved by the District Engineer.

Joint restraining systems using Tyton joint gaskets with metal retainer clips shall not be used.

The approved restrained joints shall have been tested to withstand the thrust of a blind end assembly at the rated working pressure of either the pipeline or the fitting on which the restrained joint is used with not less than a 2.0 safety factor.

12-2.07 Polyethylene Encasement for Ductile Iron Pipe

Where shown on the plans or designated in the Special Conditions of this Contract, ductile iron pipe shall be furnished with an 8-mil polyethylene encasement conforming to AWWA C105.

12-2.08 PVC Primer and Solvent Cement

Primer and solvent cement for use with PVC Schedule 40 and 80 pipeline material and fittings shall conform to ASTM F-656 and D-2564 respectively.

12-2.09 Mechanical Couplings

This section shall include flexible couplings, flanged adapter couplings, transition couplings, insulated couplings and reducing couplings required for use with ductile iron, and PVC distribution and transmission pipe.

Unless specified otherwise, cast-iron couplings shall be used. If the plans call for connection to steel pipe, steel couplings shall be used. Cast insulated couplings shall be used to connect steel pipe to ductile iron pipe. Full circle clamp couplings will not be allowed in place of PVC pipe couplings. All couplings shall be furnished with corten or zinc-plated, chromate protected steel bolts and nuts.

Couplings shall be as manufactured by Christy Metal Products, Inc., Dresser Industries, Inc., Smith-Blair, Inc., or approved equal.

### 12-2.10 Concrete

Concrete for reaction blocking shall be 2,000 psi and concrete for replacing sidewalks, curbs, gutters, driveways, and road crossing caps shall be 3,000 psi, both conforming in all respects to the requirements for Concrete Work.

### 12-2.11 Locating Wire and Connectors

Locating wire shall be coated 10-gauge solid copper.

Connectors shall be brass split-bolt connectors or other type of mechanically tightened joint connector approved by the District Engineer. Wire nuts or twisted joints shall not be used.

### 12-2.12 Sand-cement Slurry Backfill and Compactable Concrete Mix Design

Sand-cement slurry shall consist of washed sand, free from clay and organic material of which 100% will pass a 3/4" screen, at least 75% will pass a No. 4 sieve and no more than 5% will pass a No. 200 sieve. The sand shall be mixed thoroughly with type 1 or 2 cement, at a ratio of 1-1/2 sacks per cubic yard of sand and enough water to accommodate mixing and placing. The sand slurry shall cure for 48 hours prior to placing and compacting replacement asphalt.

As an alternative to the slurry backfill above, the following mix may also be used to backfill trenches above the pipeline: Compactable Concrete material shall include, per cubic yard; 77% of 3/8" aggregate (crushed rock), 23% sand, 188 pounds of cement (2-sack), and 12 gallons of water. The material shall be compacted in one-foot lifts using a vibraplate or whacker. Traffic may resume on the material when hardened. Curing for a minimum of 48 hours required prior to placing and compacting replacement asphalt.

### 12-2.13 Aggregate Base and Crushed Rock

Rock products used for replacing base materials under pavement, replacing shoulders, placing gravel roads and driveway, and all other locations shown on the plans or required by existing condition to be replaced, shall be CALTRANS Class 2 aggregate base, or crushed rock, all as shown on the plans and specified herein.

#### 12-2.13-A CALTRANS Class 2 Aggregate Base

Aggregate base used under pavement restoration and along paved road shoulders shall conform to CALTRANS, Section 26, Class 2, 3/4" maximum.

#### 12-2.13-B Crushed Rock

Crushed rock aggregate for use in restoring gravel roads, road shoulders, gravel driveways and other similar areas, shall conform to CALTRANS, Section 26, Class 2, 1 1/2" maximum (3/4" maximum, if replacing 3/4" gravel), except that all material shall have 100% crushed, angular surfaces.

### 12-2.14 Replacement Pavement

Replacement of asphalt pavement shall be asphaltic concrete pavement conforming to CALTRANS, Section 39, and meeting the aggregate grading requirement for 1/2" maximum, medium gradation, and using grade PG 64-10 paving asphalt conforming to CALTRANS, Section 92. If overlay is required, the Contractor shall mill the edges of existing asphalt to provide a smooth transition. Replacement of concrete pavement shall be at least Class A concrete conforming to concrete described elsewhere in these specifications, and installed and finished equal to original concrete.



### 12-2.15 Chip Seal

Replacement of chip seal shall consist of medium screenings and RS-2 oil, all conforming to CALTRANS, Section 37-1.

### 12-2.16 Straw Bales

Straw bales used for sediment filters shall be full size bales bound with wire or nylon; twine binding will not be accepted.

## 12-3 Installation

### 12-3.01 General

This work shall consist of excavating the pipe trench to the lines and grades shown on the plans, controlling groundwater, installing the pipe, fittings, locating wire, and backfilling. The Contractor's attention is directed to the Special Conditions of this Contract and all applicable permits for other conditions affecting installation.

### 12-3.02 Horizontal Alignment

The Contractor shall follow the horizontal alignment as staked in the field. The Contractor's attention is directed to Construction Staking in the Special Conditions of this Contract. The horizontal alignment shall follow the staked alignment with a maximum variation of plus or minus 6 inches on straight sections and plus or minus 12 inches on curved sections.

### 12-3.03 Vertical Alignment

The vertical alignment shown on the plans shall be maintained within the limits described herein. If construction staking is required, the Contractor shall comply with requirements for Construction Staking as described in the Special Conditions of this Contract.

#### 12-3.03-A Vertical Alignment Design Data

In areas where the vertical alignment is delineated on the plans with alignment data including, but not limited to, vertical curve data with elevations, beginning and end of curves, length of curves and slope of intervening tangents; the vertical alignment shall be staked. The Contractor shall follow the staked vertical alignment with a maximum variation of plus or minus one-tenth of a foot, except that allowed variations shall not create a slope within any one length of pipeline material that has a positive or negative slope opposite of that shown on the plans.

#### 12-3.03-B Percent Slopes

In areas where the vertical alignment is delineated on the plans with a percent slope, a minimum uniform slope must be maintained. The percent slope is intended to establish a uniform grade between two locations of critical depth in order to avoid installing an air release valve. These locations of critical depth may include, but are not limited to, areas of low ground elevation with intervening high ground, structures or underground utilities, or other areas that fix water main elevations. The Contractor shall, in advance of trench excavation in the area, assist the Surveyors by clearing, potholing, or by other means necessary to establish the required critical elevations for verifying the required grade in the field. The vertical alignment shall then be staked. The Contractor shall follow the

staked vertical alignment with a maximum variation of plus or minus one-tenth of a foot, except that allowed variations shall not create a slope within any one length of pipeline material that has a positive or negative slope opposite of that shown on the plans.

#### 12-3.03-C Vertical Clearances and Other Controlling Elevations

In areas where the vertical alignment is dimensioned on the plans, or is a requirement of applicable encroachment permits, as a clearance requirement; examples include, but are not limited to, clearance under or over a road culvert, canal, drainage course, structure, or utility or clearance under a road surface; or where the vertical alignment is shown on the plans entering or exiting new or existing vaults or structures which then become controlling elevations; the Contractor shall, in advance of trench excavation in the area, verify the depth of any features that must be cleared, entered, or exited; and shall adjust grades in the vicinity of the controlling elevation so as to closely follow the profile shown on the plans and to avoid changes in the overall positive or negative slope of the vertical alignment. Depths found in conflict with the vertical alignment shown on the plans shall immediately be brought to the attention of the District Engineer. The Contractor shall not vary from the vertical alignment as shown on the plans, without prior approval of the District Engineer.

#### 12-3.03-D Minimum Cover

In areas where the vertical alignment is delineated on the plans as minimum cover, it is the intent to maintain the stated minimum cover at all the critically low ground elevations along the alignment; to create a smooth, even line for the pipeline invert despite undulations in the ground surface between the low elevations; and to avoid changes in the overall positive or negative slope of the vertical alignment. This intent shall apply to all areas not covered by vertical alignment data, percent slopes, or controlling elevations; all as described in this section. The Contractor shall plan the trench excavation far enough in advance by identifying the areas of critically low ground elevation and then shall comply with the intent stated herein for the vertical alignment shown on the plans. This process will create short sections of pipeline with more than the minimum cover, but only for the purpose of following the vertical alignment shown on the plans. The Contractor shall not create sections with less than minimum cover. The Contractor shall not vary from the vertical alignment as shown on the plans, without prior approval of the District Engineer.

#### 12-3.04 Separation of Water Mains and Sanitary Sewers

All water main installations shall conform to the "California Waterworks Standards" contained in Section 64630, Title 22 California Administrative Code. Among others, these standards specify separation requirements between water mains and sanitary sewer lines. It was the intent in the design of the water main horizontal and vertical alignment to provide the separations shown on the plans. No water mains shall be installed or changes made that conflict with the separation requirements. The District Engineer shall be notified immediately if a conflict or potential conflict exists.

#### 12-3.05 Pipe Lengths

Pipe lengths shall be selected so that pipe can be installed through horizontal or vertical curves, or any combination thereof, without exceeding the maximum joint deflection as recommended by the manufacturer, or maximum pipe barrel deflection as allowed by these specifications. All curves exceeding these requirements shall be made with fittings, or by selecting shorter pipe

lengths. Individual pipe lengths shall not be less than one half the standard length unless approved by the Engineering Manager.

#### 12-3.06 Dust Control

The Contractor shall control dust resulting from performance of this work either inside or outside of the right of way. Dust shall be controlled by applying either water or dust palliative, or both, for the alleviation or prevention of dust nuisance. Water shall be applied in accordance with CALTRANS, Section 17 and Dust Palliatives shall conform to and shall be applied in accordance with CALTRANS, Section 18. Tank water may be obtained from the District in accordance with the Special Conditions of these contract documents.

#### 12-3.07 Pipe Trench Excavation

This work shall consist of pipe trench excavation regardless of character of surface and subsurface conditions including location of underground facilities, blasting, over-excavating, and shoring. The Contractor's attention is directed to any applicable permits, agreements and licenses contained in the Special Conditions of this Contract.

##### 12-3.07-A Paved Areas

Areas paved with asphalt or concrete shall be marked for alignment and trench width. Asphalt and concrete paving, or sidewalks, shall be cut with a saw in neat parallel lines. The cut lines shall be at least 6" outside each edge of the trench width to prevent overbreaking and cracking of the paved surfaces.

##### 12-3.07-B Trench Configuration

The trench shall be excavated to allow the pipe to be aligned in the approximate center. Trench widths shall permit the pipe to be laid and joined properly and to allow for proper placement and compaction of backfill material. In no case shall the trench width be less than the pipe OD plus 16 inches. The trench sidewalls shall be as near vertical as possible except where sloping is permitted by District Engineer. The trench bottom shall be as smooth as possible. The trench bottom shall provide a firm, uniform, and continuous bedding for the pipe. Properly sized and placed bell holes shall be provided at each joint. Mounding of trench bottom to support pipe will not be allowed.

##### 12-3.07-C Stockpiling

The Contractor shall exercise caution in stockpiling excavated and import materials so as not to interfere with public traffic and so as to maintain a clear distance from the trench sufficient to prevent collapse of the trench wall.

##### 12-3.07-D Tree Roots

Tree roots three inches in diameter and larger, which are encountered during trenching operations, shall not be cut or damaged. The vertical alignment of the pipe shall be adjusted, at the direction of the District Engineer, to avoid conflict with large tree roots. Should large tree roots be damaged or broken, the Contractor shall cut the root cleanly and wrap the cut end with 6-mil polyethylene film and secure with tape.

#### 12-3.07-E Underground Facilities

The Contractor shall proceed with caution in excavation and preparation of the trench so that the exact location of all underground facilities may be determined. Upon request, the District will locate its facilities at no expense to the Contractor. The request shall be placed with the "Underground Service Alert" by calling (800) 642-2444. It shall be the Contractor's responsibility to contact the owners of all other underground facilities, including private water mains and private service lines. All damage to underground facilities due to the failure of the Contractor to have the facilities located or due to carelessness in excavation after the facilities are located, shall be the Contractor's responsibility. Location of existing underground facilities on the plans or in the field does not relieve the Contractor of responsibility to determine their exact location.

#### 12-3.07-F Drilling and Blasting

The handling, transport, and usage of explosives shall be in accordance with California State General Industry Safety Orders, Group 18, and applicable local laws and regulations. Required permits shall be obtained by the Contractor and a copy furnished to the District Engineer. The Contractor shall be fully responsible for any damage to the work or adjacent private property due to blasting operations. The Contractor shall also be held liable for all injury to, or death of persons caused by explosives.

Blasting shall be done with light charges and in such a manner that the material outside the prescribed neat lines will be preserved with a minimum of damage or disturbance. Whenever it is determined by the District Engineer that blasting might injure the foundation upon or against which concrete is to be placed, the District Engineer may direct that the use of explosives be discontinued and the removal of material be completed by means of pneumatic hand tools, barring or wedging. No blasting shall be done within one hundred (100) feet of any concrete that is less than seven (7) days old. The depth of holes, loading and intensity of the blasting shall be determined by the Contractor subject to the acceptance of the District Engineer. Said acceptance shall in no way relieve the Contractor of liability.

#### 12-3.07-G Over Excavation

Trenches for all types of PVC pipeline materials shall be over excavated to provide for a minimum 6-inch sand bedding. Trenches for ductile iron pipe shall be over excavated by a minimum of 6 inches in areas of rock, hardpan, shale, or other unsuitable bedding materials, all as shown on the plans.

Trenches in areas of underground water shall be over excavated to allow for 6 inches or more of permeable backfill, as required for Pipe Trench Backfill, as described elsewhere in this section.

Any areas of trench over excavated beyond the lines and grades shown on the plans or specified herein shall be brought back up to proper grade using suitable materials as approved by the District Engineer. This material shall be compacted to the specified degree prior to placing any pipe or sand bedding in the trench.

#### 12-3.07-H Ground Water and Unsuitable Material

Material taken from excavations where excessive groundwater or surface water or other sources of water have rendered the material unsuitable for trench backfill shall be removed from the site and replaced with suitable material. The over wet material may, at the Contractor's option, be dried to a proper moisture content and reused in the work, provided the material meets all other requirements of these specifications.

#### 12-3.07-I Disposal of Material

The Contractor shall dispose of all unused and unsuitable material. The Contractor shall make arrangements for disposing of, storing, or areas for drying unsuitable material. Prior to using any areas outside the project right of way, the Contractor shall secure a signed release from the owner, all as required in the Special Conditions of this Contract.

#### 12-3.07-J Trench and Excavation Support

Trench and excavation support shall conform in all respects to shoring, as described elsewhere in these specifications.

#### 12-3.07-K Rock Excavation

##### 12-3.07-K (1) Description

If during the normal excavation operations the contractor considers the native material to be rock, the District Engineer shall be notified. If determined by the District Engineer to be rock then the removal of this material shall be considered extra work. The criteria that the District Engineer shall use to determine rock shall be based on one of the following:

1. Equipment with a minimum mass of 22 tons and net power rating of 140 hp or more. The tractor unit shall be in good operating condition and operated by experienced personnel which then excavates material at a rate of less than three cubic yards per hour as witnessed by the District Engineer (or)
2. A single boulder or detached piece of rock that cannot be lifted by a single piece of equipment as described in the preceding paragraph. Change of bucket to accommodate lifting the rock shall not be considered extra work.

When rock is encountered during excavation, it shall be stripped of earth by the contractor. The contractor shall submit written procedures for rock removal operations which will be subject to the approval of the District Engineer. These procedures shall include any or a combination of the following:

1. Large tractor unit with an attached ripper unit. The ripper to be attached to the tractor shall be the most efficient parallelogram type recommended by the tractor or ripper manufacturer. The ripper shall have a single shank in good condition with a sharpened cutting point.
2. Rock hammer attached to large tractor. The size and model of rock hammer shall be as recommended by its manufacture to be efficient when attached to the large tractor.

3. Hydraulic rock splitting equipment. Procedures should be per manufacture's recommendations.
4. Blasting. Shall be minimized in residential areas and only with prior written District Engineer approval.

12.3.07-K (2) Measurement and Payment

Payment for rock excavation shall be made as an extra in addition to the standard excavation for the project. The District Engineer shall determine the method of measurement and payment from one of the following:

- A) The Contractor shall supply the District with a written detailed cost estimate per cubic yard of excavated material. Rock excavation may commence only after the District Engineer approves the estimate, or revised estimate. This cost shall be full compensation for equipment, labor and overhead required for excavation of the rock. The loading, hauling, screening, dumping and/or spreading of the rock material shall be based on the original contract quote price.
- B) Rock excavation shall be paid as Force Account per Section 7-1.04.

12-3.08 Pipe and Fitting Installation

This work shall include storing and handling of the pipe and fittings, installation procedures and precautions, completion of joints, corrosion protection, pipes placed in casings, locating wires, and reaction blocking requirements.

12-3.08-A Storage and Handling

All pipe and fittings shall be unloaded, stored, lowered into the trench and joined, using suitable tools and equipment and in a manner that will prevent damage to the material, joints, coating, or lining. Storage and handling shall be in accordance with manufacturer's recommendations.

Damaged pipe will be rejected. The Contractor shall clearly mark the rejected pipe and remove it from the immediate construction area. When approved by the District Engineer, damaged pipe may be repaired in accordance with the manufacturer's recommendations and used in the construction. Replacement or repair of rejected pipe, if allowed, shall be the Contractor's responsibility and accomplished at no cost to the District.

12-3.08-B Installation

In addition to the specific guidelines contained herein, the following references shall be used as guidelines and specifications for the installation of the listed pipeline material:

Ductile Iron (DIP)	AWWA C600
PVC Pressure Pipe	AWWA Manual M23*
PVC Transmission Pipe	AWWA Manual M23
PVC Schedule 40 and 80 Pipe	ASTM D-2855 and AWWA Manual M23

\*Except that the allowable minimum bending radius for PVC pipe shall be increased as follows: 4" dia.= 200', 6" dia.= 300', 8" dia.= 300', 10" dia. = 350'

All foreign material shall be removed from the inside of the pipe or fitting and the joint shall be properly cleaned prior to lowering the pipe or fitting into the trench. Care shall be taken to prevent foreign material from entering the pipe or fitting while it is being placed in the trench. The pipe and fittings shall be kept clean and dry in accordance with AWWA C651, Section 4.1.

The bell end of the pipe shall face the direction of laying. On slopes greater than 10 percent, laying shall begin at the bottom of the slope and proceed upward. The joining procedure and the maximum allowable joint deflection shall be as recommended by the manufacturer. Pipe shall not be installed when water is in the trench, when the trench bottom is wet or frozen, or when, in the opinion of the District Engineer, the trench conditions or weather are unsuitable for proper installation.

All plain ends of pipe, either standard lengths or cut lengths, shall be marked on the barrel with a circumferential stripe that will accurately indicate the position of the pipe end within the joint when assembled correctly.

The Contractor shall take all necessary precautions to prevent floatation of the pipe. Any pipe and fitting displaced by floatation shall be removed and reinstalled.

At all times when pipe laying is not in progress, the open ends of the pipe in the trench shall be closed with a water tight plug or other means approved by the District Engineer. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.

Cutting of pipe for valves, fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or its coating and lining. Cut ends shall be properly prepared to be equivalent to the factory joint. Any coating or lining damaged by the cutting shall be repaired as directed by the District Engineer. Remnant pieces shall be set aside for use at the next closure if possible.

All pipe with bell-and-spigot joints, joint couplings or other joint configuration constituting an increase in pipe diameter shall have holes provided for the joints such that the pipe is in continuous contact with the trench bottom between joints.

Insulating couplings, flanges, or bushings specified herein shall be used for all connections between dissimilar metals.

Where shown on the plans or designated in the General Conditions of this Contract, ductile iron pipe shall be furnished with a polyethylene wrap. Installation of the film shall conform to AWWA C105. Where the limits of required wrapping do not end at a joint, the wrap shall be extended to the next joint so that no individual length of pipe is partially wrapped.

No trenches or excavations shall be left open overnight, except as described in the Special Conditions of this Contract and approved by the District.

The Contractor's attention is also directed to the General Conditions of this Contract regarding restrictions on weekend, holiday, and night work.

#### 12-3.08-C Corrosion Protection

All pipe, fittings, and couplings and joints having bolts, glands, set screws or other metal fasteners to be covered with backfill material, regardless of the type of water main material, shall be protected from corrosion after assembly by wrapping with polyethylene film. The valve body, joints, couplings, and pipe or fittings within three feet on either side of the joint shall be thoroughly wrapped with two layers of 6-mil polyethylene film having a minimum sheet width of 3 feet. The film shall be held firmly in place with duct tape.

Backfilling operations shall be conducted so as not to damage or displace the polyethylene wrap.

If polyethylene encasement for sections of ductile iron pipe are shown on the plans or designated in the Special Conditions of this Contract, it shall be installed in conformance with AWWA C105. The Contractor's attention is directed to the materials section for a description of polyethylene encasement for ductile iron pipe.

#### 12-3.08-D Reaction Blocking

All pipe joints, fittings, and appurtenances that will remain in the final work and are exposed to thrust or deflection and not positively restrained shall be supported by concrete reaction blocking. Concrete reaction blocking shall also be placed on all fittings used for 2" PVC Schedule 40 and 80 pipe. The size and configuration of reaction blocking shall be as shown on the plans or as directed by the District Engineer.

The concrete shall be placed between undisturbed soil and the fittings or appurtenance to be supported. Concrete shall not be placed on or around the pipe, bells, flanges, or other joints. If contact with concrete is unavoidable, these areas shall be protected with a double wrap of 6-mil polyethylene film to allow for disassembly and repair of the fitting or appurtenance. Thrust blocks placed on blind flanges shall be separated from other thrust blocks on the same fitting with plywood so as to facilitate future removal of the thrust block and blind flange.

All horizontal deflections in excess of 6 degrees and all vertical deflections that are concaved upward and in excess of 6 degrees shall have a thrust block placed to the limits shown on the plans. Thrust blocks shall be installed at the terminus of each pipeline reach unless otherwise shown on the plans. Thrust blocks shall also be installed at all tees, wyes, crosses, and reduced fittings.

All vertical deflections that are concaved downward and in excess of 6 degrees shall have an anchor block placed to the limits shown on the drawings or as directed by the District Engineer.

No structural load or pressure shall be applied to a thrust block for a minimum of 24 hours after installation.



### 12-3.08-E Locating Wire Installation

A locating wire shall be installed over all non-metallic pipe and over all metallic pipe with O-ring or mechanical joints which do not have bonding straps as shown on the plans. The wire shall be centered on and taped to the pipe. All splices and branch connections shall be secured tightly with brass split-bolt or parallel connectors.

### 12-3.09 Pipe Trench Backfill

This work shall consist of selecting, preparing, importing, placing, and compacting backfill materials.

#### 12-3.09-A Backfill Selection

Native material removed from the trench may be used for backfill material provided it meets all of the requirements set forth on the plans and in these specifications. Native backfill material may be mechanically screened to meet these requirements. Materials excavated from the trench which are not used for trench backfill shall be disposed of in a manner described elsewhere in this section.

The Contractor shall import the type and quantities of backfill materials not found on the job site at no cost to the District. The Contractor shall provide the equipment and materials necessary to collect samples of the native materials and proposed import material for testing, all as directed by the District Engineer.

The class or type of backfill material shown on the plans and designated in these specifications shall meet the following criteria:

Class 1 Material. Three types of materials are acceptable; 1) naturally occurring (not crushed) rounded sand, 2) crushed sand, and 3) decomposed granite. All material shall be free from clay, organic, or other deleterious material, shall have a sand equivalent of at least 50, and shall meet the following percent passing by weight gradations:

<u>Sieve Size</u>	<u>Natural Sand</u>	<u>Crushed Sand</u>	<u>Decomposed Granite</u>
1-1/2"	100	--	
3/4"	75-100	100	100
No. 4	55-100	75-100	75-100
No. 200	0-5	0-15	0-5

Class 2 Material. Select excavated earth, free from stones or lumps exceeding 1" in greatest dimension, vegetable matter, or other deleterious material.

Class 3 Material. Select excavated earth, free from stones or lumps exceeding 2" in greatest dimension, vegetable matter or other deleterious material.

Class 4 Material. Select excavated earth, free from stones or lumps exceeding 4" in greatest dimension, vegetable matter or other deleterious material.

Permeable Backfill Material. Hard, durable, clean gravel, or crushed stone, free from organic material, clay balls, or other deleterious substance, conforming to one of the following grades:

<u>Sieve Size</u>	<u>Percentage 1/2"</u>	<u>Passing 1-1/2"</u>
2"	--	100
1-1/2"	--	95-100
3/4"	100	50-100
1/2"	95-100	
3/8"	70-100	13-55
No. 4	0-55	0-25
No. 8	9-10	0-5
No. 200	0-3	0-3

#### 12-3.09-B Backfilling Operations

Native and imported backfill material shall be screened or otherwise prepared before placing the material in the trench. Backfill material shall be at or near optimum moisture content. Excessive moisture must be removed by windrowing and air-drying. Dry soils shall be moistened and thoroughly mixed.

Backfill material required for over-excavated trenches shall be placed, compacted to the required density, and smoothed out prior to installing the pipe.

Backfill material shall be placed up to the springline (horizontal centerline) of the pipe and compacted to the required density.

The remainder of the backfill material shall be placed in uniform horizontal layers not exceeding 8" in thickness before compaction.

#### 12-3.09-C Sand-cement Slurry or Compactable Concrete Backfill

All water main and service line crossings under paved roadways (excluding paved residential driveways) shall be backfilled from 6" above the pipe to the underside of the replacement paving with sand-cement slurry, except as shown otherwise on the plans, or required by provisions of an encroachment permit or other agreement. The pipeline shall be bedded and backfilled to 6" above the pipe with Class 1 material prior to placing the sand-cement slurry. As an alternative to sand – cement slurry compactable concrete may also be used.

All pipe trench which requires tunneling under features such as walks, curbs, retaining walls, or other rigid or concrete features, shall be backfilled with sand-cement slurry from within 6" of the top of the pipe to up underneath, and if necessary, around the bottom of the feature so as to provide adequate support.

Sand-cement slurry shall not be placed around valve complexes and related fittings. These areas shall be backfilled and compacted with aggregate base material conforming to CALTRANS Class 2.

Sand-cement slurry shall be as specified elsewhere in this section.

#### 12-3.09-D Backfill for Wet Conditions

Where groundwater or other sources of water are encountered in the trench which create unsuitable trench conditions, or render the native material unsuitable, the trench

shall be over excavated and the pipe bedded on permeable backfill. The pipe shall also be shaded and a portion of the remainder of the trench depth backfilled with permeable backfill, as directed by the District Engineer.

Impervious clay plugs shall be placed across the trench to prevent migration of the water down the pipeline trench, all at the direction of the District Engineer.

#### 12-3.09-E Backfill Compaction

Backfill material shall be compacted by mechanical tamping. Other means of mechanical compaction may be employed only after receiving approval of the District Engineer. Compacting equipment or methods that produce horizontal or vertical earth pressure that may cause excessive displacement or damage to the pipe or trench walls, shall not be used.

Compaction of backfill material by ponding or jetting will not be permitted.

Relative compaction of not less than 95 percent shall be obtained within all roadways and driveways. This shall include all areas within the road or driveway cross sections which includes the area between the top of cut and toe of fill. 95-percent relative compaction is specified here and on the plans as a minimum requirement, and the Contractor shall apply additional compactive effort so as to prevent any and all future settlement of the trench and surrounding areas. The Contractor shall be responsible for restoring the trench to a condition as good as or better than the road cross section and its ability to perform its intended function, including proper compaction over and above 95%, if required. Compaction requirements are minimums. Within public right of way, the Contractor shall follow requirements of the appropriate regulatory body.

Relative compaction in all other areas, unless otherwise shown on the plans, shall be 85 percent.

To prevent excessive live loads on the pipe, sufficient densified backfill, but not less than 2 feet over the pipe, shall be in place before power-operated hauling or compacting equipment travels over the pipe.

#### 12-3.10 Connection to Existing Water Mains

Connection of new water mains to existing water mains where a "Wet Tap" is not required, shall be as shown on the plans and as described elsewhere in these specifications. Where a "Wet Tap" is required on the plans, the work shall be as described for Water Main Taps elsewhere in these specifications. Connections will be allowed only after the new water mains and appurtenances have successfully passed a pressure and leak test in conformance with Testing and Disinfecting, as described elsewhere in these specifications. For additional details regarding connections and outages, the Contractor's attention is directed to the Special Conditions of this Contract.

#### 12-3.11 Temporary Erosion Control

The Contractor's attention is directed to the Special Conditions of this Contract for permits or agreements requiring temporary erosion control. The Contractor is to follow the approved Storm Water Pollution Prevention Plan (SWPPP) for the project and implement the appropriate Best Management Practices (BMPs) For projects not requiring a SWPPP the Contractor shall take whatever measures necessary to prevent excessive erosion of areas disturbed by this work

and shall prevent sediments from leaving the work areas. Measures may include, but not be limited to filter fabric fences, straw bale dikes, interceptor swales, or other methods, all as approved by District Engineer.

## 12-4 Trench Restoration and Final Cleanup

### 12-4.01 General

This work shall consist of restoration of areas above and adjacent to the trench and areas outside the immediate work area, including paved surfaces, graveled surfaces, unimproved surfaces, and final cleanup. This work shall be performed in a timely manner so as to minimize any inconvenience to the public.

The Contractor's attention is directed to the Special Conditions of this Contract for any specific requirements contained in Right-of-Way Agreements, Encroachment Permits, agreements or licenses.

### 12-4.02 Paved Surfaces

Trench restoration in areas of asphalt or concrete pavement shall be as shown on the plans, and as specified in the Encroachment Permit. Materials shall be as specified elsewhere in this section. Asphalt pavement shall be stored, proportioned, mixed, spread and compacted; and a paint binder (tack coat) shall be applied, all as specified in CALTRANS Section 39. Concrete pavement shall conform in all respects to Concrete Work, described elsewhere in these specifications. This work shall be done with a high degree of workmanship in order to produce a smooth, uniform and visually appealing patch without disturbance, marring or blemishing of adjacent paved areas. All pavement striping, including letters and arrows, shall be replaced.

All trench crossings and other trenches or excavation located within chip seal roads shall be patched using a minimum of 8" aggregate base and 2" of asphaltic pavement, except as shown otherwise on the plans, or required by provisions of an encroachment permit or other agreement.

### 12-4.03 Chip Seal

All new pavement in chip seal roads, all pavement replacement in areas of pavement which have been previously chip sealed, or "armour coated" and areas of existing chip seal or "armour coat" which are damaged by the Contractor's activities, shall receive a coat of chip seal, all as shown on the plans and as specified in the Encroachment Permit. Materials for chip seal shall be as specified elsewhere in this section. Site preparation, emulsion application, spreading screenings, and finishing shall all conform to CALTRANS, Section 37-1.

### 12-4.04 Paved Road Shoulders

Shoulders within 2 feet of the edge of paved roads which are disturbed by trenching and backfilling operations, shall be finished with a 2' wide aggregate base shoulder, all as shown on the plans, specified herein, and as specified in the Encroachment Permit, if applicable. This gravel shoulder will be required regardless of shoulder condition prior to start of work, unless shoulder area was treated with materials superior to that specified herein, in which case, the shoulder area shall be restored to an as good or better condition.

#### 12-4.05 Graveled Surfaces

Graveled surfaces include, but are not limited to roadways, driveways, shoulder areas of unpaved roads, or walkways; all of which had gravel surfaces prior to the start of work.

Trench restoration in areas of graveled surfaces shall be as shown on the plans. Materials shall be as specified elsewhere in this section. The 8" minimum depth of gravel shall be placed over the trench limits after the underlying trench backfill has been compacted and approved. The gravel shall be compacted to 95 percent relative compaction. Enough gravel shall be placed over the trench so that after compaction, the trench surface blends into surrounding areas.

Graveled surfaces outside the trench limits that have been used for storing spoils, or which have been otherwise contaminated directly or indirectly by Contractor's operations, or otherwise damaged, shall have the contaminated materials removed and fresh gravel of equal quantities spread and compacted in its place.

Other gravel surfaces of roads, driveways and shoulders damaged by the Contractor's activities shall be repaired as directed by the District Engineer.

The type of gravel, either aggregate base or crushed rock, used for restoration shall be as shown on the plans. If not shown on the plans, the type shall closely match the type of gravel present prior to the start of construction. The District Engineer must approve the type of gravel prior to placement by the Contractor. If necessary, to match pre-existing conditions, the gravel shall be compacted and rolled in place for a hard durable surface.

#### 12-4.06 Unimproved Surfaces

Unimproved surfaces include all areas not paved or graveled, or having a particular type of hard surface. These areas shall be restored to their original ground contours. The Contractor's attention is directed to the Special Conditions of this Contract for Yard and Pasture Restoration, and Special Rights-of-Way requirements. In addition, all irrigation and sprinkler systems shall be restored and all ornamental structures and materials including, but not limited to, fences, planters, curbs, dividers, walkways, stepping stones, and paving slabs shall be restored. Unless otherwise specified in the Special Conditions, vegetative ground cover within the designated working areas shall not be replaced by the Contractor.

The area directly over the trench outside of yard areas shall be left slightly mounded parallel with the trench.

#### 12-4.07 Final Cleanup

All areas over and around the trench and appurtenances, and all other areas and surfaces disturbed by the construction activities shall be restored to an equal or better condition as existed prior to the start of construction. This also includes fences, walkways, mailboxes, signs, walls and all other private and public appurtenances to the property or right of way.

### 12-5 Measurement and Payment

#### 12-5.01 Measurement

Work performed under this section shall be measured as the number of lineal feet of the various diameter water mains, all of which have been completely installed. Measurement shall be made

to the nearest lineal foot, measured along the centerline of the pipe and bends. Tees, wyes, and crosses shall be measured along their centerline as the size of the larger pipe involved.

#### 12-5.02 Payment

The contract unit prices shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all the work necessary for the installation of Water Mains as shown on the plans, or as designated in these specifications. A description of the work is included at the head of this section. Any work associated herewith, but not included in other bid items, shall be deemed as included in the work described in this Section.